SPATIAL ECOLOGY OF AND PUBLIC ATTITUDES TOWARD

MONK PARAKEETS NESTING ON ELECTRIC UTILITY STRUCTURES

IN DALLAS AND TARRANT COUNTIES, TEXAS

A Dissertation

by

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ABSTRACT

Monk parakeets (*Myiopsitta monachus*) were introduced to the United States (US) where they established naturalized populations. They often build their bulky twig nests on electric utility structures, causing economic damage. From May 2010–February 2013, we examined the spatial ecology of and public attitudes toward monk parakeets nesting on electric utility structures in Dallas and Tarrant counties, Texas, US.

As nest sites, monk parakeets selected electric switchyards and substations constructed with multiple flat surfaces and acute-angles, within small fenced areas, with large canopy trees and taller anthropogenic structures within 100 m. Multi-scale analysis of urban land use-land cover (LULC) suggested the surrounding landscape had little impact on nest-site selection.

Monk parakeets used canopy LULC more often than pavement, grass, buildings, or water. They traveled farthest from their nests during winter. Flock sizes were highly variable, yet largest during nonbreeding season. They foraged on a broad range of native vegetation and exhibited a diverse diet of flowers, fruits, acorns, grass blades, wild dry seeds, leaf buds, insect larvae, and commercial bird seed.

We evaluated sociological variables as predictors of opposition to managing monk parakeets nesting on electric utility structures. Most survey participants were affluent, well-educated, older Caucasians who were unknowledgeable about, inexperienced with, and unsure about the impacts of monk parakeets. They indicated least opposition to nest removal and structural modification. When opposing, they

would most likely do so socially and through petitions. Participants were influenced by their desire for monk parakeets to feed at their bird feeders or nest in their yard, people and groups important to them, and their perceived ease of opposing.

Our results suggest LULC manipulation and food-based strategies are not reasonable for controlling urban monk parakeets. We recommend an outreach program explaining monk parakeet biology and the impacts of their nesting habits. We suggest targeting affluent areas adjacent to electric structures with nests and the predictors driving participants' behaviors. To provoke least opposition, we advise nest removal and structural modification. We recommend electric companies conduct cost-benefit analyses exploring feasibility of modifying construction elements preferred by monk parakeets and redesigning new construction to reduce risk of future nesting on electric utility structures.

DEDICATION

Anyone can be a father, but it takes someone special to be a dad, and that's why I call you dad, because you are so special to me.

—Wade A. Boggs, American baseball player

With much love and respect, I dedicate this work to Roger C. Stone (1935–2013), the man whom I considered my Dad. When I was a young adult, Roger stepped in and filled the empty shoes of a strong male figure in my life. He was one of my greatest champions of my quest for knowledge. I am forever grateful for his unwavering support and encouragement for whatever I pursued.

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CHAPTER I

INTRODUCTION

The monk parakeet (*Myiopsitta monachus*) is native to and common in the temperate to subtropical lowlands of South America (Lever 1987). They nest in open environments with good visibility, usually in a cluster of tall, sturdy trees or on anthropogenic structures with minimal understory (Burger and Gochfeld 2005, Eberhard 1996, Forshaw 1989, Humphrey and Peterson 1978). Members of the parrot family (Psittacidae) are well-known cavity nesters (Forshaw 1989). Monk parakeets are an exception, as they construct their own enclosed nests of tightly intertwined twigs and use them year-round for both breeding and roosting (Forshaw 1989, Bucher et al. 1991, Navarro et al. 1992, Martella and Bucher 1993, Eberhard 1996). Monk parakeet nests are often joined, forming large nest structures with separate chambers for individual breeding pairs, and those nest structures are often clustered in areas, forming large colonies of many individuals (Forshaw 1989, Goodfellow 1977). In South America, monk parakeets exhibit year-round feeding territories and dietary opportunism in canopy and on the ground, feeding on seeds, grains, fruits, berries, nuts, leaf buds, flowers, grasses, and sometimes insects and their larvae (Forshaw 1973, Long 1981, Bucher 1992, Spreyer and Bucher 1998). Their fondness for grain and orchard crops makes them an agricultural pest in Uruguay and Argentina (Darwin 1833, Godoy 1963, Mott 1973, de Grazio and Besser 1975) where they have caused agricultural loss and damage (Bucher and Bedano 1976, Lever 1987).

From the late 1960s until 1992, monk parakeets were legally imported into United States (US) as popular, inexpensive caged birds (Davey et al. 2004, CITES 2012). Accidental and intentional releases of imports and pets resulted in naturalized, self-sustaining populations in several states (Devlin 1970, Bull 1973, Davis 1974, Neidermyer and Hickey 1977, Spreyer and Bucher 1998). Populations established predominately in urban and suburban environments (Garber 1993, Neidermyer and Hickey 1977, Stevenson and Anderson 1994, Trimm 1973), where they build their nest structures in trees and on anthropogenic structures, such as buildings, light poles, communication towers, and electric utility structures (Hyman and Pruett-Jones 1995, Minor et al. 2012, Roscoe et al. 1973, Spreyer and Bucher 1998). Naturalized monk parakeets in North America consumed many of the same food items reported in South America (Bump 1971, Bull 1973, Freeland 1973, Shields et al. 1974, Olivieri and Pearson 1992), yet were reportedly more dependent upon bird feeders, especially throughout the winter (Hyman and Pruett-Jones 1995, South and Pruett-Jones 2000, Newman et al. 2008). To date, monk parakeets have yet to become major agricultural pests in the US (Neidermyer and Hickey 1977, Spreyer and Bucher 1998, Tillman et al. 2001, Avery et al. 2006, Pruett-Jones et al. 2012). Instead, they have caused economic damage resulting from their building their twig nests on electric utility structures and causing fires and power outages when nest material interferes with electrical equipment (Bucher 1984, Bucher and Martín 1987, Avery et al. 2002, Pruett-Jones et al. 2005, Avery et al. 2006). Furthermore, management of monk parakeet nests often evokes strong public outcry and opposition (Spreyer 1994, Avery et al. 2006, Korosec 2006).

From May 2010 through February 2013, we conducted research on naturalized monk parakeets nesting on electric utility structures in Dallas and Tarrant counties, Texas, US. We endeavored to learn how monk parakeets used urban habitat, how they behaved, and what structural and landscape features at what spatial scales influenced their nest-site selection of electric utility structures. We conducted a human dimensions survey to identify a nest management strategy that would evoke the least public outcry and opposition. To our knowledge, no one has used radiotelemetry methods to collect diurnal activity pattern data of monk parakeets. Understanding an avian species' habitat use, behaviors, and nest-site selection can be important when exploring management strategies where the species is a nuisance and unwanted. Chapter II discusses monk parakeet habitat use and behaviors, Chapter III reports foraging behavior specifically, and Chapter IV discusses monk parakeet selection of electric utility structures as nest sites. We found no previous studies addressing human-monk parakeet conflicts in urban environments where the species has naturalized. Identifying which wildlife management actions are acceptable and unacceptable, and understanding why, allows wildlife managers to develop appropriate management actions aligning with public expectations (Decker et al. 2001, Decker 2012). Chapter V reports public attitudes toward management of monk parakeets nesting on electric utility structures. Chapter VI is a summary of all chapters.

CHAPTER II

UNDERSTANDING HABITAT USE AND BEHAVIORS

OF NON-NATIVE MONK PARAKEETS IN DALLAS, TEXAS

SYNOPSIS

The monk parakeet (*Myiopsitta monachus*) is an introduced species in some urban areas, where some residents view it as desirable and electric utility companies judge it as a pest. We used radiotelemetry to assess diurnal activity patterns, flock-size variation, flock composition, movements, and urban land use-land cover (LULC) selection of naturalized monk parakeets in Dallas, Texas, United States. We tracked 20 radio-tagged individuals, recording 1,059 locations from August 2011–May 2012. Their most frequent activities were foraging (37%, SD = 10%, CI = 36–38%), performing nest maintenance (16%, SD = 8%, CI = 15–18%), and resting (16%, SD = 6%, CI = 15–17%). Foraging was the most common activity during summer (31%, CI = 24–38%), autumn (40%, CI = 35–45%), and winter (44%, CI = 39–49%), then nest maintenance (33%, CI = 25–40%) became the priority during spring. Overall, monk parakeet flock sizes averaged 10 individuals (SD = 8) yet were highly variable (range = 1–38). Flock sizes differed significantly among seasons, with flock sizes during autumn ($\bar{x}$ = 12, SD = 9, range = 1–38) and winter ($\bar{x}$ = 13, SD = 8, range = 2–38) significantly larger than summer ($\bar{x}$ = 8, SD = 5, range = 1–30) and spring ($\bar{x}$ = 5, SD = 2, range = 1–11). Away from the nest colonies, monk parakeets congregated more often in conspecific flocks (66%, n = 201) than in heterospecific aggregations (34%, n = 105). When in

heterospecific aggregations, we observed them with 18 avian and 2 mammalian species, yet most often with great-tailed grackle (*Quiscalus mexicanus*; 24%, *CI* = 17–31%) and European starling (*Sturnus vulgaris*; 24%, *CI* = 17–31%). Distances traveled by monk parakeets from their nest colonies varied significantly among seasons, with average winter distances ($\bar{x}$ = 526 m, *SD* = 502 m, range = 8–1,434 m) significantly farther than average distances during summer ($\bar{x}$ = 273 m, *SD* = 238 m, range = 19–1,372 m), autumn ($\bar{x}$ = 286 m, *SD* = 340 m, range = 19–1,602 m), and spring ($\bar{x}$ = 278 m, *SD* = 299 m, range = 24–1,021 m). At the greatest distances from their nest colonies, monk parakeets used canopy and residential property the most. Our telemetry data suggest monk parakeets in Dallas County did not select urban LULC categories at random. They used canopy (trees and shrubs) LULC more often than areas covered with pavement, grass, buildings, or water. Electric utility managers, landscape and urban planners, animal damage control officials, and wildlife managers who want to control urban monk parakeet populations might do so with LULC manipulation. While reducing canopy appears the most obvious approach, we suggest this with trepidation, as canopy LULC is most likely an important resource for native urban species. Avian enthusiasts wishing to support urban monk parakeet populations might increase the number of bird feeders and keep them well-stocked from late autumn to early spring.

INTRODUCTION

The monk parakeet (*Myiopsitta monachus*) is native to South America where it is associated with a variety of vegetation types, including dry *Acacia* scrubland, savanna woodlands, open forests, palm groves, agricultural croplands, fruit orchards, and urban parks (Bump 1971, Forshaw 1989). These vegetation types lay in the temperate to subtropical lowlands between 20–48° S latitude, where temperatures and precipitation range broadly (–12–44° C and 17–178 cm, respectively; Bump 1971, Davis 1974). From the late 1960s until 1992, >160,000 monk parakeets were imported as popular, inexpensive caged birds into the United States (US; Davey et al. 2004, CITES 2012). Accidental and intentional releases of the parrots resulted in naturalized, self-sustaining populations in several states (Devlin 1970, Bull 1973, Davis 1974, Neidermyer and Hickey 1977, Spreyer and Bucher 1998). Most of the populations became established in close proximity to major cities, zoos, seaports, and airports (Bump 1971, Forshaw 1989) within landscapes dominated by anthropogenic activity and disturbed vegetation types (Wiley et al. 1992).

Little attention has focused on how monk parakeets use their native or introduced habitats. Previous monk parakeet research in the species' native range focused on foraging behavior (Mott 1973, de Grazio and Besser 1975) and nesting (Humphrey and Peterson 1978, Lanning 1991, Eberhard 1996, Burger and Gochfeld 2005). Where the species has been introduced and naturalized, researchers examined monk parakeet foraging behavior and diet (Hyman and Pruett-Jones 1995, South and Pruett-Jones 2000), habitat selection (Sol et al. 1997), and nest-site selection, especially where they nest on electric utility structures and cause economic damage (Burger and Gochfeld 2000, Avery et al. 2002, Burger and Gochfeld 2009).

To our knowledge, no one has used radiotelemetry methods to collect diurnal activity pattern data of monk parakeets. Telemetry enables researchers to locate specific individuals quickly and repeatedly in order to record their movements and activities systematically across the landscape (Samuel and Fuller 1996). This in turn provides insights into an animal's social behaviors, as well as how it uses time and space for survival and reproduction (Sutherland 1998, Berger et al. 1999, Bowyer 2004).

Predation risk (Westcott and Cockburn 1988) and body size (Gilardi and Munn 1998) have been suggested as predictors of social behaviors and movement patterns in parrots. As predation risk increases, parrots may increase flock size to devote less time to vigilance and more time to foraging (Pulliam 1973). Smaller species are generally more susceptible to predation; therefore, it is logical that smaller species might assemble in larger flocks (Gilardi and Munn 1998). Another explanation for social behaviors and movements is spatial and temporal variability of food resources (Macdonald 1983, Anderson et al. 2005, Young and Van Aarde 2010). South and Pruett-Jones (2000) suggested flocking patterns of naturalized monk parakeets in Chicago, Illinois, US, were in relation to seasonal changes in resources. Additionally, increased movements during periods of low resource availability has been reported in other parrot species (Saunders 1980;1990, Salinas-Melgoza 2003, Ortiz-Maciel et al. 2010).

As part of a broader investigation of monk parakeet nest-site selection of electric utility structures (Reed et al. 2014), we examined the diurnal activity patterns, flock-size variation, flock composition, movements, and ranges of radio-tagged monk parakeets in a north Texas urban environment. Our objectives for this study were to: (1) identify which features and areas in the urban environment monk parakeets were attracted to, (2) determine when they moved to those areas, and (3) understand differences in individual social behaviors among the areas they used.

We predicted monk parakeets would conduct the majority of their diurnal activities (e.g., nest maintenance, vocalizing, resting, and social interactions) at or near their nest colonies. When away from their nest colonies, we expected monk parakeets to forage in both conspecific flocks and heterospecific aggregations. We also hypothesized monk parakeet movements and ranges in our study area would be smaller during breeding season (spring–summer) and larger during nonbreeding season (autumn–winter), especially during winter when food resources are typically scarcer. We expected monk parakeets would use residential properties, specifically those with bird feeders, more often than business properties when away from their nest colonies. Since monk parakeets use trees and shrubs for nest twigs (Roscoe et al. 1973), food resources (Spreyer and Bucher 1998), and perches (J. Reed, unpublished data), we expected they used canopy (trees and shrubs) more often than other urban LULC classifications (i.e., pavement, building, grass, and water). Understanding how monk parakeets use the urban environment may assist with formulating strategies to manage populations where they cause problems and are unwanted.

STUDY AREA

We conducted research in Dallas County, a major metropolitan area in north Texas, US, at latitude 32.8° N (Figure 2.1). The county's total area is 2,352 km^2, of which 97% is land and 3% is water, and the 2010 human population density was 1,040 individuals/km^2 (U.S. Census Bureau 2010). Although the county lies within the Blackland Prairie ecoregion (Texas Parks and Wildlife 2012), it has been severely altered by high human activity. The county now consists of industrial, commercial, and residential development with patchy vegetative remnants.

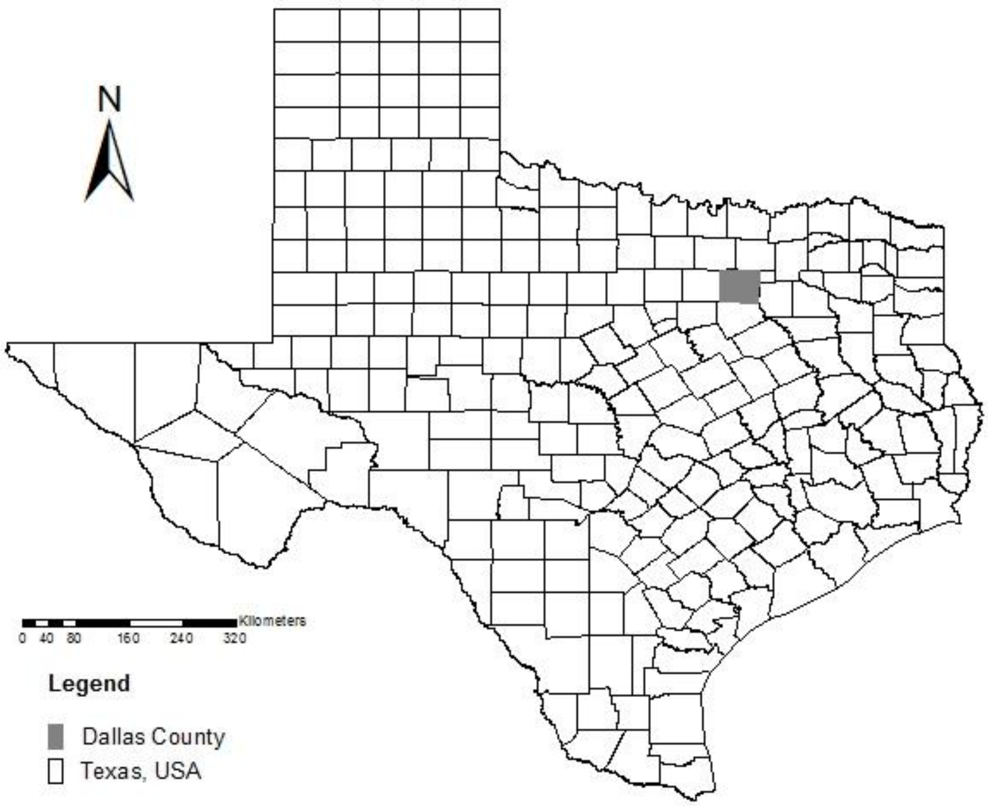

Figure 2.1. Map of Texas showing Dallas County, USA.

Dominant native tree species in Dallas County included oak (*Quercus* spp.) and elm (*Ulmus* spp.), interspersed with hackberry (*Celtis* spp.), ash (*Fraxinus* spp.), ashe juniper (*Juniperus ashei*), cottonwood (*Populus deltoides*), and red mulberry (*Morus rubra*). Dominant non-native trees included crepe myrtle (*Lagerstroemia indica*) and callery pear (*Pyrus calleryana*), interspersed with Chinaberry (*Melia azedarach*), Chinese tallow (*Triadica sebifera*), and Chinese privet (*Ligustrum lucidum*). Most of these species are common throughout the southeastern US and Texas urban areas (Little 1980, Gilman 1997). The non-native turf grasses St. Augustine (*Stenotaphrum secundatum*) and Bermudagrass (*Cynodon dactylon*) constituted the majority of the manicured grass areas. Few public grass areas contained native buffalograss (*Bouteloua dactyloides*). Hawks (*Buteo jamaicensis*, *Accipiter cooperii*, and *A. striatus*) and feral cats (*Felis catus*) inhabited the study area and were among the potential and known predators of monk parakeets (J. Reed, unpublished data).

Monk parakeets were breeding in Dallas County as early as 1973 (Williams 1974). By the early 1980s, populations were increasing exponentially in Dallas and several of the State's other major urban areas (Pruett-Jones et al. 2005). About the same time, the north Texas power utility, Oncor Electric Delivery (Dallas, Texas; hereinafter called Oncor), began experiencing monk parakeets nesting on its electric utility structures (i.e., transmission towers, switchyards, substations, and distribution poles; D. A. Boyle, Oncor Electric Delivery, personal communication). This nesting behavior has caused electric delivery disruption and economic damage ever since.

In Dallas County, historical July–December precipitation averaged 73 cm and temperatures averaged 16° C min. and 27° C max., while historical January–May precipitation averaged 83 cm and temperatures averaged 10° C min. and 21° C max. (NOAA 2013). During our research, Dallas County experienced drought conditions, ranging from abnormally to exceptionally dry (U.S. Drought Monitor 2011), and record high temperatures. From July–December 2011, the total precipitation was 5 cm and the average temperature was 23° C (17° C min. and 29° C max.; NOAA 2013). The winter was unseasonably dry and warm, followed by an early spring. The January–May 2012 total precipitation was 9 cm and the average temperature was 18° C (12° C min. and 23° C max.; NOAA 2013).

METHODS

Trapping

From July–December 2011, we trapped monk parakeets as needed to maintain ≥10 individuals with functioning radio-transmitter collars concurrently across 3 electric utility stations in Dallas County. To capture monk parakeets, we installed platform bait stations (see Avery et al. 2008) with non-functional reproductions of the E-Z Catch Remote Fire 36" x 36" trap (Wildlife Control Supplies, East Granby, CT) at 9 electric utility stations (i.e., switchyards and substations) with active monk parakeet colonies. We monitored and baited the stations daily with a blend of striped and black oil sunflower seeds, white proso millet, and safflower seeds (Wild Birds Unlimited, Carmel, IN). When monk parakeets began feeding routinely at the bait stations, we switched to safflower seeds exclusively to minimize non-target species and maximize monk parakeet feeding activity. Prior to capture events, we replaced the replica with the functional trap and supervised it while it was armed. We terminated baiting and trapping efforts once we radio-tagged 4–5 monk parakeets each at 3 electric utility stations (1 switchyard and 2 substations).

We weighed each captured monk parakeet to the nearest gram and aged it as adult ($\geq$1 years old) or juvenile (<1 year old) based upon absence or presence, respectively, of oral flanges (Roscoe et al. 1973). We identified older juveniles by their white, bare-skin orbital ring compared to the adults' grayish or dark-colored, bare-skin orbital ring (see Hyman and Pruett-Jones 1995) and older juveniles' darker, slate gray forehead feathers compared to the adults' lighter, gray-white forehead feathers (Spreyer and Bucher 1998). We collected >3 breast feathers from each parrot for DNA sex identification conducted at Veterinary Molecular Diagnostics, Inc. (Milford, OH).

To each monk parakeet's right leg we attached a 7.94 mm diameter (6.35 mm inside diameter) stainless steel wire, butt-end, numbered leg band (DL Products, Glendora, CA; Meyers 1994). We color-coded each parrot's crown and cheeks with a unique, individualized color combination using Marvy Uchida non-toxic colored fabric markers (Uchida of America, Corp., Torrance, CA) to assist with field-identification until the colors faded. At each of the 3 electric stations, we fit 4–5 monk parakeets each with a VHF 2-stage radio-transmitter collar, fixed-loop antenna, each with a unique frequency within 151 MHz (Model SOPB-2070, Wildlife Materials, Inc., Murphysboro, IL). Transmitters weighed 3–5 g each and we attached the appropriately weighted transmitter <5% of each monk parakeet's body mass (Appendix A). Average body weight for 32 captured monk parakeets was 116.6 g (*SD* = 10.3 g, range 98–143 g) including both weights of 4 individuals captured twice.

Telemetry

We tracked 20 radio-tagged monk parakeets from August 2011–May 2012, locating them 3 days a week, randomly once a day during daylight hours (when monk parakeets are active). We located our marked individuals within 5 randomly assigned 2–3-hour intervals: Early AM (0700–1000 hours CDT, 0630–0900 hours CST), Late AM (1000–1230 hours CDT, 0900–1100 hours CST), Early PM (1230–1500 hours CDT, 1100–1300 hours CST), Mid-PM (1500–1730 hours CDT, 1300–1500 hours CST), and Late PM (1730–2030 hours CDT, 1500–1730 hours CST). As days shortened and lengthened, we adjusted the beginning of the first interval and the end of the last interval in accordance with sunrise and sunset, respectively. We assigned our research seasons based on summer-winter solstice and autumn-spring equinox dates within the respective calendar year: summer (21 June–22 September 2011), autumn (23 September–21 December 2011), winter (22 December 2011–19 March 2012), and spring (20 March–19 June 2012). We designated spring–summer as breeding season and autumn–winter as nonbreeding season (see Hyman and Pruett-Jones 1995, Spreyer and Bucher 1998).

We located radio-tagged monk parakeets via homing (White and Garrott 1990, Samuel and Fuller 1996) using an R410 scanning receiver (ATS, Isanti, MN) and a TR-2 receiver (Telonics, Inc., Mesa, AZ) attached to a 3-element Yagi antenna, both vehicle-mounted and handheld as needed. We tracked each radio-tagged monk parakeet until its radio-transmitter battery failed (battery life $\bar{x}$ = 143 days, *SD* = 32 days, range = 67–185 days), the radio-transmitter collar fell off, or the parrot died.

When we located a radio-tagged monk parakeet, we observed from a distance with 10–22 x 50 zoom binoculars. To describe monk parakeet diurnal activity patterns, flock-size variation, flock composition, movements, and ranges we recorded 8 categories (O'Donnell and Dilks 1988): (1) date, (2) time, (3) parrot identification, (4) activity (first observed only), (5) substrate (i.e., air, canopy [trees and shrubs; including species], ground, bird feeder, or bait station), (6) property type (residential or business), (7) flock size, and (8) absence or presence and number of different species. We defined flock size as the total number of monk parakeets, marked and unmarked, together in the same location (see South and Pruett-Jones 2000), in the absence and presence of other species. We considered monk parakeets at their nests (0 m) when they were inside, on, or adjacent to their nests, as well as flying over their nests, perched on transmission lines immediately above their nests, and on the ground immediately underneath their nests.

Diurnal Activity Patterns

When we located radio-tagged monk parakeets, we recorded the first single activity observed for each individual. We grouped activities into 8 categories: (1) drinking, (2) flying, (3) foraging, (4) performing nest maintenance, (5) playing, (6) preening-allopreening, (7) resting, and (8) vocalizing. We considered monk parakeets flying when we observed them in flight and their radio-transmitter signals faded as we watched them moving away through the air. We defined performing nest maintenance as the collection and manipulation of twigs. We defined playing as individuals interacting (not allopreening; social play; Bekoff 1978) and manipulating objects, specifically vegetation (not foraging or performing nest maintenance; diversive exploration; Drickamer et al. 1996).

We ceased observations when the radio-tagged individual(s) showed signs of disturbance or flew away due to our arrival, when they stopped the first observed activity, or after 30 minutes had passed without any change in activity (see O'Donnell and Dilks 1988). So as not to disturb monk parakeets and condition them further to depart upon our arrival, we observed up to 30 minutes before approaching the location where we first found them. After either monk parakeets departed or 30 minutes had passed, we walked to where they had been or were and obtained a UTM location coordinate with a handheld GPS unit. We conducted all research with methods approved by the Texas A&M University Animal Care and Use Committee (AUP 2011-044).

Urban LULC Selection

We projected all UTM coordinates onto 2010 NAIP 1 m NC/CIR DOQQ imagery (1-m pixel resolution, 4-band Digital Orthophoto Quarter-Quad aerial imagery) for Dallas County (TNRIS 2011) in ArcMap 10.0 (Environmental Systems Research Institute, Inc., Redlands, CA). Before implementing an LULC classification, a suitable classification scheme is required based upon research objectives, characteristics of the study area, and selected remote sensing data (Lu and Weng 2007). We classified the urban landscape into 5 broad, easily distinguishable LULC categories, i.e., pavement, building, canopy (trees and shrubs), grass, and water, on the aerial imagery using supervised Image Classification (Gorte 1999) in the Spatial Analyst Tool of ArcMap 10.0. The urban

LULC classifications were clearly identifiable on the aerial images to discern with visual interpretation. The pavement classification included all paved areas, such as roads, parking lots, and walkways, as well as the herbicide-treated, coarse aggregate (crushed stone ≤6.4 cm) areas within the fenced electric stations. The building classification comprised all residential, commercial, and industrial structures. The canopy classification contained all tree and shrub crown cover. The grass classification included all manicured lawns and native and non-native grass areas. The water classification consisted of all lakes, ponds, rivers, creeks, and swimming pools.

Movements

We quantified ranges of individual radio-tagged monk parakeets with ≥28 telemetry locations each. It is recommended to obtain ≥30 locations per radio-tagged animal to approximate each individual's home range for estimation of area used (Seaman et al. 1999). We obtained ≥30 locations ($\bar{x}$ = 59, *SD* = 28, range = 28–116; Appendix B) for all but 1 of 17 radio-tagged monk parakeets. We defined range as the area around a nest colony navigated by a radio-tagged monk parakeet during its normal activities of food gathering, breeding, and offspring rearing (see Burt 1943). We used Geospatial Modelling Environment (GME; www.spatialecology.com, accessed 6 April 2012) to estimate range size of each radio-tagged parrot tracked during the life of its radio transmitter using 100% minimum convex polygon (MCP) with least squares cross validation (LSCV; Mohr 1947, Harris et al. 1990, White and Garrott 1990). While there is a natural bias of overestimating range with 100% MCPs (Worton 1987, White and

Garrott 1990), we used this method to include all available data describing the outer limits of each radio-tagged monk parakeet's movements.

Data Analyses

Monk parakeets are gregarious, which makes it difficult to get independent observations of individuals in the same flock. Accordingly, we reduced the dataset to individual flocks (n = 519) containing ≥1 radio-tagged monk parakeet to satisfy the assumption of independence when investigating flock-size variation, flock composition, movement distances, urban LULC classifications, and property type.

We quantified frequency, relative frequency (%), and 95% confidence intervals (*CI*) of 8 activities observed for radio-tagged monk parakeets from August 2011–May 2012. We tested for differences in activities among seasons using Kruskal-Wallis one-way analyses of variance. Under the assumption that monk parakeets would travel farther to important resources or to perform important behaviors, we calculated distances from each nest colony to their respective radio-tagged monk parakeet UTM coordinates on the 2010 NAIP 1 m NC/CIR DOQQ imagery of Dallas County in ArcMap 10.0. For each of the 8 activities, we quantified average distance ($\bar{x}$), standard deviation (*SD*), and range. We used ANOVA to test for differences in mean distances of activities among seasons. Using Pearson's Chi-square, we tested for differences in flock-size variation and flock composition away from the nest colonies and between breeding and nonbreeding seasons. For cell counts of expected values <5, we used Kruskal-Wallis one-way analyses of variance.

We investigated seasonal selection of urban LULC classifications by monk parakeets with ≥15 locations per season. Using ArcMap 10.0, we quantified the composition of available urban LULC classification within each parrot's 100% MCP range and the collective seasonal ranges (comparable to Johnson [1980] third-order selection). We examined point location to calculate the proportion of each urban LULC classification used by each parrot within its 100% MCP range per season. We conducted compositional analysis (encompasses all MANOVA/MANCOVA-type linear models; Aebischer et al. 1993) of proportional habitat use by individual monk parakeets using package 'adehabitatHS' in R x64 2.15.0 (www.R-project.org, accessed 3 January 2012). We compared the relative frequency (%) of each monk parakeet's observed locations on each urban LULC classification to the proportion of that LULC classification available within each individual's 100% MCP range and seasonal range (Thomas and Taylor 1990, Aebischer et al. 1993). LULC classifications not used by monk parakeets were recorded as 0.01% (see Aebischer et al. 1993).

For all significant results, we used one-way ANOVA to test for differences among means, Levene's test for homogeneity of variances, Tukey's test for equal variances, and Tamhane's T2 test for unequal variances. We conducted analyses in SPSS 20.0 (IBM Corporation, Armonk, NY) and R x64 2.15.0. All significance levels were $\alpha = 0.05$.

RESULTS

From April–December 2011, we captured 32 monk parakeets (17 F, 15 M; Appendix A) at 3 electric stations in Dallas County, Texas, US. We equipped 25 individuals (12 F, 13

M) with radio-transmitter collars. Four radio-tagged parrots were recaptured and their radio-transmitter collars replaced. We collected 1,059 locations (summer, *n* = 166; autumn, *n* = 350; winter, *n* = 399; and spring *n* = 144) for 20 radio-tagged monk parakeets (11 F, 9 M) from August 2011–May 2012 (Appendix B). Forty-one percent (41%, *n* = 431) of the locations were at (0 m) the nests and 59% (*n* = 628) were away from (≥8 m) the nests. Over 10 months, we tracked radio-tagged monk parakeets an average 49 individual days (*SD* = 20 individual days, range = 14–79 individual days). Of the 14 radio-transmitter collars we tracked from attachment to battery failure (excluding predation, dropped collars, or faulty transmitters), average battery life was 143 days (*SD* = 32 days, range = 67–185 days). We were unable to attract and capture monk parakeets from March–June of either year, which resulted in a small sample size for spring and no data for June–July.

Table 2.1. Frequency, relative frequency (%), average distance (m) from nest colonies, standard deviation (*SD*), and range of 8 activities for 1,059 telemetry locations of monk parakeets in Dallas County, Texas, USA, August 2011–May 2012.

			Distance (m) from nest colony		
Activity	Frequency	Relative frequency	$\bar{x}$	*SD*	Range
Total	1,059				
Drinking	17	2%	136	88	24–327
Flying	5	1%	619	586	0–1,286
Foraging	395	37%	416	417	0–1,602
Performing nest maintenance	175	16%	19	61	0–386
Playing	16	1%	110	198	0–499

Table 2.1. Continued

Activity	Frequency	Relative frequency	Distance (m) from nest colony		
			$\bar{x}$	*SD*	Range
Preening-allopreening	125	12%	198	389	0–1,332
Resting	174	16%	212	417	0–1,576
Vocalizing	152	14%	88	168	0–650
Away from nests (≥8 m)	628				
Drinking	17	3%	136	88	94–178
Flying	3	<1%	1031	221	780–1,281
Foraging	376	60%	437	416	395–479
Performing nest maintenance	26	4%	126	107	85–167
Playing	5	1%	353	201	177–529
Preening-allopreening	76	12%	325	456	223–428
Resting	71	11%	520	517	400–640
Vocalizing	54	9%	246	200	193–300
At nests (0 m)	431				
Drinking	0	0%	0	0	0
Flying	2	<1%	0	0	0
Foraging	19	4%	0	0	0
Performing nest maintenance	149	35%	0	0	0
Playing	11	3%	0	0	0
Preening-allopreening	49	11%	0	0	0
Resting	103	24%	0	0	0
Vocalizing	98	24%	0	0	0

Diurnal Activity Patterns

We used all locational data (n = 1,059) to determine diurnal activity patterns of 20 radio-tagged monk parakeets. We observed monk parakeets foraging most often (37%, *SD* = 10%, *CI* = 36–38%) followed by performing nest maintenance (16%, *SD* = 8%, *CI* = 15–18%), resting (16%, *SD* = 6%, *CI* = 15–17%), vocalizing (14%, *SD* = 6%, *CI* = 13–15%), preening-allopreening (12%, *SD* = 7%, *CI* = 11–13%), drinking (2%, *SD* = 2%, *CI* = 1–3%), playing (1%, *SD* = 1%, *CI* = 1–2%), and flying (1%, *SD* = 1%, *CI* = 0–1%; Table 2.1). There was a significant difference (Kruskal-Wallis χ^2 = 26.4, df = 3, P < 0.001) in monk parakeet activities among seasons (Figure 2.2). Foraging was the most common activity during summer (31%, *CI* = 24–38%), autumn (40%, *CI* = 35–45%), and winter (44%, *CI* = 39–49%; Table 2.2) and performing nest maintenance was the primary activity during spring (33%, *CI* = 25–40%). The second most prevalent activity varied among the seasons. Monk parakeets were perched and vocalizing in summer (27%, *CI* = 20–34%), performing nest maintenance in autumn (17%, *CI* = 13–20%), resting in winter (16%, *CI* = 12–19%), and foraging in spring (20%, *CI* = 14–27%).

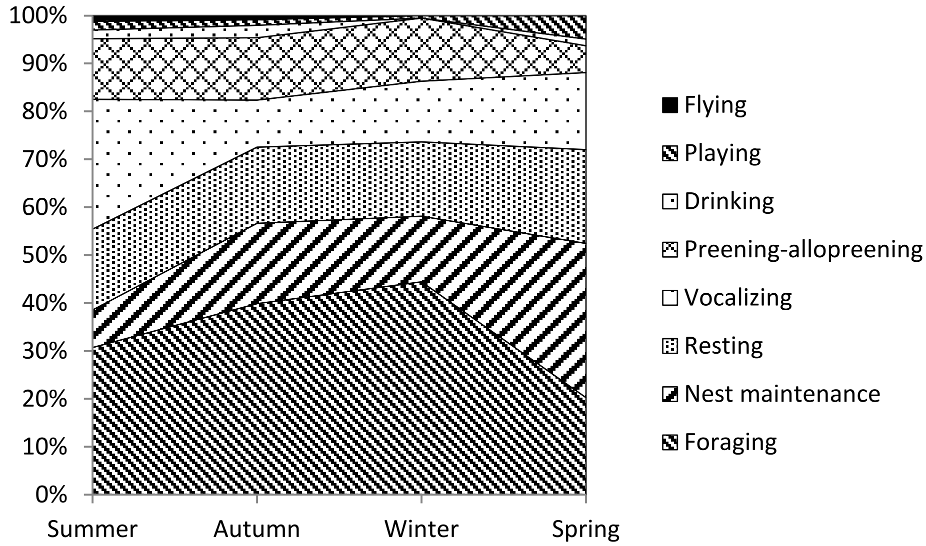

Figure 2.2. Relative frequency (%) of 8 activities per season for 20 radio-tagged monk parakeets at (0 m) and away from (≥8 m) their nest colonies in Dallas County, Texas, USA, August 2011–May 2012.

Table 2.2. Frequency, relative frequency (%), average distance (m) from nest colonies, standard deviation (*SD*), and range (m) for 8 activities per season of monk parakeets in Dallas County, Texas, USA, August 2011–May 2012.

	Summer				Autumn				Winter				Spring			
Activity	Frequency	Relative frequency	Average distance (m)	*SD* (m)	Frequency	Relative frequency	Average distance (m)	*SD* (m)	Frequency	Relative frequency	Average distance (m)	*SD* (m)	Frequency	Relative frequency	Average distance (m)	*SD* (m)
Drinking	3	2%	145	4	12	3%	151	95	0	0%	0	0	2	1%	30	8
Flying	2	1%	0	0	3	1%	1031	221	0	0%	0	0	0	0%	0	0
Foraging	51	31%	321	230	139	40%	270	272	176	44%	559	507	29	20%	412	360
Performing nest maintenance – at nests	11	7%	0	0	56	16%	0	0	54	13%	0	0	33	23%	0	0
Performing nest maintenance – collecting nest twigs	2	1%	380	8	2	1%	177	0	3	1%	126	108	14	10%	124	69
Playing	3	2%	90	84	4	1%	374	249	2	1%	0	0	7	5%	0	0
Preening-allopreening	21	13%	60	77	45	13%	85	179	51	13%	384	533	8	6%	7	21
Resting	28	17%	235	286	55	16%	152	380	63	16%	348	531	28	19%	3	15
Vocalizing	45	27%	251	208	34	10%	45	131	50	13%	10	24	23	16%	0	0
Total	166				350				399				144			

Flock-size Variation and Flock Composition

Using a reduced set of locations (n = 306) ≥8 m from the nests, we found monk parakeet flock size averaged 10 individuals (SD = 8, range = 1–38). There was a significant difference (F = 12.57, df = 3, P < 0.001) in average flock sizes among seasons (Figure 2.3). Average flock sizes during autumn ($\bar{x}$ = 12, SD = 9, range = 1–38, n = 104) and winter ($\bar{x}$ = 13, SD = 8, range = 2–38, n = 88) were significantly larger than during summer ($\Delta\bar{x}$ = –4, SE = 1, P = 0.001; $\bar{x}$ = 8, SD = 5, range = 1–30, n = 84) and spring ($\Delta\bar{x}$ = –7, SE = 1, P < 0.001; $\bar{x}$ = 5, SD = 2, range = 1–11, n = 30).

