USE OF URBAN BIRD FEEDERS BY WHITE-WINGED DOVES AND GREAT-TAILED GRACKLES IN TEXAS

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ABSTRACT.— As White-winged Doves (*Zenaida asiatica*) and Great-tailed Grackles (*Quiscalus mexicanus*) expanded their range northward, these species have shown an increased affinity for urban areas, perhaps because of constant supply of anthropogenic food sources. We compared use of bird feeders by both of these species to established avian species in urban central Texas. We used 15 feeding stations in San Marcos and 15 in San Antonio. We digitally recorded interaction events for half-hour intervals in summer 2009 and winter 2010. We used recordings to calculate total time spent by each species at each feeding station, count the number of aggressive interactions, and determine participants in each interaction. In summer, White-winged Doves and Great-tailed Grackles used feeding stations more than other avian species. In winter, there was little difference between feeding station use by White-winged Doves and Great-tailed Grackles; however, House Sparrows used feeding stations significantly more than both species. White-winged Doves were displaced by other species during summer, but became more aggressive in winter, perhaps because food resources may have been limited more so in winter than summer. The results of our study are consistent with the possibility that maintenance of range expansion populations of White-winged Doves and Great-tailed Grackles has been facilitated by the ability of each species to use anthropogenic food sources.

Historically, the primary range of White-winged Doves (*Zenaida asiatica*) in Texas only extended as far north as the lower Rio Grande Valley (LRGV) with smaller populations in the Trans-Pecos region of Texas (Cottam and Trefethen 1968, George et al. 1994). However, since the 1950s range expansion has resulted in breeding populations as far north as Kansas (Cottam and Trefethen 1968, Moore 2001, Schwertner et al. 2002). This change in distribution has been attributed to loss and fragmentation of breeding habitat in the LRGV because of increased agricultural production, urbanization, industrialization, and weather events (severe freezes) that damaged citrus groves used as nesting sites (Cottam and Trefethen 1968, Curtis and Ripley 1975, Purdy and Tomlinson 1991, George et al. 1994, Hayslette et al. 1996, Brush and Cantu 1998).

Great-tailed Grackles (*Quiscalus mexicanus*) have undergone a similar range expansion within the United States. The original breeding range occurred only as far north as South Texas in the late 1800s; however, Great-tailed Grackles now breed in 20 states (Dinsmore and Dinsmore 1993, Wehtje 2003). Their expansion predated that of White-winged Doves by about 60 years with Great-tailed Grackles common in San Antonio, Texas by 1890 and Austin, Texas by 1902 (Attwater 1892, Schutze 1902). While habitat loss in the LRGV is likely the driving cause of Great-tailed Grackle expansion, the species may have expanded its range by taking advantage of increasing agricultural food resources (e.g., cattle feedlots) north of the LRGV (USDA-NASS 2000, Wehtje 2003).

Since expanding northward, both White-winged Doves and Great-tailed Grackles have shown an ability to successfully reproduce in urban areas (Small et al. 1989, West et al. 1993, Johnson and Peer 2001, Wehtje 2003). Urban areas may be

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facilitating expansion by providing a constant food source from various anthropogenic sources (Wehtje 2003).

Urban populations of nesting White-winged Doves also exhibit a reduction in migratory behavior, with a proportion of the population becoming year-round residents, likely taking advantage of a reliable food supply in the form of backyard feeders (George 1991, West et al. 1993, Hayslette and Hayslette 1999, Small et al. 2005). Great-tailed Grackles do not migrate and, since they are highly omnivorous (Johnson and Peer 2001), they may also take advantage of constant anthropogenic food sources such as refuse dumpsters and bird feeders. In a greater context, Moller (2009) found among European and North African bird species, those known to be "urban-adapted" tended to have larger geographic ranges than non-urban species; indirect evidence and inference the use of urban environments may facilitate range expansion.