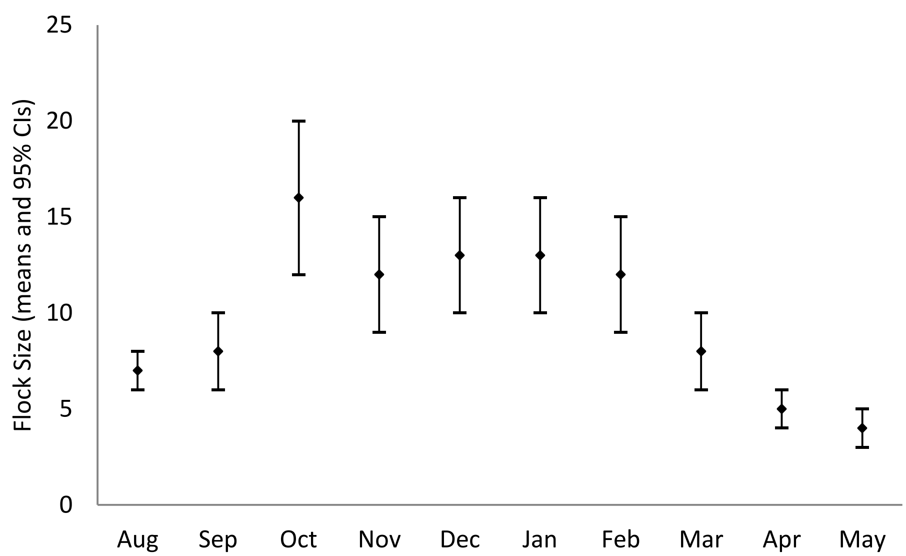

Figure 2.3. Flock size means and 95% confidence intervals (CI) per month for 20 radio-tagged monk parakeets in Dallas County, Texas, USA, August 2011–May 2012.

There was a significant difference (F = 2.9, df = 7, P = 0.006) in monk parakeet average flock size among activities. Flock sizes were significantly smaller when radio-tagged monk parakeets were performing nest maintenance ($\bar{x}$ = 7, *SD* = 4, range = 1–15, *n* = 13) than when they were preening-allopreening ($\Delta\bar{x}$ = 7, *SE* = 2, *P* = 0.029; $\bar{x}$ = 14, *SD* = 10, range = 2–38, *n* = 36) and foraging ($\Delta\bar{x}$ = 5, *SE* = 1, *P* = 0.042; $\bar{x}$ = 11, *SD* = 8, range = 1–38, *n* = 173). When radio-tagged monk parakeets were drinking, flock sizes averaged 12 ($\bar{x}$ = 12, *SD* = 8, range = 2–28, *n* = 8); when resting, flock sizes averaged 8 (*SD* = 8, range = 1–37, *n* = 38); when playing, flock sizes averaged 8 (*SD* = 1, range = 6–9, *n* = 3); when vocalizing, flock sizes averaged 8 (*SD* = 6, range = 1–25, *n* = 33); and when flying, flock sizes averaged 3 (*SD* = 3, range = 1–5, *n* = 2).

There was a significant difference (*F* = 3.62, *df* = 3, *P* = 0.014) in monk parakeet average flock size among urban LULC use. Flock sizes were significantly larger when radio-tagged monk parakeets were in or over canopy ($\bar{x}$ = 9, *SD* = 7, range = 1–38, *n* = 194) than when they were on or over grass ($\Delta\bar{x}$ = –3, *SE* = 1, *P* = 0.034; $\bar{x}$ = 13, *SD* = 9, range = 1–38, *n* = 81). Flock sizes averaged 13 individuals when monk parakeets were on or over pavement ($\bar{x}$ = 13, *SD* = 10, range = 1–37, *n* = 29) and averaged 10 individuals when on or over buildings ($\bar{x}$ = 10, *SD* = 1, range = 9–11, *n* = 2).

Away (≥8 m) from the nest colonies, we observed monk parakeets more often in conspecific flocks (66%, *n* = 201) than heterospecific aggregations (34%, *n* = 105). There was no significant difference (*F* = 1.534, *df* = 1, *P* = 0.216) in average number of monk parakeets per flock between conspecific and heterospecific aggregations. We observed monk parakeets with 18 avian and 2 mammalian species (Table 2.3). Monk parakeets most often associated with great-tailed grackle (*Quiscalus mexicanus*; 24%, *CI* = 17–31%) and European starling (*Sturnus vulgaris*; 24%, *CI* = 17–31%; Table 2.3).

Table 2.3. Frequency, relative frequency (%), and 95% confidence intervals (*CI*) for 18 avian and 2 mammalian species observed associating with monk parakeets in Dallas County, Texas, USA, August 2011–May 2012.

				95% *CI*	
Common name	Species	Frequency	Relative frequency	Lower	Upper
Great-tailed grackle	*Quiscalus mexicanus*	37	24%	0.172	0.306
European starling	*Sturnus vulgaris*	37	24%	0.172	0.306
Mourning dove	*Zenaida macroura*	21	14%	0.082	0.189
White-winged dove	*Zenaida asiatica*	14	9%	0.045	0.135
Eurasian collared-dove	*Streptopelia decaocto*	11	7%	0.031	0.111
Blue jay	*Cyanocitta cristata*	6	4%	0.008	0.069
Rock dove	*Columba livia*	6	4%	0.008	0.069
Eastern fox squirrel	*Sciurus niger*	5	3%	0.004	0.060
Red-bellied woodpecker	*Melanerpes carolinus*	4	3%	0.001	0.051
House sparrow	*Passer domesticus*	3	2%	–0.002	0.041
Northern mockingbird	*Mimus polyglottos*	3	2%	–0.002	0.041
House finch	*Haemorhous mexicanus*	2	1%	–0.005	0.031
Northern cardinal	*Cardinalis cardinalis*	1	1%	–0.006	0.019
Carolina chickadee	*Poecile carolinensis*	1	1%	–0.006	0.019
Eastern cottontail	*Sylvilagus floridanus*	1	1%	–0.006	0.019
Dark-eyed junco	*Junco hyemalis*	1	1%	–0.006	0.019
Red-winged blackbird	*Agelaius phoeniceus*	1	1%	–0.006	0.019
Carolina wren	*Thryothorus ludovicianus*	1	1%	–0.006	0.019

When in heterospecific aggregations, monk parakeets most often foraged with other species on the ground or in tree-shrub canopy (42%, *CI* = 32–51%) and at bird feeders (20%, *CI* = 12–28%). We also observed them preening-allopreening (12%, *CI* = 6–19%), resting (11%, *CI* = 5–17%), vocalizing (8%, *CI* = 2–13%7), drinking (3%, *CI* = 0–6%), playing (2%, *CI* = −1–4%), and flying (1%, −1–3%).

Urban LULC Selection

We calculated the seasonal range (100% MCP; ha) of each radio-tagged monk parakeet (n = 17; Table 2.4). Average range during winter ($\bar{x}$ = 80.76 ha, *SD* = 29.45 ha, *CI* = 62.05–99.47 ha) was significantly larger (F = 6.483, df = 3, P = 0.001) than summer ($\bar{x}$ = 19.94 ha, *SD* = 8.00 ha, *CI* = 13.79–26.09 ha) and spring ($\bar{x}$ = 29.04 ha, *SD* = 7.04 ha, *CI* = 17.84–40.24 ha). Average autumn range was 55.81 ha (*SD* = 50.08 ha, *CI* = 22.17–89.45 ha).

Table 2.4. Average and individual100% minimum convex polygon (MCP) and 85% and 50% kernel density estimators (KDE) per season for 17 monk parakeets in Dallas County, Texas, USA, August 2011–May 2012.

	100% MCP (ha)									
Season	$\bar{x}$	*SD*	95% *CI*	*n*	Bird	Sex	100% MCP (ha)	85% KDE (ha)	50% KDE (ha)	*n*
Summer	19.94	8.00	13.79–26.09	9	2	M	19.30	24.62	8.28	19
					4	F	7.02	10.83	3.34	17
					6	F	34.37	35.17	9.53	16
					10	F	16.21	30.32	12.00	20
					12	M	22.79	41.45	14.66	18
					13	M	22.79	39.55	14.68	20
					14	F	25.24	46.98	16.46	18
					15	M	20.63	30.95	9.94	20

Table 2.4. Continued

	100% MCP (ha)									
Season	$\bar{x}$	*SD*	95% *CI*	*n*	Bird	Sex	100% MCP (ha)	85% KDE (ha)	50% KDE (ha)	*n*
Autumn	55.81	50.08	22.17–89.45	11	2	M	133.65	50.55	10.79	25
					4	F	13.81	12.71	37.66	17
					6	F	122.20	62.17	13.39	36
					12	M	10.21	11.72	2.53	24
					13	M	125.33	50.73	13.38	39
					14	F	10.21	12.63	2.86	22
					15	M	55.65	32.77	8.87	38
					17	F	60.21	31.18	8.57	36
					20	F	58.36	41.36	10.57	38
					21	M	15.06	24.31	7.83	26
					24	F	9.25	4.03	1.11	24
Winter	80.76	29.45	62.05–99.47	12	13	M	99.95	119.92	32.73	37
					15	M	99.68	106.10	28.31	37
					17	F	59.93	51.93	9.33	34
					20	F	59.93	62.26	12.20	35
					21	M	26.67	15.56	3.78	26
					23	F	34.26	75.77	25.82	15
					24	F	70.79	82.67	19.18	34
					27	F	110.20	155.60	45.89	37
					29	M	110.53	152.55	44.05	38
					30	F	98.86	136.37	33.69	27
					31	F	98.59	120.81	33.69	26
					32	M	99.69	108.50	30.07	37
Spring	29.04	7.04	17.84–40.24	4	13	M	24.12	22.91	6.24	23
					15	M	26.28	29.80	8.92	21
					29	M	39.49	38.17	8.50	23
					32	M	26.28	24.26	5.12	21

We calculated the percentage of each urban LULC classification within the 100% MCP range for radio-tagged monk parakeets (*n* = 17), each with ≥15 locations per season, across 3 study sites (Table 2.5). Thirteen individuals had ≥15 locations in >1 season. Monk parakeets did not select urban LULC components within their 100% MCP ranges at random (λ = 0.011, *P* = 0.002). Rankings of LULC classification importance were (most to least): (1) canopy, (2) pavement and grass (equally), (3) building, and (4) water.

Table 2.5. Percentage of each urban land use-land cover classification within the 100% MCP range for 17 radio-tagged monk parakeets across 3 study sites in Dallas County, Texas, USA, August 2011–May 2012.

	100% MCP (ha)				
Location	Building	Pavement	Grass	Canopy	Water
Central	14.36	18.42	38.73	32.66	0.54
Morrison	37.09	99.22	62.89	11.20	0.25
Richardson	93.69	25.88	69.02	17.77	0.31

Movements

Using the reduced set of locations (*n* = 306) ≥8 m from the nests, we found no significant difference (*F* = 1.280, *df* = 1, *P* = 0.259) in distances traveled from the nest colonies between monk parakeet sexes: males ($\bar{x}$ = 380 m, *SD* = 403 m, range = 8–1,512 m, *n* = 126) and females ($\bar{x}$ = 330 m, *SD* = 369 m, range = 10–1,602 m, *n* = 180). There also was no significant difference (*F* = 0.195, *df* = 1, *P* = 0.659) in distances traveled from the nest colonies between age classes: adults ($\bar{x}$ = 336 m, *SD* = 333 m, range = 19–1,372 m, *n* = 95) and juveniles ($\bar{x}$ = 357 m, *SD* = 405 m, range = 8–1,602 m, *n* = 211).

Overall, we found monk parakeets locations averaged 351 m (*SD* = 384 m, range = 8–1,602 m, *n* = 306) from their nest colonies. There was a significant difference (F = 9.309, df = 3, $P < 0.001$; Figure 2.4) in average distance from the nest colonies among seasons. Winter location distances ($\bar{x}$ = 526 m, *SD* = 502 m, range = 8–1,434 m, *n* = 88) were significantly farther than location distances for summer ($\Delta\bar{x}$ = –253 m, *SE* = 59 m, $P < 0.000$; $\bar{x}$ = 273 m, *SD* = 238 m, range = 19–1,372 m, *n* = 84), autumn ($\Delta\bar{x}$ = –240 m, *SE* = 63 m, P = 0.001; $\bar{x}$ = 286 m, *SD* = 340 m, range = 19–1,602 m, *n* = 88), and spring ($\Delta\bar{x}$ = –248 m, *SE* = 76 m, P = 0.010; $\bar{x}$ = 278 m, *SD* = 299 m, range = 24–1,021 m, *n* = 30). There also was a significant difference (F = 7.363, df = 1, P = 0.007) in average distance from the nest colonies between breeding and nonbreeding seasons. On average, monk parakeet locations were farther from their nest colonies during nonbreeding season ($\bar{x}$ = 396 m, *SD* = 438 m, range = 8–1,602 m, *n* = 88) than during breeding season ($\bar{x}$ = 274 m, *SD* = 254 m, range = 19–1,372 m, *n* = 88).

There was a significant difference (F = 3.356, df = 7, P = 0.002) in average distance from the nest colonies among activities. Average distance to monk parakeet foraging locations ($\bar{x}$ = 392 m, *SD* = 388 m, range = 8–1,602 m, *n* = 173) were significantly farther than average distance to drinking ($\Delta\bar{x}$ = –255 m, *SE* = 47 m, P = 0.001; $\bar{x}$ = 137 m, *SD* = 105 m, range = 24–327 m, *n* = 8), performing nest maintenance ($\Delta\bar{x}$ = –229 m, *SE* = 44 m, $P < 0.001$; $\bar{x}$ = 163 m, *SD* = 118 m, range = 8–386 m, *n* = 13), and vocalizing ($\Delta\bar{x}$ = –152 m, *SE* = 45 m, P = 0.032; $\bar{x}$ = 240 m, *SD* = 198 m, range =

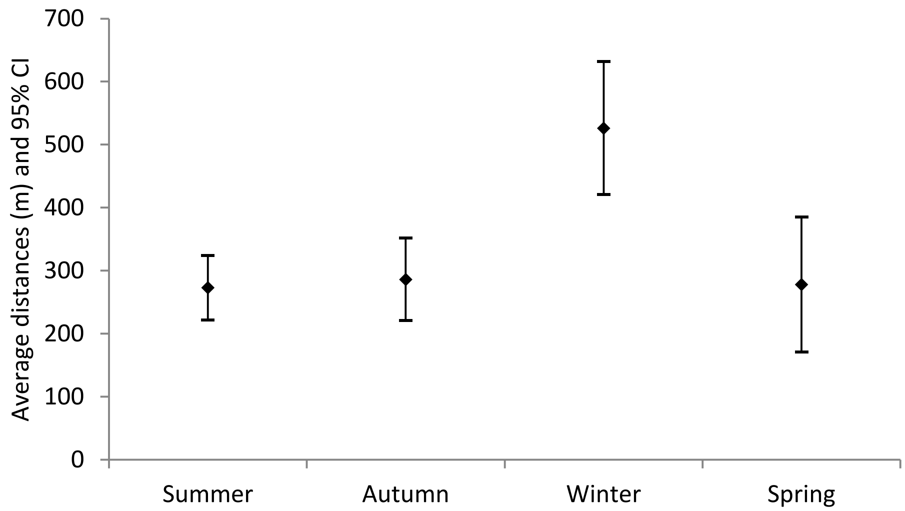

Figure 2.4. Average distances (m) and 95% confidence intervals (*CI*) of 20 radio-tagged monk parakeets per season for 306 locations away from (≥8 m) their nest colonies in Dallas County, Texas, USA, August 2011–May 2012.

19–650 m, n = 33). Distances to locations of monk parakeets flying averaged 1,095 m (SD = 271 m, range = 903–1,286 m, n = 2), resting averaged 431 m (SD = 495 m, range = 19–1,576 m, n = 38), playing averaged 256 m (SD = 213 m, range = 103–499 m, n = 3), and preening-allopreening averaged 248 m (SD = 377 m, range = 14–1,332 m, n = 36).

There was a significant difference (F = 40.704, df = 1, $P < 0.001$) in average distance from the nest colonies between use of property types. From the nest colonies, monk parakeets utilized residential property at greater distances ($\bar{x}$ = 552 m, SD = 426 m, range = 31–1,602 m, n = 92) than business property ($\bar{x}$ = 264 m, SD = 330 m, range = 8–1,512 m, n = 214).

There was a significant difference ($F = 3.567$, $df = 3$, $P = 0.015$) in average distance from the nest colonies among use of urban LULC. Average distance to canopy ($\bar{x} = 401$ m, $SD = 383$ m, range = 19–1,602 m, $n = 194$) was significantly farther than average distance to pavement ($\Delta\bar{x} = -209$ m, $SE = 75$ m, $P = 0.030$; $\bar{x} = 192$ m, $SD = 321$ m, range = 8–1,286 m, $n = 29$). Average distance to grass ($\Delta\bar{x} = -110$ m, $SE = 50$ m, $P = 0.127$; $\bar{x} = 291$ m, $SD = 390$ m, range = 10–1,434 m, $n = 81$) and buildings ($\Delta\bar{x} = -167$ m, $SE = 269$ m, $P = 0.926$; $\bar{x} = 234$ m $SD = 132$ m, range = 141–327 m, $n = 2$) were not significantly different.

There was a significant difference ($F = 11.216$, $df = 7$, $P < 0.001$) in average distance from the nest colonies among use of substrates. Average distance to bird feeders ($\bar{x} = 898$ m, $SD = 317$ m, range = 648–1,297 m, $n = 15$) were significantly farther than average distance to bait stations ($\Delta\bar{x} = -858$ m, $SE = 82$ m, $P < 0.001$; $\bar{x} = 40$ m, $SD = 18$ m, range = 19–56 m, $n = 19$), distribution-transmission lines ($\Delta\bar{x} = -655$ m, $SE = 98$ m, $P < 0.001$; $\bar{x} = 242$ m, $SD = 276$ m, range = 14–948 m, $n = 27$), electric stations ($\Delta\bar{x} = -865$ m, $SE = 82$ m, $P < 0.001$; $\bar{x} = 33$ m, $SD = 16$ m, range = 8–53 m, $n = 8$), ground ($\Delta\bar{x} = -653$ m, $SE = 93$ m, $P < 0.001$; $\bar{x} = 244$ m, $SD = 306$ m, range = 10–1,434 m, $n = 47$), and trees ($\Delta\bar{x} = -510$ m, $SE = 87$ m, $P < 0.001$; $\bar{x} = 389$ m, $SD = 389$ m, range = 19–1602 m, $n = 185$). Average distance to air ($\Delta\bar{x} = -197$ m, $SE = 208$ m, $P = 1.000$; $\bar{x} = 1,095$ m, $SD = 271$ m, range = 903–1,286 m, $n = 2$) and building roof tops ($\Delta\bar{x} = -664$ m, $SE = 124$ m, $P = 0.300$; $\bar{x} = 234$ m, $SD = 132$ m, range = 141–327 m, $n = 2$) were not significantly different.

There was no significant difference ($F = 1.010$, $df = 1$, $P = 0.316$) in average distance from the nest colonies between monk parakeets in conspecific flocks and heterospecific aggregations. We observed monk parakeets in conspecific flocks at average distance 367 m (*SD* = 391 m, range = 10–1,602 m, $n = 201$) and in heterospecific aggregations at average distance 320 m (*SD* = 370 m, range = 8–1,512 m, $n = 105$).

DISCUSSION

Marks can adversely affect an animal's physiology or behavior, at least temporarily, ranging from mild irritation resulting from increased grooming to factors that can lead to death, such as infection or increased vulnerability to predators (Nietfeld et al. 1996). Our color markings, radio-transmitter collars, and leg bands may have temporarily affected our marked parrots in regards to their behavior, social interactions, and vulnerability to predation. While we did not measure adverse affects during our study, we did observe marked individuals and their flock mates devote excessive attention to the radio-transmitter collars within the first week of attachment. Afterwards and throughout the remaining life of their transmitter batteries, we observed marked monk parakeets behaving the same as unmarked individuals.

Diurnal Activity Patterns

Overall, we located and observed monk parakeets away from their nests foraging more than twice as often as we located and observed them at their nests attending to nest maintenance. Similar to other studies, we found nest maintenance was concentrated in spring preceding breeding season (Martella and Bucher 1993, Hyman and Pruett-Jones

1995). Previous literature reported monk parakeets spent most of their time at or near their nests resting (Bump 1971) and foraging, socializing, and roosting (Sol et al. 1997), as well as spending significant time and energy carrying and manipulating twigs for nest building and maintenance (Shields et al. 1974, Bucher et al. 1991). The discrepancy between our results and previous research may be due to study design. We were the first to incorporate radio-transmitter technology into monk parakeet research. With radio-tagged monk parakeets, we were able to locate specific individuals repeatedly and record their locations and activities systematically across the urban landscape. Our radiotelemetry study design also allowed us to differentiate seasonal variation of monk parakeet activity patterns. The information from our study provides a more accurate picture of monk parakeet activity budgets in the urban environment than previously reported.

Flock-size Variation and Flock Composition

As expected, monk parakeets in our study area were gregarious and flock size was highly variable, similar to other monk parakeet studies (Friedmann 1927, Long 1981, Forshaw 1989, Collar and Juniper 1992, Hyman and Pruett-Jones 1995). Flock-size variability in our study area appeared to be seasonal in nature and correlated with reproduction, comparable to other naturalized psittacine studies attributing seasonal flock-size variation to reproduction (Froke 1981, Collins and Kares 1997, Mabb 1997, South and Pruett-Jones 2000).

Monk parakeet flock size varied with activity, with flock sizes larger when they were foraging and preening-allopreening. Although monk parakeets assembled most often in conspecific flocks, we also observed them in heterospecific aggregations, primarily foraging, and monk parakeet numbers were not significantly different in either grouping. Monk parakeets may assemble in larger flocks and with other avian species for one or more reasons. One explanation is improved foraging success through information sharing among flock members (Moynihan 1962, Murton 1971, Krebs et al. 1972, Krebs 1973). Another explanation is reduced predation risk (Lazarus 1972, Powell 1974, Curio 1976, Bertram 1978, Popp 1988). Smaller species are more susceptible to predation and may lead them to flock in larger groups, as well as with larger species (Westcott and Cockburn 1988). Monk parakeets are considered small to medium-sized parrots, measuring 29 cm and weighing 90–120 g (Forshaw 1989). When foraging, our monk parakeets aggregated frequently with the larger great-tailed grackle (M 46 cm, 190 g; F 38 cm, 105 g; Cornell University 2014). Our results are similar to previous research that found other parrot species sometimes assemble in multispecies aggregations in their native environments (Westcott and Cockburn 1988, Chapman et al. 1989, Forshaw 1989). In addition to response to predation risk, these multispecies aggregations also may serve as information sharing for food resources, especially when such resources are limited or patchily distributed (Ward and Zahavi 1973, Westcott and Cockburn 1988). From our observations, urban monk parakeets may use other species as indicators for some food sources, especially bird feeders. This was evident at our bait stations, as we observed other avian species and fox squirrels feeding at the bait stations before monk parakeets fed there (J. E. Reed, unpublished data).

Monk parakeet flock size also varied with LULC use. Average flock sizes were significantly larger when monk parakeets assembled over canopy (on distribution-transmission lines) or in canopy LULC (both leafed and bare) than when they were over grass (on distribution-transmission lines) or on grass LULC. Based on detectability by predators, we would expect there to be no difference. The iridescent green plumage of monk parakeets is difficult to detect both in canopy foliage and on green grassy areas (J. E. Reed, unpublished data). Furthermore, birds are usually safer from predators when concealed and inaccessible, such as within canopy, and when they can detect approaching predators from a distance, such as when on grassy areas (Thiollay 1999). Our results may be biased towards canopy LULC usage (discussed below), however, by our reduced ability to detect the signals of radio-tagged monk parakeets when they were on the ground in the urban environment.

Urban LULC Selection

Monk parakeets showed a significant urban LULC classification preference within their ranges. Preference for the less available canopy (trees and shrubs) is not surprising, as monk parakeets utilize trees and shrubs for nest twigs (Roscoe et al. 1973), food resources (Spreyer and Bucher 1998), and perches (J. Reed, unpublished data). While our results showed monk parakeets used canopy LULC the most, this may be a biased result due to reduced radio-transmitter signal strength when monk parakeets were on the ground (i.e., pavement and grass). We suggest future radiotelemetry studies of monk parakeets address this when selecting radio-transmitter technology.

Movements

Since monk parakeets are gregarious, we expected to find no differences in location distances away from the nests between sexes or age classes. We were surprised, however, there was no difference in distances from the nest colonies between conspecific flocks and heterospecific aggregations. Since monk parakeet nest colonies are comprised of many individuals that do not always flock together (J. E. Reed, unpublished data), we expected to find radio-tagged parrots assembled in heterospecific aggregations more often when away from the nest colonies, especially when foraging.

During winter, monk parakeets in our study area traveled greater distances, where we usually found them foraging or resting in canopy near a food resource on residential property. An important expenditure for any animal is travel costs, which may strongly influence efficient use of spatially distributed resources (Stamps and Eason 1989). As food resources vary spatially and temporally, animal movements may increase or decrease to satisfy daily energy requirements (Macdonald 1983, Anderson et al. 2005, Young and Van Aarde 2010). Increased movements during periods of low resource availability has been reported in other parrot species, such as the lilac-crowned parrot (*Amazona finschi*; Salinas-Melgoza 2003), maroon-fronted parrot (*Rhynchopsitta terrisi*; Ortiz-Maciel et al. 2010), and white-tailed black cockatoo (*Calyptorhynchus funereus latirostris*; Saunders 1980,1990). The variation in movements shown by our radio-tagged monk parakeets was likely to maximize their foraging efficiency in response to the density, placement, or quality of food resources (resource dispersion hypothesis; Macdonald 1983, Mitchell and Powell 2004). Although we did not measure resource availability and distribution in our study area, we learned that some residents stocked their bird feeders only from late autumn to early spring each year and monk parakeets had been visiting them "for years" (J. Reed, unpublished data). Given that our radio-tagged monk parakeets repeatedly visited the same food resources, especially bird feeders during winter, we presume urban monk parakeets learn where important food resources are and expect them to be available (place hypotheses; Krechevsky 1932, O'Keefe and Nadel 1978, Spencer 2012).

Our results likely have some limitations. Our inability to capture monk parakeets from March–June of either may affect our results in relation to spring and summer; however, we had sufficient data to represent monk parakeet habitat use and behavior in a north Texas urban environment from late summer through early spring. Nonetheless, our study provides insight previously unavailable about the use of a non-native urban environment by naturalized monk parakeets. Our results reveal monk parakeets spend more time away from their nest sites foraging and in the canopy than previously reported. Additionally, monk parakeets appear willing and capable of traveling distances to important seasonally available food resources, which may structure their range areas.

MANAGEMENT IMPLICATIONS

Electric utility managers, landscape and urban planners, animal damage control officials, and wildlife managers who want to control urban monk parakeet populations might do so with LULC manipulation. While reducing canopy appears the most obvious approach, we suggest this with trepidation, as canopy LULC is most likely an important resource for native urban species. Avian enthusiasts wishing to support urban monk parakeet populations might increase the number of bird feeders and keep them well-stocked from late autumn to early spring.

CHAPTER III

FORAGING BEHAVIOR OF MONK PARAKEETS IN A TEXAS URBAN ENVIRONMENT

SYNOPSIS

The foraging behavior of naturalized monk parakeets (*Myiopsitta monachus*) has received little study where the species has been introduced. From August 2011–May 2012, we examined the foraging behavior of 17 radio-tagged monk parakeets in Dallas County, Texas, United States, and collected 375 foraging records. We observed monk parakeets foraging on a broad range of local, native vegetation that included 31 genera (22 native, 2 cultivated, and 7 non-native taxa) from 20 families. Monk parakeets exhibited a diverse diet consisting of commercial bird seed, flowers, fruits, acorns, grass blades, wild dry seeds, leaf buds, and insect larvae (in galls). Diet varied among seasons, most likely due to food item availability, and monk parakeets consumed all 9 food categories during winter. They fed primarily in the canopy (57%, *CI* = 49–64%) and less often on the ground (25%, *CI* = 19–32%), at our bait stations (10%, *CI* = 5–14%), or at residential bird feeders (9%, *CI* = 4–13%). Foraging flock sizes were highly variable ($\bar{x}$ = 12, *SD* = 8, *CI* = 10–13, range = 1–38), being smallest in May ($\bar{x}$ = 5, *SD* = 1, *CI* = 4–6) and largest during October ($\bar{x}$ = 17, *SD* = 11, *CI* = 12–22). Monk parakeets foraged most often in conspecific flocks (62%, *CI* = 54–69%, *n* = 108) averaging 12 individuals (range = 1–38). When we observed monk parakeets foraging with other species (15 avian and 2 mammalian species), they did so most often with great-tailed

grackle (*Quiscalus mexicanus*; 27%, *CI* = 20–34%, *n* = 30) and European starling (*Sturnus vulgaris*; 17%, *CI* = 11–23%, *n* = 19) during summer. Monk parakeets foraged the greatest distances ($\bar{x}$ = 531 m, *SD* = 497 m, range = 0–1,434 m) from their nest colonies during winter, specifically to residential bird feeders ($\bar{x}$ = 898 m, *SD* = 317 m, range = 647–1,297 m). Our results suggest food is not a limiting factor for monk parakeets in southern urban environments. Feeding stations provided by humans may assist nominally with monk parakeet winter survival in Dallas County, and we believe monk parakeet populations will persist there with or without commercial bird seed provided by humans. This provides further evidence that naturalized monk parakeets adapt to local, native food sources and adjust to seasonal food availability. Additionally, urban monk parakeets sometimes foraged with native avian species. For these reasons, food-based management strategies may not be viable for controlling monk parakeets in urban areas.

INTRODUCTION

The foraging behavior of monk parakeets (*Myiopsitta monachus*) has received some study in the species' native South American range (Bucher et al. 1991), yet very little is known about its foraging behavior in introduced ranges (Spreyer and Bucher 1998). In South America, monk parakeets exhibit year-round feeding territories and dietary opportunism both in the canopy and on the ground, where they feed on seeds, grains, fruits, berries, nuts, leaf buds, flowers, grasses, and sometimes insects and their larvae (Forshaw 1973, Long 1981, Bucher 1992, Spreyer and Bucher 1998). Monk parakeets' fondness for grain and orchard crops make them an agricultural pest in Uruguay (Darwin

1833, Mott 1973, de Grazio and Besser 1975) and Argentina where annual crop losses reportedly ranged from 2–45% (Godoy 1963), and caused an estimated 0.6–10 million United States (US) dollars in damage each year (Bucher and Bedano 1976, Lever 1987). However, it is believed that farmers often overstate crop damage caused by parrots (Bucher 1992, Canavelli et al. 2013).

From the late 1960s to 1992, >160,000 monk parakeets were imported into the US as popular, inexpensive caged birds during the legal pet-bird trade (Davey et al. 2004, CITES 2012). Due to accidental and intentional releases, monk parakeets established naturalized, self-sustaining populations in several states (Devlin 1970, Bull 1973, Neidermyer and Hickey 1977, van Bael and Pruett-Jones 1996, Pruett-Jones and Tarvin 1998). The first published diet reports for North American monk parakeets were based upon casual, opportunistic observations. Naturalized monk parakeets in Connecticut, Pennsylvania, New Jersey, New York, and Virginia, US, consumed many of the same food items reported in South America, yet monk parakeets in North America were said to be dependent upon bird feeders throughout the winter (Bump 1971, Bull 1973, Freeland 1973, Shields et al. 1974, Olivieri and Pearson 1992). Two opportunistic studies conducted in Chicago, Illinois, US, reported monk parakeet diet varying widely and changing seasonally (Hyman and Pruett-Jones 1995, South and Pruett-Jones 2000). Similar to their South American relatives, monk parakeets in Chicago fed both in the canopy and on the ground. In Chicago, monk parakeets consumed leaf buds and flowers in spring, fruit in summer, berries and wild seeds in autumn, and subsisted solely on bird seed at residential feeders in winter. In south Florida, however, food analyses of captured monk parakeets revealed ≥75% of their food items consisted of commercial seed from bird feeders (Newman et al. 2008).

As monk parakeets began naturalizing in North America, wildlife managers were most concerned the species would become an agricultural pest like their South American relatives (Bull 1971, Bump 1971, Alden 1973, Roscoe et al. 1973, Davis 1974). To date, however, monk parakeets have yet to become major agricultural pests in the US (Neidermyer and Hickey 1977, Spreyer and Bucher 1998, Tillman et al. 2001, Avery et al. 2006, Pruett-Jones et al. 2012). Instead, they have caused economic damage resulting from their building bulky twig nests on electric utility structures and causing fires and power outages (Avery et al. 2002).

Understanding the foraging behavior of an introduced species can be an important variable for exploring food-based management strategies where the species is a nuisance and unwanted. Several authors have suggested dietary information, specifically winter food sources, was the greatest monk parakeet research priority in North America (Olivieri and Pearson 1992, South and Pruett-Jones 2000, Avery et al. 2006). Knowledge of monk parakeet foraging behavior also may help explain the species' successful establishment in urban environments (South and Pruett-Jones 2000).

Foraging behaviors, such as a broad, adaptable diet and gregariousness, are important characteristics of a successful biological invader (Elton 1958; Ehrlich 1986,1989). Having a broad, adaptable diet allows an introduced species to exploit a large variety of food resources in novel environments. Species adept at foraging innovations, such as foraging on a variety of substrates (e.g., canopy, ground, and feeding stations), also may contribute to successful establishment in new environments (South and Pruett-Jones 2000). Increasing foraging flock size (gregariousness) may facilitate food finding in patchy urban environments, improve predator detection and evasion, reduce dedication to vigilant behavior, and enhance foraging capabilities (Morse 1977, Pulliam and Caraco 1984, Westcott and Cockburn 1988). Furthermore, gregarious species are more likely to forage with other social groups, and heterospecific aggregations may offer increased foraging and anti-predator advantages (Morse 1977).

Another key component to understanding foraging behaviors is determining the relative value of different foods to an animal's fitness. Like other animals, monk parakeets most likely forage to maximize energy intake (optimal foraging theory [OFT]; MacArthur and Pianka 1966). Therefore, it is likely monk parakeets will travel farther from their nest colonies for important food resources that maximize their fitness.

Our research goal was to contribute to the limited body of foraging behavior literature for introduced monk parakeets. We endeavored to understand if their foraging behaviors contribute to their success in urban environments and determine the potential for food-based management strategies for controlling their populations. We predicted monk parakeets in north Texas consumed the same food types (i.e., seeds, grains, fruits, nuts, leaf buds, flowers, grasses, and insects and their larvae) reported for their South American relatives, although from North American plant species. Based upon results reported in Chicago, Illinois, US, we expected differences in food category consumption as resource availability changed with the seasons. We expected to find north Texas monk parakeets subsisting on commercial seed from residential bird feeders during the winter when food resources were presumably scarcer. Furthermore, we expected monk parakeets to travel farther from their nest colonies for food resources during winter. Since monk parakeets are gregarious, we predicted monk parakeets foraged in larger conspecific flocks during nonbreeding season than during breeding season. We also expected to find them foraging with other urban avian species.

STUDY AREA

We conducted monk parakeet foraging behavior research in Dallas County, a major metropolitan area in north central Texas, US (Figure 3.1). Dallas County lies within the Blackland Prairie ecoregion (Texas Parks and Wildlife 2012); however, it has been altered severely by high human activity. The county consists of residential, commercial, and industrial development ranging from inner city to suburban areas. The county's 2010 human population density was 1,040 individuals/km^2 (U.S. Census Bureau 2010).

Dominant native tree species in Dallas County included oak (*Quercus* spp.) and elm (*Ulmus* spp.), interspersed with hackberry (*Celtis* spp.), ash (*Fraxinus* spp.), ashe juniper (*Juniperus ashei*), cottonwood (*Populus deltoids*), and red mulberry (*Morus rubra*). Dominant non-native tree species included crepe myrtle (*Lagerstroemia indica*) and callery pear (*Pyrus calleryana*), interspersed with Chinaberry (*Melia azedarach*), Chinese tallow (*Triadica sebifera*), and Chinese privet (*Ligustrum lucidum*). Most of these tree species are common in Texas urban areas and throughout the southeastern US (Little 1980, Gilman 1997). The majority of the manicured grass areas consisted of non-native grasses, specifically St. Augustine (*Stenotaphrum secundatum*) and Bermudagrass

(*Cynodon dactylon*). Few public grass areas contained native buffalograss (*Bouteloua dactyloides*).

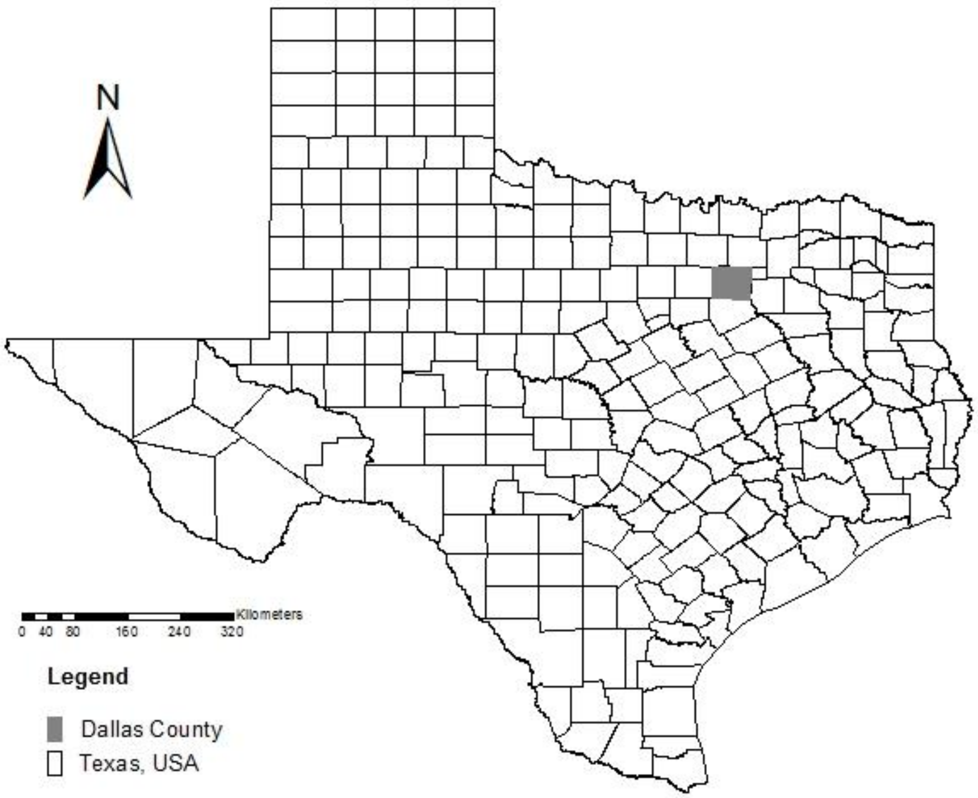

Figure 3.1. Map of Texas showing Dallas County, USA.

In Dallas County, typical July–December precipitation averages 73 cm and temperatures average 16° C min. and 27° C max., while typical January–May precipitation averages 83 cm and temperatures average 10° C min. and 21° C max. (NOAA 2013). During our research, Dallas County experienced drought conditions, ranging from abnormally to exceptionally dry (U.S. Drought Monitor 2011), and record high temperatures. From July–December 2011, the total precipitation was 5 cm and the average temperature was 23° C (17° C min. and 29° C max.; NOAA 2013). An unseasonably dry, warm winter and early spring followed. From January–May 2012, the total precipitation was 9 cm and the average temperature was 18° C (12° C min. and 23° C max.; NOAA 2013).

METHODS

We trapped monk parakeets intermittently from July–December 2011 in an effort to maintain 10 individuals with functioning radio transmitter collars at 3 electric stations (i.e., switchyards and substations) in Dallas County. To trap monk parakeets, we constructed elevated bait stations (see Avery et al. 2008) with non-functioning replicas of the E-Z Catch Remote Fire 36" x 36" trap (Wildlife Control Supplies, East Granby, CT). We installed a bait station each at 9 electric stations with active monk parakeet colonies. We baited the stations daily with a blend of striped and black oil sunflower seeds, safflower seeds, and white proso millet (Wild Birds Unlimited, Carmel, IN). When monk parakeets began feeding routinely at the bait stations, we switched to only safflower seeds to reduce non-target species and increase monk parakeet feeding activity. Prior to capture, we replaced the replica trap with the functional trap and supervised it while it was armed. We ceased baiting and trapping efforts once we radio-tagged 4–5 monk parakeets each at 3 electric stations (1 switchyard and 2 substations).

We weighed each monk parakeet and aged it as adult (≥1 year old) or juvenile (<1 year old) by absence or presence, respectively, of oral flanges (Roscoe et al. 1973). As juveniles aged and lost their oral flanges, we identified them by their white-colored, bare skin orbital ring compared to the adults' grayish- or dark-colored, bare skin orbital ring (see Hyman and Pruett-Jones 1995) and darker (slate gray) forehead feathers compared to adults' lighter (gray-white) forehead feathers (Spreyer and Bucher 1998). We collected >3 breast feathers from each parrot for DNA sex identification conducted at Veterinary Molecular Diagnostics, Inc. (Milford, OH).

To each monk parakeet's right leg, we attached a 7.94 mm diameter (6.35 mm inside diameter) stainless steel wire, butt-end, numbered leg band (DL Products, Glendora, CA; Meyers 1994). We color-coded each parrot's crown and cheeks with Marvy Uchida non-toxic, colored fabric markers (Uchida of America, Corp., Torrance, CA) to facilitate field-identification until the colors faded. At each of 3 locations, we fitted 4–5 monk parakeets each with a VHF 2-stage radio transmitter collar, fixed-loop antenna, each with a unique frequency within 151 MHz (Model SOPB-2070, Wildlife Materials, Inc., Murphysboro, IL). Transmitters weighed 3–5 g each, and we attached the appropriately weighted transmitter <5% of each monk parakeet's body mass (Appendix A).

We tracked radio-tagged monk parakeets from August 2011–May 2012, locating them 3 days a week, randomly once a day during daylight hours when they were active. We located birds within 5 randomly assigned 2–3-hour intervals: Early AM (0700–1000 hours CDT, 0630–0900 hours CST), Late AM (1000–1230 hours CDT, 0900–1100 hours CST), Early PM (1230–1500 hours CDT, 1100–1300 hours CST), Mid-PM (1500–1730 hours CDT, 1300–1500 hours CST), and Late PM (1730–2030 hours CDT, 1500-1730 hours CST). As days shortened and lengthened, we adjusted the beginning of the first interval and the end of the last interval in accordance with sunrise and sunset, respectively. Foraging behavior analyses are more meaningful when based upon biologically significant time designations instead of arbitrary chronologies (Morrison et al. 1998). We designated our research seasons based on summer–winter solstice and autumn-spring equinox dates within the respective calendar year: summer (4 August–22 September 2011), autumn (23 September–21 December 2011), winter (22 December 2011–19 March 2012), and spring (20 March–23 May 2012). We assigned spring–summer as breeding season and autumn–winter as nonbreeding season (see Hyman and Pruett-Jones 1995, Spreyer and Bucher 1998).

We located radio-tagged monk parakeets via homing (White and Garrott 1990, Samuel and Fuller 1996) using an R410 scanning receiver (ATS, Isanti, MN) and a TR-2 receiver (Telonics, Inc., Mesa, AZ) from a vehicle using a mounted 3-element Yagi antenna and, when necessary, by foot using a handheld 3-element Yagi antenna. We tracked each radio-tagged monk parakeet until its radio-transmitter battery failed (≤5-month battery life), the radio-transmitter collar fell off, or the individual died.

When we located a radio-tagged monk parakeet, we observed from a distance with 10–22 x 50 zoom binoculars. We recorded: (1) date, (2) time, (3) parrot identification, (4) substrate (canopy, ground, bird feeder, or bait station), (5) food source (species and part, if a plant), (6) foraging flock size, and (7) absence or presence and number of other species foraging with the parrots. We defined foraging flock size as the number of monk parakeets simultaneously feeding in the same location (see South and Pruett-Jones 2000).

We included only direct foraging observations and recorded the exact food item or items consumed by monk parakeets. If they were observed feeding on >1 food item in a location, we recorded each item as an individual feeding bout (see Galetti 1993). A feeding bout represented ≥1 monk parakeet foraging together, and we recorded a new bout if they switched to another food source while being observed (Altmann 1974). This is a robust diet calculation method to accentuate the diversity of food items consumed by parrots (Galetti 1993). We ceased observations when the radio-tagged individual(s) showed signs of disturbance or flew away due to our arrival, when they stopped the first observed activity, or after 30 minutes had passed without any change in activity (see O'Donnell and Dilks 1988). So as not to disturb monk parakeets and condition them further to depart upon our arrival, we observed up to 30 minutes before approaching the location where we first found them. After either monk parakeets departed or 30 minutes had passed, we walked to where monk parakeets had been foraging and recorded the location with a handheld GPS unit. We verified food items consumed and examined any fallen items on the ground. If >1 food items were consumed in the same location, we recorded each food item at the same UTM coordinate.

We grouped food items consumed into 9 categories: (1) acorns, (2) flowers, including catkins, (3) fruits, including pulp and seed, (4) grass blades, (5) leaf buds, (6) wild dry seeds, (7) commercial bird seed, (8) insect larvae, and (9) unknown. We quantified the food items consumed by monk parakeets based on frequency and relative frequency (%) of feeding observations of individual radio-tagged individuals (Snyder et al. 1987, Galetti 1993, South and Pruett-Jones 2000, Robinet et al. 2003). We conducted all research with methods approved by the Texas A&M University Animal Care and Use Committee (AUP 2011-044).

Data Analyses

We quantified frequency and relative frequency (%) of 9 food categories consumed by individual radio-tagged monk parakeets from August 2011–May 2012. We tested for differences among seasons using Kruskal-Wallis one-way analyses of variance.

We used individual foraging flocks containing ≥1 radio-tagged monk parakeet to investigate foraging substrates, flock-size variation, and flock composition. We tested for differences among seasons and between breeding and nonbreeding seasons using Pearson's Chi-square. For cell counts of expected values <5, we used Kruskal-Wallis one-way analyses of variance.

We calculated distances from each nest colony to their respective monk parakeet foraging locations on 2010 NAIP 1 m NC/CIR DOQQ imagery (1-m pixel resolution, 4-band Digital Orthophoto Quarter-Quad aerial imagery) of Dallas County (TNRIS 2011) in ArcMap 10.0 (Environmental Systems Research Institute, Inc., Redlands, CA). For each of the 9 food categories, we calculated average distances ($\bar{x}$), standard deviations (*SD*), and 95% confidence intervals (*CI*). We used ANOVA to test for differences in foraging distances among seasons. We conducted all analyses in SPSS 20.0 (IBM Corporation, Armonk, NY) using significance level $\alpha = 0.05$.

RESULTS

From April–December 2011, we captured 32 monk parakeets (17 F, 15 M; Appendix A) at 3 electric stations in Dallas County, Texas, US. We equipped 25 individuals (12 F, 13

M) with radio-transmitter collars. Four radio-tagged parrots were recaptured and their radio-transmitter collars replaced. We collected 375 foraging locations (summer, $n = 52$; autumn, $n = 124$; winter, $n = 176$; and spring $n = 23$) for 17 radio-tagged monk parakeets (10 F, 7 M) from August 2011–May 2012 (Appendix C). Being unable to attract and capture monk parakeets from mid-March–June resulted in a small sample size for spring and no data for June–July. We expect this affects our results in relation to spring and summer; however, we had sufficient data to represent monk parakeet foraging behavior during autumn and winter.

Diet

We separated foraging locations containing >1 food item and >1 plant species, producing an extended dataset of 416 feeding bouts. We observed monk parakeets feeding on 31 genera of plants, plus 1 unidentified herbaceous plant and 1 unidentified turf grass, 2 genera of insect larvae (in galls), commercial bird seed, and unknown item(s) amongst coarse aggregate (crushed stone ≤6.4 cm; Table 3.1).

Monk parakeets utilized 20 plant families, which included 13 tree families (Bignoniaceae, Cannabaceae, Cupressaceae, Ebenaceae, Euphorbiaceae, Fabaceae, Fagaceae, Lythraceae, Salicaceae, Meliaceae, Moraceae, Rosaceae, and Ulmaceae), 5 herbaceous families (Acanthaceae, Asteraceae, Brassicaceae, Fabaceae, and Urticaceae), 1 parasitic family (Viscaceae), and the grass family (Poaceae; Table 3.1). Of the plant species, 22 were native to North America, 2 were cultivated fruit trees, and 7 were exotics from Africa, Asia, Australia, or Europe. The beech family (Fagaceae) was the most utilized plant family (31%, $SD = 2\%$ $CI = 31–32\%$, $n = 103$), with southern live

Table 3.1. Frequency and relative frequency (%) of food items (plants, insects, and commercial bird seed) utilized by 17 radio-tagged monk parakeets in Dallas County, Texas, USA, August 2011–May 2012.

Family Species	Common name	Origin	Plant part	Summer	Autumn	Winter	Spring	Frequency	Relative frequency
Trees									
BIGNONIACEAE									
Catalpa bignoniooides	Southern catalpa	Native	Fruit (Seed pods)	0	0	2	0	2	<1%
CANNABACEAE									
Celtis laevigata	Sugarberry	Native	Fruit	1	4	0	0	5	1%
CUPRESSACEAE									
Juniperus ashei	Ashe juniper	Native	Fruit	2	0	0	0	2	<1%
EBENACEAE									
Diospyros spp.	Cultivated persimmon	Cultivated	Fruit	2	0	0	0	2	<1%
EUPHORBIACEAE									
Triadica sebifera	Chinese tallow	Exotic: Asia	Fruit/Seeds (white tallow covering only)	0	0	5	0	5	1%
FABACEAE									
Prosopis glandulosa	Honey mesquite	Native	Fruit (Seed pods)	0	1	0	0	1	<1%

Table 3.1. Continued

Family Species	Common name	Origin	Plant part	Summer	Autumn	Winter	Spring	Frequency	Relative frequency
FAGACEAE									
Quercus virginiana	Southern live oak	Native	Acorns	2	26	31	1	60	14%
			Flowers (Catkins)	0	0	0	1	1	<1%
Quercus boyntonii	Boynton's post oak	Native	Acorns	0	1	0	0	1	<1%
			Flowers (Catkins)	0	0	2	0	2	<1%
			Leaf buds	0	0	2	0	2	<1%
Quercus buckleyi	Texas red oak	Native	Flowers (catkins)	0	0	8	0	8	2%
			Leaf buds	0	0	11	0	11	3%
LYTHRACEAE									
Lagerstroemia indica	Crepe myrtle	Exotic: Asia	Seed pods	9	4	0	0	13	3%
SALICACEAE									
Populus monilifera	Plains cottonwood	Native	Fruit	0	0	0	8	8	2%
MELIACEAE									
Melia azedarach	Chinaberry	Exotic:	Fruit	1	1	2	0	4	1%
		Asia	Leaf buds	0	0	2	0	2	<1%

Table 3.1. Continued

Family Species	Common name	Origin	Plant part	Summer	Autumn	Winter	Spring	Frequency	Relative frequency
MORACEAE									
Morus rubra	Red mulberry	Native	Fruit	0	0	0	3	3	1%
Maclura pomifera	Osage-orange	Native	Flowers	0	0	0	3	3	1%
ROSACEAE									
Pyrus calleryana	Callery pear	Exotic:	Fruit	4	5	2	0	11	3%
		Asia	Leaf buds	0	0	2	0	2	<1%
Pyrus spp.	Cultivated pear	Cultivated	Fruit	1	0	0	0	1	<1%
ULMACEAE									
Ulmus crassifolia	Cedar elm	Native	Flowers	1	0	0	0	1	<1%
			Fruit/Seeds	1	16	0	0	17	4%
Ulmus americana	American elm	Native	Flowers	0	0	13	0	13	3%
			Seeds	0	0	11	1	12	3%
			Leaf buds	0	0	5	0	5	1%
Herbaceous									
ACANTHACEAE									
Symphyotrichum subulatum	Baby’s breath aster	Native	Flowers	0	1	0	0	1	<1%

Table 3.1. Continued

Family Species	Common name	Origin	Plant part	Summer	Autumn	Winter	Spring	Frequency	Relative frequency
ASTERACEAE									
Aster oblongifolius	Fall aster	Native	Flowers	0	7	8	0	15	4%
Pyrrhopappus carolinianus	Texas dandelion	Native	Flowers	0	0	0	2	2	<1%
BRASSICACEAE									
Capsella bursa-pastoris	Shepherd's purse	Exotic: Europe, Asia	Flowers	0	0	8	0	8	2%
			Seeds	0	2	8	0	10	2%
FABACEAE									
Trifolium repens	Dutch clover	Exotic: Europe, Africa, Asia	Flowers	0	4	0	0	4	1%
URTICACEAE									
Urtica dioica	Nettle	Native	Flowers	0	0	0	1	1	<1%
Unidentified	Unidentified	Unknown	Flowers	0	0	0	2	2	<1%

Table 3.1. Continued

Family Species	Common name	Origin	Plant part	Summer	Autumn	Winter	Spring	Frequency	Relative frequency
Parasitic									
VISCACEAE									
Phoradendron spp.	Mistletoe	Native	Flowers	1	0	0	0	1	<1%
Host plants:			Fruit	0	0	1	0	1	<1%
Ulmus crassifolia	Cedar elm								
Celtis laevigata	Sugarberry								
Grasses									
POACEAE									
Cynodon dactylon	Bermudagrass	Exotic: Africa, Asia, Australia, Europe	Flowers	0	4	2	0	6	1%
			Grass blades	0	6	2	0	8	2%
Buchole dactyloides	Buffalograss	Native	Grass blades	0	0	0	1	1	<1%
Digitaria texana	Texas crabgrass	Native	Grass blades	0	2	8	0	10	2%
Stenotaphrum secundatum	St. Augustine grass	Native	Grass blades	15	9	8	0	32	8%
Unidentified	Unidentified grass	Unknown	Grass blades	1	0	0	2	3	1%

Table 3.1. Continued

Family Species	Common name	Origin	Plant part	Summer	Autumn	Winter	Spring	Frequency	Relative frequency
Insect larvae (galls)									
PSYLLIDAE									
Pachypsylla venusta	Petiole gall psyllid	Native	Insect gall	0	2	4	0	6	1%
Host plant:	Sugarberry								
Celtis laevigata									
CYNIPIDAE									
Andricus crystallinus	Leaf gall wasp	Native	Insect gall	0	16	2	0	18	4%
Host plant:	Live oak								
Quercus virginiana									
Other									
Bird feeders	Mixed seed	NA	Commercial bird seed	6	8	24[a]	0	38	9%
Bait stations	Mixed seed	NA	Commercial bird seed	5	21	7[b]	0	33	8%
Ground	Unknown item amongst coarse aggregate (crushed stone ≤6.4 cm)	NA	Unknown item amongst coarse aggregate (crushed stone ≤6.4 cm)	0	0	18	1	19	5%
TOTAL				52	140	198	26	416	100%

[a]No bait stations
[b]March 2012

oak (*Q. virginiana*) the most utilized (77%, *SD* = 2%, *CI* = 77–77%, *n* = 79) beech member for flowers (catkins), parasitic wasp larvae in galls, and acorns. The grass family (Poaceae) was the second most utilized plant family (21%, *SD* = 1%, *CI* = 20–21%, *n* = 68).

Commercial bird seed (17%, *CI* = 14–21%, *n* = 71) was the most commonly consumed food category throughout our study, at both residential bird feeders (9%, *CI* = 6–12%, *n* = 38) and our bait stations (8%, *CI* = 5–10%, *n* = 33; Table 3.1). Flowers (16%, *CI* = 13–20%, *n* = 68) were a close second, followed by fruit (15%, *CI* = 12–19%, *n* = 63), acorns (15%, *CI* = 11–18%, *n* = 61), and grass blades (13%, *CI* = 10–16%, *n* = 54). To a lesser degree, monk parakeets consumed wild dry seeds (8%, *CI* = 5–11%, *n* = 34), insect larvae (6%, *CI* = 3–8%, *n* = 24), leaf buds (5%, *CI* = 3–7%, *n* = 22), and unknown item amongst coarse aggregate (5%, *CI* = 3–7%, *n* = 19).

Monk parakeet diet changed seasonally (χ^2 = 23.8, *df* = 3, $P \leq 0.001$; Figure 3.2). Winter diet contained all 9 food categories (Table 3.2). Consumption of leaf buds only occurred in winter (Figure 3.2). Monk parakeets consumed the tender leaf buds primarily of American elm (*U. americana*) and occasionally of Boynton's post oak (*Q. boyntonii*), Texas red oak (*Q. buckleyi*), callery pear, and Chinaberry. Consumption of an unknown item occurred primarily in winter (95%, *n* = 18) and only once in early spring (5%, *n* = 1), when we observed monk parakeets foraging in the herbicide-treated, coarse aggregate substrate underneath their nests on the electric station steel support structures with the locked fenced enclosures.

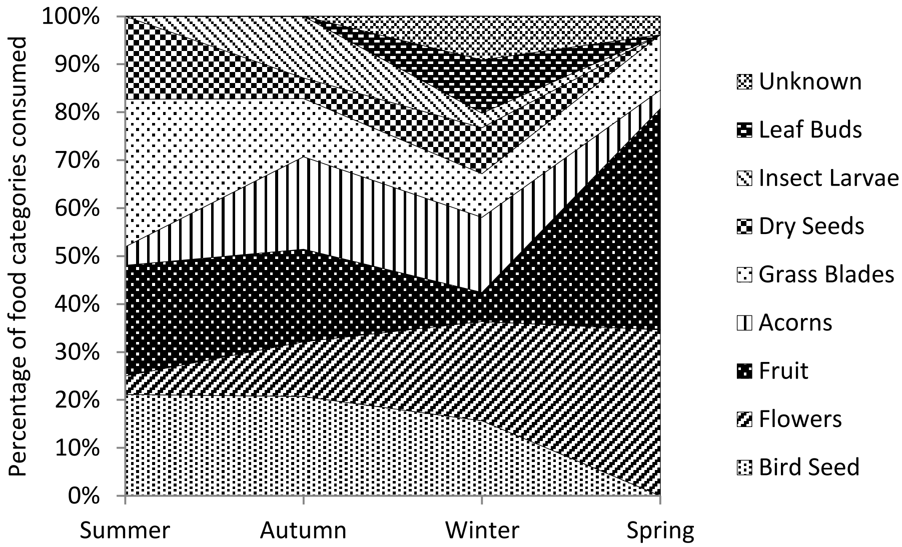

Figure 3.2. Nine food categories consumed (%) per season by 17 radio-tagged monk parakeets in Dallas County, Texas, USA, August 2011–May 2012.

Monk parakeets ate the flowers of 15 plant species (Table 3.1), consuming all flower parts. Tree flowers accounted for the majority of our flower consumption observations (41%, n = 28) and 46% (n = 13) of those were American elm. American elm produces abundant and inconspicuous flowers that typically emerge in early spring before the leaves (Little 1980). During our study, this began in late winter when trees and herbaceous plants flowered earlier than normal due to the unseasonably warm weather. Based on relative frequency within each season, monk parakeet flower consumption was highest in spring (35%, n = 9; Table 3.2).

Based on relative frequency within each season, observations of acorn consumption (n = 61) was highest in autumn (19%, n = 27; Table 3.2). We observed monk parakeets consuming acorns when they began developing on the trees until they

Table 3.2. Frequency and relative frequency (%) of variability of 9 food categories consumed per season by 17 radio-tagged monk parakeets in Dallas County, Texas, USA, August 2011–May 2012.

	Total		Summer		Autumn		Winter		Spring	
Food category	Frequency	Relative frequency	Frequency	Relative frequency	Frequency	Relative frequency	Frequency	Relative frequency	Frequency	Relative frequency
Commercial bird seed[a]	71	17%	11	21%	29	21%	31	16%	0	0%
Flowers	68	16%	2	4%	16	11%	41	21%	9	35%
Fruit	63	15%	12	23%	27	19%	12	6%	12	46%
Acorns	61	15%	2	4%	27	19%	31	16%	1	4%
Grass blades	54	13%	16	31%	17	12%	18	9%	3	12%
Seeds, wild dry	34	8%	9	17%	6	4%	19	10%	0	0%
Insect larvae (galls)	24	6%	0	0%	18	13%	6	3%	0	0%
Leaf buds	22	5%	0	0%	0	0%	22	11%	0	0%
Unknown item amongst coarse aggregate (crushed stone ≤6.4 cm)	19	5%	0	0%	0	0%	18	9%	1	4%
Total	416		52		140		198		26	

[a]Includes both residential bird feeders and research bait stations

lay ripe on the ground. Observations of commercial bird seed consumption were highest in summer (21%, n = 11) and autumn (21%, n = 29).

Monk parakeets foraging on the blades of turf grasses was highest during summer (31%, n = 16). We observed monk parakeets masticating grass blades, primarily of St. Augustine, and dropping them. When we walked into the area where they had been foraging, we found wads of chewed grass blades on the ground.

We observed monk parakeets consuming fruit more often in spring (46%, n = 12). Monk parakeets switched fruit sources with the seasons, from 13 genera of plants (Table 3.1). During autumn, monk parakeets consumed fruit of callery pear, sugarberry (*C. laevigata*), and cedar elm (*U. crassifolia*). Cedar elm produce abundant and inconspicuous flowers and fruit in the fall as opposed to spring (Little 1980). During summer, monk parakeets consumed fruit of callery pear and cultivated pear and persimmon trees in residential yards. During winter, we observed monk parakeets consuming fruit of callery pear, southern catalpa (*Catalpa bignonioides*), and exotic tree species, such as Chinaberry and Chinese tallow. During spring, we found them eating fruit of cottonwood and mulberry.

Monk parakeets consumed insect larvae in galls primarily in autumn (13%, n = 18). Monk parakeets consumed insect larvae of a cynipid wasp (possibly *Andricus crystallinus*; n = 18) in fuzzy galls on the underside of southern live oak leaves and the larvae of a psyllid (*Pachypsylla venusta*; n = 6) in leaf petiole galls of sugarberry trees. Wild dry seed consumption was highest in summer (17%, n = 9).

Examining the variability of the 9 food items within each season, we found monk parakeets consuming primarily grass blades (31%, *CI* = 18–43%; Table 3.2), fruit (23%, *CI* = 12–34%), and commercial bird seed (21%, *CI* = 10–32%) during summer. During autumn, we found them consuming mostly commercial bird seed (21%, *CI* = 14–25%), fruit (19%, *CI* = 13–26%), and acorns (19%, *CI* = 13–26%). During winter, we observed monk parakeets eating primarily flowers (21%, *CI* = 15–26%), commercial bird seed (16%, *CI* = 11–21%), and acorns (16%, *CI* = 11–21%). During spring, we found them consuming mostly fruit (46%, *CI* = 27–65% and flowers (35%, *CI* = 16–53%).

From the foraging data (n = 375), we extracted 175 individual foraging flocks with ≥1 radio-tagged monk parakeets. We used this dataset to analyze foraging distances, substrates, flock size, and heterospecific feeding aggregations.

Foraging Distance

Monk parakeets traveled the farthest for commercial seed at residential bird feeders ($\bar{x}$ = 898 m, *SD* = 317 m, range = 647–1,297 m; Table 3.3; Figure 3.3), followed by flowers ($\bar{x}$ = 580 m, *SD* = 493 m, range = 10–1,434 m), leaf buds ($\bar{x}$ = 529 m, *SD* = 551 m, range = 115–1,280 m), insect larvae ($\bar{x}$ = 511 m, *SD* = 563 m, range = 183–1,602 m), wild dry seed ($\bar{x}$ = 468 m, *SD* = 164 m, range = 281–818 m), fruit ($\bar{x}$ = 384 m, *SD* = 272 m, range = 21–878 m), acorns ($\bar{x}$ = 309 m, *SD* = 282 m, range = 8–1,331 m), grass blades ($\bar{x}$ = 153 m, *SD* = 111 m, range = 22–396 m), bird seed at our bait stations ($\bar{x}$ = 38 m, *SD* = 19 m, range = 19–56 m), and unknown item amongst coarse aggregate ($\bar{x}$ = 0). Monk parakeet foraging distance was significantly farther (F = 5.324, df = 3, P = 0.002; Table 3.4;

Table 3.3. Average distances to 9 food categories from 3 monk parakeet colonies in Dallas County, Texas, USA, August 2011–May 2012.

		Distance (m) from nest colonies			
				Range	
Food category	*n*	$\bar{x}$	*SD*	Lower	Upper
Commercial bird seed, residential feeders	15	898	317	647	1,297
Flowers	27	580	493	10	1,434
Leaf buds	4	529	551	115	1,280
Insect larvae	11	512	564	183	1,602
Seeds, wild dry	9	468	164	281	818
Fruit	35	384	272	21	878
Acorns	31	309	282	8	1,331
Grass blades	18	153	111	22	396
Commercial bird seed, bait stations	19	38	19	19	56
Unknown item amongst coarse aggregate (crushed stone ≤6.4 cm)	6	0	0	0	0

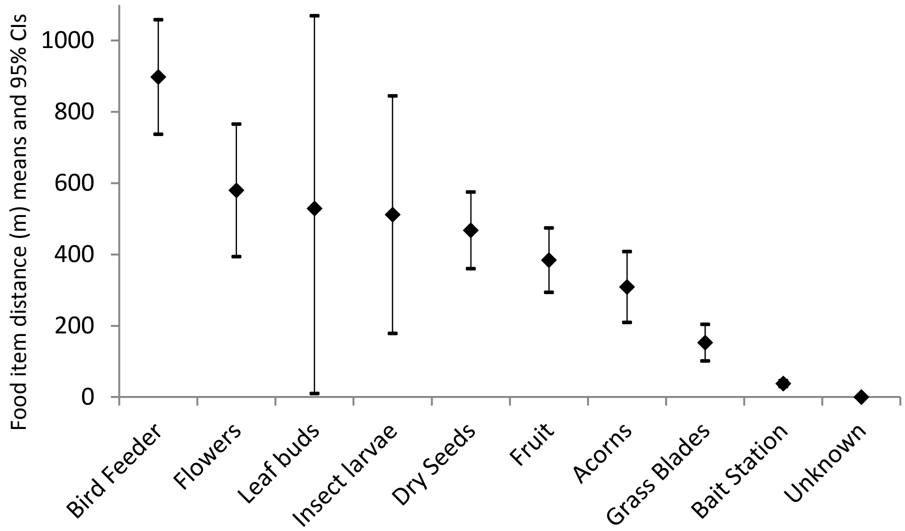

Figure 3.3. Foraging distance (m) means and 95% confidence intervals (*CI*) to 9 food items consumed by 17 radio-tagged monk parakeets in Dallas County, Texas, USA, August 2011–May 2012.

Table 3.4. Average distances (m) per season to foraging locations from 3 monk parakeet colonies in Dallas County, Texas, USA, August 2011–May 2012.

		Distance (m) from nest colonies			
				Range	
Food category	*n*	$\bar{x}$	*SD*	Lower	Upper
Summer	31	302	241	19	818
Autumn	62	279	289	19	1,602
Winter	64	531	497	0	1,434
Spring	18	385	345	0	1,021

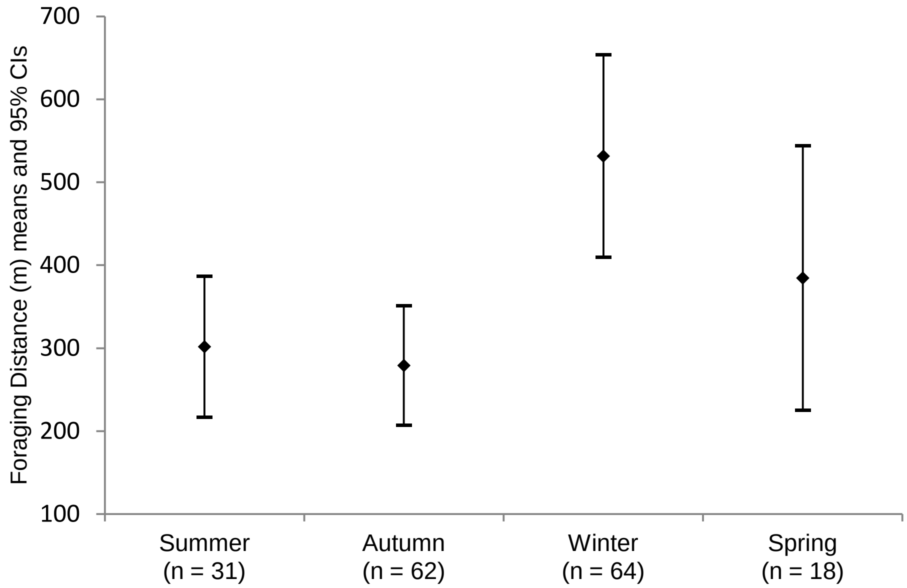

Figure 3.4. Foraging distance (m) means and 95% confidence intervals (*CI*) per season for 17 radio-tagged monk parakeets in Dallas County, Texas, USA, August 2011–May 2012.

Foraging Substrate

We found monk parakeets foraging most often in the canopy (57%, *CI* = 49–64%; Figure 3.5) and less often on the ground (25%, *CI* = 19–32%), at our bait stations (10%, *CI* = 5–14%), or at residential bird feeders (9%, *CI* = 4–13%). There was no significant difference ($\chi^2 = 3.1$, $df = 3$, $P = 0.38$) in foraging substrates among seasons.

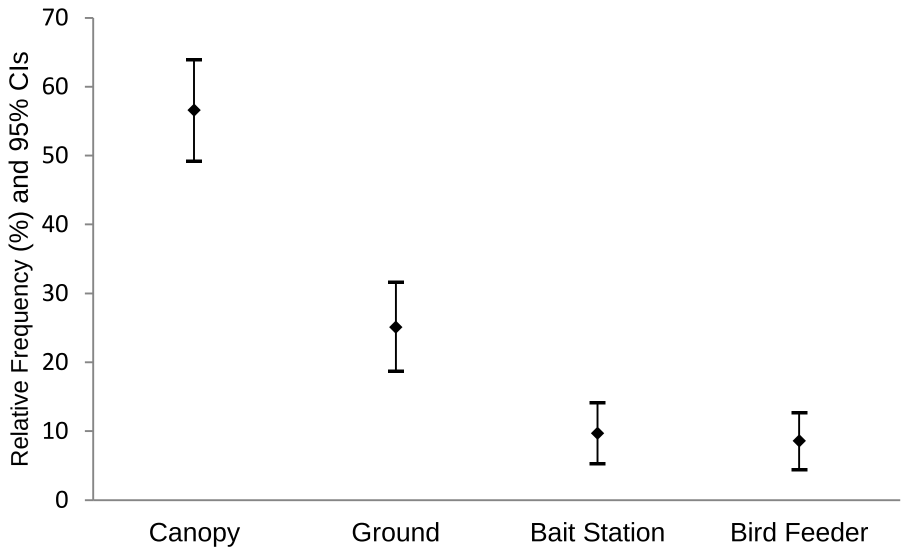

Figure 3.5. Relative frequency (%) and 95% confidence intervals (*CI*s) of foraging substrates for 17 radio-tagged monk parakeets in Dallas County, Texas, USA, August 2011–May 2012.

Foraging Flock Size

Monk parakeet foraging flock size was highly variable (range = 1–38) and averaged 12 birds (*SD* = 8, *CI* = 10–13, *n* = 175). Of the 175 foraging flocks observed, 99 flocks (57%, *CI* = 49–64%) contained >10 birds. There was a significant difference ($\chi^2 = 21.8$, *df* = 9, *P* = 0.01; Figure 3.6) in foraging flock size among months. Average foraging flock size was largest in October ($\bar{x} = 17$, *SD* = 11, *CI* = 12–22) and smallest in May ($\bar{x} = 5$, *SD* = 1, *CI* = 4–6).

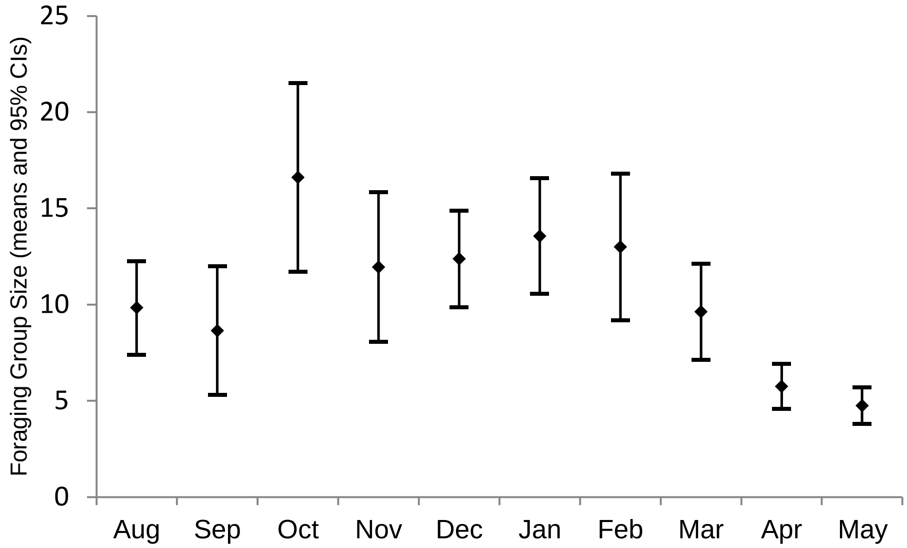

Figure 3.6. Monthly mean size and 95% confidence intervals (*CI*s) of monk parakeet foraging flock size, both conspecific and heterospecific aggregations, in Dallas County, Texas, USA, August 2011–May 2012.

There was a significant difference ($\chi^2 = 14.0$, $df = 3$, $P = 0.003$) in foraging flock size among seasons. Average foraging flock size was larger ($\chi^2 = 12.1$, $df = 1$, $P = 0.001$) during nonbreeding season (autumn and winter, mean rank = 96.3; $\bar{x} = 26$, $SD = 8$, range 1–38) than for breeding season (spring and summer, mean rank = 66.7; $\bar{x} = 8$, $SD = 7$, range 1–26). We found no difference ($\chi^2 = 7.2$, $df = 3$, $P = 0.07$) in foraging flock size among substrates, with mean rank 105.3 for ground, 83.6 for canopy, 80.0 for bird feeder, and 76.3 for bait station.

Table 3.5. Frequency, relative frequency (%), and 95% confidence intervals (*CI*) of 15 avian and 2 mammalian species observed foraging (n = 112) with monk parakeets in Dallas County, Texas, USA, August 2011–May 2012.

				95% *CI*	
Common name	Species	Frequency	Relative frequency	Lower	Upper
Great-tailed grackle	*Quiscalus mexicanus*	30	26.8%	0.186	0.350
European starling	*Sturnus vulgaris*	19	17.0%	0.100	0.239
Mourning dove	*Zenaida macroura*	14	12.5%	0.064	0.186
White-winged dove	*Zenaida asiatica*	8	7.1%	0.024	0.119
Eurasian collared-dove	*Streptopelia decaocto*	8	7.1%	0.024	0.119
Eastern fox squirrel	*Sciurus niger*	6	5.4%	0.012	0.095
Rock dove	*Columba livia*	5	4.5%	0.000	0.083
Blue jay	*Cyanocitta cristata*	5	4.5%	0.000	0.083
Red-bellied woodpecker	*Melanerpes carolinus*	4	3.6%	0.001	0.070
Red-winged blackbird	*Agelaius phoeniceus*	4	3.6%	0.001	0.070
House sparrow	*Passer domesticus*	2	1.8%	–0.007	0.042
House finch	*Haemorhous mexicanus*	2	1.8%	–0.007	0.042
Northern cardinal	*Cardinalis cardinalis*	1	0.9%	–0.008	0.026
Northern mockingbird	*Mimus polyglottos*	1	0.9%	–0.008	0.026
Carolina chickadee	*Poecile carolinensis*	1	0.9%	–0.008	0.026
Carolina wren	*Thryothorus ludovicianus*	1	0.9%	–0.008	0.026
Eastern cottontail	*Sylvilagus floridanus*	1	0.9%	–0.008	0.026

Heterospecific Feeding Aggregations

We found monk parakeets foraging most often in conspecific flocks (62%, *CI* = 54–69%, *n* = 108) compared to heterospecific aggregations (38%, *CI* = 31–45%, *n* = 67). We observed monk parakeets foraging with 15 avian species and 2 mammalian species (Table 3.5), most often with great-tailed grackle (*Quiscalus mexicanus*; 27%, *CI* = 20–34%, *n* = 30), European starling (*Sturnus vulgaris*; 17%, *CI* = 11–23%, *n* = 19), and mourning dove (*Zenaida macroura*; 13%, *CI* = 7–18%, *n* = 14).

There was no significant difference in flock size between heterospecific feeding aggregations (χ^2 = 0.001, *df* = 1, *P* = 0.976) or between monk parakeet breeding and nonbreeding seasons (χ^2 = 1.259, *df* = 1, *P* = 0.262). There was a significant relationship (χ^2 = 8.5, *df* = 3, *P* = 0.036) between monk parakeets foraging in conspecific flocks and heterospecific aggregations among seasons. During summer (*n* = 31), we observed monk parakeets foraging in heterospecific aggregations (58%, *CI* = 41–75%, *n* = 18) more often than in conspecific flocks (42%, *CI* = 25–59%, *n* = 13). During autumn (*n* = 62), we observed monk parakeets foraging in heterospecific aggregations (40%, *CI* = 28–52%, *n* = 25) less often than in conspecific flocks (60%, *CI* = 47–72%, *n* = 37). During winter (*n* = 64), we observed monk parakeets foraging in heterospecific aggregations (31%, *CI* = 20–43%, *n* = 20) less often than in conspecific flocks (69%, *CI* = 57–80%, *n* = 44). During spring (*n* = 18), we observed monk parakeets foraging in heterospecific aggregations (22%, *CI* = 3–41%, *n* = 4) less often than conspecific flocks (78%, *CI* = 51–93%, *n* = 14).

There was a significant relationship (χ^2 = 15.153, *df* = 3, *P* = 0.002) between heterospecific feeding aggregations and substrate type (canopy, ground, bird feeder, or bait station). We observed monk parakeets foraging in conspecific flocks more often in the canopy (41%, *CI* = 33–48%) and on the ground (15%, *CI* = 10–20%). There was no difference (χ^2 = 2.210, *df* = 1, *P* = 0.137) between conspecific foraging in canopy and on the ground. We found monk parakeets foraging in heterospecific aggregations more often at bird feeders (6%, *CI* = 3–10%) and our bait stations (6%; *CI* = 2–9%).

DISCUSSION

Diet

In our study, monk parakeets demonstrated a highly variable and seasonal diet. Diet variability was likely in response to the availability of different food resources throughout the year (Cannon 1981). Monk parakeets utilized a broad variety of native plants and few exotic plants. Comparing our results to monk parakeet diet in South America, monk parakeets in north Texas consumed many of the same food items, (e.g., leaf buds, flowers, fruits, nuts, seeds, and occasional insect larvae [Bucher et al. 1991, Spreyer and Bucher 1998]), only from different plant genera. We found no mention of acorns, grass blades, or commercial bird seed consumption in South America.

We also found north Texas monk parakeets consuming many of the same food items previously reported for North America, including commercial bird seed, nuts (including acorns), wild and cultivated fruits, leaf buds, flowers, and seeds of grasses and herbaceous plants (Bull 1973, Davis 1974, Neidermyer and Hickey 1977, Hyman and Pruett-Jones 1995, South and Pruett-Jones 2000). However, monk parakeets in north Texas utilized plant families Fagaceae and Poaceae the most, while monk parakeets in Chicago, Illinois, utilized plant families Poaceae and Rosaceae the most. The difference between tree families may be because there are more nut-bearing trees (oak trees) in the north Texas urban environment and more fruit-bearing trees in the Chicago, Illinois, urban environment.