Because White-winged Doves and Great-tailed Grackles are relatively recent colonizers of urban areas, we compared their utlization of anthropogenic food sources to exploitation by established urban species. A study of interactions between penned Mourning Doves (*Zenaida macroura*), a sympatric congener of White-winged Doves, and Eurasian Collared Doves (*Streptopelia decaocto*), an invasive exotic species expanding across the United States, found both species exhibited aggression toward each other at feeders, but neither displaced the other (Poling and Hayslette 2006). Zenaida Doves (*Zenaida aurita*) in Barbados engaged in both territorial defense and communal feeding depending on food availability (Dolman et al. 1996, Lefebvre et al. 2006, Lefebvre et al. 2007). Because aggression is often heightened when food is reliable and clustered in a small area (Dubois and Giraldeau 2003), we surmised frequent bouts of aggression could be expected at feeders.

If exploitation of anthropogenic food sources has been a factor in maintaining range expansion populations of White-winged Doves and Great-tailed Grackles, then these two species should utilize "backyard bird feeders" extensively; perhaps, even more so than historically established urban species (e.g., House Sparrows, *Passer domesticus;* Northern Cardinals, *Cardinalis cardinalis*). Our objective was to compare the use of feeders by White-winged Doves and Great-tailed Grackles with other, established native species. We predicted that White-winged Doves and Great-tailed Grackles would use feeders more than the established resident species.

MATERIALS AND METHODS

Study Area.—We conducted our study at 30 locations in central Texas: 15 each in northeastern San Antonio and in San Marcos. Live oak (*Quercus fusiformis*) and Ashe juniper (*Juniperus asheii*) woodlands primarily compose the natural vegetation surrounding these two cities, and these two species also comprise a substantial part of the vegetation within these cities. While San Antonio (including the smaller cities of Live Oak, Selma, Universal City, and Converse) is more urbanized than San Marcos, both contain neighborhoods of varying ages, commercial development, and city parks containing old growth and sapling trees, a woody understory, and short grasses. Rivers run through both cities. Every study site chosen had savannah-like habitat common to residential yards and parks and locations inhabited by White-winged Doves and Great-tailed Grackles. We attempted to select sites with vegetative and structural features as similar as possible.

Data Collection.—We located feeding stations in yards at residential homes, parks, or businesses at least 0.5 km apart to limit visitation of the same bird at more than one station within a day. Each feeding station (roughly simulating a commercial bird feeder) consisted of a metal tray (38.8 $\times$ 25.9 cm) filled with 2 cups (454 g) of commercial wild bird-seed mix (including millet, milo, sunflower seeds, and wheat). All trays were located on the ground, allowing access by all avian species (Losito et al. 1990) and reducing complications in defining presence of individual birds at a feeding station (see below). We placed trays near a tree at each site, but outside of the canopy to maximize visibility. We baited feeding stations on the day before observations began to allow birds time to discover the food source. We replenished feeding stations daily before an observation period.

We operated and observed 5 stations each week (1 tray per location), such that during our study of 6 weeks (3 weeks in each city), 6 sets of 5 stations were observed. We alternated baiting sites between San Marcos and San Antonio weekly to prevent habitation by birds to feeders. During each day of a given week, 5 sites (in either San Antonio or San Marcos) were tested for 5 consecutive days. Observation periods lasted for 30 min with the first period starting 30 min after sunrise each morning, followed by the other 4 periods later in the morning allowing for the observer to move between sites. The order for station testing was rotated temporally so no station was observed at the same time twice (e.g., a site observed at 0900 h on day one was observed at 0800 h on day two, and so on) within a given week.

After arriving at a site and feeding station, we allowed 15 min of settle time following placing food in each tray before beginning the 30 min observation period. Observations were made at a sufficient distance to avoid disruption of feeding while still allowing an adequate line of sight (about 4 m). When possible observations were made from a blind (car or house).