During winter, we found monk parakeets feeding at residential bird feeders up to 1.3 km from their nest colonies. Therefore, we are in agreement with Minor et al. (2012) that it is unlikely that proximity to bird feeders limits monk parakeets. Although monk parakeets consumed bird seed throughout our study, and more so during winter, our results imply they did not depend solely upon bird seed like their northern counterparts (Shields et al. 1974, Walsten 1985, Hyman and Pruett-Jones 1995, South and Pruett-Jones 2000). Lepczyk et al. (2004) found bird feeder density was greater in urban environments and Fuller et al. (2008) believed increased bird feeder density could have a positive impact on urban bird populations. We did not know how many residential bird feeders were available for monk parakeet foraging throughout our research period. In contrast to northern monk parakeets subsisting solely on bird seed during the winter, monk parakeets in our study area consumed the greatest variety of food items during winter. This may be because more wild food items are available during the milder winters of Dallas, Texas (December–March average range = 8.3–14.8° C; NOAA 2013) compared to the colder winters of Chicago, Illinois (December–March average range = –3.3–3.6° C; NOAA 2013). Furthermore, the winter during our research period was unseasonably warm (+2.5° C) compared to historical average temperatures for the area (see Study Area). We expect the seasonal differences in diet between Dallas County and Chicago, Illinois, monk parakeet populations (Table 3.6) are best explained by seasonal temperature differences. This hypothesis is supported by Davis et al. (2013), who found that monk parakeet distribution in the southern US is best explained by biophysical variables, specifically January dew point temperature. We also agree with Hyman and Pruett-Jones (1995) and South and Pruett-Jones (2000) that monk parakeets' apparent highly-adaptable diet is one reason the species successfully persists in a variety of new environments beyond its native range. Furthermore, we agree with Johnson and Logue (2009) the variability of monk parakeet diet most likely depends upon local availability of food resources.

Table 3.6. Comparison of the most common food types consumed per season reported for naturalized monk parakeets in Dallas County, Texas, and Hyde Park, Chicago, Illinois, USA.

Location	Summer	Autumn	Winter	Spring
Dallas County,	Grass blades	Bird seed	Flowers	Fruit
Texas	Fruit	Fruit	Bird Seed	Flowers
		Acorns	Acorns	
Hyde Park,	Fruit	Fruit (berries)	Bird seed	Flowers
Chicago,	Seeds, wild	Seeds, wild		Leaf buds
Illinois				

There is little mention of monk parakeet consumption of insects in North America (Lever 1987) and we found only 1 South American report quantifying insect consumption. Aramburu and Corbalan (2000) found insects in the stomach contents of monk parakeet nestlings, presumably the result of preening for ectoparasites. During autumn and early winter, we observed monk parakeets consuming the larvae of a cynipid wasp in fuzzy galls on the underside of live oak leaves and the larvae of a psyllid in leaf petiole galls of sugarberry trees. Based upon observations of substantial amounts of airborne live oak leaf gall fuzz during monk parakeet feeding bouts and dropped sugarberry petiole galls, it did not appear parrots were consuming the plant material. Monk parakeet consumption of insect larvae in galls during our study was concentrated during the post-fledgling period, when the maturing insect larvae are available (autumn through early winter; Bugguide.net 2013). Monk parakeets may be opportunistically exploiting an ephemeral protein-rich food source associated with post-reproductive events, such as juvenile molting or increased mobility with their parents, or both (Diaz and Peris 2011).

We are unaware of other reports of parrot species masticating grass blades. Instead, we found reports of grass seed and root consumption (Long 1984, Forshaw 1989, Juniper and Parr 1998) and one report of monk parakeets ingesting grass blades (Olivieri and Pearson 1992). Since monk parakeets in our study area were masticating grass blades during the hottest, driest month (August), they may have done so to extract the water content or soluble minerals and other nutrients. Further study is required to determine the reason(s) urban monk parakeets masticate grass blades.

We do not know what monk parakeets were consuming while foraging amongst the coarse aggregate underneath their nests on the electric station support structures. The electric stations are within locked fenced enclosures and we were unable to gain access. Further study may be warranted to determine what monk parakeets were consuming amongst the coarse aggregate substrate.

Foraging Distance

We found monk parakeets foraging both at their nest colonies and up to 1.6 km away. The farthest distance occurred in autumn, when we found monk parakeets feeding on insect larvae of sugarberry petiole galls. Overall, monk parakeets traveled the farthest average distance from their nest colonies to commercial seed at residential bird feeders. On average, however, monk parakeets traveled farther during winter. At the greater distances, we found monk parakeets foraging on flowers, insect larvae, acorns, commercial seed at residential bird feeders, and leaf buds. We expect the colder winter months caused monk parakeets to travel more broadly and farther from their nest colonies in search of high-protein food resources, such as commercial seed at residential bird feeders.

Foraging Substrates

We found monk parakeets foraging more often in the canopy. It is well documented they forage both in the canopy and on the ground (Forshaw 1989, Bucher et al. 1991, Hyman and Pruett-Jones 1995, South and Pruett-Jones 2000), but to what degree one way or the other was unknown. Monk parakeets may prefer to forage in the canopy where they are less vulnerable to predators. However, ground foraging may be under-represented in our study because we had difficulty detecting the signals of radio-tagged individuals when they were on the ground. When we did locate monk parakeets on the ground, we experienced diminished radio transmitter signal range.

Foraging Flock Size

As expected, monk parakeets in our study area were gregarious (Forshaw 1989, Collar and Juniper 1992). They foraged in large flocks during autumn and winter (nonbreeding season) and smaller flocks during spring and summer (breeding season). Foraging flock sizes were highly variable (range = 1–38), averaging 12 individuals per flock, and 57% of the flocks contained >10 birds. In Argentina, monk parakeets were gregarious throughout the year and flock sizes were highly variable, ranging 15–50 (Friedmann 1927) or 10–15 individuals, yet sometimes exceeding 100 (Long 1981). In Chicago, Illinois, monk parakeet foraging flock sizes also were highly variable, ranging 1–55 individuals and averaging 9/flock (Hyman and Pruett-Jones 1995) and 1–31 individuals and averaging 5/flock (South and Pruett-Jones 2000; Table 3.7). Our average monk parakeet foraging flock size may be larger than Chicago averages because colony sizes in Dallas and Tarrant counties were likely larger (J. E. Reed, unpublished data) and most individuals from the same colony foraged together in large flocks.

We found monk parakeet foraging flock sizes largest in October (nonbreeding season) and smallest in May (breeding season). This pattern also was reported in Chicago, Illinois (South and Pruett-Jones 2000). One explanation for monk parakeets foraging in large flock sizes may be to exploit scarce or widely dispersed food resources or to minimize predation risk (Ward and Zahavi 1973, Charnov and Krebs

Table 3.7. Comparison of mean ()flock size of naturalized monk parakeets in Hyde Park, Chicago, Illinois, and Dallas County, Texas, USA.

Location	$\bar{x}$	*SD*	Range	Mode	Median	*n*
Hyde Park, Chicago, Illinois April 1992–February 1993 (Hyman and Pruett-Jones 1995)	9	Unknown	1–55	Unknown	Unknown	167
Hyde Park, Chicago, Illinois July 1998–June 1999 (South and Pruett-Jones 2000)	5	0.3	1–31	Unknown	4	300
Dallas County, Texas August 2011–May 2012	12	8	1–38	4, 6, 8, 20	9	175

1975, Cannon 1984, South and Pruett-Jones 2000). Exploitation of scarce or widely dispersed food resources may be especially true during winter, when larger flock sizes may help the season's juveniles learn food resource locations quickly (Cannon 1981) or help facilitate detection and exploitation of abundant but short-lived resources (Ward and Zahavi 1973). The larger foraging flock size also reduces vigilance per individual, allowing more time for foraging efforts (South and Pruett-Jones 2000). We expect the larger flock sizes beginning in July and peaking in October most likely reflect the season's offspring becoming mobile and foraging with their parents and colony members across the urban landscape. After the peak of October, foraging flock size appeared to decrease each month until the onset of breeding season in April–May.

Heterospecific Feeding Aggregations

Monk parakeets mostly foraged in conspecific flocks consisting of mates, family members, or colony members. We observed them foraging in conspecific flocks more often in the canopy and on the ground than when feeding at bird feeders or our bait stations. Monk parakeets foraged in heterospecific aggregations more often at bird feeders and our bait stations, with no apparent aggressive interaction with the other species. Reports of monk parakeet behavior towards other avian species have been mixed, with some reporting aggressive behavior (Trimm 1972, Freeland 1973, Davis 1974) and others reporting sociability (Gilbert 1984, Walsten 1985). From our observations, we suspect monk parakeets may use other species as indicators for some food sources, especially bird feeders. This was evident at our bait stations, as we observed other avian species and fox squirrels feeding at the bait stations before monk parakeets fed there.

As far as we know, our research was the first systematic study of monk parakeet foraging behavior in the US. Our observational study of radio-tagged monk parakeets identifies the principal food items and seasonal variation in their diet in an urban environment. Our results substantiate previous reports that monk parakeets have broad, seasonal food preferences that enable them to adapt to and exploit a wide variety of food resources. We agree with other authors that food is not a limiting factor for monk parakeets in areas where they have been introduced (Bump 1971, Sol et al. 1997). It appears the urban environment in Dallas, Texas, provided ample food resources to support the broad, seasonal diet habits of naturalized monk parakeets. This may help explain why they have naturalized successfully in urban environments outside their native range. Our results imply that a broad diet, adaptability to multiple foraging substrates, ability and willingness to travel distances to food resources, and formation of large foraging flocks, both conspecific and heterospecific aggregations, contribute to the monk parakeet's success as invaders.

CHAPTER IV

SELECTION OF ELECTRIC UTILITY STRUCTURES AS NEST SITES BY MONK PARAKEETS*

SYNOPSIS

Monk parakeets (*Myiopsitta monachus*) build nests of twigs and use them year-round for both breeding and roosting. In their native South American range, monk parakeets historically nested in the tallest, sturdiest trees in an area. In their North American range, monk parakeets often construct nests on anthropogenic structures, most notably electric utility structures. This nesting behavior causes economic damage. We investigated monk parakeets nesting in Dallas and Tarrant counties, Texas, United States, to identify which features and spatial scales influenced their selection of electric stations as nest sites. Examining 28 pairs of electric stations (with and without nests), we found monk parakeets selected electric stations with multiple flat surfaces and acute-angled construction within small fenced enclosure areas and surrounded by large canopy trees (dbh >30 cm) and taller anthropogenic structures within 100 m. Further analysis of urban land use and land cover classifications (pavement, building, canopy, grass, and water) on 3 scales (100 m, 625 m, and 1,250 m) suggested the surrounding landscape had little impact on monk parakeet nest-site selection. We recommend electric utility and wildlife managers who want to prevent monk parakeets from nesting on electric

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utility structures conduct a cost-benefit analysis exploring the feasibility of retrofitting or replacing vulnerable construction style elements preferred by monk parakeets. Managers also should consider redesigning future electric station support tower construction to reduce risk of monk parakeets nesting on new structures.

INTRODUCTION

Where a bird chooses to build its nest is an important decision for its reproductive success (Gill 1990, Latif et al. 2012). Avian nest-site choice is often associated with structural stability (reducing destruction by inclement weather, human disturbance, etc.; Coon et al. 1981), concealment (decreasing predation risk), and proximity to usable habitat (Gill 1990). Nest sites vary among avian taxa and occur in and on various substrates, including vegetation, cavities, ground, and anthropogenic structures (Gill 1990). Furthermore, the placement of nests is often a function of the features surrounding the site at different spatial scales (Wiens 1989).

Members of the parrot family (Psittacidae) are well-known cavity nesters (Forshaw 1989). An exception is the monk parakeet (*Myiopsitta monachus*), which constructs enclosed nests of tightly intertwined twigs and uses them year-round for both breeding and roosting (Bucher et al. 1991, Eberhard 1996, Forshaw 1989, Martella and Bucher 1993, Navarro et al. 1992). Monk parakeet nests are often joined, forming large nest structures with separate chambers for individual breeding pairs, and those nest structures are often clustered in areas, forming large colonies of many individuals (Forshaw 1989, Goodfellow 1977).

The monk parakeet is native to and common in the temperate to subtropical lowlands of Bolivia, Paraguay, Brazil, Uruguay, and Argentina, South America (Lever 1987). In their native range, monk parakeets nest in open environments with good visibility, usually in a cluster of tall, sturdy structures (i.e., native and non-native trees, and anthropogenic structures) with minimal understory (Burger and Gochfeld 2005, Eberhard 1996, Forshaw 1989, Humphrey and Peterson 1978). Nonetheless, monk parakeet nests are still vulnerable to predation from a host of different predators (e.g., mammals, birds, and snakes) and their large, heavy nests can fall if not securely placed (Martín and Bucher 1993, Spreyer and Bucher 1998). Accordingly, it has been suggested monk parakeets select nesting sites to avoid predators and high winds (Burger and Gochfeld 2005).

From the late 1960s until 1992, >160,000 monk parakeets were legally imported into the United States (US) as part of the pet bird trade (CITES 2012, Davey et al. 2004). Accidental and intentional releases of monk parakeets in the continental US resulted in naturalized populations in several states, where populations exhibited exponential growth and range expansion (Neidermyer and Hickey 1977, Pruett-Jones and Tarvin 1998, van Bael and Pruett-Jones 1996). By the early 1970s, monk parakeets were reported in at several states (Garber 1993, Neidermyer and Hickey 1977, van Bael and Pruett-Jones 1996). During the 2011–2012 Christmas Bird Count, 2,482 monk parakeets were counted in the US; however, the populations were not evenly distributed, with Florida and Texas home to 68% of the monk parakeets recorded (National Audubon Society 2011).

Monk parakeets in the US are found predominately in urban and suburban environments (Garber 1993, Neidermyer and Hickey 1977, Stevenson and Anderson 1994, Trimm 1973), where they build their nest structures in trees and on anthropogenic structures, such as buildings, light poles, communication towers, and electric utility structures (Hyman and Pruett-Jones 1995, Minor et al. 2012, Roscoe et al. 1973, Spreyer and Bucher 1998). One concern surrounding the growth and range expansion of naturalized monk parakeet populations is their propensity for constructing their nest structures on electric utility structures, particularly the tall steel support towers of substations (changes the voltage levels) and switchyards (connects and disconnects lines on the power grid; hereinafter grouped as electric stations; Figure 4.1). When monk parakeet nest material interferes with electric utility equipment, it can cause short circuiting or overheating, resulting in power outages, fires, and electrical service disruption to both residential and business customers (Avery et al. 2002, Avery et al. 2006, Pruett-Jones et al. 2005). The economic costs of power outages caused by monk parakeet nest structures include sales revenue loss (including loss of operations for business customers), damaged equipment repair, and power restoration; plus, the cost of repeated nest structure removal (Newman et al. 2008). To illustrate, the estimated costs associated with outages caused by monk parakeet nests in south Florida during 2001 were $585,000, affecting >21,000 electricity customers (Avery et al. 2002). Therefore, there is clear economic incentive to prevent monk parakeets from nesting on electric utility structures (Avery et al. 2002).

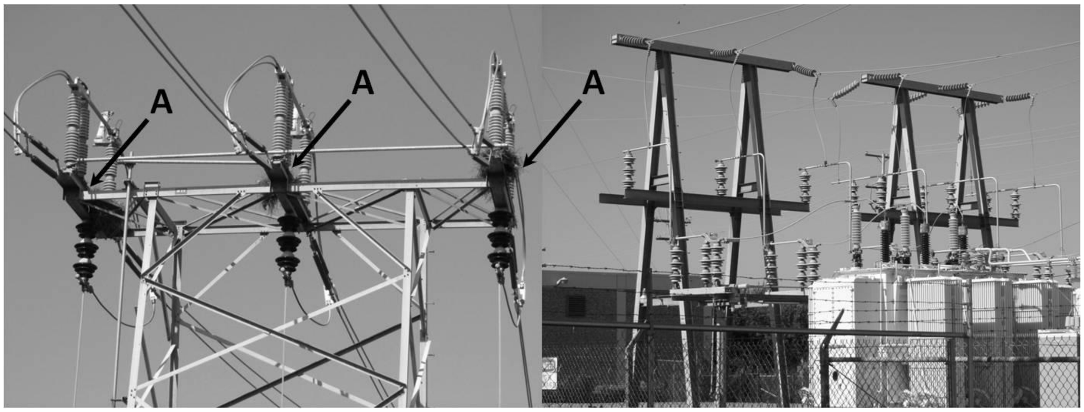

Figure 4.1. Examples of 2 electric station steel support structure towers commonly used in substations and switchyards in Dallas County, Texas, USA. One is constructed with multiple flat surfaces and acute angles (left) with monk parakeet nest structures (A) and the other is constructed with minimal flat surfaces and minimal acute angles without nest structures (right).

Currently, there is insufficient information about how the structural characteristics and surrounding land uses at electric stations influence monk parakeet nest-site selection at multiple scales. However, if electric utility companies hope to prevent nesting on their structures, it is important we obtain a better understanding of the structural, vegetative, and landscape variables that promote and dissuade monk parakeets from nesting on electric stations. In this manuscript, we aim to specifically (1) understand how features of the electric stations and their surrounding environment (<100 m) influence monk parakeet nest-site selection and (2) understand how different land use and land cover (LULC) classifications influence nest-site selection at 3 scales (100 m, 600 m, and 1,250 m). Based on monk parakeet natural history, we formulated the following hypotheses: (1) monk parakeets would nest on electric stations if they were the tallest structures in the immediate vicinity; (2) monk parakeets would select electric stations with multiple flat surfaces and acute angles for nest sites to improve stability of nests (Avery et al. 2006); (3) in urban environments without sizable forest patches (i.e., Dallas/Fort Worth Metroplex), monk parakeets would select areas with more trees and canopy cover for nest twigs, food resources, shaded perches, and protective cover; and (4) as highly gregarious birds, monk parakeets would be more likely to nest on an electric station if it was close to an active colony.

STUDY AREA

Our study site encompassed Dallas and Tarrant counties in north central Texas, US. Both counties are metropolitan areas with high human activity and residential, commercial, and industrial development. Human population density was 1,040/km^2 for Dallas County and 809/km^2 for Tarrant County (U.S. Census Bureau 2010). Both counties are located in the Blackland Prairie and Oak Woods and Prairies ecoregions of Texas (Texas Parks and Wildlife 2012); however, human activity has severely altered the native vegetation. Dominant large canopy tree species in the 2 counties included native oak (*Quercus* spp.) and elm (*Ulmus* spp.), and non-native Chinaberry (*Melia azedarach*) and Chinese tallow (*Triadica sebifera*). Areas of manicured grass were dominated by St. Augustine (*Stenotaphrum secundatum*) and Bermudagrass (*Cynodon dactylon*).

Monk parakeet populations have been increasing in Texas since the early 1980s (Pruett-Jones et al. 2005). Around the same time, the north Texas power utility, Oncor Electric Delivery (hereinafter called Oncor), experienced an increase of monk parakeets nesting on its electric utility structures in Dallas and Tarrant counties (D. A. Boyle, Oncor Electric Delivery, personal communication). During our research, there were 268 electric stations collectively within Dallas (n = 183) and Tarrant (n = 85) counties.

METHODS

From June 2010–August 2012, we located monk parakeet nest structures throughout Dallas and Tarrant counties using sightings provided by Oncor personnel, residents, business owners, local bird club members, ebird.org (http://ebird.org/content/ebird/), and Texbirds (http://listserv.uh.edu/archives/texbirds.html). We defined a monk parakeet nest structure as a twig structure with one or more nesting chamber attended by ≥1 monk parakeet (see Hyman and Pruett-Jones 1995). We defined a monk parakeet colony as ≥1 nest structure on the same substrate or different substrates within 200 m of each other (Burger and Gochfeld 2005). When we located a nest structure, we used adaptive cluster sampling (Morrison et al. 2008) to search for additional nest structures within 200 m and considered them all part of the same colony (see Burger and Gochfeld 2005). We used a handheld GPS unit to obtain a UTM point for each individual electric transmission tower, distribution pole, athletic field light, communication tower, and tree with a nest structure, and one UTM point in the center of each electric station's 2 steel support structures with ≥1 monk parakeet nest structure. We mapped all UTM points on 2010 NAIP 1 m NC/CIR DOQQ imagery (1-m pixel resolution, 4-band Digital Orthophoto Quarter-Quad aerial imagery) of Dallas and Tarrant counties (TNRIS 2011) in ArcMap 10.0 (Environmental Systems Research Institute, Inc., Redlands, CA). We acquired the UTM points of Oncor electric stations within Dallas and Tarrant counties and mapped them on the same 2010 NAIP 1 m NC/CIR DOQQ imagery in ArcMap 10.0. From the

UTM points projected onto the imagery, we created a monk parakeet distribution map (Figure 4.2).

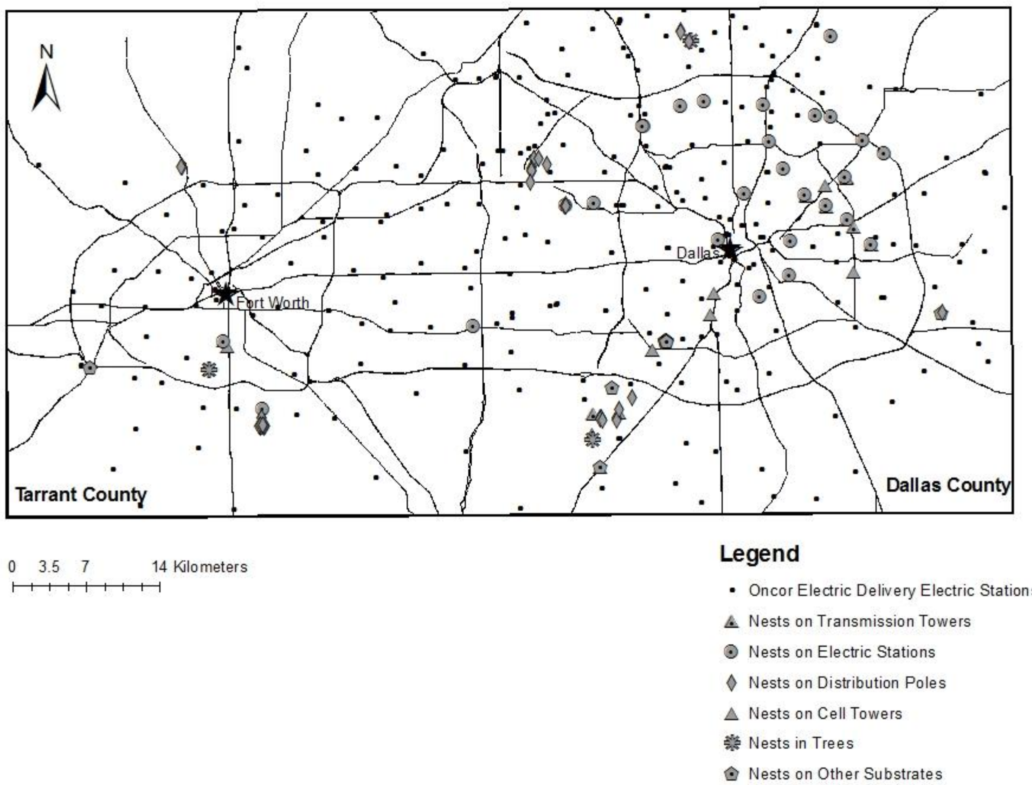

Figure 4.2. Distribution of monk parakeet colonies in Tarrant and Dallas counties, Texas, USA, 2010–2012.

Nest-site Characteristics

We identified electric stations with a monk parakeet colony and paired each with its nearest electric station without a colony. In ArcMap 10.0, we measured the distance from each electric station with a monk parakeet colony to its nearest electric station. When we visited electric stations we discovered 2 distinct construction styles. One construction style consisted of multiple flat girder surfaces with multiple acute angles and other construction styles consisted of rounded surfaces or minimal flat girder surfaces with few, acute angles (see Avery et al. 2006; Figure 4.1).

At each electric station, we quantified 7 variables at the station and the immediate vicinity (<100 m) that we believed biologically relevant to nesting monk parakeets: (1) “construction style” of the electric station, either multiple flat girder surfaces and acute angles (hereinafter called “multi-angled”) or minimal flat girder surfaces and acute angles (hereinafter called “minimal angles”); (2) “nestable height,” the height (m) of the actual nest structures or the potential nestable area on each electric station without nests; (3) “fenced area,” the area (ha) of the fenced enclosure around each electric station; (4) “taller,” the presence of a taller, nestable, anthropogenic structure within 100 m of each electric station; (5) “trees,” the presence or absence of a canopy tree with diameter at breast height (dbh) >30 cm in each quadrant within 100 m of each electric station; (6) “tree height,” the height (m) of the nearest canopy tree with dbh >30 cm in each quadrant within 100 m of each electric station; (7) “tree distance,” the distance (m) to the nearest canopy tree with dbh >30 cm in each quadrant within 100 m of each electric station. We added an 8th variable, “active distance,” that accounted for the distance (m) from each electric station to the nearest electric station with an active monk parakeet colony. We measured all distances from the center between each electric station’s 2 steel support tower structures where monk parakeets most often nested.

Using point-centered quarter sampling method, we identified the nearest tree with dbh >30 cm in each quadrant within 100 m of each electric station (see Cottam et al. 1953). We measured heights and distances with an InSight 400LH laser hypsometer and rangefinder (Opti-Logic, Tullahoma, TN). We used a handheld GPS unit to obtain UTM points of the trees and taller nestable anthropogenic structures. We projected all UTM points onto our 2010 NAIP 1 m NC/CIR DOQQ imagery in ArcMap 10.0 and measured distances from the center between each electric station's 2 steel support structures to the trees, taller nestable anthropogenic structure, nearest electric station with a monk parakeet colony, and nearest electric station without a colony. We also calculated the area of the fenced enclosures around each electric station.

LULC Classification

To understand the influence of the surrounding landscape on monk parakeet selection of electric stations as nest sites, we categorized urban LULC into 5 broad classifications (pavement, building, canopy [tree and shrub crown cover], grass, and water) on the 2010 NAIP 1 m NC/CIR DOQQ imagery using supervised Image Classification (Gorte 1999) in ArcMap 10.0 Spatial Analyst Tool. The LULC classifications were clearly distinguishable; therefore, we used visual interpretation to identify pavement, buildings, canopy, grass, and water. The pavement classification included all paved areas, such as roads, parking lots, and walkways, as well as the herbicide-treated, graveled areas within the fenced electric stations. All residential, commercial, and industrial structures comprised the building classification. The canopy classification contained all tree and shrub cover. All manicured lawns and native and non-native grass areas comprised the grass classification. The water classification consisted of all lakes, ponds, rivers, creeks, and swimming pools. In ArcMap 10.0, we buffered concentric circles centered around the 2 steel structure towers of each electric station with and without nest structures and calculated hectare values for each LULC classification (pavement, building, canopy, grass, and water) on 3 spatial scales: 100 m, 625 m, and 1,250 m. We chose the 1,250-m scale because it was half the average 2.5 km distance between electric stations. For the second scale we chose 625 m, which was half the distance of the 1,250 m scale. We chose the 100 m scale to investigate the immediate area around each electric station. Examining multiple scales in relation to the species and research question can offer broader insight to the animal-resource relationship (Litvaitis et al. 1996). Evaluating resources at different spatial scales also reduces the potential effects from subjectively defining what is perceived to be available to an animal (Porter and Church 1987).

Table 4.1. Twelve candidate models evaluating monk parakeet nest-site selection of electric stations in Dallas and Tarrant counties, Texas, USA, 2010–2012.

	Model variables[a], including a constant and random variable (paired electric station)	K^b	AIC_c[c]	ΔAIC_c[d]	w_i[e]
5	Construction style + nestable height + fenced area + trees + active distance	7	37.300	0.0	0.8211
6	Construction style + nestable height + fenced area + active distance	6	41.250	4.0	0.1139
7	Construction style + trees + active distance	5	43.557	6.3	0.0359
4	Construction style + fenced area + active distance	5	45.907	8.6	0.0111

Table 4.1. Continued

	Model variables[a], including a constant and random variable (paired electric station)	K^b	AIC_c[c]	ΔAIC_c[d]	w_i[e]
3	Construction style + active distance	4	46.089	8.8	0.0101
1	Construction style + nestable height + fenced area + trees + tree height + tree distance + taller + active distance	10	47.451	10.2	0.0051
8	Construction style + tree height + active distance	5	49.077	11.8	0.0023
11	Nestable height + fenced area + active distance	5	53.827	16.5	0.0002
9	Nestable height + fenced area + trees + tree height + tree distance + taller + active distance	9	54.940	17.6	0.0001
10	Nestable height + tree height + taller + active distance	6	55.170	17.9	0.0001
2	Construction style	3	65.050	27.8	<0.0001
12	Construction style + trees + taller	5	65.817	28.5	<0.0001

[a]Variable notation: construction style = either multiple flat girder surfaces and acute angles or minimal flat girder surfaces and acute angles; nestable height = the height (m) of the actual nest structures or the potential nestable area on each electric station; fenced area = area (ha) of fenced enclosure around each electric station; trees = average number of nearest large canopy trees (diameter at breast height [dbh] >30 cm) in each quadrant within 100 m; tree height = average height (m) of nearest large canopy trees (dbh >30 cm) in each quadrant within 100 m; tree distance = average distance (m) of nearest large canopy trees (dbh >30 cm) in each quadrant within 100 m; taller = absence or presence of a taller nestable anthropogenic structure within 100 m; and active distance = distance (m) to nearest electric station with active monk parakeet colony.
[b]K = number of variables in the model
[c]AICc = Akaike's Information Criterion (AIC) corrected for small sample size
[d]ΔAICc = relative difference to the smallest AICc
[e]w_i = Akaike weights

Data Analyses

To understand how the features of electric stations (n = 28 pairs) and their surrounding environment (within 100 m) influenced monk parakeet nest-site selection, we developed 12 candidate models (Table 4.1) with the 8 variables discussed above (construction style, nestable height, fenced area, taller, trees, tree height, tree distance, and active distance). We looked for correlations among variables and removed 1 of 2 variables with >0.70 correlation. During ground surveys, we discovered electric stations had 2 different construction designs (Figure 4.1). We then developed 11 candidate models (Table 4.2) with all variables except construction style to examine selection of electric stations with multi-angled construction (n = 23 pairs). Fenced area and tree distance were highly correlated; therefore, we removed tree distance from this analysis.

Table 4.2. Eleven candidate models evaluating monk parakeet nest-site selection of electric stations with multiple flat surfaces and acute-angled construction in Dallas and Tarrant counties, Texas, USA, 2010–2012.

Model, including a constant and random variable (paired electric station)		K	AIC_c	ΔAIC_c	w_i
10	NestHt+Fenced+Taller	5	52.64	0	0.5866
1	NestHt+Trees+TreeHt+Fenced+Taller+ Active	8	55.05	2.406	0.1762
11	Fenced+Taller	4	55.38	2.742	0.1489
9	Fenced	3	56.96	4.323	0.0675
5	Trees+Active	4	60.79	8.152	0.0100
8	Trees+Taller	4	62.7	10.06	0.0038
3	NestHt+Trees+Active	5	63.52	10.88	0.0025
2	Active	3	65.11	12.47	0.0011

Table 4.2. Continued

Model, including a constant and random variable (paired electric station)		K	AIC_c	ΔAIC_c	w_i
7	NestHt+TreeHt+Taller+Active	6	64.11	11.47	0.0019
6	TreeHt+Active	4	64.89	12.25	0.0013
4	NestHt	3	71	18.36	<.0.0001

Variable notation: nestable height = the height (m) of the actual nest structures or the potential nestable area on each electric station; fenced area = area (ha) of fenced enclosure around each electric station; trees = average number of nearest large canopy trees (diameter at breast height [dbh] >30 cm) in each quadrant within 100 m; tree height = average height (m) of nearest large canopy trees (dbh >30 cm) in each quadrant within 100 m; tree distance = average distance (m) of nearest large canopy trees (dbh >30 cm) in each quadrant within 100 m; taller = absence or presence of a taller nestable anthropogenic structure within 100 m; and active distance = distance (m) to nearest electric station with active monk parakeet colony.

To understand how LULC influenced monk parakeet nest-site selection of electric stations at different landscape scales (100 m, 625 m, and 1,250 m), we developed 7 candidate models (Table 4.3) with the 5 LULC classifications (pavement, building, canopy, grass, and water) to explain the presence or absence of nest structures on paired electric stations (n = 28). We then developed 8 candidate models (Table 4.4) to investigate the same 3 scales around electric stations with multi-angled construction with nest structures (n = 23) paired with their nearest electric stations with multi-angled construction without nest structures.

Table 4.3. Seven candidate models determining influence of 5 urban land use-land cover classifications at 3 scales on monk parakeet nest-site selection of electric stations in Dallas and Tarrant counties, Texas, USA, 2010–2012.

	Model, including a constant and random variable (paired electric station)	K	AICc	ΔAICc	w_i
100-m scale					
7	Null model	2	82.1	0.0	0.8282
5	Pavement + building	4	87.2	5.1	0.0641
4	Water + grass + canopy	5	87.8	5.7	0.0475
3	Canopy + pavement + building	5	88.2	6.1	0.0401
6	Water + grass + canopy + building	6	91.0	8.9	0.0097
2	Grass + canopy + pavement + building	2	91.2	9.1	0.0089
1	Water + grass + canopy + pavement + building	7	94.6	12.5	0.0016
625-m scale					
7	Null model	2	82.1	0.0	0.7986
5	Pavement + building	4	85.8	3.7	0.1231
4	Water + grass + canopy	5	88.4	6.3	0.0339
3	Canopy + pavement + building	5	88.8	6.7	0.0278
6	Water + grass + canopy + building	6	91.4	9.3	0.0075
2	Grass + canopy + pavement + building	6	91.4	9.3	0.0075
1	Water + grass + canopy + pavement + building	7	94.6	12.5	0.0015

Table 4.3. Continued

Model, including a constant and random variable (paired electric station)		K	AICc	ΔAICc	w_i
1,250-m scale					
7	Null model	2	82.1	0.0	0.7413
5	Pavement + building	4	85.6	3.5	0.1315
4	Water + grass + canopy	5	86.9	4.8	0.0663
3	Canopy + pavement + building	5	88.5	6.4	0.0297
6	Water + grass + canopy + building	6	90.1	8.0	0.0139
2	Grass + canopy + pavement + building	6	90.1	8.0	0.0139
1	Water + grass + canopy + pavement + building	7	92.9	10.8	0.0034

For all analyses, we fit each model using generalized linear mixed model (GLMM) with paired electric stations as a random effect, a binomial distribution (nest or no nest), and a log link using Package 'lme4' in R x64 2.15.0 (www.R-project.org, accessed 3 January 2012). We used an information-theoretic approach and evaluated the models using Akaike's Information Criterion (AIC) corrected for small sample size (AICc), the relative difference to the smallest AICc (ΔAICc), and Akaike weights (w_i) to select the most parsimonious predictive model (Burnham and Anderson 2002). We disregarded models >4 AICc units from the best model, considering them implausible representations of the data (Burnham and Anderson 2002). We calculated parameter estimates and 95% confidence intervals (*CI*) for the parameters of the best and competing models, and considered a parameter relevant if its *CI* did not include zero (Burnham and Anderson 2002).

RESULTS

From June 2010–August 2012, we located 56 monk parakeet colonies containing 235 nest structures. Forty-two (75%) of the nest colonies were on electric utility structures and 28 of those were on electric stations, with an average of 4.4 nest structures per station (*SD* = 3.1, range 1–11). At the electric stations, monk parakeets built their nest structures on the steel support structure towers (Figure 4.1) at an average height of 13.4 m (*SD* = 3.0 m, range 5.0 m–24.0 m), usually within and around the C-beam supports and their intersecting flat-surfaced, multi-angled girders (Figure 4.1).

Selection at the Nest-site

Our best competing models for selection of features at the electric station and surrounding vicinity (within 100 m) included construction style, nestable height, fenced area, trees, and active distance (Table 4.1, models 5 and 6). Based on the model-averaged estimates, construction style ($\hat{\beta}$ = 5.224, *CI* = 0.809–9.639), presence of a large canopy trees ($\hat{\beta}$ = 2.089, *CI* = 0.264–3.914), and proximity to an active colony ($\hat{\beta}$ = 0.003, *CI* = 0.001–0.005) were relevant predictors of monk parakeet selection of electric stations as nest sites. Monk parakeets selected electric stations with multi-angled construction (with a nest $\bar{x}$ = 82%, without a nest $\bar{x}$ = 25%) over minimum angle construction and electric stations surrounded by more large trees (with nest $\bar{x}$ = 3.4, without nest $\bar{x}$ = 3.0; Appendix E). The average distance from an electric station with a monk parakeet nest to another electric station with a nest was further ($\bar{x}$ = 4.0 km) than the average distances from an electric station with a nest to an electric station without a nest ($\bar{x}$ = 2.2 km; Appendix E).

For the second analysis of features at the station and surrounding vicinity we excluded the construction style variable and examined the remaining 7 variables for only electric stations with multi-angled construction with monk parakeet nest structures (n = 23) paired with their nearest electric station with multi-angled construction without nest structures. Our best models included nestable height, fenced area, presence of a large canopy trees (dbh >30 cm), proximity to an active colony, and taller nestable anthropogenic structure (Table 4.2, models 10, 1, and 11). Based on their model-averaged estimates of these variables, only presence of a fenced area ($\hat{\beta}$ = –2.713, CI = –4.701––0.725) and taller nestable anthropogenic structure ($\hat{\beta}$ = 2.659, CI = 0.1331–1.028) were relevant predictors of monk parakeet nest-site selection of multi-angled electric stations. Monk parakeets selected electric stations with a smaller fenced area (with a nest $\bar{x}$ = 2,964 m^2, without a nest $\bar{x}$ = 15,945 m^2) and the presence of a taller nestable anthropogenic structure within 100 m (with a nest $\bar{x}$ = 90%, without a nest $\bar{x}$ = 80%; Appendix E).

LULC 3-scale Analyses

The LULC of the urban landscape surrounding electric stations with and without monk parakeet nest structures consisted of building (27–34%), pavement (24–32%), grass (22–29%), and canopy (10–22%; Appendix F). There was very little water (≤2%) present around electric stations either with or without monk parakeet nests. We compared 7 models containing the 5 LULC classifications at 3 scales (100 m, 625 m, and 1,250 m) buffered around each electric station (n = 28 pairs) with nest structures paired with its nearest electric station without nest structures, and found the null model was the best model at all 3 scales (Table 4.3, model 7). We compared 8 models of the 5 LULC classifications at 3 scales buffered around each electric station (n = 23) with multi-angled construction and nest structures paired with its nearest electric station with multi-angled construction without nest structures. We found the null model was the best model for both the 625-m and 1,250-m scales (Table 4.4, model 7). At the 100-m scale, our best competing models contained the variables canopy, pavement, and building (Table 4.4, models 3, 5, 7, and 8). However, only the amount of pavement ($\hat{\beta}$ = 2.772, CI = 0.326–5.218) and the area covered by canopy ($\hat{\beta}$ = 1.829, CI = 0.148–3.510) appeared to be relevant predictors of monk parakeet nest-site selection of electric stations. Monk parakeets selected areas with more pavement (used $\bar{x}$ = 31%, unused $\bar{x}$ = 25%) and canopy cover (used $\bar{x}$ = 16%, unused $\bar{x}$ = 11 %) within 100 m of an electric station (Appendix F).

Table 4.4. Eight candidate models determining influence of 5 urban land use-land cover classifications at 3 scales on monk parakeet nest-site selection of electric stations with multiple flat surfaces and acute-angled construction in Dallas and Tarrant counties Texas, USA, 2010–2012.