We conducted observations from 20 July to 22 August 2009 and from 25 January to 5 March 2010. We used a digital video camera (Sanyo Model Xacti HD, SANYO North America Corporation, San Diego, California) to record the 30-min observation periods and transferred all recordings to DVDs for later analysis. From these recordings we determined the amount of time (sec) each species spent at a feeding station. We defined presence at a feeder as a bird being physically on the feeder or within 1 m. We counted each instance of intraspecific and interspecific displacement during interactions (with displacement defined as an individual's position at a feeder being adversely affected as a result of the behavior or arrival of another individual) and noted the aggressor species and displaced species in each interaction.

Statistical Analysis.—Studies involving presence-absence of animals are generally predisposed to produce data sets containing large numbers of zeros, limiting the possible analysis. Consequently, if a species did not appear at a feeding station during the 5 observation periods, those zeros were designated null measurements and excluded from analyses because we could not determine with certainty whether the species was actually in the area. We included data from all stations where White-winged Doves or Great-tailed Grackles were present at least 1 day of the observation week, thus assuming the species was in the area but intermittently visited the feeding station. A multifactor ANOVA revealed no significant differences ($P > 0.1$) among the 30 locations, time of observation, or day of the week in overall time spent by birds (all species combined) at a feeding station. Therefore, there was no need to include these factors as grouping or blocking variables in subsequent analyses.

We used one-tailed paired *t*-tests to compare the time White-winged Doves spent at a feeding station with time spent by other species. To correct for the possibility of inflated Type I error (due to conducting a substantial number of significance tests), we used a Bonferroni-corrected alpha level when assessing the significance of *t*-tests. For another species to be used for comparison, there had to be at least 10 observation periods with both White-winged Doves and the other species present during an observation week. Preliminary assessments indicated this was a sufficient sample size to ensure normality of the response variable. We then repeated this analysis with Great-tailed Grackles as the focal species. These *t*-tests were performed for both summer and winter data separately. We also calculated percentage of 30 min observation periods that each species was present at a feeding station, so comparisons could be made between paired species, despite different numbers of observation periods where each species was present.

To get a clearer assessment of direct aggressive interaction, a count was taken of every instance an individual displaced another. We defined displacement as an individual moving from its location as a result of the action of another individual. The displacing species and displaced species were recorded. These counts were summed for each season. For each species in each season, the percentage of conspecific interactions was calculated out of total displacer events. For example, if a White-winged Dove exhibited aggressive behavior to another White-winged Dove in 192 out of 237 displacement events, it had a conspecific displacement percentage of 81%. An aggression ratio was also determined for each species in each season. The ratio was calculated by dividing the number of times a species was the displacer of a heterospecific individual by the number of times the species was displaced by a heterospecific individual. Therefore, a ratio > 1 indicated the species had a greater probability of being the aggressor, while a ratio < 1 indicated the species had a greater probability of being displaced.

RESULTS

In summer, White-winged Doves spent significantly more time at feeding stations than Inca Doves, *Columbina inca*, ($t_1 = 3.53$, $P < 0.001$), Northern Cardinals ($t_1 = 4.16$, $P < 0.001$), Blue Jays, *Cyanocitta cristata*, ($t_1 = 3.84$, $P <$

0.001), and Brown-headed Cowbirds, *Molothrus ater*, (t_1 = 4.00, P = 0.001) (Table 1). Great-tailed grackles spent significantly more time at feeding stations than Northern Cardinals (t_1 = 2.88, P = 0.004) and Blue Jays (t_1 = 5.15, $P < 0.001$) but not more or less time than any of the other four species (Table 2).

In winter, White-winged Doves did not use feeding stations more often than other species (Table 3). House Sparrows actually used feeding stations significantly more than White-winged Doves (t_1 = -2.96, P = 0.001; Table 3). Great-tailed Grackles' use of feeding stations changed in winter as well, with no remarkable difference in time spent at feeding stations compared to other species. Again, House Sparrows also used feeding stations significantly more than Great-tailed Grackles (t_1 = −5.00, $P < 0.001$; Table 4).