Model, including a constant and random variable (paired electric station)		K	AICc	ΔAICc	w_i
100-m scale					
8	Canopy + pavement	4	64.8	0.0	0.6129
3	Canopy + pavement + building	5	68.1	3.3	0.1185
5	Pavement + building	4	68.1	3.3	0.1177
7	Null model	2	68.4	3.5	0.1040
2	Grass + canopy + pavement + building	6	71.8	7.0	0.0184
6	Water + grass + canopy + building	6	72.0	7.1	0.0174
4	Water + grass + canopy	5	73.3	8.5	0.0089
1	Water + grass + canopy + pavement + building	7	76.0	11.2	0.0022
625-m scale					
7	Null model	2	68.4	0.0	0.8150
4	Water + grass + canopy	5	73.7	5.3	0.0567
5	Pavement + building	4	73.9	5.6	0.0503
8	Canopy + pavement	4	74.0	5.6	0.0490
3	Canopy + pavement + building	5	77.2	8.8	0.0099
2	Grass + canopy + pavement + building	6	77.4	9.0	0.0089
6	Water + grass + canopy + building	6	77.4	9.0	0.0089

Table 4.4. Continued

Model, including a constant and random variable (paired electric station)		K	AICc	ΔAICc	w_i
625-m scale continued					
1	Water + grass + canopy + pavement + building	7	81.3	12.9	0.0013
1,250-m scale					
7	Null model	2	68.4	0.0	0.6575
4	Water + grass + canopy	5	71.8	3.4	0.1208
5	Pavement + building	4	72.4	4.0	0.0871
8	Canopy + pavement	4	73.1	4.7	0.0623
6	Water + grass + canopy + building	6	74.9	6.5	0.0256
2	Grass + canopy + pavement + building	6	74.9	6.5	0.0255
3	Canopy + pavement + building	5	75.6	7.3	0.0173
1	Water + grass + canopy + pavement + building	7	78.6	10.2	0.0039

DISCUSSION

Monk parakeets have proven themselves an adaptable species capable of nesting on various substrates, both in their native and introduced ranges (Avery et al. 2002, Burger and Gochfeld 2005, Humphrey and Peterson 1978, Hyman and Pruett-Jones 1995, Minor et al. 2012). Parakeets appeared to nest on electric utility structures considerably more than large canopy trees (dbh >30 cm) or other anthropogenic structures (i.e., athletic field lights and communication towers) prevalent on our study site in Dallas and Tarrant counties. Our results suggest monk parakeets selected electric stations as nest sites based on features and LULC at the station and within 100 m of the station.

As we predicted, monk parakeets selected electric stations with multi-dimensional surfaces consisting of flat surfaces and multiple acute angles. A likely explanation for their use of multi-angled construction is this design improves stability of nests (Avery et al. 2006, Newman et al. 2008). In addition to multi-angled construction, this design involves small spaces that provide perfect insertion points for securing the first nest twigs (Harrison 1973). Monk parakeets in our study did not appear to select the electric station steel support towers because they were the tallest structures in the immediate vicinity. In fact, contrary to our predication, monk parakeets selected to nest on electric stations with taller anthropogenic structures in close proximity. The selection of areas with tall structures may provide more perches and mimic the nest-site selection of monk parakeets in their native range, where they nest in open areas with a cluster of a few large trees (Burger and Gochfeld 2005).

In addition to construction style, as predicted we found monk parakeets preferred electric stations with more large canopy trees (dbh >30 cm) and more canopy cover (tree and shrub crown cover) within 100 m of the stations. Large canopy trees (dbh >30 cm) are an important resource for monk parakeets, as the trees provide nest twigs, food items, shaded perches, and protective cover. Monk parakeets obtain the majority of their nest twigs as live wood, cutting them by rotating their beaks back and forth to sever from the trees (Roscoe et al. 1973), and then carry the twigs in their beaks back to the nest site. Oaks and elms were common large canopy trees (dbh >30 cm) surrounding the electric stations, and during our research we observed monk parakeets utilizing these tree species for nest twigs, food items, and perching locations (J. E. Reed, unpublished data). The proximity to large canopy trees and increased canopy cover around nest sites also may be important for fledglings that need cover from potential predators, such as birds of prey and feral domestic cats (*Felis catus*; J. E. Reed, unpublished data).

Contrary to our prediction, monk parakeets did not place their nests on electric stations closest to other electric stations with nesting colonies. In fact, occupied stations did not appear to be evenly distributed across the study area. Most of the colonies on our study site were clustered and less than <7 km apart. This spacing of nesting colonies could suggest monk parakeets place their colonies to reduce competition for resources around the nest site. Additionally, there were 5 colonies >7 km from the nearest colony. Long-distance dispersal or independent introductions, or both may explain the presence of these peripheral colonies. Goncalves da Silva et al. (2010) found genetic evidence for frequent long-distance dispersal (~100 km) of monk parakeets in the US, which differed from previous estimates of shorter dispersal distances (≤2 km) of the species in its native range (Bucher et al. 1991, Martín and Bucher 1993). Alternatively, peripheral colonies may have established from independent releases known to have occurred across the 2 counties since the 1980s (B. J. Simmons, Fort Worth, and R. Bell, Everman, personal communications).

Our results suggest the surrounding landscape did not influence monk parakeet selection of electric stations as nest sites at the larger scales (625 m and 1,250 m). Within 100 m of electric stations with monk parakeet nest structures, however, proportions were greater for paved areas correlating positively with monk parakeet nest-site selection. Either this is a spurious correlation or biologically meaningful for water availability and usage. We never observed monk parakeets utilizing the water of lakes, ponds, rivers, creeks, swimming pools, or bird baths (J. E. Reed, unpublished data). Instead, pavement may be important to urban monk parakeets for water pooling. We often observed monk parakeets drinking from and bathing in pooled water on the pavement after lawn watering and rains.

MANAGEMENT IMPLICATIONS

As monk parakeet populations continue to grow and expand their range, the probability of future nesting on electric utility structures increases. Researchers have recently begun investigating multiple variables and scales to determine monk parakeet distribution or nest-site selection in urban, non-native ranges. Several large-scale studies in Spain found monk parakeets associated with high tree and human population density (Munoz and Real 2006, Rodriguez-Pastor et al. 2012, Strubbe and Matthysen 2009). A smaller scale study in south Florida, US, found monk parakeets associated with both high and low human-populated residential areas (Newman et al. 2008). Another small-scale study in Chicago, Illinois, US, found monk parakeet distribution there may be negatively affected by a large human population density (Minor et al. 2012). Our multi-variable, multi-scale examination of electric stations as nest sites revealed that electric stations of flat, multi-angled construction within small fenced enclosures surrounded by large canopy trees, tall anthropogenic structures, and pavement appear to make suitable nesting sites for monk parakeets in urban landscapes.

Altering the amount of pavement and anthropogenic structures around electric utility stations in the urban environment may not be a plausible solution to prevent monk parakeets from nesting on the electric station structures. However, increasing the fenced footprint of an electric station and reducing canopy cover (tree and shrub crown cover) and number of large canopy trees (dbh >30 cm) around the station might be a viable strategy to reduce the risk of nesting on an electric substation. Modifying or retrofitting multi-angled construction styles is likely the most effective strategy to reduce the probability of monk parakeets nesting on vulnerable electric substations, yet it may not be an economically viable solution. We recommend electric utility managers conduct a cost-benefit analysis to compare the expense of modifying or replacing electric stations with the realized and potential costs from monk parakeet induced power outages. Nonetheless, it is clear that electric utility companies should strongly consider utilizing a minimum angle design for future electric station construction in a passive effort to reduce the risk of future monk parakeet nesting.

CHAPTER V

PUBLIC ATTITUDES REGARDING MONK PARAKEET NEST MANAGEMENT

SYNOPSIS

Electric utility structures have become a prominent landscape component in the United States, providing a contemporary nesting substrate for some avian species. While the majority of these are native, at least one is an introduced, non-migratory species: the monk parakeet (*Myiopsitta monachus*). Unlike most members of the parrot family (Psittacidae), monk parakeets build their own enclosed nests of twigs, which they use and maintain year-round for both breeding and roosting. Monk parakeets have the propensity to build their nests on electric utility structures, which has caused significant economic damage. Electric utility and wildlife managers have employed various strategies in an effort to prevent this nesting behavior, with little success. Instead, commonly employed management methods (nest removal and lethal control) often evoke strong public outcry and opposition. We employed a sociological survey using the theory of planned behavior (TPB) to evaluate 8 sociodemographic and 4 sociopsychological variables as predictors of opposition responses to methods (lethal control, reproductive control, and nest removal) for managing monk parakeets nesting on electric utility structures. Of 402 surveys (250 mail, 152 telephone) attempted, 43 were completed (11% response rate). Most survey participants were affluent, well-educated, middle-aged or older, white-Caucasians. Most participants were unknowledgeable about, inexperienced with, and unsure about the potential or known impacts of monk parakeets. As expected, participants showed the least opposition for nest removal and electric utility structure modification. When they did respond in opposition, participants indicated they were most likely to (1) express opinions to family and friends or through social media and (2) initiate or sign a petition in opposition to nest management strategies. Participants responding in opposition appeared significantly influenced by (1) their desire for monk parakeets to feed at their bird feeders or nest in their yard, (2) people and groups who were important to them, and (3) their perceived ease of responding and acting. We recommend electric utility and wildlife managers develop a public education program explaining monk parakeet biology and the economic impacts of their nesting habits on electric utility structures. We suggest implementing the outreach program in areas adjacent to electric utility structures with monk parakeet nests, especially those in affluent areas, and targeting the predictors driving participants' behaviors. To provoke the least public opposition, we propose nest removal and electric utility structural modification for managing monk parakeets nesting on electric utility structures.

INTRODUCTION

Electric utility structures have become a prominent landscape component in industrialized countries (Infante and Peris 2003) and avian species have caused economic damage to electric utility equipment since the 1920s (Michener 1928). In the United States (US), these structures have become common nesting sites for several avian species, including crows (*Corvus corax*), ravens (*C. corone*), and various raptors (orders Accipitriformes and Falconiformes; Simpson and Ruiz 1974, Dean 1975, Austin-Smith and Rhodenizer 1983, Steenhof et al. 1993). The number of avian species causing damage is relatively small, yet their impacts can be significant with economic damage estimates ranging $450–$140,000 per outage (James et al. 1999, Avery et al. 2002).

The monk parakeet (*Myiopsitta monachus*) is an introduced avian species that nests on electric utility structures in the US (Freeland 1973, Roscoe et al. 1973, Bucher and Martín 1987, Hyman and Pruett-Jones 1995, Spreyer and Bucher 1998). This species is a non-migratory native of South America (Forshaw 1973). More than 160,000 monk parakeets were imported from the late 1960s until 1992 into the US as popular, inexpensive caged birds during the legal pet bird trade (Davey et al. 2004, CITES 2012). Due to accidental and intentional releases, monk parakeets established naturalized, self-sustaining populations in several states (Devlin 1970, Bull 1973, Davis 1974, Neidermyer and Hickey 1977, Spreyer and Bucher 1998) and began exhibiting exponential growth and range expansion by the early 1970s (Garber 1993, van Bael and Pruett-Jones 1996, Pruett-Jones and Tarvin 1998). Monk parakeet populations have not been evenly distributed, however. During the 2011–12 Christmas Bird Count (CBC), 2,482 monk parakeets were counted in the US, with 68% reported in Florida and Texas (National Audubon Society 2011).

Although monk parakeets in the US have not caused the damage to agricultural crops or competed with native avian species as originally expected (Tillman et al. 2004, Avery et al. 2006), the species' nesting behavior on electric utility structures has caused economic damage (Avery et al. 2002). Unlike most members of the parrot family (Psittacidae), monk parakeets build their own enclosed nests of twigs, which they use and maintain year-round for both breeding and roosting (Forshaw 1989, Bucher et al. 1991, Navarro et al. 1992, Martella and Bucher 1993, Eberhard 1996). Several monk parakeet pairs typically build separate nesting chambers joined together to form large compound nest structures, and each chamber has its own entrance (Bull and Ricciuti 1974, Goodfellow 1977, Forshaw 1989, Olivieri and Pearson 1992). Oftentimes, there are several nest structures clustered together on the same substrate or different substrates in an area, forming large colonies of many monk parakeets (Goodfellow 1977, Forshaw 1989, Collar and Juniper 1992). Nest material can interfere with electrical equipment and cause overheating or short-circuiting, resulting in fires and electric service disruption to consumers (Bucher 1984, Bucher and Martín 1987, Avery et al. 2002, Pruett-Jones et al. 2005, Avery et al. 2006). Furthermore, indirect power outages may occur when predators (e.g., snakes and squirrels) are attracted to the nests and electrocuted in the process (James et al. 1999). The economic costs associated with monk parakeet nests involve sales revenue loss, damaged equipment repair, power restoration, and nest removal, plus loss of operations for business customers (Newman et al. 2008). There is economic incentive, therefore, to prevent monk parakeets from nesting on electric utility structures (Avery et al. 2002).

In an attempt to prevent monk parakeets from nesting on the structures, managers have employed various strategies, including lethal control, chemical repellents, scaring devices, and nest removal (Avery et al. 2006). Visual and auditory repellents usually become ineffective, because monk parakeets habituate to them quickly (Inglis 1980, Slater 1980) and monk parakeets are usually attracted by agonistic calls (Martella and

Bucher 1990). Nest removal is the most common management method used, yet it is a short-term solution if the substrate is not modified to prevent future nesting. Otherwise, dislodged monk parakeets usually return immediately and rebuild a new nest in the same location within 2 weeks (Bull and Ricciuti 1974, Avery et al. 2002, Avery et al. 2006).

Not only have these methods failed to manage monk parakeets nesting on electric utility structures, but they often evoke strong public outcry and opposition (Spreyer 1994, Avery et al. 2006). People who get involved with monk parakeet nesting issues are usually strongly opinionated either for or against when it comes to whether the parrots should stay or go. Olivieri and Pearson (1992) reported that "for every 10 to 15 people who have contacted us in the past 17 months to talk about Monk Parakeets, there is one who is ready to shoot them all." Additionally, monk parakeets can have high profile exposure in various media, including Sports Illustrated, Houston Chronicle-Dallas Bureau, National Public Radio (NPR), New York Times, and Connecticut Post (Gilbert 1984, Korosec 2006, Wilder 2006, Silverman 2009, Dixon 2010). In 2005, for example, a Dallas, Texas, US, resident used her sports utility vehicle (SUV) to block the entrance to an Oncor Electric Utility electric substation in protest to workers removing monk parakeet nests from the 13.5 m tall support structures. The 45-year-old Caucasian woman then proceeded to telephone friends, neighbors, and media outlets. Her actions brought the nest removal to an immediate halt and the event became a headline (Korosec 2006).

In the US, management of wildlife species (native or non-native) often depends upon public acceptance, and a lack of acceptance may disrupt proposed management actions and policies (Deblinger et al. 1993, Donnelly and Vaske 1995, Avery et al. 2002). Public involvement has placed wildlife management issues on ballots, sometimes leading to policy modifications and limiting options available to wildlife managers (Zinn et al. 1998). This may be the result of changing demographics, greater diversity of values, and increasing involvement of politically effective interest groups (Peterson and Manfredo 1993, VanDruff et al. 1996). For example, members of conservation and nongovernmental organizations (NGOs) have become more involved with wildlife and conservation issues (Decker et al. 2001). Therefore, identifying which wildlife management actions are acceptable and unacceptable, and understanding why, allows wildlife managers to develop appropriate management actions aligning with public expectations (Decker et al. 2001, Decker 2012). One way to do this is through human dimensions research. This approach has been utilized to identify publicly-accepted management solutions for several species, including bear (*Ursus americanus*; Peyton 1989), white-tailed deer (*Odocoileus virginianus*; Stout et al. 1997, Fulton et al. 2004, Lauber and Knuth 2004), and moose (*Alces alces*; Donnelly and Vaske 1995).

To our knowledge, no studies have attempted to address human-monk parakeet conflicts in urban environments where this species has naturalized. The goal of our research was to identify a monk parakeet nest management strategy least likely to generate public outcry and opposition. Using the theory of planned behavior (TPB; Ajzen 1985,1991), we utilized a sociological survey to evaluate variables that might predict public opposition responses to 2 monk parakeet behaviors and 4 methods for managing their nests on electric utility structures. The variables included sociopsychological factors (i.e., beliefs and attitudes [attitude toward the behavior], influence and expectations of others [subjective norm], and ease of response and action [perceived behavioral control]) and sociodemographic variables (e.g., gender, age, ethnic group, education, and property value). Since few residences rely upon electricity to conduct business and some residences provide bird feeders, we expected more residences than businesses would be supportive of naturalized monk parakeets in the urban setting. Based upon previous media reports (Korosec 2006, Silverman 2009, Dixon 2010, Sullivan 2013), we predicted the majority of survey participants would be well-educated, affluent, middle-aged, white-Caucasian females who were members of conservation groups or NGOs. Based upon the same reports, we expected public opposition to monk parakeet population control methods, such as lethal and reproductive control. We predicted public preference would be favorable for a nonlethal, minimally invasive management strategy, such as nest removal, for monk parakeets nesting on electric utility structures.

STUDY AREA

We conducted our survey in Dallas and Tarrant counties in north central Texas, US (Figure 5.1), where monk parakeets nest on electric utility structures (Figure 5.2; Reed et al. 2014). Both counties are highly populated metropolitan areas, with human population density 1,040/km^2 for Dallas County and 809/km^2 for Tarrant County (U.S. Census Bureau 2010). Monk parakeets began breeding in Dallas, Texas, as early as 1973 (Williams 1974) and populations began increasing exponentially in the early 1980s (Pruett-Jones et al. 2005). About the same time, the local electric utility company,

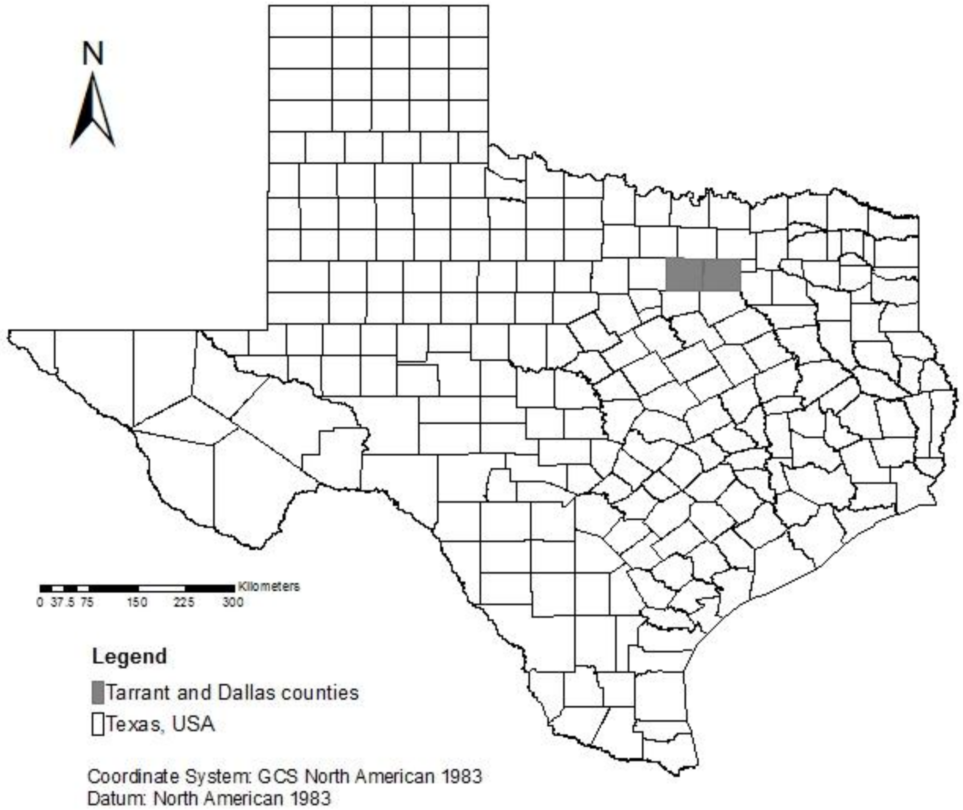

Figure 5.1. Map of Texas showing Tarrant and Dallas counties, USA.

Oncor Electric Delivery (hereinafter called Oncor), Dallas, Texas, US, began experiencing an increase of monk parakeets nesting on its electric utility structures (D. A. Boyle, Oncor Electric Delivery, personal communication). Oncor operates the largest transmission (>22,500 km) and distribution (>164,000 km) system in Texas, delivering electricity to >7 million consumers in 91 (36%) of the 254 Texas counties (Oncor Electric Delivery 2012). Approximately 268 (28%) of Oncor's 960 switchyards and substations were in Dallas and Tarrant counties (n = 183 and n = 85, respectively).

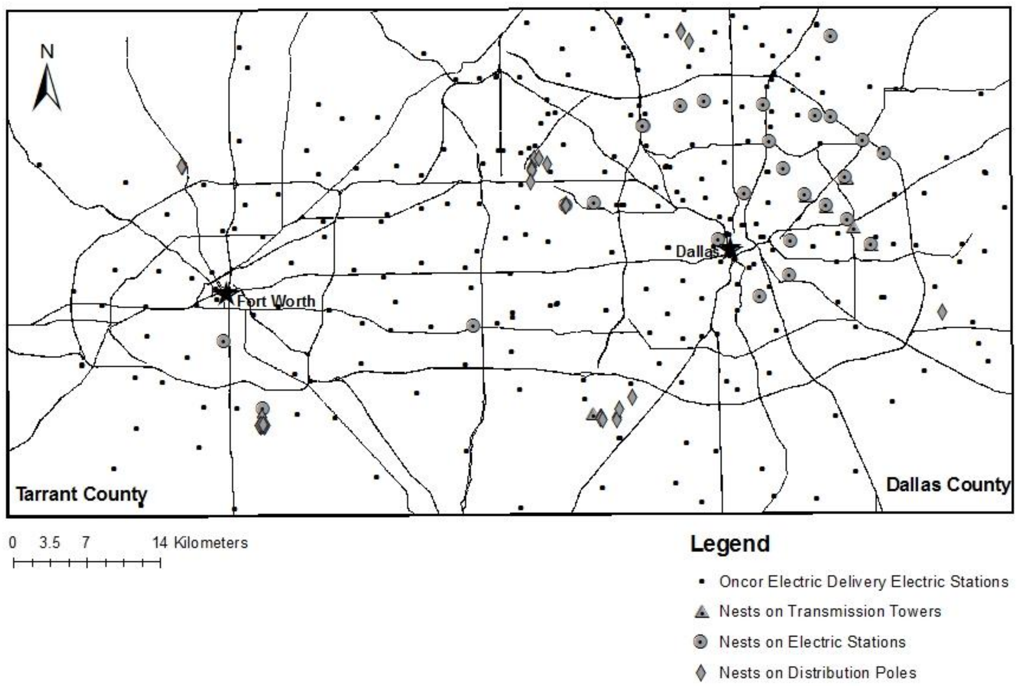

Figure 5.2. Distribution of monk parakeet nests on electric utility structures, Tarrant and Dallas counties, Texas, USA, May 2010–August 2012.

METHODS

Survey Design and Sampling

From September 2012–February 2013, we surveyed individuals from residences and businesses regarding monk parakeet behaviors and management of monk parakeets nesting on electric utility structures. We developed a 21-question survey (Appendix G) using the TPB to measure behavioral beliefs and attitudes toward the behavior, normative beliefs and subjective norms, and control beliefs and perceived behavioral control (Ajzen 1985,1991). The questions measured anticipated actions in opposition to 2 monk parakeet behaviors (excessive noise and nests causing power outages; discussed in section Dependent Variables) and 4 management methods (lethal control, reproductive control, nest removal and structural modification during breeding season, and nest removal and structural modification during nonbreeding season; discussed in section Dependent Variables) to prevent monk parakeets from nesting on electric utility structures (dependent variables) and sociopsychological and sociodemographic variables (independent variables). We pre-tested the survey with 6 volunteers representing the research population to determine clarity of questions and completion time, and adjusted the survey accordingly.

We used a multimode survey design approach involving mail and telephone methods in an attempt to increase survey coverage (Waksberg 1978, Cunningham et al. 1997, Nathan 2001, Parackal 2003, Srinath et al. 2004) and participant response rate (Poe et al. 1990, Fowler Jr. et al. 2002, de Leeuw 2005). Multimode survey designs are often utilized, because each survey mode administered alone often has coverage issues (Biemer and Lyberg 2003, Lepkowski et al. 2008, Counselman et al. 2009, Kreuter 2013). For example, conducting a telephone survey alone runs the risk of under-representing those who rely primarily or solely on mobile phones and conducting mail surveys alone often results in low response rate.

Mail Survey

We generated a sample size of 250 residences and businesses by randomly selecting ≤8 points adjacent to each monk parakeet colony (*n* = 33) nesting on electric utility structures (Figure 5.2; Reed et al. 2014) projected onto 2010 NAIP 1 m NC/CIR DOQQ imagery (1-m pixel resolution, 4-band Digital Orthophoto Quarter-Quad aerial imagery) of Dallas and Tarrant counties (TNRIS 2011) in ArcMap 10.0 (Environmental Systems Research Institute, Inc., Redlands, CA). If a random point fell upon canopy, grass, water, or pavement, we selected the nearest residential or business building. Using Google Maps (http://maps.google.com/), we obtained the address for each randomly selected point. We verified addresses and obtained names and 2009 property values from city-data.com (City-Data.com 2013).

We used a modified Dillman Method (i.e., pre-notice letter, study packet, reminder-thank you postcard, and follow-up calls) to improve survey response rate (Dillman 1978). Within a 4-week period, we mailed a personalized survey announcement postcard, survey packet, and reminder–thank you postcard to each randomly selected residential and business address. If an announcement postcard or survey packet returned undeliverable, we re-mailed that item to a new randomly selected address adjacent to the same monk parakeet colony.

All survey documents were preprinted and hand-personalized for each recipient. Each survey packet included: a personalized invitation letter with instructions; 2 hand-signed, hand-dated informed consent forms; a numbered survey with instructions; and a postage-paid business reply envelope. We hand-addressed each survey packet envelope and attached individual postage stamps. For unique identification consistency, we placed a monk parakeet sticker (http://www.zazzle.com/) on each announcement postcard, survey packet envelope, and reminder-thank you postcard.

For each non-response addressee, we attempted to locate a telephone number in The White Pages (WhitePages 2013). If we could obtain a telephone number, we made

≤4 follow-up call attempts to solicit survey completion and return. If we did not reach a person by the fourth attempt and the call rang to an answering machine, we left a call-back number and message explaining the reason for our call, and asked if the household would complete and return the survey.

Telephone Survey

For the telephone survey, we utilized random digit dialing (RDD). RDD offers the inclusion of unlisted and cell phone numbers that would otherwise be missed if numbers were selected solely from a phone book (Waksberg 1978). We identified banks of 100 contiguous numbers proportionally adjacent to electric utility structures with monk parakeet nests (Figure 5.2; Reed et al. 2014). We compiled a random generation of the last 2 digits of each bank of 100 numbers using Microsoft Excel 2007 (Microsoft, Redmond, WA). We made ≤4 call attempts to reach a household. When we reached a potential participant, we ask for the household's United States Postal Service (USPS) ZIP code in order to associate the household with an area where monk parakeets nested on electric utility structures. Only households adjacent to monk parakeet colonies on electric utility structures qualified to participate in our survey. If we did not reach a person by the fourth attempt and the call rang to an answering machine, we left a call-back number and message explaining the reason for our call, and asked the household to return our call if it was interested in participating in our survey.

Dependent Variables

We evaluated participant opposition responses (beliefs and attitudes) to 2 monk parakeet behaviors: (1) excessive noise and (2) nests causing power outages (hereinafter called power outage). We evaluated participant opposition responses to 4 management strategies: (1) lethal control (by capturing and euthanizing); (2) reproductive control (by providing reproductive inhibitor treated seed; see Avery et al. 2008); (3) nest removal during breeding season, transferring any eggs and nestlings to a wildlife rehabilitation center, and modifying the electric utility structure to prevent future nesting (hereinafter called nest removal breeding); and (4) nest removal during nonbreeding season and modifying the electric utility structure to prevent future nesting (hereinafter called nest removal nonbreeding).

Participant opposition responses to monk parakeet behaviors and nest management strategies included: (1) contact the electric company; (2) contact the media (TV, newspapers, etc.); (3) contact officials (police, mayor, city council members, etc.); (4) organize or participate in a protest; (5) initiate or sign a petition; (6) attend meetings or join a group or organization; (7) express opinions to family and friends or through social media (Facebook®, Twitter®, YouTube™, etc.), and (8) take no action. For each statement response within each of the 6 dependent variable groups (excessive noise, power outage, lethal control, reproductive control, nest removal breeding, and nest removal nonbreeding), we asked participants to respond on a 5-point scale (Strongly Disagree, Disagree, Do Not Know, Agree, or Strongly Agree).

Independent Variables

We investigated 4 groups of sociopsychological variables (independent variables): (1) knowledge about and experience with monk parakeets; (2) concerns about monk parakeet nesting behavior; (3) influence and expectations of others; and (4) ease of response and action. There were 12 statements pertaining to participants' knowledge about and experience with monk parakeets and 5 statements regarding their concerns with monk parakeet nesting behavior (Appendix H, Table 5.1). The influence and expectations (subjective norms) of others and the ease of response and actions (perceived behavioral control) variable groups both contained the same 6 statements as the dependent variable (listed in section Dependent Variables). For the subjective norms, we asked how family, friends, neighbors, and groups important to the participant expected him or her to respond in opposition to the 2 monk parakeet behaviors and 4 methods for managing monk parakeets nesting on electric utility structures. We did not separate specific reference groups or measure participants' motivation to comply. For all 4 groups of sociopsychological variables, we used the same 8 opposition responses for the dependent variables (listed in section Dependent Variables) and asked participants to respond on a 5-point scale (Strongly Disagree, Disagree, Do Not Know, Agree, or Strongly Agree).

We measured 6 sociodemographic independent variables: (1) involvement with conservation organizations and issues, (2) gender, (3) age, (4) ethnic group, (5) education level, and (6) building style (business or residence; Appendix H, Table 5.2). We asked participants to respond on a 3-point scale (True, False, or Do Not Know) for 3 statements regarding their involvement with conservation organizations and issues: (1) I am a member of a conservation group or non-government organization (NGO); (2) In the past, I have signed a petition or protested in opposition to a conservation issue; and (3) In the past, I have signed a petition or protested in favor of a conservation issue. We obtained 2009 property values from city-data.com (City-Data.com 2013). We conducted this research under Texas A&M University IRB Protocol number 2012-0501.

Data Analyses

We calculated the survey response rate and the descriptive frequency data for the independent and dependent variables. We assessed internal consistency of our measurement scale using Cronbach's alpha and considered values ≥0.70 indicating satisfactory internal reliability (Cronbach 1951, Bland and Altman 1997, Connelly 2011). For scales with low internal reliability, we used Spearman's rank correlation coefficient (r_s) to identify any association among variables. We performed principal component analysis (PCA) to reduce independent and dependent variables to their principal components while maximizing variance (Jolliffee 1986). We accepted components with eigenvalues ≥1.0, grouped variables with loading values ≥0.6, and excluded components containing only 1 variable. On the resulting data, we executed linear regression modeling to test the contribution of the independent variables to predict the dependent variables. We eliminated independent variables with variance inflation factors (VIFs) >10 from the models. We examined each significant full model ($P < 0.05$) for at least 1 significant independent variable parameter estimate ($P < 0.05$). We tested for statistical significance in R^2 value change between full and reduced models using a partial F-test (Chatterjee and Hadi 1988) to identify if a reduced model better predicted the dependent variable. We used $\alpha = 0.05$ as the acceptable level of statistical significance. We conducted statistical analyses with SPSS 20.0 (IBM Corporation, Armonk, NY) and SAS 9.3 X64 7PRO (SAS Institute, Inc., Cary, NC).

RESULTS

Response Rate

Of the 250 residences and businesses invited to participate in the mail survey, 124 (49.6%) did not respond, 86 (34.4%) declined to participate, 2 (0.8%) did not speak English, 1 (0.4%) converted to a telephone survey, and 37 (14.8%) returned a mail survey. Two of the surveys returned by mail were incomplete and excluded from further analyses. The resulting response rate was 14% (*n* = 36) for the mail survey mode.

Of the 935 telephone numbers called, 152 (16%) were working numbers of which 72 (47%) neither answered nor returned our call, 48 (32%) declined to participate, 18 (12%) did not qualify, 7 (5%) did not speak English, 4 (3%) converted to a mail survey, and 3 (2%) participated in a telephone survey. The resulting response rate was 5% (*n* = 7) for the telephone survey mode. Since we had a low response rate for both survey modes, we pooled the data (*n* = 43) for a combined 11% response rate.

Sociodemographics

The majority of the completed surveys were from Dallas County (79%; *n* = 34) compared to Tarrant County (21%; *n* = 9). More residences (72%; *n* = 31) participated than businesses (28%; *n* = 12). Most property values ranged $100,000–$499,999 (61%; *n* = 26), followed by <$100,000 (28%; *n* = 12), ≥$1,000,000 (7%; *n* = 3), and $500,000–$999,999 (5%; *n* = 2). Twenty-three males (54%) and 20 females (46%) participated. All indicated their age group: 37% (*n* = 16) were 45–54 years old, 28% (*n* = 12) were 55–64 years old, 14% (*n* = 6) were ≥65 years old, 12% (*n* = 5) were 25–34 years old, and 9% (*n* = 4) were 35–44 years old. The majority of the survey participants were white-

Caucasian (84%; n = 36), while 4 (9%) were Other and 3 (7%) preferred not to answer. Twenty-two (51%) participants had a college or technical school degree, followed by 12 (28%) with a graduate or professional degree, 7 (16%) with some college or technical school, 1 (2%) with a high school or equivalency diploma, and 1 (2%) preferred not to answer.

Four (9%) participants were current members of a conservation group or NGO. When asked if they had signed a petition or protested for a conservation issue, none of the survey participants reported they had done so in opposition, while 10 (23%) answered they had done so in favor. Among the statements, there was very low internal reliability (Cronbach's α = 0.346). We found no significant association between participants being a current member of a conservation group or NGO and either signing a petition or protesting in opposition to (r_s = 0.043, P = 0.785, n = 42) or in favor of (r_s = 0.138, P = 0.388, n = 41) a conservation issue. There was a significant correlation between participants signing a petition or protesting in opposition to and in favor of a conservation issue (r_s = 0.328, P = 0.036, n = 41). Based on this statistic, one statement including both "in opposition to" and "in favor of" would be sufficient when asking about participants' involvement with signing a petition or protesting regarding a conservation issue.

Knowledge about and Experience with Monk Parakeets

Most survey participants either agreed or were unsure if monk parakeets migrate to Texas (18% and 49%, respectively). Over half also agreed or were unsure if monk parakeets are native to Texas (12% and 47%, respectively). Most (84%) survey participants reported they had seen a wild monk parakeet in either Dallas or Tarrant counties. Over half said they could not see or were unsure if they could see a monk parakeet nest from their home (49% and 16%, respectively). More than half were unsure (60%) if monk parakeets use their nests year-round, while 5% believed they do not.

When asked if monk parakeets contribute to the quality of urban life, 47% of participants agreed they do and 37% were unsure. Over half of participants agreed (56%) monk parakeets are noisy. Most survey participants either did not want or were unsure if they want monk parakeets to feed at their bird feeders (40% and 35%, respectively). Most survey participants either did not want or were uncertain if they want monk parakeets to nest in their yard (42% and 30%, respectively).

Most survey participants were unsure (67%) if monk parakeets carry diseases that threaten native species, pets, or human life, while 23% believed they do not and 7% believed they do. Most survey participants were unsure (56%) if monk parakeets cause environmental or agricultural damage, while 28% believed they do not and 16% believe they do. Most survey participants were unsure (51%) if monk parakeets cause economic damage, while 21% believe they do not and 28% believe they do.

Concerns about Nesting Behavior

Most participants were unsure or disagreed that monk parakeet nests on electric utility structures cause fires (49% and 25%, respectively). Most were unsure or disagreed that monk parakeet nests on electric utility structures cause power outages (43% and 24%, respectively). Most participants had not or were unsure if they had experienced a power outage they knew caused by a monk parakeet nest (56% and 40%, respectively).

Participants were equally in agreement (44%) and disagreement (44%) they would be upset to experience a power outage caused by a monk parakeet nest, while the remaining 12% were unsure. Few more participants agreed (44%) than disagreed (40%) they would be willing to go up to 4 hours without electric power caused by a monk parakeet nest, while the remaining 16% were unsure.

Preferences for Management Strategies

In response to monk parakeets nesting near a participant's home and making too much noise, 72% of participants indicated they would not take action and 14% were not sure what they would do. The other 14% indicated they would take action, primarily through expressing their opinions about the noise to family and friends or through social media. In response to a monk parakeet nest causing a power outage in a participant's area, 63% of participants indicated they would not take action and 13% were unsure how they would respond. The remaining 23% indicated they would take action, primarily by contacting the electric company about the power outage.

In response to wildlife managers capturing and euthanizing (lethal control) monk parakeets, 45% of participants indicated they would not take action and 15% were uncertain what they would do. The other 41% indicated they would take action in opposition to the management method, primarily by initiating or signing a petition and expressing opinions to family and friends or through social media.

In response to wildlife managers providing treated seed to prevent monk parakeets from producing young (reproductive inhibitor), 54% indicated they would not take action and 16% did not know what they would do. The other 30% indicated they would take action in opposition to the management method, primarily by initiating or signing a petition and expressing opinions to family and friends or through social media.

In response to wildlife managers removing monk parakeet nests during breeding season, transferring any eggs and nestlings to a wildlife rehabilitation center, and modifying the electric utility structure to prevent future nesting, 69% of participants indicated they would not take action and 17% were unsure what they would do. The remaining 14% indicated they would take action in opposition to the management method, primarily by expressing opinions to family and friends or through social media. In response to wildlife managers removing monk parakeet nests during nonbreeding season and modifying the electric utility structure to prevent future nesting, 68% of participants indicated they would not take action and 19% were uncertain how they would respond. The remaining 13% indicated they would take action in opposition to the management method, primarily by expressing opinions to family and friends or through social media.

Principal Component Analysis (PCA)

The PCA of knowledge about and experience with monk parakeets resulted in 4 components containing 9 of the 12 original items (Appendix H, Table 5.3). Individually the components explained between 10–31% of the variance and combined 75% of the variance in the items in question; the loadings of the items were ≥ 0.6. The first component consisted of the participant wanting monk parakeets to (f) nest in his or her yard and (g) feed at his or her bird feeder. The second component placed emphasis upon (d) monk parakeets use their nests all year, (a) monk parakeets migrate to Texas, and (h) monk parakeets are noisy. The third component had high loadings associated with (b) monk parakeets are native to Texas and (j) monk parakeets cause environmental or agricultural damage. The fourth component consisted of (c) the participant has seen a wild monk parakeet in either Dallas or Tarrant counties and (l) monk parakeets contribute to the quality of urban life. Cronbach's alpha for the set of items was 0.452.

The PCA of concerns about monk parakeet nesting behavior resulted in a single component containing all 5 original items (Appendix H, Table 5.3), in order of loading importance (high–low): (b) monk parakeet nests on electric utility structures cause power outages; (e) participant is willing to go ≤4 hours without electrical power resulting from a monk parakeet nest; (a) monk parakeet nests on electric utility structures cause fires; (d) participant would be upset to experience a power outage caused by a monk parakeet nest; and (c) participant has experienced a power outage known to be caused by a monk parakeet nest. The component explained 54% of the variance in the items and the loadings were ≥0.6. Cronbach's alpha for the set of items was 0.783.

The PCA of influence and expectations of others on participant responses to excessive noise resulted in 2 components with item loadings ≥0.6 (Appendix H, Table 5.4). The first component explained 66% of the variance and placed greater emphasis on non-contact responses, in order of loading importance (high–low): (e) initiate or sign a petition; (f) attend meetings or join a group or organization; and (d) organize or participate in a protest. The second component explained 16% of the variance and was characterized by high loadings associated with contact responses, in order of importance (high–low): (c) contact officials; (b) contact the media; (g) express opinions to family and friends or through social media; and (a) contact the electric company. Cronbach's alpha for the set of all 8 items was 0.877.

The PCA of influence and expectations of others on participant opposition responses to 1 monk parakeet behavior (power outage; Appendix H, Table 5.4) and 4 management methods (lethal control, reproductive control, nest removal breeding, nest removal nonbreeding; Appendix H, Table 5.5) of monk parakeet nests on electric utility structures produced single components per response or management statement. The single components explained 70–80% of the variance in the items in question and the loadings of those items were ≥0.6. For opposition responses to power outage, the single component placed greater emphasis on 6 of the 8 responses, in order of loadings (high–low): (d) organize or participate in a protest; (f) attend meetings or join a group or organization; (b) contact the media; (c) contact officials; (e) initiate or sign a petition; and (g) express opinions to family and friends or through social media. Cronbach's alpha for the set of items was 0.837. For opposition responses to lethal control, the single component included all 8 responses, in order of loadings (high–low): (d) organize or participate in a protest; (f) attend meetings or join a group or organization; (e) initiate or sign a petition; (g) express opinions to family and friends or through social media; (b) contact the media; (c) contact officials; (a) contact the electric company; and (h) take no action. For opposition responses to reproductive control, the single component included all 8 responses, in order of loadings (high–low): (d) organize or participate in a protest;

(c) contact officials; (f) attend meetings or join a group or organization; (b) contact the media; (e) initiate or sign a petition; (g) express opinions to family and friends or through social media; (a) contact the electric company; and (h) take no action. For opposition responses to nest removal breeding, the single component consisted of 7 of the 8 responses, in order of loadings (high–low): (d) organize or participate in a protest; (f) attend meetings or join a group or organization; (e) initiate or sign a petition; (b) contact the media; (c) contact officials; (g) express opinions to family and friends or through social media; and (a) contact the electric company. For opposition responses to nest removal nonbreeding, the single component consisted of all 8 responses, in order of loadings (high–low): (b) contact the media; (d) organize or participate in a protest; (f) attend meetings or join a group or organization; (c) contact officials; (e) initiate or sign a petition; (g) express opinions to family and friends or through social media; (a) contact the electric company; and (h) take no action. For all 4 sets of management statements, Cronbach's alpha values were >0.900.

The PCA of ease of response and action on participant responses to 2 monk parakeet behaviors (excessive noise and power outage; Appendix H, Table 5.6) and 1 management method (nest removal nonbreeding; Appendix H, Table 5.7) of monk parakeet nests on electric utility structures resulted in 2 components each, with item loadings ≥0.6. For opposition responses to excessive noise, the first component explained 58% of the variance and placed greater emphasis on 3 of the 8 responses, in order of loadings (high–low): (d) organize or participate in a protest; (f) attend meetings or join a group or organization; and (e) initiate or sign a petition. The second component explained 16% of the variance and was characterized by high loadings associated with 4 of the 8 responses, in order of loadings (high–low): (g) express opinions to family and friends or through social media; (a) contact the electric company; (c) contact officials; and (b) contact the media. For opposition responses to power outage, the first component explained 55% of the variance and placed greater emphasis on 3 of the 8 responses, in order of loadings (high–low): (d) organize or participate in a protest; (e) initiate or sign a petition; and (f) attend meetings or join a group or organization. The second component explained 19% of the variance and consisted of 3 of the 8 responses, in order of loadings (high–low): (a) contact the electric company; (g) express opinions to family and friends or through social media; and (c) contact officials. For opposition responses to nest removal nonbreeding, the first component explained 61% of the variance characterized by high loadings associated with 4 of the 8 responses, in order of loadings (high–low): (a) contact the electric company; (c) contact officials; (b) contact the media; and (g) express opinions to family and friends or through social media. The second component explained 17% of the variance and consisted of 3 of the 8 responses, in order of loadings (high–low): (f) attend meetings or join a group or organization; (e) initiate or sign a petition; and (d) organize or participate in a protest. All Cronbach's alpha values were ≥0.800.

The PCA of ease of response and action on participant responses to 3 monk parakeet nest management methods (lethal control, reproductive control, and nest removal breeding) produced single components per management statement, with item loadings ≥0.6 (Appendix H, Table 5.7). For opposition responses to lethal control, the single component explained 70% of the variance and included 6 of the 8 responses, in order of loadings (high–low): (c) contact officials; (b) contact the media; (e) initiate or sign a petition; (d) organize or participate in a protest; (f) attend meetings or join a group or organization; and (g) express opinions to family and friends or through social media. For opposition responses to reproductive control, the single component explained 63% of the variance and consisted of 7 of the 8 responses, in order of loadings (high–low): (c) contact officials; (b) contact the media; (d) organize or participate in a protest; (e) initiate or sign a petition; (f) attend meetings or join a group or organization; (a) contact the electric company; and (g) express opinions to family and friends or through social media. For opposition responses to nest removal breeding, the single component explained 66% of the variance and consisted of 6 of the 8 responses, in order of loadings (high–low): (b) contact the media; (d) organize or participate in a protest; (f) attend meetings or join a group or organization; (c) contact officials; (e) initiate or sign a petition; and (g) express opinions to family and friends or through social media. All Cronbach's alpha values were ≥0.800.

The PCA of beliefs and concerns about managing monk parakeets (dependent variable) when responding to 2 behaviors (excessive noise and power outage) resulted in 2 components with item loadings ≥0.6 (Appendix H, Table 5.8). For excessive noise, the first component explained 58% of the variance and placed greater emphasis on 5 of the 8 responses, in order of loadings (high–low): (d) organize or participate in a protest; (b) contact the media; (e) initiate or sign a petition; (f) attend meetings or join a group or organization; and (g) express opinions to family and friends or through social media.

The second component explained 13% of the variance and consisted of 3 of the 8 responses, in order of loadings (high–low): (h) take no action; (a) contact the electric company; and (c) contact officials. For power outage, the first component explained 55% of the variance and was characterized by high loadings associated with 5 of the 8 responses, in order of loadings (high–low): (d) organize or participate in a protest; (f) attend meetings or join a group or organization; (e) initiate or sign a petition; (c) contact officials; and (b) contact the media. The second component explained 16% of the variance and consisted of 2 of the 8 responses, in order of loadings (high–low): (h) take no action and (g) express opinions to family and friends or through social media. Cronbach's alpha values were 0.882 for both sets of items.

The PCA for the remaining 4 statements regarding beliefs and concerns (dependent variable) about 4 methods (lethal control, reproductive control, nest removal breeding, and nest removal nonbreeding) for managing monk parakeet nests on electric utility structures produced a single component containing all 8 original items per management statement (Appendix H, Table 5.9). The single factors explained 69–74% of the variance in the items in question and the loadings of those items were ≥0.6. For opposition responses to lethal control, the single component included, in order of loadings (high–low): (c) contact officials; (h) take no action; (d) organize or participate in a protest; (e) initiate or sign a petition; (f) attend meetings or join a group or organization; (b) contact the media; (g) express opinions to family and friends or through social media; and (a) contact the electric company. For opposition responses to reproductive control, the single component included, in order of loadings (high–low):

(b) contact the media; (c) contact officials; (d) organize or participate in a protest; (e) initiate or sign a petition; (f) attend meetings or join a group or organization; (g) express opinions to family and friends or through social media; (h) take no action; and (a) contact the electric company. For opposition responses to nest removal breeding, the single component included, in order of loadings (high–low): (d) organize or participate in a protest; (e) initiate or sign a petition; (f) attend meetings or join a group or organization; (b) contact the media; (c) contact officials; (a) contact the electric company; (g) express opinions to family and friends or through social media; and (h) take no action. For opposition responses to nest removal nonbreeding, the single component included, in order of loadings (high–low): (f) attend meetings or join a group or organization; (d) organize or participate in a protest; (c) contact officials; (b) contact the media; (e) initiate or sign a petition; (g) express opinions to family and friends or through social media; (a) contact the electric company; and (h) take no action. Cronbach's alpha values were >0.900 for all 4 sets of items.

Linear Regression Modeling

We examined a full model of 24 independent variables to predict each of the 8 dependent variables for participants' actions and responses to 2 monk parakeet behaviors and 4 management methods of monk parakeet nests on electric utility structures. We found the model was significant for 7 of the 8 dependent variables (Appendix H, Table 5.10) and 6 of the 7 significant models contained ≥1 significant variable. When we computed differences in R^2 values between the statistically significant full models and their reduced models, the full models appeared best for predicting participants' opposition response behavior (Appendix H, Table 5.11).

Participants responding in opposition to monk parakeets making too much noise (component 1: organize or participate in a protest; contact the media; initiate or sign a petition; attend meetings or join a group or organization; or express opinions to family and friends or through social media) were significantly influenced (F = 4.10, P = 0.001; Appendix H, Table 5.10) by 19 of the 24 independent variables (Appendix H, Table 5.12, full model [Appendix H, Table 5.13, reduced model]). The model included all 4 components of knowledge about and experience with monk parakeets, the component for concerns about monk parakeet nesting behavior, 4 of the 7 components of influence and expectations of others, 7 of the 9 components of perceived ease of response and action, and the demographic variables gender, age, and education. Four of the model variables were significant: (1) influence and expectation of others, monk parakeets making too much noise component 2 (P = 0.033, β = 0.333); (2) ease of response and action, monk parakeets making too much noise component 2 (P = 0.032, β = –0.663); (3) ease of response and action, monk parakeet nest causing a power outage component 1 (P = 0.049, β = 0.569); (4) ease of response and action, monk parakeet nest causing a power outage component 2 (P = 0.011, β = 0.573).

Participants responding to monk parakeets making too much noise (component 2: take no action; contact the electric company; and contact officials) were significantly influenced (F = 3.05, P = 0.007; Appendix H, Table 5.10) by 19 of the 24 independent variables (Appendix H, Table 5.14, full model [Appendix H, Table 5.15, reduced model]). The model included all 4 components of knowledge about and experience with monk parakeets, the component for concerns about monk parakeet nesting behavior, 4 of the 7 components of influence and expectations of others, 7 of the 9 components of perceived ease of response and action, and the demographic variables gender, age, and education. Two of the model variables were significant: (1) influence and expectations of others, monk parakeets making too much noise component 2 (P = 0.043, β = 0.353); and (2) participant age (P = 0.033, β = 0.291).

Participants responding to a power outage caused by a monk parakeet nest (component 1: organize or participate in a protest; attend meetings or join a group or organization; initiate or sign a petition; contact officials; and contact the media) were significantly influenced (F = 3.19, P = 0.007; Appendix H, Table 5.10) by 18 of the 24 independent variables (Appendix H, Table 5.16, full model [Appendix H, Table 5.17, reduced model]). The model included all 4 components of knowledge about and experience with monk parakeets, the component for concerns about monk parakeet nesting behavior, 4 of the 7 components of influence and expectations of others, 6 of the 9 components of perceived ease of response and action, and the demographic variables gender, age, and education. Three of the model variables were significant: (1) component 4 of knowledge about and experience with monk parakeets (P = 0.035, β = –0.357); (2) influence and expectation of others, component 1 for monk parakeets making too much noise (P = 0.005, β = 0.442); and (3) participant age (P = 0.014, β = 0.306).

Participants responding to a power outage caused by a monk parakeet nest (component 2: organize or participate in a protest; attend meetings or join a group or organization; initiate or sign a petition; contact officials; and contact the media) appeared not influenced by the 24 independent variables. The model was not statistically significant (F = 1.30, P = 0.283; Appendix H, Table 5.10) and there were no significant variables (Appendix H, Table 5.18, full model [Appendix H, Table 5.19, reduced model]).

Participants responding to wildlife managers capturing and euthanizing (lethal control) monk parakeets were significantly influenced (F = 7.24, P = <0.0001; Appendix H, Table 5.10) by 19 of the 24 independent variables (Appendix H, Table 5.20, full model [Appendix H, Table 5.21, reduced model]). The model included all 4 components of knowledge about and experience with monk parakeets, the component for concerns about monk parakeet nesting behavior, 4 of the 7 components of influence and expectations of others, 7 of the 9 components of perceived ease of response and action, and the demographic variables gender, age, and education. Three of the model variables were significant: (1) component 1 of knowledge about and experience with monk parakeets (P = 0.002, β = 0.397); (2) influence and expectations of others, if wildlife managers capture and euthanize monk parakeets (P = 0.027, β = 0.435); and (3) ease of response and action, if wildlife managers capture and euthanize monk parakeets (P = 0.005, β = 0.397).

Participants responding to wildlife managers providing treated seed to prevent monk parakeets from reproducing (reproductive control) were significantly influenced

(F = 2.74, P = 0.015; Appendix H, Table 5.10) by 19 of the 24 independent variables (Appendix H, Table 5.22, full model [Appendix H, Table 5.23, reduced model]). The model included all 4 components of knowledge about and experience with monk parakeets, the component for concerns about monk parakeet nesting behavior, 4 of the 7 components of influence and expectations of others, 7 of the 9 components of perceived ease of response and action, and the demographic variables gender, age, and education; however, there were no significant variables in the model. However, there were no statistically significant variables predicting participants' opposition responses to wildlife managers using reproductive control as a monk parakeet management method.

Participants responding to wildlife managers removing monk parakeet nests during breeding season, transferring any eggs and nestlings to a wildlife rehabilitation center, and modifying the electric utility structure to prevent future nesting (nest removal breeding) were significantly influenced (F = 6.88, P = <0.0001; Appendix H, Table 5.10) by 19 of the 24 independent variables (Appendix H, Table 5.24, full model [Appendix H, Table 5.25, reduced model]). The model included all 4 components of knowledge about and experience with monk parakeets, the component for concerns about monk parakeet nesting behavior, 4 of the 7 components of influence and expectations of others, 7 of the 9 components of perceived ease of response and action, and the demographic variables gender, age, and education. The only significant variable was influence and expectations of others, if wildlife managers remove nests during breeding season (P = 0.002, β = 0.397).

Participants responding to wildlife managers removing monk parakeet nests during nonbreeding season and modifying the electric utility structure to prevent future nesting (nest removal nonbreeding) were significantly influenced by (F = 6.88, P = <0.0001; Appendix H, Table 5.10) 19 of the 24 independent variables (Appendix H, Table 5.26, full model [Appendix H, Table 5.27, reduced model]). The model included all 4 components of knowledge about and experience with monk parakeets, the component for concerns about monk parakeet nesting behavior, 4 of the 7 components of influence and expectations of others, 7 of the 9 components of perceived ease of response and action, and the demographic variables gender, age, and education. Three of the model variables were significant variables included: (1) influence and expectation of others, if wildlife managers remove nests during breeding season, transferring any eggs and nestlings to a wildlife center, and modify the electric utility structure to prevent future nesting (P = 0.001, β = 0.529); (2) ease of response and action, if a monk parakeet nest causes a power outage component 1 (P = 0.042, β = –0.468); and (3) ease of response and action, if wildlife managers remove nests during nonbreeding season and modify the electric utility structure to prevent future nesting component 2 (P = 0.023, β = 0.273).

DISCUSSION

Response Rate

We were disappointed with the low response rate to our multi-mode survey. We were surprised there was a greater response with the mail survey than the telephone survey, as we expected the opposite (Lepkowski et al. 2008). Initially, we thought our telephone survey response rate was low because our call period was during the 2012 US presidential election and the following fall and early winter holiday season. However, we extended our telephone survey call period through February 2013 and offered a mail survey option, yet we experienced little increase in response rate. We suspect the low response rate resulted for various reasons, including participants' language barrier, lack of time, or lack of interest. There is evidence, however, that response rates are declining across all survey modes (Hox and Leeuw 1994, Hartge 1999, Steeh et al. 2001). To increase response rate of future surveys, we suggest offering a Spanish version and reducing the length.

Sociodemographics

We expect the response rate from Dallas County was proportionally greater than for Tarrant County because there were more monk parakeet colonies nesting on electric utility structures in Dallas County (Figure 5.2). As anticipated, more residences than businesses participated in our survey. The majority of businesses we spoke with declined to participate, because they either did not have time or required permission from their corporate office. To increase response rate of businesses, we suggest reducing the length of the survey and contacting corporate offices asking permission for their local branch to participate.

As expected, most survey participants were affluent, well-educated, middle-aged or older white-Caucasians. We were surprised males and females participated almost equally in our survey. Furthermore, we were surprised so few were current members of a conservation group or NGO or had not signed a petition or protested in favor or opposition to a conservation issue. To increase demographic diversity participation in future surveys, we recommend offering the survey in other languages, specifically Spanish, and offering an incentive to participate, such as a monetary incentive.

Knowledge about and Experience with Monk Parakeets

Our results imply that most survey participants were unknowledgeable about monk parakeet biology, specifically the species being non-migratory and non-native to Texas, and using their nests year-round for both breeding and roosting. Our results also suggest most participants were unsure about the potential or realized impacts of monk parakeets. Even though we targeted potential survey participants living adjacent to monk parakeet colonies nesting on electric utility structures, most participants could not see a monk parakeet nest near their home. Only 2 participants reported experiencing a power outage they knew was caused by a monk parakeet nest. Furthermore, the majority of our survey participants were unaware monk parakeet nests on electric utility structures have caused fires and power outages. Although almost half stated they would be willing to go ≤4 hours without electric power caused by a monk parakeet nest, most indicated they would be upset to do so.

Even though almost half of our survey participants believed monk parakeets contribute to the quality of urban life, over half agreed they are noisy and did not want them feeding at their bird feeders or nesting in their yard. This knowledge eliminates an alternative management strategy we did not measure directly: constructing specially designed monk parakeet nesting platforms in the yards of residents who oppose management of monk parakeet nests on nearby electric utility structures. This information supports previous accounts of residents declining offers from Oncor to build monk parakeet nesting platforms in residents' yards (D. Boyle, Oncor Electric Delivery, personal communication).

Preferences for Management Strategies

The results of our survey imply that participants were less likely to act in opposition to monk parakeet behavior, i.e., excessive noise and power outages, and more likely to act in opposition to management of monk parakeets nesting on electric utility structures, i.e., population control and nest removal. If participants were to act in opposition to monk parakeet behavior, they were most likely to express opinions to family and friends or through social media and contact the electric company. Of the 4 management methods we surveyed, participants were more likely to oppose population control methods, i.e., lethal or reproductive control. The top 2 opposition responses were to (1) initiate or sign a petition and (2) express opinions to family and friends or through social media. The few participants who opposed nest removal and electric utility structure modification indicated they were most likely to express opinions to family and friends or through social media.

Despite few survey participants affirming they had signed a petition supporting or opposing conservation issues in the past, our survey results imply initiating or signing a petition would be their primary opposition response. Signing a petition is a form of protest behavior (Valenzuela 2013). Macintosh (2004) defined a petition as "a formal request to a higher authority signed by one or a number of citizens." Petitions present an issue and state an associated request for resolution on a local, regional, national, or international level (Briassoulis 2010). Organizations and individuals initiating and signing a petition to gain support on issues has become more prevalent through various online e-petition websites (Briassoulis 2010,2011), such as petitiononline.com, thepetitionsite.com, ipetitions.com, and change.org. This online petition format is a quick, easy, low-cost tool (Panagiotopoulos et al. 2011) with the capability to acquire a large number of signatures, often representing a wide range of ages, genders, nationalities, educations, incomes, professions, occupations, cultures, and special interest groups (Briassoulis 2010), as well as a wide geographic extent.

The second most common opposition response indicated by our survey was participants expressing their opinions to family and friends or through social media. Valenzuela (2013) found a positive relationship between frequency of social media use and protest behavior, such as demonstrations and petitions. Social media offers access to a large number of contacts and common interest groups (Lovejoy and Saxton 2012), thereby enabling individuals and groups to obtain information, express opinions, and engage in activism more readily on a broad scale (Valenzuela 2013).

Predictors of Participants' Beliefs and Attitudes

Participants in our survey appeared more likely to act in opposition to monk parakeet excessive noise when influenced by people or groups who are important to them. They appeared less likely to respond in opposition when considering the ease of responding to the excessive noise and more likely to respond in opposition when considering the ease of responding to a monk parakeet nest causing a power outage. Survey participants ≥45 years old appeared more likely to respond in opposition to monk parakeets making too much noise.

Participants appeared less likely to act in opposition to a power outage caused by a monk parakeet nest if they had seen a wild monk parakeet in Dallas or Tarrant counties and if they believed that monk parakeets contribute to the quality of urban life. They appeared more likely to act in opposition to a power outage caused by a monk parakeet nest when influenced by people or groups who are important to them. Survey participants ≥45 years old appeared more likely to respond in opposition to a monk parakeet nest causing a power outage.

Participants appeared more likely to act in opposition to wildlife managers capturing and euthanizing (lethal control) monk parakeets if the participants wanted monk parakeets to feed at their bird feeders or nest in their yard. Participants also appeared more likely to act when influenced by people or groups who are important to them and based on their perception of how easy it would be to respond and act in opposition.

Participants appeared more likely to act in opposition to wildlife managers removing monk parakeet nests and modifying electric utility structures to prevent future nesting both during breeding (nest removal breeding) and nonbreeding (nest removal nonbreeding) seasons when the participants were influenced by people or groups who are important to them. Participants appeared less likely to act in opposition to wildlife managers removing monk parakeet nests during nonbreeding season and modifying the electric utility structure to prevent future nesting (nest removal nonbreeding) based on their perception of how easy it would be to respond and act when considering a monk parakeet nest causing a power outage. Participants appeared more likely to act as a result of their perception of how easy it would be to respond and act if wildlife managers removed nests and modified electric utility structures during nonbreeding season.

Our survey results suggest a lack of public knowledge about the biology and impacts, realized and potential, of naturalized monk parakeets. We suggest electric utility companies develop and employ an outreach effort to educate the public about monk parakeet basic biology and the economic impacts of their nesting habits on electric utility structures. These efforts might be best implemented in areas adjacent to electric utility structures with monk parakeet nests, especially those in affluent areas, as well as targeting the predictors driving participants' behaviors. When managing monk parakeets nesting on electric utility structures, our survey results suggest nest removal and modifying the structures to prevent future nesting any time of the year will provoke the least public opposition.

MANAGEMENT IMPLICATIONS

Effective strategies to manage monk parakeets nesting on electric utility structures need to address the social and psychological factors that determine public response. Any management method chosen requires public cooperation (Trimm 1973). Since some survey participants seemed to enjoy the presence of monk parakeets in the urban environment, the public holds the potential to short-circuit attempts to manage and prevent monk parakeets from nesting on electric utility structures. Although we identified a management strategy that appears to evoke minimal public opposition, we suggest interpreting our results with caution due to limitations of our research. First, our small sample size resulted in low statistical power. Second, there may be influences other than those we tested. Lastly, there are other management methods we did not include in our survey due to length restrictions. We limited ours to the 4 methods, ranging from one extreme (lethal control) to another (non-lethal, least invasive), based on what we believed plausible for the urban environment.

CHAPTER VI

SUMMARY

Monk parakeets (*Myiopsitta monachus*) were imported into the United States (US) during the legal pet bird trade from the 1960s until 1992. Due to incidental and intentional releases, monk parakeets established naturalized populations in several states. Monk parakeets often build their bulky twig nests on electric utility structures, which can cause economic damage. To identify a non-lethal management solution to this problem, we examined the spatial ecology of and public attitudes toward monk parakeets nesting on electric utility structures in the urban environment of Dallas and Tarrant counties, Texas, US. We conducted our research from May 2010–February 2013.

HABITAT USE AND BEHAVIORS

From August 2011–May 2012, we used radiotelemetry to assess the diurnal activity patterns, flock-size variation, flock composition, movements, and urban land use-land cover (LULC) classification selection of naturalized monk parakeets. We tracked 20 (11 F, 9 M) radio-tagged monk parakeets at 3 electric stations (1 switchyard and 2 substations) in Dallas County and recorded 1,059 locations (summer, n = 166; autumn, n = 350; winter, n = 399; and spring n = 144). Most of the locations were ≥8 m from the nests (61%, n = 646) compared to at the nests (39%, n = 413), differing from previous studies reporting monk parakeets spend most of their time at or near their nests (Bump 1971, Shields et al. 1974, Sol et al. 1977, Bucher et al. 1991). This discrepancy is most likely due to study design, as we were the first to incorporate radio-transmitter technology into monk parakeet research. This allowed us to locate specific individuals repeatedly and record their activities systematically.

We found monk parakeets most frequently foraging (37%, *CI* = 0.344–0.402), followed by performing nest maintenance (16%, *CI* = 0.142–0.187) and resting (16%, *CI* = 0.142–0.187). Monk parakeet activities differed among seasons (Kruskal-Wallis χ^2 = 26.4, *df* = 3, *P* <0.001). Foraging was the most common activity during summer (31%, *CI* = 24–38%), autumn (40%, *CI* = 35–45%), and winter (44%, *CI* = 39–49%), and performing nest maintenance most often in spring (33%, *CI* = 25–40%). Flock sizes were highly variable ($\bar{x}$ = 10, *SD* = 8, range = 1–38), similar to other monk parakeet studies (Friedmann 1927, Long 1981, Forshaw 1989, Collar and Juniper 1992, Hyman and Pruett-Jones 1995). Average flock sizes differed significantly (*F* = 12.57, *df* = 3, *P* < 0.001) among seasons, with flock sizes during autumn ($\bar{x}$ = 12, *SD* = 9, range = 1–38, *n* = 104) and winter ($\bar{x}$ = 13, *SD* = 8, range = 2–38, *n* = 88) larger than during summer ($\Delta\bar{x}$ = –4, *SE* = 1, *P* = 0.001; $\bar{x}$ = 8, *SD* = 5, range = 1–30, *n* = 84) and spring ($\Delta\bar{x}$ = –7, *SE* = 1, *P* < 0.001; $\bar{x}$ = 5, *SD* = 2, range = 1–11, *n* = 30). Such seasonal variability in flock sizes also has been reported in other naturalized psittacine studies (Froke 1981, Collins and Kares 1997, Mabb 1997, South and Pruett-Jones 2000).

Away from the nest colonies, monk parakeets congregated in conspecific flocks (66%, *n* = 201) more than heterospecific aggregations (34%, *n* = 105), yet average monk parakeet numbers per flock did not differ (*F* = 1.534, *df* = 1, *P* = 0.216). They associated with 18 avian and 2 mammalian species, most often with great-tailed grackle (*Quiscalus mexicanus*; 24%, *CI* = 17–31%) and European starling (*Sturnus vulgaris*;

24%, *CI* = 17–31%). Our results are similar to previous research finding parrot species sometimes assemble in multispecies aggregations (Westcott and Cockburn 1988, Chapman et al. 1989, Forsaw 1989). Naturalized monk parakeets may assemble in larger flocks and with other avian species to improve foraging success (Moynihan 1962, Murton 1971, Krebs et al. 1972, Ward and Zahavi 1973, Westcott and Cockburn 1988)) or to reduce predation risk (Lazarus 1972, Powell 1974, Curio 1976, Bertram 1978, Popp 1988), or both.

Distances traveled from their nest colonies did not differ significantly ($F = 1.280$, $df = 1$, $P = 0.259$) between monk parakeet sexes: males ($\bar{x} = 380$ m, $SD = 403$ m, range = 8–1,512 m, $n = 126$) and females ($\bar{x} = 330$ m, $SD = 369$ m, range = 10–1,602 m, $n = 180$). Distances traveled also did not differ significantly $F = 0.195$, $df = 1$, $P = 0.659$) between age classes: adults ($\bar{x} = 336$ m, $SD = 333$ m, range = 19–1,372 m, $n = 95$) and juveniles ($\bar{x} = 357$ m, $SD = 405$ m, range = 8–1,602 m, $n = 211$). Overall, monk parakeet locations averaged 351 m ($SD = 384$ m, range = 8–1,602 m, $n = 306$) from their nest colonies. From their nest colonies, we located our radio-tagged monk parakeets within the ≤2 km dispersal distances previously reported by Bucher et al. (1990) and Martín and Bucher (1993). Average distances from the nest colonies differed significantly ($F = 9.309$, $df = 3$, $P < 0.001$) among seasons, with average winter distances farthest ($\bar{x} = 526$ m, $SD = 502$ m, range = 8–1,434 m, $n = 88$) and spring distances shortest ($\bar{x} = 278$ m, $SD = 299$ m, range = 24–1,021 m, $n = 30$). Furthermore, monk parakeet locations were farther from their nest colonies during nonbreeding season ($\bar{x} = 396$ m, $SD = 438$ m, range = 8–1,602 m, $n = 88$) than during breeding season ($\bar{x} = 274$ m, $SD = 254$ m, range

= 19–1,372 m, n = 88). Monk parakeet movements may have varied in response to spatially and temporally distributed resources (Macdonald 1983, Stamps and Eason 1989, Mitchell and Powell 2004, Anderson et al. 2005, Young and Van Aarde 2010). Other researchers also observed variable movements with other parrot species (Saunders 1980, 1990; Salinas-Melgoza 2003; Ortiz-Maciel et al. 2010).

Monk parakeets did not select urban LULC classifications within their 100% MCP ranges at random (λ = 0.011, P = 0.002). Overall, they used canopy LULC more often than pavement, grass, buildings, or water. At the greatest distances from their nest colonies, monk parakeets used canopy ($\bar{x}$ = 401 m, SD = 383 m, range = 19–1,602 m, n = 194) and residential property ($\bar{x}$ = 552 m, SD = 426 m, range = 31–1,602 m, n = 92) on or near food resources, such as bird feeders, the most. Preference for the less available canopy (trees and shrubs) is not surprising, as monk parakeets utilize trees and shrubs for nest twigs (Roscoe et al. 1973), food resources (Spreyer and Bucher 1998), and perches (J. Reed, unpublished data).

Wildlife managers who wish to control urban monk parakeet populations might do so with habitat manipulation. While our results imply reducing canopy, we suggest this with trepidation, as canopy LULC is most likely an important resource for native urban species. Avian enthusiasts wishing to support urban monk parakeet populations might increase the number of bird feeders and keep them well-stocked from late autumn to early spring.

FORAGING BEHAVIORS

From the locational data we examined monk parakeet foraging behavior, extracting 375 foraging records (summer, n = 52; autumn, n = 124; winter, n = 176; and spring n = 23) for 17 radio-tagged individuals (10 F, 7 M). Monk parakeets exhibited a diverse diet consisting of commercial bird seed, flowers, fruit, acorns, grass blades, wild dry seeds, leaf buds, insect larvae (in galls), and an unknown item amongst coarse aggregate (crushed stone ≤6.4 cm) underneath their nests on the electric utility stations. We observed monk parakeets foraging on a broad range of local, native vegetation. They utilized 31 genera of plants (22 native, 2 cultivated, and 7 non-native taxa) from 20 families, plus 1 unidentified herbaceous plant and 1 unidentified turf grass. The beech family (Fagaceae) was the most utilized plant family (31%, SD = 2%, CI = 31–32%, n = 103), with southern live oak (*Q. virginiana*) the most utilized (77%, SD = 2%, CI = 77–77%, n = 79) beech member for flowers (catkins), parasitic wasp larvae in galls, and acorns. The grass family (Poaceae) was the second most utilized plant family (21%, SD = 1%, CI = 20–21%, n = 68). Monk parakeet diet variability in Dallas County was comparable to that reported for monk parakeets in South America (Bucher et al. 1991, Spreyer and Bucher 1998) and other North American populations (Bull 1973, Davis 1974, Neidermyer and Hickey 1977, Hyman and Pruett-Jones 1995, South and Pruett-Jones 2000).

Monk parakeet diet varied among seasons ($\chi^2 = 23.8$, $df = 3$, $P \leq 0.001$), and winter diet contained all 9 food categories. Seasonal diet variability was likely in response to the availability of different food resources throughout the year (Cannon 1981).

Monk parakeets foraged primarily in the canopy (57%, *CI* = 49–64%) and less often on the ground (25%, *CI* = 19–32%), at our bait stations (10%, *CI* = 5–14%), or at residential bird feeders (9%, *CI* = 4–13%). This is surprising, since previous research reported monk parakeets foraging both in the canopy and on the ground (Forshaw 1989, Bucher et al. 1991, Hyman and Pruett-Jones 1995, South and Pruett-Jones 2000), but how much either way was unknown. Monk parakeets may prefer to forage in the canopy where they are less vulnerable to predators. However, ground foraging may be under-represented in our study because we had difficulty detecting the signals of radio-tagged individuals when they were on the ground.

Monk parakeet foraging flock size was highly variable (range = 1–38) and averaged 12 birds (*SD* = 8, *CI* = 10–13, *n* = 175). Flock size variability also has been reported in Argentina (Friedmann 1927, Long 1981) and Chicago, Illinois (Hyman and Pruett-Jones 1995, South and Pruett-Jones 2000). As found in Chicago, monk parakeet foraging flock size differed significantly among months (χ^2 = 21.8, *df* = 9, *P* = 0.01), with May the smallest ($\bar{x}$ = 5, *SD* = 1, *CI* = 4–6) and October the largest ($\bar{x}$ = 17, *SD* = 11, *CI* = 12–22).

We observed monk parakeets foraging in conspecific flocks more often (62%, *CI* = 54–69%, *n* = 108) than in heterospecific flocks (38%, *CI* = 31–45%, *n* = 67). We observed them foraging with 15 avian and 2 mammalian species, most often with great-tailed grackle (27%, *CI* = 20–34%, *n* = 30), European starling (17%, *CI* = 11–23%, *n* =

19), and mourning dove (*Zenaida macroura*; 13%, *CI* = 7–18%, *n* = 14), with no apparent aggressive interaction. Reports of monk parakeet behavior towards other avian species have been mixed, with some reporting aggressive behavior (Trimm 1972, Freeland 1973, Davis 1974) and others reporting sociability (Gilbert 1984, Walsten 1985). Monk parakeets in Dallas County may use other species as indicators for some food sources, as we observed other species feeding at our bait stations before monk parakeets. There was a significant relationship ($\chi^2 = 8.5$, $df = 3$, $P = 0.036$) between monk parakeets foraging in conspecific flocks and heterospecific aggregations among seasons. They foraged in heterospecific aggregations 58% (*CI* = 41–75%) of the time during summer compared to 40% (*CI* = 28–52%) of the time during autumn, 31% (*CI* = 20–43%) of the time during winter, and 22% (*CI* = 3–41%) of the time during spring.

Monk parakeet foraging distance was significantly farther ($F = 5.324$, $df = 3$, $P = 0.002$) during winter ($\bar{x} = 531$ m, *SD* = 497 m, range = 0–1,434 m) than summer ($\bar{x} = 302$ m, *SD* = 240 m, range = 19–818 m), autumn ($\bar{x} = 279$ m, *SD* = 289 m, range = 19–1,602 m), or spring ($\bar{x} = 384$ m, *SD* = 345 m, range = 0–1,021 m). Comparable to Minor et al. (2012), we agree stocked residential bird feeders may assist nominally with monk parakeet winter survival in Dallas County, yet we suspect their populations will persist there with or without them. Given their broad diet, it appears food is not a limiting factor for monk parakeets in southern urban environments. This provides further evidence that naturalized monk parakeets adapt to local, native food sources and adjust to seasonal food availability. Additionally, urban monk parakeets sometimes foraged with native avian species. For these reasons, food-based management strategies may not be viable for controlling monk parakeet populations in urban areas.

NEST-SITE SELECTION

We investigated which features and spatial scales influenced monk parakeet selection of electric stations as nest sites. Examining 28 pairs of electric stations (with and without nests), we found monk parakeets selected electric stations with multiple flat surfaces and acute-angled construction (with a nest $\bar{x}$ = 82%, without a nest $\bar{x}$ = 25%) within small fenced enclosure areas (with a nest $\bar{x}$ = 2,964 m^2, without a nest $\bar{x}$ = 15,945 m^2) and surrounded by large canopy trees (dbh >30 cm; with nest $\bar{x}$ = 3.4, without nest $\bar{x}$ = 3.0) and taller anthropogenic structures (with a nest $\bar{x}$ = 90%, without a nest $\bar{x}$ = 80%) within 100 m. The multi-dimensional surfaces with their small spaces provide perfect insertion points for securing the first nest twigs (Harrison 1973) and improved stability of nests (Avery et al. 2006, Newman et al. 2008) may be explanations for monk parakeets nesting on electric utility structures. The presence of taller structures within 100 m of these preferred electric stations may mimic the nest-site selection of monk parakeets in their native range, where they nest in open areas with a cluster of a few large trees (Burger and Gochfeld 2005). Further analysis of urban LULC classifications (pavement, building, canopy, grass, and water) on 3 scales (100 m, 625 m, and 1,250 m) suggested the surrounding landscape had little impact on monk parakeet nest-site selection.

We recommend electric utility managers who want to prevent monk parakeets from nesting on their structures conduct a cost-benefit analysis exploring the feasibility of retrofitting or replacing vulnerable construction style elements preferred by monk parakeets. Electric utility managers also should consider redesigning future electric station support tower construction to reduce risk of monk parakeets nesting on new structures.

PUBLIC ATTITUDES REGARDING NEST MANAGEMENT

Management of monk parakeet nests often provokes strong public opposition. We employed a sociological survey using the theory of planned behavior (TPB) to evaluate 8 sociodemographic and 4 sociopsychological variables as predictors of opposition responses to methods (lethal control, reproductive control, and nest removal) for managing monk parakeets nesting on electric utility structures.

Of 402 surveys (250 mail, 152 telephone) attempted, 43 were completed (11% response rate). Most survey participants were white-Caucasian (84%, n = 36), ≥45 years old (79%, n = 34), living in residential homes (72%, n = 31) with property values >$100,000 (66%, n = 28), and had some or more tertiary education (95%, n = 41). Few participants were involved with conservation groups (9%, n = 4) or issues (23%, n = 10). Most participants were unknowledgeable about (≤67%), inexperienced with (≤96%), and unsure about the potential or known impacts (≤74%) of monk parakeets.

Participants were more likely to respond in opposition to monk parakeet management methods (≤41%) than to undesirable monk parakeet behavior (excessive noise and power outages; ≤23%). As expected, participants showed the least opposition for nest removal and electric utility structure modification. Participants who indicated they might take action in opposition to management methods indicated they were most likely to (1) express opinions to family and friends or through social media and (2) initiate or sign a petition. Participants who would respond in opposition to monk parakeet behavior appeared significantly influenced by: (1) people and groups who were important to them, (2) their perceived ease of responding and acting, (3) their age, and (4) their experience with naturalized monk parakeets. Participants who would respond in opposition to management of monk parakeets nesting on electric utility structures appeared significantly influenced by (1) their desire for monk parakeets to feed at their bird feeders or nest in their yard, (2) people and groups who were important to them, and (3) their perceived ease of responding and acting.

We suggest electric utility and wildlife managers develop an outreach program for educating the public about monk parakeet biology and the economic impacts of their nesting habits on electric utility structures. The program should target affluent areas adjacent to electric utility structures with monk parakeet nests, as well as the predictors driving participants' behaviors. To provoke the least public outcry and opposition, we suggest nest removal and structural modification for managing monk parakeets nesting on electric utility structures.

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APPENDIX A

MONK PARAKEETS CAPTURED AND MARKED AT 3 ELECTRIC STATIONS IN DALLAS COUNTY, TEXAS, APRIL–DECEMBER 2011

Bird ID	Sex	Age	Body mass (g)	Radio mass (g)	Captured	Last signal	Status	Last seen
1	M	A	134	4	06-Apr-11	13-Apr-11	Dropped radio	13-Apr-11
2	M	A	125	5	15-May-11	20-Oct-11	Battery expired	08-Dec-11
3	F	A	116	None	04-Jun-11	Not applicable	Escaped	04-Jun-11
4	F	A	120	5	10-Jul-11	04-Oct-11	Battery expired	21-Nov-11
4	*Recaptured*		123	4	10-Dec-11	31-Dec-11	Faulty radio	24-Jan-12
5	M	A	110	5	10-Jul-11	Never found	Predation	04-Aug-11
6	F	J	129	4	10-Jul-11	31-Dec-11	Battery expired	02-Feb-12
7	F	J	107	None	10-Jul-11	Not applicable	Unknown	10-Jul-11
8	M	J	125	None	10-Jul-11	Not applicable	Unknown	10-Jul-11
9	M	A	116	5	23-Jul-11	24-Jul-11	Deceased	24-Jul-11
10	F	J	109	4	23-Jul-11	08-Oct-11	Unknown	08-Oct-11
11	F	A	106	4	23-Jul-11	24-Jul-11	Unknown	24-Jul-11
12	M	J	120	5	02-Aug-11	19-Nov-11	Predation	19-Nov-11
13	M	J	119	4	02-Aug-11	10-Dec-11	Replaced radio	--
13	*Recaptured*		126	4	10-Dec-11	17-May-12	Battery expired	23-May-12
14	F	A	105	5	02-Aug-11	08-Nov-11	Predation	08-Nov-11
15	M	A	125	5	02-Aug-11	10-Dec-11	Replaced radio	--
15	*Recaptured*		143	4	10-Dec-11	28-Apr-12	Battery expired	23-May-12
16	F	J	103	None	02-Aug-11	Not applicable	Unknown	23-May-12
17	F	J	115	5	04-Aug-11	07-Feb-12	Battery expired	07-May-12
18	M	A	98	4	04-Aug-11	11-Aug-11	Predation	09-Aug-11
19	F	A	102	None	04-Aug-11	Not applicable	Unknown	04-Aug-11

Appendix A. Continued

Bird ID	Sex	Age	Body mass (g)	Radio mass (g)	Captured	Last signal	Status	Last seen
20	F	J	101	5	24-Sep-11	10-Mar-12	Battery expired	07-May-12
21	M	A	116	5	24-Sep-11	10-Nov-11	Battery expired	07-May-12
22	F	A	105	None	24-Sep-11	Not applicable	Unknown	24-Sep-11
23	F	A	110	5	20-Oct-11	20-Oct-11	Faulty radio	20-Oct-11
23	*Recaptured*		116	4	10-Dec-11	14-Jan-12	Dropped radio	08-Mar-12
24	F	A	114	5	20-Oct-11	08-Mar-12	Battery expired	13-Mar-12
25	M	A	114	None	20-Oct-11	Not applicable	Unknown	20-Oct-11
26	M	A	117	4	18-Nov-11	21-Nov-11	Faulty radio	29-Apr-12
27	F	A	117	4	10-Dec-11	15-Mar-12	Battery expired	16-Apr-12
28	M	A	129	3	10-Dec-11	10 Dec 2011	Dropped radio	28-Apr-12
29	M	A	131	3	10-Dec-11	23-May-12	Battery expired	23-May-12
30	F	A	107	3	10-Dec-11	10-Dec-11	Faulty radio	15-May-12
31	F	A	126	4	10-Dec-11	10-Dec-11	Faulty radio	31-Mar-12
32	M	A	119	4	10-Dec-11	28-Apr-12	Battery expired	15-May-12

APPENDIX B

HABITAT-USE LOCATIONS BY SEASON FOR 20 RADIO-TAGGED MONK PARAKEETS IN DALLAS COUNTY, TEXAS, USA, AUGUST 2011–MAY 2012.

				Number of locations								
				Summer 2011		Autumn 2011		Winter 2011–12		Spring 2012		
Bird	Sex	Days tracked (*SD*)	Transmitter battery life (days)	Locations	At nest (%)	Locations	At nest (%)	Locations	At nest (%)	Locations	At nest (%)	Total
2	M	68	158	19	36.8	22	54.5	0	0.0	0	0.0	41
4	F	41	93	16	43.8	16	43.8	9	66.7	0	0.0	41
6	F	75	174	16	20.0	35	42.9	7	100.0	0	0.0	57
10	F	33	77	20	5.0	8[a]	12.5	0	0.0	0	0.0	28
12	M	43	109	18	16.7	23	56.5	0	0.0	0	0.0	41
13	M	56[b], 68[c]	130[b], 159[c]	20	15.0	38	34.2	35	31.4	23	52.2	116
14	F	38	98	18	11.1	20	55.0	0	0.0	0	0.0	38
15	M	56[a], 60[b]	130[b], 140[c]	20	25.0	38	39.5	36	33.3	21	42.9	115
17	F	79	185	20	5.0	36	16.7	32	37.5	11	100.0	99
20	F	72	168	0	0.0	37	21.6	34	29.4	9	100.0	80
21	M	29	67	0	0.0	23	30.4	22	45.5	10	100.0	55
23	F	23	35	0	0.0	8	50.0	14	28.6	1	100.0	23
24	F	59	138	0	0.0	23	91.3	33	45.5	1	100.0	57
26	M	14	0[d]	0	0.0	6	0.0	6	50.0	2	50.0	14
27	F	67	157	0	0.0	4	25.0	36	27.8	9	33.3	49
28	M	14	0[d]	0	0.0	1	100.0	12	58.3	1	100.0	14
29	M	71	165	0	0.0	4	25.0	37	24.3	23	52.2	64
30	F	35	0[d]	0	0.0	3	33.3	25	40.0	7	42.9	35
31	F	31	0[d]	0	0.0	1	0.0	25	36.0	5	100.0	31
32	M	60	140	0	0.0	4	25.0	36	30.6	21	66.7	61
Total				166		350		399		144		1,059

[a]Grayed-out data were not used in seasonal movement analyses.

[b]First radio-transmitter collar

[c]Second radio-transmitter collar

[d]Faulty radio-transmitter collar

APPENDIX C

FORAGING LOCATIONS BY SEASON FOR 17 RADIO-TAGGED MONK PARAKEETS IN DALLAS COUNTY, TEXAS, USA, AUGUST 2011–MAY 2012.

		Number of telemetry locations				
Bird	Sex	Summer 2011	Autumn 2011	Winter 2011–12	Spring 2012	Total
2	M	5	5	0	0	10
4	F	4	6	0	0	10
6	F	3	10	0	0	13
10	F	9	0	0	0	9
12	M	5	6	0	0	11
13	M	4	17	16	5	42
14	F	8	5	0	0	13
15	M	5	16	17	5	43
17	F	9	25	18	0	52
20	F	0	21	22	0	43
21	M	0	11	9	0	20
24	F	0	2	11	0	13
27	F	0	0	20	0	20
29	M	0	0	20	9	29
30	F	0	0	13	0	13
31	F	0	0	13	0	13
32	M	0	0	17	4	21
Total		52	124	176	23	375

APPENDIX D

SUBSTRATE TYPES FOR MONK PARAKEET NEST COLONIES (*N* = 50) IN DALLAS AND TARRANT COUNTIES, TEXAS, MAY 2010–AUGUST 2012.

Substrate	Dallas County	Tarrant County	Total
Transmission structures	8	0	8
Electric stations (switchyards and substations)	25	3	28
Distribution poles	30	25	55
Cell phone towers	9	2	11
Athletic field lights	11	0	11
Light poles	1	0	1
Signs	0	1	1
Trees	2	2	4

APPENDIX E

MEANS, STANDARD DEVIATIONS, AND RANGES OF 7 VARIABLES FOR DETERMINING MONK PARAKEET SELECTION OF ELECTRIC STATIONS AS NEST SITES IN DALLAS AND TARRANT COUNTIES, TEXAS, MAY 2010–AUGUST 2012.

Variable	With monk parakeet nest structures			Without monk parakeet nest structures		
	Mean	*SD*	Range	Mean	*SD*	Range
Electric station pairs (n = 28) all construction styles						
Nestable height (m)	13.4	3.0	5.0–24.0	10.6	3.6	4.3–14.7
Fenced enclosure area (m^2)	3,772	4,789	836–23,984	4,581	7,065	628–37,122
Trees (0–4), ≥ 30 dbh within 100 m	3.4	0.8	1–4	3.0	1.1	0–4
Tree distance (m)	45.1	19.6	18.4–85.6	48.1	22.5	0.0–87.9
Tree height (m)	10.4	2.3	7.0–18.8	10.5	3.2	0.0–14.3
Taller nestable anthropogenic structure	0.9	0.3	0–1	0.5	0.5	0–1
Active distance (km)	4.0	2.7	1.5–14.5	2.2	9.5	0.5–4.9
Electric station pairs (n = 23) multiple flat surfaces and acute-angled construction only						
Nestable height (m)	13.6	0.7	13.0–16.4	13.6	0.7	13.1–16.1
Fenced enclosure area (m^2)	2,964	2,865	836–12,795	15,945	16,354	1485–37,122
Trees (0–4), ≥ 30 dbh	3.70	0.56	1–4	2.91	1.12	0–4

Appendix E. Continued

	With monk parakeet nest structures			Without monk parakeet nest structures		
Variable	Mean	*SD*	Range	Mean	*SD*	Range
Tree distance (m)	40.2	17.8	18.4–85.6	45.0	21.8	0.0–69.6
Tree height (m)	10.8	2.3	7.5–18.8	9.8	3.0	0.0–14.3
Taller nestable anthropogenic structure	0.9	0.3	0–1	0.8	0.4	0–1
Active distance (km)	3.2	1.3	1.5–7.7	2.4	1.0	5.0–4.3

Variable notation: nestable height = the height (m) of the actual nest structures or the potential nestable area on each electric station; Fenced enclosure area = area (m^2) of fenced enclosure around each electric station; Trees (0–4) = average number of nearest large canopy trees (diameter at breast height [dbh] >30 cm) in each quadrant within 100 m of electric station; Tree height = average height (m) of nearest large canopy trees (dbh >30 cm) in each quadrant within 100 m of electric station; Tree distance = average distance (m) of nearest large canopy trees (dbh >30 cm) in each quadrant within 100 m of electric station; Taller nestable anthropogenic = absence or presence of a taller nestable anthropogenic structure within 100 m; and Active distance = distance (m) to nearest electric station with active monk parakeet colony.

APPENDIX F

PERCENTAGES, STANDARD DEVIATIONS, AND RANGES OF 5 URBAN LAND USE-LAND COVER (LULC) CLASSIFICATIONS AT 3 SCALES FOR DETERMINING MONK PARAKEET SELECTION OF ELECTRIC STATIONS AS NEST SITES IN DALLAS AND TARRANT COUNTIES, TEXAS, MAY 2010–AUGUST 2012.

Scale	With monk parakeet nest structures			Without monk parakeet nest structures		
LULC	Percentage (%)	SD (%)	Range (%)	Percentage (%)	SD	Range (%)
Electric station pairs (n = 28) all construction						
100 m						
Pavement	32	13	27–37	30	5	25–35
Building	32	13	27–37	33	5	28–38
Canopy	13	13	9–18	10	5	5–15
Grass	22	13	17–27	26	5	21–31
Water	1	13	-4–6	1	5	-4–7
625 m						
Pavement	26	11	22–30	30	2	28–33
Building	30	11	26–34	31	2	28–33
Canopy	20	11	16–24	15	2	13–18
Grass	23	11	19–27	23	2	21–25
Water	2	11	-2–6	1	2	-1–4
1,250 m						
Pavement	24	10	21–28	30	4	24–32

Appendix F. Continued

Scale	With monk parakeet nest structures			Without monk parakeet nest structures		
LULC	Percentage (%)	SD (%)	Range (%)	Percentage (%)	SD	Range (%)
Building	28	10	24–32	28	4	26–34
Canopy	22	10	18–26	17	4	13–22
Grass	23	10	19–27	24	4	19–28
Water	2	10	-2–6	1	4	-3–5
Electric station pairs (n = 23) flat, multi-angled construction						
100 m						
Pavement	31	12	27–36	25	14	19–30
Building	29	12	24–33	34	14	29–40
Canopy	16	12	11–21	11	14	5–17
Grass	23	12	18–28	29	14	24–35
Water	1	12	-4–6	1	14	-5–6
625 m						
Pavement	28	10	23–32	27	5	23–32
Building	27	10	24–32	28	5	24–33
Canopy	21	10	16–25	21	5	16–25
Grass	22	10	17–26	23	5	18–27
Water	2	10	-2–7	1	5	-4–5
1,250 m						
Pavement	26	10	22–31	25	5	20–29
Building	27	10	23–31	30	5	25–35
Canopy	22	10	18–26	21	5	17–26
Grass	22	10	18–26	23	5	19–28

Scale	With monk parakeet nest structures			Without monk parakeet nest structures		
LULC	Percentage (%)	SD (%)	Range (%)	Percentage (%)	SD	Range (%)
Water	2	10	-2–7	1	5	-4–5

APPENDIX G

ATTITUDES REGARDING MANAGEMENT OF MONK PARAKEETS

NESTING ON ELECTRIC UTILITY STRUCTURES

IN DALLAS AND TARRANT COUNTIES, TEXAS, USA

AgriLIFE RESEARCH & EXTENSION
Texas A&M System

TEXAS A&M UNIVERSITY

Attitudes Regarding Management of Monk Parakeets Nesting on Electric Utility Structures

Photo Credit: Janet E. Reed

Dallas and Tarrant Counties Public Survey

Survey Instructions:

Your answer to each question is important for us to have a good understanding of your feelings and views about managing Monk Parakeets nesting on electric utility structures in your area. Please answer each question by checking the appropriate box or circling the appropriate number. More than one answer choice might apply to you, so read all the choices before marking the answer which you believe is <u>most true for you</u>.

Your answers will be kept completely anonymous. Please <u>do not</u> write or sign your name on this survey. If you wish to comment on any question or explain any of your answers, write in the space provided at the end of the survey.

When completed, please place your signed consent form and survey in the enclosed postage-paid envelope and return in the mail. Upon receipt, your signed consent form and completed survey will be separated so that your identity is not linked to your answers. Keep the other consent form copy for your records.

Address any correspondence to:

Monk Parakeet Survey
Dept. of Wildlife & Fisheries Sciences
Texas A&M University
210 Nagle Hall MS 2258
College Station, TX 77843-2258

Thank you for completing the survey!

Working Definitions (refer to this page when answering the questions):

<u>Conservation group and non-governmental organization (NGO)</u> refer to organizations such as Audubon Society, National Wildlife Federation, Nature Conservancy, Sierra Club, World Wildlife Fund, etc.

<u>Economic damage</u> refers to harm, impairment, mutilation, or loss of property, resulting in a loss of property value or the impairment of property usefulness.

<u>Electric utility structures</u> refer to any structure that transmits and delivers electricity, such as transmission towers, switchyards, substations, distribution poles, and transformers, and do not include cellular or other communication towers.

<u>Euthanize</u> refers to the humane, painless killing of an animal.

<u>Monk Parakeet</u> (*Myiopsitta monachus*) also refers to Quaker Parrot or Quaker Parakeet.

<u>Wildlife Manager</u> refers to a person who uses the best available science in attempt to balance the needs of wildlife with the needs of people. Wildlife management includes game keeping, wildlife conservation, and pest control.

2

Attitudes Regarding Management of Monk Parakeets Nesting on Electric Utility Structures

The purpose of this study is to inform scientific researchers, wildlife managers, and electric utility companies about the views of residential and commercial persons regarding the management of Monk Parakeets nesting on electric utility structures.

Section 1 of 7: Involvement with Conservation Organizations and Issues

The following statements measure your involvement with conservation organizations and issues.

Q1. Based on your experience, please indicate if the following statements are True or False for you by checking the appropriate box. Please answer "Do not know" if you are unsure.

a. I am a member of a conservation group or non-government organization (NGO).

☐ True ☐ False ☐ Do not know

b. In the past, I have signed a petition or protested in opposition to a conservation issue.

☐ True ☐ False ☐ Do not know

c. In the past, I have signed a petition or protested in favor of a conservation issue.

☐ True ☐ False ☐ Do not know

Section 2 of 7: Knowledge about and Experience with Monk Parakeets

The following statements measure your knowledge about and experience with Monk Parakeets.

Q2. Based on your knowledge and experience, how strongly do you agree or disagree with the following statements? Circle the most appropriate number for you. Please answer "Do Not Know" if you are unsure.

	Strongly disagree		Do Not Know		Strongly agree
a. Monk Parakeets migrate to Texas.	-2	-1	0	+1	+2
b. Monk Parakeets are native to Texas.	-2	-1	0	+1	+2
c. I have seen a wild Monk parakeet in either Dallas or Tarrant counties.	-2	-1	0	+1	+2
d. Monk Parakeets use their nests all year.	-2	-1	0	+1	+2
e. I can see a Monk parakeet nest from my home.	-2	-1	0	+1	+2
f. I want Monk Parakeets to nest in my yard.	-2	-1	0	+1	+2

	Strongly disagree		Do Not Know		Strongly agree
g. I want Monk Parakeets to feed at my bird feeder.	-2	-1	0	+1	+2
h. Monk Parakeets are noisy.	-2	-1	0	+1	+2
i. Monk Parakeets carry diseases that endanger native species, pets, or human life.	-2	-1	0	+1	+2
j. Monk Parakeets cause environmental or agricultural damage.	-2	-1	0	+1	+2
k. Monk Parakeets cause economic damage.	-2	-1	0	+1	+2
l. Monk Parakeets contribute to the quality of urban life.	-2	-1	0	+1	+2

Section 3 of 7: Concerns about Monk Parakeet Nesting Behavior

The following statements measure the strengths of your beliefs and concerns about Monk Parakeets nesting on electric utility structures.

Q3. How strongly do you agree or disagree with the following statements? Circle the most appropriate number for you. Please answer "Do Not Know" if you are unsure.

	Strongly disagree		Do Not Know		Strongly agree
a. Monk Parakeet nests on electric utility structures cause fires.	-2	-1	0	+1	+2
b. Monk Parakeet nests on electric utility structures cause power outages.	-2	-1	0	+1	+2
c. I have experienced a power outage I know was caused by a Monk Parakeet nest.	-2	-1	0	+1	+2
d. I would be upset to experience a power outage caused by a Monk Parakeet nest.	-2	-1	0	+1	+2
e. I am willing to go without electrical power caused by a Monk Parakeet nest for up to 4 hours.	-2	-1	0	+1	+2

Section 4 of 7: Your Beliefs and Concerns about Managing Monk Parakeets

The following statements measure the strengths of your beliefs and concerns about managing Monk Parakeets nesting on electric utility structures. How strongly do you agree or disagree with the following statements about managing Monk Parakeets nesting on electric utility structures? Circle the most appropriate number for you. Please answer "Do Not Know" if you are unsure.

Q4. If Monk Parakeets nesting near my home make too much noise, I would:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the noise	-2	-1	0	+1	+2
d. Initiate or sign a petition opposing the noise	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the noise	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q5. If a Monk Parakeet nest causes a power outage in my area, I would:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing power outages caused by Monk Parakeet nests	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing power outages caused by Monk Parakeet nests	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing power outages caused by Monk Parakeet nests	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q6. If wildlife managers capture and euthanize Monk Parakeets, I would:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the activity	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the activity	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the activity	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q7. If wildlife managers provide treated seed to prevent Monk Parakeets from producing young, I would:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the activity	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the activity	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the activity	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q8. If wildlife managers remove Monk Parakeet nests, give any eggs and young birds to a wildlife center, and modify the electric utility structure to prevent future nesting, I would:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the activity	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the activity	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the activity	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q9. If wildlife managers remove Monk Parakeet nests that do not have eggs or young birds, and then modify the electric utility structure to prevent future nesting, I would:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the activity	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the activity	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the activity	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Section 5 of 7: Influence and Expectations of Others

The following statements may look similar to earlier statements; however, these measure something different. The next six statements measure the influence and expectations of family, friends, neighbors, or groups who are important to you. How strongly do you agree or disagree with the following statements about the expectations of others about your actions in response to Monk Parakeets and the management of their nests on electric utility structures? Circle the most appropriate number for you. Please answer "Do Not Know" if you are unsure.

Q10. If Monk Parakeets nesting near my home make too much noise, most family, friends, neighbors, or groups who are important to me expect me to:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the noise	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the noise	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the noise	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q11. If a Monk Parakeet nest causes a power outage in my area, most family, friends, neighbors, or groups who are important to me expect me to:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing power outages caused by Monk Parakeet nests	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing power outages caused by Monk Parakeet nests	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing power outages caused by Monk Parakeet nests	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q12. If wildlife managers capture and euthanize Monk Parakeets, most family, friends, neighbors, or groups who are important to me expect me to:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the activity	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the activity	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the activity	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q13. If wildlife managers provide treated seed to prevent Monk Parakeets from producing young, most family, friends, neighbors, or groups who are important to me expect me to:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the activity	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the activity	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the activity	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q14. If wildlife managers remove Monk Parakeet nests, give any eggs and young birds to a wildlife center, and modify the electric utility structure to prevent future nesting, most family, friends, neighbors, or groups who are important to me expect me to:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the activity	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the activity	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the activity	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q15. If wildlife managers remove Monk Parakeet nests that do not have eggs or young birds, and then modify the electric utility structure to prevent future nesting, most family, friends, neighbors, or groups who are important to me expect me to:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the activity	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the activity	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the activity	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Section 6 of 7: Ease of Response and Action

The following statements may look similar to earlier statements; however, these measure something different. The next six statements measure the strengths of your beliefs about how easily you believe that you can respond or take action to Monk Parakeets nesting on electric utility structures and to management strategies of those nests. How strongly do you agree or disagree with the following statements about how easy it will be for you to respond and perform an action? Please circle the most appropriate number for you. Please answer "Do Not Know" if you are unsure.

Q16. If Monk Parakeets nesting near my home make too much noise, it is easy for me to:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the noise	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the noise	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the noise	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q17. If a Monk Parakeet nest causes a power outage in my area, it is easy for me to:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing power outages caused by Monk Parakeet nests	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing power outages caused by Monk Parakeet nests	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing power outages caused by Monk Parakeet nests	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q18. If wildlife managers capture and euthanize Monk Parakeets, it is <u>easy</u> for me to:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the activity	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the activity	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the activity	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q19. If wildlife managers provide treated seed to prevent Monk Parakeets from producing young, it is <u>easy</u> for me to:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the activity	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the activity	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the activity	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q20. If wildlife managers remove Monk Parakeet nests, give any eggs and young birds to a wildlife center, and modify the electric utility structure to prevent future nesting, it is easy for me to:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the activity	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the activity	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the activity	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Q21. If wildlife managers remove Monk Parakeet nests that do not have eggs or young birds, and then modify the electric utility structure to prevent future nesting, it is easy for me to:

	Strongly disagree		Do Not Know		Strongly agree
a. Contact the electric company	-2	-1	0	+1	+2
b. Contact the media (TV, newspapers, etc.)	-2	-1	0	+1	+2
c. Contact officials (police, mayor, city council members, etc.)	-2	-1	0	+1	+2
d. Organize or participate in a protest opposing the activity	-2	-1	0	+1	+2
e. Initiate or sign a petition opposing the activity	-2	-1	0	+1	+2
f. Attend meetings or join a group or organization opposing the activity	-2	-1	0	+1	+2
g. Express my opinions to family, friends, or through social media (Facebook®, Twitter®, YouTube™, etc.)	-2	-1	0	+1	+2
h. Take no action	-2	-1	0	+1	+2

Section 7 of 7: Demographics

Is this a business or residence?

- ☐ Business
- ☐ Residence

Are you male or female?

- ☐ Male
- ☐ Female

Which of the following best describes your age?

- ☐ 18 to 24
- ☐ 25 to 34
- ☐ 35 to 44
- ☐ 45 to 54
- ☐ 55 to 64
- ☐ 65 or older
- ☐ Prefer not to answer

Which of the following most closely identifies your racial or ethnic group?

- ☐ White or Caucasian
- ☐ Black or African American
- ☐ Hispanic or Latino
- ☐ Asian or Pacific Islander
- ☐ American Indian or Alaskan Native
- ☐ Other
- ☐ Prefer not to answer

What is the highest level of education that you achieved?

- ☐ Grade school
- ☐ High school or equivalency
- ☐ Some college or technical school
- ☐ College or technical school graduate
- ☐ Graduate school (MS, PhD) or professional degree (MD, DDS)
- ☐ Prefer not to answer

Thank you for completing our survey! Please place your signed consent form and completed survey in the postage-paid envelope and return in the mail. Keep one consent form copy for your records.

If you have additional comments you would like to make, feel free to note them below.

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APPENDIX H

TABLES FOR CHAPTER V ATTITUDES REGARDING MANAGEMENT OF MONK PARAKEETS NESTING ON ELECTRIC UTILITY STRUCTURES IN DALLAS AND TARRANT COUNTIES, TEXAS, USA

Table 5.1. Statements used for evaluating survey participant knowledge about and experience with monk parakeets and concerns about their nesting behavior on electric utility structures.

Statement[a]	
Knowledge about and experience with monk parakeets	
1	Monk Parakeets migrate to Texas.
2	Monk Parakeets are native to Texas.
3	I have seen a wild Monk Parakeet in either Dallas or Tarrant counties.
4	Monk Parakeets use their nests all year.
5	I can see a Monk Parakeet nest from my home.
6	I want Monk Parakeets to nest in my yard.
7	I want Monk Parakeets to feed at my bird feeder.
8	Monk Parakeets are noisy.
9	Monk Parakeets carry diseases that endanger native species, pets, or human life.
10	Monk Parakeets cause environmental or agricultural damage.
11	Monk Parakeets cause economic damage.
12	Monk Parakeets contribute to the quality of urban life.

Table 5.1. Continued

	Statement[a]
Concerns about monk parakeet nesting behavior	
1	Monk Parakeet nests on electric utility structures cause fires.
2	Monk Parakeet nests on electric utility structures cause power outages.
3	I have experienced a power outage I know was caused by a Monk Parakeet nest.
4	I would be upset to experience a power outage caused by a Monk Parakeet nest.
5	I am willing to go without electrical power caused by a Monk Parakeet nest for up to 4 hours.

[a]Measured on a 5-point scale: Strongly Disagree, Disagree, Do Not Know, Agree, or Strongly Agree

Table 5.2. Categories used for evaluating sociodemographic factors in relation to responses to monk parakeet behavior and management strategies of their nests on electric utility structures.

Sociodemographic factor	Category
Type of structure	Business, Residence
Gender	Female, Male
Age of participant (yr)	18–24, 25–34, 35–44, 45–54, 55–64, ≥65, Prefer not to answer
Racial or ethnic group	American Indian or Alaskan Native, Asian or Pacific Islander, Black or African American, Hispanic or Latino, White or Caucasian, Other, Prefer not to answer
Education of participant	Grade school, High school or equivalency, Some college or technical school, College or technical school graduate, Graduate school (MS, PhD) or professional degree (MD, DDS), Prefer not to answer
Involvement with conservation organizations and issues	True, False, Do not know

Table 5.3. Results of principal components analysis (PCA) of independent variables measured for determining participant response to monk parakeet behavior and nest management methods. Bolded loading values represent statements characterizing a given component.

Predictors	Component 1	Component 2	Component 3	Component 4
Knowledge about and Experience with Monk Parakeets				
I want monk parakeets to nest in my yard.	**0.877**	0.112	-0.164	-0.038
I want monk parakeets to feed at my bird feeder.	**0.790**	-0.079	-0.278	0.194
Monk parakeets use their nests all year.	-0.031	**0.793**	-0.245	0.231
Monk parakeets migrate to Texas.	0.313	**0.733**	0.263	-0.096
Monk parakeets are noisy.	-0.332	**0.601**	0.313	0.054
Monk parakeets are native to Texas.	-0.245	-0.040	**0.849**	0.238
Monk parakeets cause environmental or agricultural damage.	-0.230	0.282	**0.697**	-0.413
I have seen a wild monk parakeet in either Dallas or Tarrant counties.	-0.064	0.296	0.047	**0.828**
Monk parakeets contribute to the quality of urban life.	0.527	-0.162	0.001	**0.676**
Variance explained (%)	30.66	20.66	13.55	10.15
Concerns about Nesting Behavior on Electric Utility Structures				
Monk parakeet nests cause power outages.	**0.795**			
I am willing to go without electrical power caused by a monk parakeet nest for up to 4 hours.	**0.764**			
Monk parakeet nests cause fires.	**0.762**			
I would be upset to experience a power outage caused by a monk parakeet nest.	**0.743**			
I have experienced a power outage I know was caused by monk parakeet nest.	**0.602**			
Variance explained (%)	54.21			

Table 5.4. Results of principal components analysis (PCA) of independent variables measured for determining influence and expectation of others for responding to 2 monk parakeet behaviors. Bolded loading values represent statements characterizing a given component.

Predictors	Component 1	Component 2
If monk parakeets nesting near my home make too much noise, people important to me expect me to:		
Initiate or sign a petition	**0.942**	0.216
Attend meetings or join a group or organization	**0.931**	0.292
Organize or participate in a protest	**0.816**	0.421
Contact officials[a]	0.203	**0.909**
Contact the media[b]	0.215	**0.904**
Express my opinions to family and friends or through social media[c]	0.461	**0.720**
Contact the electric company	0.383	**0.611**
Variance explained (%)	66.01	15.59
If a monk parakeet nest causes a power outage in my area, people important to me expect me to:		
Organize or participate in a protest	**0.883**	
Attend meetings or join a group or organization	**0.877**	
Contact the media[2]	**0.837**	
Contact officials[1]	**0.830**	
Initiate or sign a petition	**0.801**	
Express my opinions to family and friends or through social media[3]	**0.773**	
Variance explained (%)	69.59	

[a]Officials refer to police, mayor, city council members, etc.

[b]Media refers to TV, newspapers, etc.

[c]Social Media refers to Facebook®, Twitter®, YouTube™, etc.

Table 5.5. Results of principal components analysis (PCA) of independent variables measured for determining influence and expectation of others for responding to 4 monk parakeet nest management methods. Bolded loading values represent statements characterizing a given component.

Predictors	Component 1
If wildlife managers capture and euthanize monk parakeets, people important to me expect me to:	
Organize or participate in a protest	**0.951**
Attend meetings or join a group or organization	**0.944**
Initiate or sign a petition	**0.938**
Express my opinions to family and friends or through social media[c]	**0.885**
Contact the media[a]	**0.884**
Contact officials[b]	**0.867**
Contact the electric company	**0.638**
Take no action	**0.592**
Variance explained (%)	71.86
If wildlife managers provide treated seed to prevent monk parakeets from producing young, people important to me expect me to:	
Organize or participate in a protest	**0.961**
Contact officials[b]	**0.944**
Attend meetings or join a group or organization	**0.940**
Contact the media[a]	**0.936**
Initiate or sign a petition	**0.932**
Express my opinions to family and friends or through social media[c]	**0.872**
Contact the electric company	**0.755**
Take no action	**0.577**
Variance explained (%)	76.33

Table 5.5. Continued

Predictors	Component 1
If wildlife managers remove monk parakeet nests during breeding season, give any eggs and young birds to a wildlife center, and modify the electric utility structure to prevent future nesting, people important to me expect me to:	
Organize or participate in a protest	**0.947**
Attend meetings or join a group or organization	**0.943**
Initiate or sign a petition	**0.930**
Contact the media[a]	**0.894**
Contact officials[b]	**0.874**
Express my opinions to family and friends or through social media[c]	**0.833**
Contact the electric company	**0.778**
Variance explained (%)	78.75
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting, people important to me expect me to:	
Contact the media[a]	**0.958**
Organize or participate in a protest	**0.952**
Attend meetings or join a group or organization	**0.948**
Contact officials[b]	**0.944**
Initiate or sign a petition	**0.939**
Express my opinions to family and friends or through social media[c]	**0.895**
Contact the electric company	**0.867**
Take no action	**0.561**
Variance explained (%)	79.54

[a]Media refers to TV, newspapers, etc.

[b]Officials refer to police, mayor, city council members, etc.

[c]Social Media refers to Facebook®, Twitter®, YouTube™, etc.

Table 5.6. Results of principal components analysis (PCA) of independent variables measured for determining ease of response and action to 2 monk parakeet behaviors. Bolded loading values represent statements characterizing a given component.

Predictors	Component 1	Component 2
If monk parakeets nesting near my home make too much noise, it is easy for me to:		
Organize or participate in a protest	**0.938**	0.123
Attend meetings or join a group or organization	**0.884**	0.200
Initiate or sign a petition	**0.790**	0.290
Express my opinions to family and friends or through social media[c]	0.011	**0.846**
Contact the electric company	0.307	**0.769**
Contact officials[b]	0.558	**0.604**
Contact the media[a]	0.532	**0.601**
Variance explained (%)	56.87	15.63
If a monk parakeet nest causes a power outage in my area, it is easy for me to:		
Organize or participate in a protest	**0.919**	0.138
Initiate or sign a petition	**0.885**	0.171
Attend meetings or join a group or organization	**0.776**	0.371
Contact the electric company	0.198	**0.839**
Express my opinions to family and friends or through social media[c]	0.090	**0.816**
Contact officials[b]	0.377	**0.705**
Variance explained (%)	55.40	19.15

[a]Media refers to TV, newspapers, etc.

[b]Officials refer to police, mayor, city council members, etc.

[c]Social Media refers to Facebook®, Twitter®, YouTube™, etc.

Table 5.7. Results of principal components analysis (PCA) of independent variables measured for determining ease of response and action regarding 4 monk parakeet nest management methods. Bolded loading values represent statements characterizing a given component.

Predictors	Component 1	Component 2
If wildlife managers capture and euthanize monk parakeets, it is easy for me to:		
Contact officials[2]	**0.907**	
Contact the media[1]	**0.893**	
Initiate or sign a petition	**0.864**	
Organize or participate in a protest	**0.850**	
Attend meetings or join a group or organization	**0.835**	
Express my opinions to family and friends or through social media[c]	**0.626**	
Variance explained (%)	69.62	
If wildlife managers provide treated seed to prevent monk parakeets from producing young, it is easy for me to:		
Contact officials[b]	**0.910**	
Contact the media[a]	**0.898**	
Organize or participate in a protest	**0.805**	
Initiate or sign a petition	**0.800**	
Attend meetings or join a group or organization	**0.770**	
Contact the electric company	**0.691**	
Express my opinions to family and friends or through social media[c]	**0.664**	
Variance explained (%)	63.38	

Table 5.7. Continued

Predictors	Component 1	Component 2
If wildlife managers remove monk parakeet nests during breeding season, give any eggs and young birds to a wildlife center, and modify the electric utility structure to prevent future nesting, it is easy for me to:		
Contact the media[a]	**0.881**	
Organize or participate in a protest	**0.875**	
Attend meetings or join a group or organization	**0.844**	
Contact officials[b]	**0.839**	
Initiate or sign a petition	**0.834**	
Express my opinions to family and friends or through social media[c]	**0.570**	
Variance explained (%)	66.30	
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting, it is easy for me to:		
Contact the electric company	**0.885**	0.071
Contact officials[b]	**0.841**	0.351
Contact the media[a]	**0.828**	0.382
Express my opinions to family and friends or through social media[c]	**0.590**	0.245
Attend meetings or join a group or organization	0.263	**0.924**
Initiate or sign a petition	0.224	**0.898**
Organize or participate in a protest	0.299	**0.853**
Variance explained (%)	60.64	17.28

[a]Media refers to TV, newspapers, etc.

[b]Officials refer to police, mayor, city council members, etc.

[c]Social Media refers to Facebook®, Twitter®, YouTube™, etc.

Table 5.8. Results of principal components analysis (PCA) of dependent variables measured for determining response to 2 monk parakeet behaviors. Bolded loading values represent statements characterizing a given component.

Predictors	Component 1	Component 2
If monk parakeets nesting near my home make too much noise, I would oppose this by:		
Organizing or participating in a protest	**0.932**	0.152
Contacting the media[a]	**0.871**	0.133
Initiating or signing a petition	**0.776**	0.344
Attending meetings or joining a group or organization	**0.750**	0.413
Expressing my opinions to family and friends or through social media[c]	**0.552**	0.257
Taking no action	0.146	**0.840**
Contacting the electric company	0.242	**0.829**
Contacting officials[b]	0.539	**0.655**
Variance explained (%)	57.60	13.44
If a monk parakeet nest causes a power outage in my area, I would oppose this by:		
Organizing or participating in a protest	**0.911**	0.026
Attending meetings or joining a group or organization	**0.896**	0.177
Initiating or signing a petition	**0.822**	-0.035
Contacting officials[b]	**0.697**	0.469
Contacting the media[a]	**0.609**	0.341
Taking no action	-0.078	**0.889**
Expressing my opinions to family and friends or through social media[c]	0.514	**0.613**
Variance explained (%)	54.54	16.48

[a]Media refers to TV, newspapers, etc.

[b]Officials refer to police, mayor, city council members, etc.

[c]Social Media refers to Facebook®, Twitter®, YouTube™, etc.

Table 5.9. Results of principal components analysis (PCA) of dependent variables measured for determining participant response to 4 monk parakeet nest management methods. Bolded loading values represent statements characterizing a given component.

Predictors	Component 1
If wildlife managers capture and euthanize monk parakeets, I would oppose this by:	
Contacting officials[b]	**0.904**
Taking no action	**0.869**
Organizing or participating in a protest	**0.868**
Initiating or signing a petition	**0.866**
Attending meetings or joining a group or organization	**0.858**
Contacting the media[a]	**0.835**
Expressing my opinions to family and friends or through social media[c]	**0.802**
Contacting the electric company	**0.593**
Variance explained (%)	68.80
If wildlife managers provide treated seed to prevent monk parakeets from producing young, I would oppose this by:	
Contacting the media[a]	**0.950**
Contacting officials[b]	**0.928**
Organizing or participating in a protest	**0.893**
Initiating or signing a petition	**0.880**
Attending meetings or joining a group or organization	**0.875**
Expressing my opinions to family and friends or through social media[c]	**0.854**
Taking no action	**0.778**
Contacting the electric company	**0.674**
Variance explained (%)	73.65

Table 5.9. Continued

Predictors	Component 1
If wildlife managers remove monk parakeet nests during breeding season, give any eggs and young birds to a wildlife center, and modify the electric utility structure to prevent future nesting, I would oppose this by:	
Organizing or participating in a protest	**0.960**
Initiating or signing a petition	**0.937**
Attending meetings or joining a group or organization	**0.937**
Contacting the media[a]	**0.915**
Contacting officials[b]	**0.907**
Contacting the electric company	**0.780**
Expressing my opinions to family and friends or through social media[c]	**0.701**
Taking no action	**0.652**
Variance explained (%)	73.28
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting, I would oppose this by:	
Attending meetings or joining a group or organization	**0.949**
Organizing or participating in a protest	**0.942**
Contacting officials[b]	**0.912**
Contacting the media[a]	**0.911**
Initiating or signing a petition	**0.891**
Expressing my opinions to family and friends or through social media[c]	**0.778**
Contacting the electric company	**0.701**
Taking no action	**0.631**
Variance explained (%)	71.74

[a]Media refers to TV, newspapers, etc.

[b]Officials refer to police, mayor, city council members, etc.

[c]Social Media refers to Facebook®, Twitter®, YouTube™, etc.

Table 5.10. *F*- and *P*-values of full and reduced models for predicting participants' beliefs and concerns regarding management of monk parakeets in Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

	Full model		Reduced model	
Dependent variable	*F*	*P*-value	*F*	*P*-value
If monk parakeets nesting near participant's home make too much noise – Component 1	4.10	0.0012	13.29	<0.0001
If monk parakeets nesting near participant's home make too much noise – Component 2	3.05	0.0075	8.40	<0.0001
If a monk parakeet nest causes a power outage in participant's area – Component 1	3.19	0.0069	12.23	<0.0001
If a monk parakeet nest causes a power outage in participant's area – Component 2	1.30	0.2827	5.72	0.0070
If wildlife managers capture and euthanize monk parakeets	7.24	<0.0001	21.90	<0.0001
If wildlife managers provide treated seed to prevent monk parakeets from producing young	2.74	0.0152	11.77	<0.0001
If wildlife managers remove monk parakeet nests during breeding season, give any eggs and young birds to a wildlife center, and modify the electric utility structure to prevent future nesting	6.88	<0.0001	62.69	<0.0001
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting	6.74	<0.0001	63.02	<0.0001

Table 5.11. Significant differences in R^2 values between statistically significant full (n = 7) and reduced models for predicting participants' beliefs and concerns regarding management of monk parakeets in Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Dependent variable	R^2_{full}	$R^2_{reduced}$	n	P_{full}	$P_{reduced}$	F	P-value
If monk parakeets nesting near participant's home make too much noise – Component 1	0.7875	0.5963	41	19	4	0.8051	0.6780
If monk parakeets nesting near participant's home make too much noise – Component 2	0.7341	0.7091	41	19	9	0.0594	0.9999
If a monk parakeet nest causes a power outage in participant's area – Component 1	0.7420	0.6496	39	18	5	0.2984	0.9918
If wildlife managers capture and euthanize monk parakeets	0.8675	0.8456	41	19	8	0.1131	0.9999
If wildlife managers provide treated seed to prevent monk parakeets from producing young	0.7224	0.5737	40	19	4	0.4511	0.9502
If wildlife managers remove monk parakeet nests during breeding season, give any eggs and young birds to a wildlife center, and modify the electric utility structure to prevent future nesting	0.8674	0.7721	40	19	2	0.6809	0.7934
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting	0.8592	0.7684	41	19	2	0.6449	0.8264

Table 5.12. Full model with variables predicting participants' beliefs and concerns (responses) for managing monk parakeets nesting and making too much noise near participants' homes (Component 1[a]), Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Full model variables	β	P-value
Knowledge about and experience with monk parakeets – Component 1	0.0415	0.776
Participant wants monk parakeets to nest in his or her yard.		
Participant wants monk parakeets to feed at his or her bird feeder.		
Knowledge about and experience with monk parakeets – Component 2	0.0358	0.779
Monk parakeets use their nests all year.		
Monk parakeets migrate to Texas.		
Monk parakeets are noisy.		
Knowledge about and experience with monk parakeets – Component 3	0.0059	0.969
Monk parakeets are native to Texas.		
Monk parakeets cause environmental or agricultural damage.		
Knowledge about and experience with monk parakeets – Component 4	–0.1915	0.203
Participant has seen a wild monk parakeet in Dallas or Tarrant counties.		
Monk parakeets contribute to quality of urban life.		
Concerns about monk parakeet nesting behavior	0.3282	0.078
Monk parakeet nests cause power outages.		
Participant willing to go without electricity caused by monk parakeet nest for up to 4 hours.		
Monk parakeet nests on electric utility structures cause fires.		
Participant would be upset to experience a power outage caused by a monk parakeet nest.		

Table 5.12. Continued

Full model variables	β	*P*-value
Participant experienced a power outage known to be caused by a monk parakeet nest.		
Influence and expectations of others		
If monk parakeets nesting near participant's home make too much noise – Component 1	0.2439	0.092
Initiate or sign a petition		
Attend meetings or join a group or organization		
Organize or participate in a protest		
If monk parakeets nesting near participant's home make too much noise – Component 2	0.3329	0.033
Contact officials or the media		
Express opinions to family and friends or through social media		
Contact the electric company		
If wildlife managers capture and euthanize monk parakeets	–0.2149	0.362
If wildlife managers remove monk parakeet nests, transfer any eggs and nestlings to a wildlife center, and modify the electric utility structure to prevent future nesting	0.2725	0.143
Ease of response and action		
If monk parakeets nesting near my home make too much noise – Component 1	–0.5370	0.090
Organize or participate in a protest		
Attend meetings or join a group or organization		
Initiate or sign a petition		
If monk parakeets nesting near my home make too much noise – Component 2	–0.6631	0.032

Table 5.12. Continued

Full model variables	β	*P*-value
Express opinions to family and friends or through social media		
Contact the electric company, officials, or the media		
Ease of response and action continued		
If a monk parakeet nest causes a power outage in my area – Component 1	0.5687	0.049
Organize or participate in a protest		
Initiate or sign a petition		
Attend meetings or join a group or organization		
If a monk parakeet nest causes a power outage in my area – Component 2	0.5727	0.011
Contact the electric company		
Express opinions to family and friends or through social media		
Contact officials		
If wildlife managers capture and euthanize monk parakeets	–0.0356	0.827
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 1	0.2036	0.305
Contact the electric company, officials, or the media		
Express opinions to family and friends or through social media		
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 2	0.0997	0.487
Attend meetings or join a group or organization		
Initiate or sign a petition		
Organize or participate in a protest		
Gender	–0.3629	0.187
Age	0.1544	0.190

Table 5.12 Continued

Full model variables	β	*P*-value
Education	0.0575	0.768
R^2= 0.7875		
Adjusted R^2= 0.5953		
Number of participants in model -= 41		

[a]Component 1 participant responses, in order of loading importance (high–low): organize or participate in a protest; contact the media; initiate or sign a petition; attend meetings or join a group or organization; and express opinions to family and friends or through social media.

Table 5.13. Reduced model with variables predicting participants' beliefs and concerns (responses) for managing monk parakeets nesting and making too much noise near participants' homes (Component 1[a]), Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Reduced model variables	β	*P*-value
Concerns about monk parakeet nesting behavior	0.4548	0.0005
Monk parakeet nests cause power outages.		
Participant willing to go without electricity caused by monk parakeet nest for up to 4 hours.		
Monk parakeet nests on electric utility structures cause fires.		
Participant would be upset to experience a power outage caused by a monk parakeet nest.		
Participant experienced a power outage known to be caused by a monk parakeet nest.		
Influence and expectations of others		
If monk parakeets nesting near participant's home make too much noise – Component 1	0.4038	0.0007
Initiate or sign a petition		
Attend meetings or join a group or organization		
Organize or participate in a protest		
If monk parakeets nesting near participant's home make too much noise – Component 2	0.4805	<0.0001
Contact officials or the media		
Express opinions to family and friends or through social media		
Contact the electric company		

Table 5.13. Continued

Reduced model variables	β	*P*-value
Age	0.2845	0.0066
R^2 = 0.5963		
Adjusted R^2 = 0.5514		
Number of participants in model = 41		

[a]Component 1 participant responses, in order of loading importance (high–low): organize or participate in a protest; contact the media; initiate or sign a petition; attend meetings or join a group or organization; and express opinions to family and friends or through social media.

Table 5.14. Full model with variables predicting participants' beliefs and concerns (responses) for managing monk parakeets nesting and making too much noise near participants' homes (Component 2[a]), Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Full model variables	β	*P*-value
Knowledge about and experience with monk parakeets – Component 1	–0.3255	0.056
Participant wants monk parakeets to nest in his or her yard.		
Participant wants monk parakeets to feed at his or her bird feeder.		
Knowledge about and experience with monk parakeets – Component 2	–0.1036	0.471
Monk parakeets use their nests all year.		
Monk parakeets migrate to Texas.		
Monk parakeets are noisy.		
Knowledge about and experience with monk parakeets – Component 3	0.0163	0.923
Monk parakeets are native to Texas.		
Monk parakeets cause environmental or agricultural damage.		
Knowledge about and experience with monk parakeets – Component 4	–0.3130	0.069
Participant has seen a wild monk parakeet in Dallas or Tarrant counties.		
Monk parakeets contribute to quality of urban life.		
Concerns about monk parakeet nesting behavior	0.3189	0.122
Monk parakeet nests cause power outages.		
Participant willing to go without electricity caused by monk parakeet nest for up to 4 hours.		
Monk parakeet nests on electric utility structures cause fires.		
Participant would be upset to experience a power outage caused by a monk parakeet nest.		

Table 5.14. Continued

Full model variables	β	*P*-value
Participant experienced a power outage known to be caused by a monk parakeet nest.		
Influence and expectations of others		
If monk parakeets nesting near participant's home make too much noise – Component 1	0.0639	0.684
Initiate or sign a petition		
Attend meetings or join a group or organization		
Organize or participate in a protest		
If monk parakeets nesting near participant's home make too much noise – Component 2	0.3526	0.043
Contact officials or the media		
Express opinions to family and friends or through social media		
Contact the electric company		
If wildlife managers capture and euthanize monk parakeets	0.1632	0.534
If wildlife managers remove monk parakeet nests, transfer any eggs and nestlings to a wildlife center, and modify the electric utility structure to prevent future nesting	–0.2043	0.319
Ease of response and action		
If monk parakeets nesting near my home make too much noise – Component 1	–0.0020	0.995
Organize or participate in a protest		
Attend meetings or join a group or organization		
Initiate or sign a petition		
If monk parakeets nesting near my home make too much noise – Component 2	0.1446	0.659
Express opinions to family and friends or through social media		

Table 5.14. Continued

Full model variables	β	*P*-value
Contact the electric company, officials, or the media		
If a monk parakeet nest causes a power outage in my area – Component 1	–0.1783	0.565
Organize or participate in a protest		
Initiate or sign a petition		
Attend meetings or join a group or organization		
If a monk parakeet nest causes a power outage in my area – Component 2	0.1852	0.430
Contact the electric company		
Express opinions to family and friends or through social media		
Contact officials		
If wildlife managers capture and euthanize monk parakeets	–0.0148	0.935
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 1	–0.1001	0.649
Contact the electric company, officials, or the media		
Express opinions to family and friends or through social media		
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 2	0.2927	0.077
Attend meetings or join a group or organization		
Initiate or sign a petition		
Organize or participate in a protest		
Gender	–0.0331	0.912
Age	0.2913	0.033
Education	0.2378	0.282
$R^2 = 0.741$		

Table 5.14. Continued

Full model variables	β	P-value
Adjusted R^2 = 0.4936		
Number of participants in model = 41		

[a]Component 2 participant responses, in order of loading importance (high–low): express opinions to family and friends or through social media; contact the electric company; contact officials; and contact the media.

Table 5.15. Reduced model with variables predicting participants' beliefs and concerns (responses) for managing monk parakeets nesting and making too much noise near participants' homes (Component 2[a]), Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Reduced model variables	β	*P*-value
Knowledge about and experience with monk parakeets – Component 1	–0.3141	0.0136
Participant wants monk parakeets to nest in his or her yard.		
Participant wants monk parakeets to feed at his or her bird feeder.		
Knowledge about and experience with monk parakeets – Component 4	–0.2510	0.0241
Participant has seen a wild monk parakeet in Dallas or Tarrant counties.		
Monk parakeets contribute to quality of urban life.		
Concerns about monk parakeet nesting behavior	0.2547	0.0677
Monk parakeet nests cause power outages.		
Participant willing to go without electricity caused by monk parakeet nest for up to 4 hours.		
Monk parakeet nests on electric utility structures cause fires.		
Participant would be upset to experience a power outage caused by a monk parakeet nest.		
Participant experienced a power outage known to be caused by a monk parakeet nest.		
Influence and expectations of others		
If monk parakeets nesting near participant's home make too much noise – Component 2	0.3751	0.0022
Contact officials or the media		

Table 5.15. Continued

Reduced model variables	β	*P*-value
Express opinions to family and friends or through social media		
Contact the electric company		
If wildlife managers remove monk parakeet nests, transfer any eggs and nestlings to a wildlife center, and modify the electric utility structure to prevent future nesting	–0.2310	0.0882
Ease of response and action		
If a monk parakeet nest causes a power outage in my area – Component 1	0.2910	0.0082
Organize or participate in a protest		
Initiate or sign a petition		
Attend meetings or join a group or organization		
If a monk parakeet nest causes a power outage in my area – Component 2	0.2565	0.0399
Contact the electric company		
Express opinions to family and friends or through social media		
Contact officials		
Age	0.2431	0.0141
Education	0.2558	0.0669
$R^2 = 0.7091$		
Adjusted $R^2 = 0.6247$		
Number of participants in model = 41		

[a]Component 2 participant responses, in order of loading importance (high–low): express opinions to family and friends or through social media; contact the electric company; contact officials; and contact the media.

Table 5.16. Full model with variables predicting participants' beliefs and concerns about managing monk parakeets if a nest causes power outages (Component 1[a]), Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Full model variables	β	*P*-value
Knowledge about and experience with monk parakeets – Component 1	–0.0095	0.953
Participant wants monk parakeets to nest in his or her yard.		
Participant wants monk parakeets to feed at his or her bird feeder.		
Knowledge about and experience with monk parakeets – Component 2	0.0128	0.924
Monk parakeets use their nests all year.		
Monk parakeets migrate to Texas.		
Monk parakeets are noisy.		
Knowledge about and experience with monk parakeets – Component 3	0.0632	0.692
Monk parakeets are native to Texas.		
Monk parakeets cause environmental or agricultural damage.		
Knowledge about and experience with monk parakeets – Component 4	–0.3573	0.035
Participant has seen a wild monk parakeet in Dallas or Tarrant counties.		
Monk parakeets contribute to quality of urban life.		
Concerns about monk parakeet nesting behavior	0.4044	0.051
Monk parakeet nests cause power outages.		
Participant willing to go without electricity caused by monk parakeet nest for up to 4 hours.		
Monk parakeet nests on electric utility structures cause fires.		
Participant would be upset to experience a power outage caused by a monk parakeet nest.		
Participant has experienced a power outage known to be caused by a monk		

Table 5.16. Continued

Full model variables	β	*P*-value
parakeet nest.		
Influence and expectations of others		
If monk parakeets nesting near participant's home make too much noise – Component 1	0.4421	0.005
Initiate or sign a petition		
Attend meetings or join a group or organization		
Organize or participate in a protest		
If monk parakeets nesting near participant's home make too much noise – Component 2	0.1808	0.286
Contact officials or the media		
Express opinions to family and friends or through social media		
Contact the electric company		
If wildlife managers provide treated seed to prevent monk parakeets from producing young	0.1042	0.700
If wildlife managers remove monk parakeet nests, transfer any eggs and nestlings to a wildlife center, and modify the electric utility structure to prevent future nesting	0.0774	0.699
Ease of response and action		
If monk parakeets nesting near my home make too much noise – Component 1	–0.4332	0.156
Organize or participate in a protest		
Attend meetings or join a group or organization		
Initiate or sign a petition		
Attend meetings or join a group or organization		

Table 5.16. Continued

Full model variables	β	*P*-value
If a monk parakeet nest causes a power outage in my area – Component 2	0.2459	0.164
Contact the electric company		
Express opinions to family and friends or through social media		
Contact officials		
If wildlife managers capture and euthanize monk parakeets	–0.2667	0.167
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 1	–0.1492	0.492
Contact the electric company, officials, or the media		
Express opinions to family and friends or through social media		
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 2	0.0342	0.827
Attend meetings or join a group or organization		
Initiate or sign a petition		
Organize or participate in a protest		
Gender	0.0615	0.842
Age	0.3062	0.014
Education	0.0420	0.823
$R^2 = 0.7420$		
Adjusted $R^2 = 0.5097$		
Number of participants in model = 39		

[a]Component 2 participant responses, in order of loading importance (high–low): take no action; and express opinions to family and friends or through social media.

Table 5.17. Reduced model with variables predicting participants' beliefs and concerns about managing monk parakeets if a nest causes power outages (Component 1[a]), Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Reduced model variables	β	*P*-value
Knowledge about and experience with monk parakeets – Component 4	–0.3659	0.0013
Participant has seen a wild monk parakeet in Dallas or Tarrant counties.		
Monk parakeets contribute to quality of urban life.		
Concerns about monk parakeet nesting behavior	0.4468	0.0007
Monk parakeet nests cause power outages.		
Participant willing to go without electricity caused by monk parakeet nest for up to 4 hours.		
Monk parakeet nests on electric utility structures cause fires.		
Participant would be upset to experience a power outage caused by a monk parakeet nest.		
Participant has experienced a power outage known to be caused by a monk parakeet nest.		
Influence and expectations of others		
If monk parakeets nesting near participant's home make too much noise – Component 1	0.4074	0.0004
Initiate or sign a petition		
Attend meetings or join a group or organization		
Organize or participate in a protest		

Table 5.17. Continued

Reduced model variables	β	P-value
If monk parakeets nesting near participant's home make too much noise –	0.2339	0.0273
Component 2		
Contact officials or the media		
Express opinions to family and friends or through social media		
Contact the electric company		
Age	0.2922	0.0039
$R^2 = 0.6496$		
Adjusted $R^2 = 0.5965$		
Number of participants in model = 39		

[a]Component 2 participant responses, in order of loading importance (high–low): take no action; and express opinions to family and friends or through social media.

Table 5.18. Full model with variables predicting participants' beliefs and concerns about managing monk parakeets if a nest causes power outages (Component 2[a]), Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Full model variables	β	*P*-value
Knowledge about and experience with monk parakeets – Component 1	–0.2059	0.355
Participant wants monk parakeets to nest in his or her yard.		
Participant wants monk parakeets to feed at his or her bird feeder.		
Knowledge about and experience with monk parakeets – Component 2	–0.0536	0.768
Monk parakeets use their nests all year.		
Monk parakeets migrate to Texas.		
Monk parakeets are noisy.		
Knowledge about and experience with monk parakeets – Component 3	–0.0813	0.706
Monk parakeets are native to Texas.		
Monk parakeets cause environmental or agricultural damage.		
Knowledge about and experience with monk parakeets – Component 4	0.0105	0.961
Participant has seen a wild monk parakeet in Dallas or Tarrant counties.		
Monk parakeets contribute to quality of urban life.		
Concerns about monk parakeet nesting behavior	0.3177	0.242
Monk parakeet nests cause power outages.		
Participant willing to go without electricity caused by monk parakeet nest for up to 4 hours.		
Monk parakeet nests on electric utility structures cause fires.		
Participant would be upset to experience a power outage caused by a monk parakeet nest.		
Participant has experienced a power outage known to be caused by a monk		

Table 5.18. Continued

Full model variables	β	*P*-value
parakeet nest.		
Influence and expectations of others		
If monk parakeets nesting near participant's home make too much noise – Component 1	–0.1358	0.484
Initiate or sign a petition		
Attend meetings or join a group or organization		
Organize or participate in a protest		
If monk parakeets nesting near participant's home make too much noise – Component 2	0.2014	0.377
Contact officials or the media		
Express opinions to family and friends or through social media		
Contact the electric company		
If wildlife managers provide treated seed to prevent monk parakeets from producing young	–0.0474	0.897
If wildlife managers remove monk parakeet nests, transfer any eggs and nestlings to a wildlife center, and modify the electric utility structure to prevent future nesting	0.1444	0.593
Ease of response and action		
If monk parakeets nesting near my home make too much noise – Component 1	–0.0024	0.995
Organize or participate in a protest		
Attend meetings or join a group or organization		
Initiate or sign a petition		

Table 5.18. Continued

Full model variables	β	*P*-value
If a monk parakeet nest causes a power outage in my area – Component 1	–0.3874	0.282
Organize or participate in a protest		
Initiate or sign a petition		
Attend meetings or join a group or organization		
If a monk parakeet nest causes a power outage in my area – Component 2	0.3397	0.155
Contact the electric company		
Express opinions to family and friends or through social media		
Contact officials		
If wildlife managers capture and euthanize monk parakeets	0.4476	0.090
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 1	–0.2461	0.403
Contact the electric company, officials, or the media		
Express opinions to family and friends or through social media		
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 2	0.3859	0.080
Attend meetings or join a group or organization		
Initiate or sign a petition		
Organize or participate in a protest		
Gender	–0.1508	0.718
Age	0.1000	0.524
Education	0.1602	0.529
R^2 = 0.5395		
Adjusted R^2 = 0.1250		

Table 5.18. Continued

Full model variables	β	P-value
Number of participants in model = 39		

[a]Component 1 participant responses, in order of loading importance (high–low): organize or participate in a protest; attend meetings or join a group or organization; initiate or sign a petition; contact officials; and contact the media.

Table 5.19. Reduced model with variables predicting participants' beliefs and concerns about managing monk parakeets if a nest causes power outages (Component 2[a]), Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Reduced model variables	β	*P*-value
Influence and expectations of others		
If monk parakeets nesting near participant's home make too much noise – Component 2	0.3327	0.0238
Contact officials or the media		
Express opinions to family and friends or through social media		
Contact the electric company		
Ease of response and action		
If a monk parakeet nest causes a power outage in my area – Component 2	0.3477	0.0259
Contact the electric company		
Express opinions to family and friends or through social media		
Contact officials		
R^2 = 0.2412		
Adjusted R^2 = 0.1991		
Number of participants in model = 39		

[a]Component 1 participant responses, in order of loading importance (high–low): organize or participate in a protest; attend meetings or join a group or organization; initiate or sign a petition; contact officials; and contact the media.

Table 5.20. Full model with variables predicting participants' beliefs and concerns about wildlife managers capturing and euthanizing monk parakeets[a], Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Full model variables	β	*P*-value
Knowledge about and experience with monk parakeets – Component 1	0.3973	0.002
Participant wants monk parakeets to nest in his or her yard.		
Participant wants monk parakeets to feed at his or her bird feeder.		
Knowledge about and experience with monk parakeets – Component 2	–0.1058	0.301
Monk parakeets use their nests all year.		
Monk parakeets migrate to Texas.		
Monk parakeets are noisy.		
Knowledge about and experience with monk parakeets – Component 3	–0.2030	0.099
Monk parakeets are native to Texas.		
Monk parakeets cause environmental or agricultural damage.		
Knowledge about and experience with monk parakeets – Component 4	0.1977	0.101
Participant has seen a wild monk parakeet in Dallas or Tarrant counties.		
Monk parakeets contribute to quality of urban life.		
Concerns about monk parakeet nesting behavior	0.0832	0.559
Monk parakeet nests cause power outages.		
Participant willing to go without electricity caused by monk parakeet nest for up to 4 hours.		
Monk parakeet nests on electric utility structures cause fires.		
Participant would be upset to experience a power outage caused by a monk parakeet nest.		
Participant has experienced a power outage known to be caused by a monk		

Table 5.20. Continued

Full model variables	β	*P*-value
parakeet nest.		
Influence and expectations of others		
If monk parakeets nesting near participant's home make too much noise – Component 1	–0.0849	0.446
Initiate or sign a petition		
Attend meetings or join a group or organization		
Organize or participate in a protest		
If monk parakeets nesting near participant's home make too much noise – Component 2	0.2374	0.053
Contact officials or the media		
Express opinions to family and friends or through social media		
Contact the electric company		
If wildlife managers capture and euthanize monk parakeets	0.4354	0.027
If wildlife managers remove monk parakeet nests, transfer any eggs and nestlings to a wildlife center, and modify the electric utility structure to prevent future nesting	–0.0014	0.992
Ease of response and action		
If monk parakeets nesting near my home make too much noise – Component 1	0.0661	0.785
Organize or participate in a protest		
Attend meetings or join a group or organization		
Initiate or sign a petition		

Table 5.20. Continued

Full model variables	β	*P*-value
If monk parakeets nesting near my home make too much noise – Component 2	0.0225	0.922
Express opinions to family and friends or through social media		
Contact the electric company, officials, or the media		
If a monk parakeet nest causes a power outage in my area – Component 1	–0.3873	0.087
Organize or participate in a protest		
Initiate or sign a petition		
Attend meetings or join a group or organization		
If a monk parakeet nest causes a power outage in my area – Component 2	–0.1077	0.515
Contact the electric company		
Express opinions to family and friends or through social media		
Contact officials		
If wildlife managers capture and euthanize monk parakeets	0.3969	0.005
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 1	–0.0640	0.680
Contact the electric company, officials, or the media		
Express opinions to family and friends or through social media		
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 2	0.0016	0.989
Attend meetings or join a group or organization		
Initiate or sign a petition		
Organize or participate in a protest		

Table 5.20. Continued

Full model variables	β	*P*-value
Gender	0.0773	0.717
Age	0.1455	0.121
Education	0.0907	0.558
$R^2 = 0.8675$		
Adjusted $R^2 = 0.7476$		
Number of participants in model = 41		

[a]Component 1 participant responses, in order of loading importance (high–low): contact officials; take no action; organize or participate in a protest; initiate or sign a petition; attend meetings or join a group or organization; contact the media; express opinions to family and friends or through social media; contact the electric company.

Table 5.21. Reduced model with variables predicting participants' beliefs and concerns about wildlife managers capturing and euthanizing monk parakeets[a], Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Reduced model variables	β	*P*-value
Knowledge about and experience with monk parakeets – Component 1	0.4076	<0.0001
Participant wants monk parakeets to nest in his or her yard.		
Participant wants monk parakeets to feed at his or her bird feeder.		
Knowledge about and experience with monk parakeets – Component 3	–0.1531	0.0465
Monk parakeets are native to Texas.		
Monk parakeets cause environmental or agricultural damage.		
Knowledge about and experience with monk parakeets – Component 4	0.1861	0.0220
Participant has seen a wild monk parakeet in Dallas or Tarrant counties.		
Monk parakeets contribute to quality of urban life.		
Influence and expectations of others		
If monk parakeets nesting near participant's home make too much noise – Component 2	0.2349	0.0036
Contact officials or the media		
Express opinions to family and friends or through social media		
Contact the electric company		
If wildlife managers capture and euthanize monk parakeets	0.3358	0.0053
Ease of response and action		
If a monk parakeets nest causes a power outage in my area – Component 1	–0.3269	0.0015
Organize or participate in a protest		
Initiate or sign a petition		
Attend meetings or join a group or organization		

Table 5.21. Continued

Reduced model variables	β	*P*-value
If wildlife managers capture and euthanize monk parakeets	0.3587	0.0010
Age	0.1393	0.0364
R^2 = 0.8456		
Adjusted R^2 =0.8070		
Number of participants in model = 41		

[a]Component 1 participant responses, in order of loading importance (high–low): contact officials; take no action; organize or participate in a protest; initiate or sign a petition; attend meetings or join a group or organization; contact the media; express opinions to family and friends or through social media; contact the electric company.

Table 5.22. Full model with variables predicting participants' beliefs and concerns about wildlife managers providing treated seed to prevent monk parakeets from producing young[a], Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Full model variables	β	*P*-value
Knowledge about and experience with monk parakeets – Component 1	–0.0051	0.976
Participant wants monk parakeets to nest in his or her yard.		
Participant wants monk parakeets to feed at his or her bird feeder.		
Knowledge about and experience with monk parakeets – Component 2	–0.1956	0.211
Monk parakeets use their nests all year.		
Monk parakeets migrate to Texas.		
Monk parakeets are noisy.		
Knowledge about and experience with monk parakeets – Component 3	–0.0269	0.877
Monk parakeets are native to Texas.		
Monk parakeets cause environmental or agricultural damage.		
Knowledge about and experience with monk parakeets – Component 4	0.1102	0.518
Participant has seen a wild monk parakeet in Dallas or Tarrant counties.		
monk parakeets contribute to quality of urban life.		
Concerns about monk parakeet nesting behavior	–0.1157	0.572
Monk parakeet nests cause power outages.		
Participant willing to go without electricity caused by monk parakeet nest for up to 4 hours.		
Monk parakeet nests on electric utility structures cause fires.		
Participant would be upset to experience a power outage caused by a monk parakeet nest.		

Table 5.22. Continued

Full model variables	β	*P*-value
Participant has experienced a power outage known to be caused by a monk parakeet nest.		
Influence and expectations of others		
If monk parakeets nesting near participant’s home make too much noise – Component 1	–0.2965	0.080
Initiate or sign a petition		
Attend meetings or join a group or organization		
Organize or participate in a protest		
If monk parakeets nesting near participant’s home make too much noise – Component 2	0.2326	0.191
Contact officials or the media		
Express opinions to family and friends or through social media		
Contact the electric company		
If wildlife managers capture and euthanize monk parakeets	0.5208	0.063
If wildlife managers remove monk parakeet nests, transfer any eggs and nestlings to a wildlife center, and modify the electric utility structure to prevent future nesting	–0.0566	0.796
Ease of response and action		
If monk parakeets nesting near my home make too much noise – Component 1	0.0407	0.907
Organize or participate in a protest		
Attend meetings or join a group or organization		
Initiate or sign a petition		

Table 5.22. Continued

Full model variables	β	*P*-value
If monk parakeets nesting near my home make too much noise – Component 2	–0.4956	0.146
Express opinions to family and friends or through social media		
Contact the electric company, officials, or the media		
If a monk parakeet nest causes a power outage in my area – Component 1	–0.0398	0.902
Organize or participate in a protest		
Initiate or sign a petition		
Attend meetings or join a group or organization		
If a monk parakeet nest causes a power outage in my area – Component 2	0.2872	0.235
Contact the electric company		
Express opinions to family and friends or through social media		
Contact officials		
If wildlife managers capture and euthanize monk parakeets	0.2761	0.146
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 1	–0.0465	0.835
Contact the electric company, officials, or the media		
Express opinions to family and friends or through social media		
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 2	–0.1684	0.306
Attend meetings or join a group or organization		
Initiate or sign a petition		
Organize or participate in a protest		

Table 5.22. Continued

Full model variables	β	*P*-value
Gender	–0.1684	0.589
Age	0.0140	0.915
Education	–0.0108	0.961
$R^2 = 0.7224$		
Adjusted $R^2 = 0.4588$		
Number of participants in model = 40		

[a]Participant responses, in order of loading importance (high–low): contact the media; contact officials; organize or participate in a protest; initiate or sign a petition; attend meetings or join a group or organization; express opinions to family and friends or through social media; take no action; contact the electric company.

Table 5.23. Reduced model with variables predicting participants' beliefs and concerns about wildlife managers providing treated seed to prevent monk parakeets from producing young[a], Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Reduced model variables	*β*	*P*-value
Knowledge about and experience with monk parakeets – Component 4	0.1861	0.099
Participant has seen a wild monk parakeet in Dallas or Tarrant counties.		
Monk parakeets contribute to quality of urban life.		
Influence and expectations of others		
If monk parakeets nesting near participant's home make too much noise – Component 2	0.2789	0.0203
Contact officials or the media		
Express opinions to family and friends or through social media		
Contact the electric company		
If wildlife managers capture and euthanize monk parakeets	0.4874	0.006
Ease of response and action		
Education	–0.2746	0.0819
R^2 = 0.5737		
Adjusted R^2 = 0.5249		
Number of participants in model = 40		

[a]Participant responses, in order of loading importance (high–low): contact the media; contact officials; organize or participate in a protest; initiate or sign a petition; attend meetings or join a group or organization; express opinions to family and friends or through social media; take no action; contact the electric company.

Table 5.24. Full model with variables predicting participants' beliefs and concerns about wildlife managers removing monk parakeet nests during breeding season, transferring any eggs and nestlings to a wildlife center, and modifying the electric utility structure to prevent future nesting[a], Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Full model variables	β	*P*-value
Knowledge about and experience with monk parakeets – Component 1	–0.0784	0.507
Participant wants monk parakeets to nest in his or her yard.		
Participant wants monk parakeets to feed at his or her bird feeder.		
Knowledge about and experience with monk parakeets – Component 2	0.0003	0.998
Monk parakeets use their nests all year.		
Monk parakeets migrate to Texas.		
Monk parakeets are noisy.		
Knowledge about and experience with monk parakeets – Component 3	–0.1694	0.193
Monk parakeets are native to Texas.		
Monk parakeets cause environmental or agricultural damage.		
Knowledge about and experience with monk parakeets – Component 4	0.1059	0.381
Participant has seen a wild monk parakeet in Dallas or Tarrant counties.		
Monk parakeets contribute to quality of urban life.		
Concerns about monk parakeet nesting behavior	–0.1128	0.472
Monk parakeet nests cause power outages.		
Participant willing to go without electricity caused by monk parakeet nest for up to 4 hours.		
Monk parakeet nests on electric utility structures cause fires.		

Table 5.24. Continued

Full model variables	β	*P*-value
Participant would be upset to experience a power outage caused by a monk parakeet nest.		
Participant has experienced a power outage known to be caused by a monk parakeet nest.		
Influence and expectations of others		
If monk parakeets nesting near participant's home make too much noise – Component 1	–0.1117	0.329
Initiate or sign a petition		
Attend meetings or join a group or organization		
Organize or participate in a protest		
If monk parakeets nesting near participant's home make too much noise – Component 2	0.0538	0.678
Contact officials or the media		
Express opinions to family and friends or through social media		
Contact the electric company		
If wildlife managers capture and euthanize monk parakeets	0.3336	0.098
If wildlife managers remove monk parakeet nests, transfer any eggs and nestlings to a wildlife center, and modify the electric utility structure to prevent future nesting	0.6699	<0.001
Ease of response and action		
If monk parakeets nesting near my home make too much noise – Component 1	–0.0281	0.911
Organize or participate in a protest		

Table 5.24. Continued

Full model variables	β	*P*-value
Attend meetings or join a group or organization		
Initiate or sign a petition		
If monk parakeets nesting near my home make too much noise – Component 2	–0.2058	0.396
Express opinions to family and friends or through social media		
Contact the electric company, officials, or the media		
If a monk parakeet nest causes a power outage in my area – Component 1	–0.1782	0.436
Organize or participate in a protest		
Initiate or sign a petition		
Attend meetings or join a group or organization		
If a monk parakeet nest causes a power outage in my area – Component 2	0.0718	0.695
Contact the electric company		
Express opinions to family and friends or through social media		
Contact officials		
If wildlife managers capture and euthanize monk parakeets	–0.0212	0.889
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 1	–0.0809	0.611
Contact the electric company, officials, or the media		
Express opinions to family and friends or through social media		

Table 5.24. Continued

Full model variables	β	P-value
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 2	0.2084	0.091
Attend meetings or join a group or organization		
Initiate or sign a petition		
Organize or participate in a protest		
Gender	–0.1458	0.523
Age	0.0281	0.768
Education	0.2403	0.141
$R^2 = 0.8674$		
Adjusted $R^2 = 0.7414$		
Number of participants in model = 40		

[a]Participant responses, in order of loading importance (high–low): organize or participate in a protest; initiate or sign a petition; attend meetings or join a group or organization; contact the media; contact officials; contact the electric company; express opinions to family and friends or through social media; take no action.

Table 5.25. Reduced model with variables predicting participants' beliefs and concerns about wildlife managers removing monk parakeet nests during breeding season, transferring any eggs and nestlings to a wildlife center, and modifying the electric utility structure to prevent future nesting[a], Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Reduced model variables	β	*P*-value
Concerns about monk parakeet nesting behavior	–0.1931	0.0329
Monk parakeet nests cause power outages.		
Participant willing to go without electricity caused by monk parakeet nest for up to 4 hours.		
Monk parakeet nests on electric utility structures cause fires.		
Participant would be upset to experience a power outage caused by a monk parakeet nest.		
Participant has experienced a power outage known to be caused by a monk parakeet nest.		
Influence and expectations of others		
If wildlife managers remove monk parakeet nests, transfer any eggs and nestlings to a wildlife center, and modify the electric utility structure to prevent future nesting	0.7835	<0.0001
R^2 = 0.7721		
Adjusted R^2 = 0.7598		
Number of participants in model = 40		

[a]Participant responses, in order of loading importance (high–low): organize or participate in a protest; initiate or sign a petition; attend meetings or join a group or

organization; contact the media; contact officials; contact the electric company; express opinions to family and friends or through social media; take no action.

Table 5.26. Full model with variables predicting participants' beliefs and concerns about wildlife managers removing monk parakeet nests during nonbreeding season and modifying the electric utility structure to prevent future nesting[a], Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Full model variables	β	*P*-value
Knowledge about and experience with monk parakeets – Component 1	0.0839	0.470
Participant wants monk parakeets to nest in his or her yard.		
Participant wants monk parakeets to feed at his or her bird feeder.		
Knowledge about and experience with monk parakeets – Component 2	0.1449	0.162
Monk parakeets use their nests all year.		
Monk parakeets migrate to Texas.		
Monk parakeets are noisy.		
Knowledge about and experience with monk parakeets – Component 3	–0.0815	0.497
Monk parakeets are native to Texas.		
Monk parakeets cause environmental or agricultural damage.		
Knowledge about and experience with monk parakeets – Component 4	–0.0601	0.609
Participant has seen a wild monk parakeet in Dallas or Tarrant counties.		
Monk parakeets contribute to quality of urban life.		
Concerns about monk parakeet nesting behavior	–0.0235	0.869
Monk parakeet nests cause power outages.		
Participant willing to go without electricity caused by monk parakeet nest for up to 4 hours.		
Monk parakeet nests on electric utility structures cause fires.		
Participant would be upset to experience a power outage caused by a monk parakeet nest.		

Table 5.26. Continued

Full model variables	β	*P*-value
Participant has experienced a power outage known to be caused by a monk parakeet nest.		
Influence and expectations of others		
If monk parakeets nesting near participant's home make too much noise – Component 1	–0.0675	0.5449
Initiate or sign a petition		
Attend meetings or join a group or organization		
Organize or participate in a protest		
If monk parakeets nesting near participant's home make too much noise – Component 2	0.0965	0.415
Contact officials or the media		
Express opinions to family and friends or through social media		
Contact the electric company		
If wildlife managers capture and euthanize monk parakeets	0.0786	0.672
If wildlife managers remove monk parakeet nests, transfer any eggs and nestlings to a wildlife center, and modify the electric utility structure to prevent future nesting	0.5289	0.001
Ease of response and action		
If monk parakeets nesting near my home make too much noise – Component 1	0.4318	0.086
Organize or participate in a protest		
Attend meetings or join a group or organization		
Initiate or sign a petition		

Table 5.26. Continued

Full model variables	β	*P*-value
If monk parakeets nesting near my home make too much noise – Component 2	0.1112	0.632
Express opinions to family and friends or through social media		
Contact the electric company, officials, or the media		
If a monk parakeet nest causes a power outage in my area – Component 1	–0.4685	0.042
Organize or participate in a protest		
Initiate or sign a petition		
Attend meetings or join a group or organization		
If a monk parakeet nest causes a power outage in my area – Component 2	–0.1319	0.428
Contact the electric company		
Express opinions to family and friends or through social media		
Contact officials		
If wildlife managers capture and euthanize monk parakeets	–0.0441	0.732
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 1	–0.0502	0.747
Contact the electric company, officials, or the media		
Express opinions to family and friends or through social media		
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 2	0.2730	0.023
Attend meetings or join a group or organization		
Initiate or sign a petition		
Organize or participate in a protest		

Table 5.26. Continued

Full model variables	β	*P*-value
Gender	–0.1347	0.530
Age	0.0492	0.592
Education	–0.0170	0.912
$R^2 = 0.8592$		
Adjusted $R^2 = 0.7318$		
Number of participants in model = 41		

[a]Participant responses, in order of loading importance (high–low): attend meetings or join a group or organization; organize or participate in a protest; contact officials; contact the media; initiate or sign a petition; express opinions to family and friends or through social media; contact the electric company; take no action.

Table 5.27. Reduced model with variables predicting participants' beliefs and concerns about wildlife managers removing monk parakeet nests during nonbreeding season and modifying the electric utility structure to prevent future nesting[a], Dallas and Tarrant counties, Texas, USA, September 2012–February 2013.

Reduced model variables	β	*P*-value
Influence and expectations of others		
If wildlife managers remove monk parakeet nests, transfer any eggs and nestlings to a wildlife center, and modify the electric utility structure to prevent future nesting	0.7634	<0.0001
Ease of response and action		
If wildlife managers remove monk parakeet nests during nonbreeding season and modify the electric utility structure to prevent future nesting – Component 2	0.2075	0.0157
Attend meetings or join a group or organization		
Initiate or sign a petition		
Organize or participate in a protest		
R^2 = 0.7684		
Adjusted R^2 = 0.7562		
Number of participants in model = 41		

[a]Participant responses, in order of loading importance (high–low): attend meetings or join a group or organization; organize or participate in a protest; contact officials; contact the media; initiate or sign a petition; express opinions to family and friends or through social media; contact the electric company; take no action.