In summer, most White-winged Dove displacement events involved conspecific individuals and the interspecific aggression ratio was < 1 (Table 5). This pattern was reversed in winter; White-winged Doves tended to be the aggressors (aggression ratio > 1) and most displacement events involved heterospecific individuals. In summer and winter, most Great-tailed Grackle displacement events involved conspecifics, but the interspecific aggression was also high (> 2) in both seasons (Table 5). The Great-tailed Grackle was one of the most aggressive species in summer and winter. The Northern Cardinal was the only other species with a similar level of aggression in both seasons (Table 5).

DISCUSSION

As populations of White-winged Doves and Great-tailed Grackles spread northward, the

TABLE 1. Percent time spent at feeding stations when White-winged Doves and other species were both present at feeding stations in San Marcos and San Antonio, Texas during summer 2009.

	White-winged Dove	Other Species	t_1	P^*	Species Present Most
Great-tailed Grackle	21.3	21.6	−0.05	0.48	No Difference
Mourning Dove	19.3	18.2	0.13	0.45	No Difference
Inca Dove	31.1	6.20	3.53	<0.01	White-winged Dove
Northern Cardinal	22.4	6.41	4.16	<0.01	White-winged Dove
Blue Jay	15.3	3.57	3.84	<0.01	White-winged Dove
House Sparrow	17.9	18.7	−0.18	0.43	No Difference
House Finch	14.8	5.02	1.82	0.048	No Difference
Brown-headed Cowbird	23.9	1.72	4.00	<0.01	White-winged Dove

* The Bonferroni adjustment was calculated by dividing α = 0.05 by 8 comparisons performed, resulting in an adjusted α = 0.0063

TABLE 2. Percent time spent at feeding stations when Great-tailed Grackles and other species were both present at the feeding stations in San Marcos and San Antonio, Texas during summer 2009.

	Great-tailed Grackle	Other Species	t_1	P^*	Species Present Most
Mourning Dove	29.4	13.3	2.25	0.021	No Difference
Inca Dove	7.41	12.1	−0.69	0.25	No Difference
Northern Cardinal	17.5	6.64	2.88	<0.01	Great-tailed Grackle
Blue Jay	24.5	2.53	5.15	<0.01	Great-tailed Grackle
House Sparrow	25.4	13.9	2.38	0.011	No Difference
Painted Bunting	21.3	5.24	2.64	0.014	No Difference

* The Bonferroni adjustment was calculated by dividing α = 0.05 by 6 comparisons performed, resulting in an adjusted α = 00.071.

TABLE 3. Percent time spent at feeding stations when White-winged Doves and other species were both present at the feeding stations in San Marcos and San Antonio, Texas during winter 2010.

	White-winged Dove	Other Species	t_1	P^*	Species Present Most
Great-tailed Grackle	15.7	10.8	0.97	0.17	No Difference
Mourning Dove	15.5	19.2	−0.51	0.31	No Difference
Inca Dove	18.0	6.9	1.90	0.041	No Difference
Northern Cardinal	15.8	5.9	2.18	0.020	No Difference
House Sparrow	13.0	21.0	−2.96	<0.01	House Sparrow

[*] The Bonferroni adjustment was calculated by dividing α = 0.05 by 5 comparisons performed, resulting in α = 0.01.

TABLE 4. Percent time spent at feeding stations when Great-tailed Grackles and other species were both present at feeding stations in San Marcos and San Antonio, Texas during winter 2010.

	White-winged Doves	Other Species	t_1	P^*	Species Present Most
Mourning Dove	9.56	14.6	−0.65	0.26	No Difference
Inca Dove	9.65	6.81	0.62	0.27	No Difference
Northern Cardinal	4.76	4.26	0.21	0.42	No Difference
House Sparrow	6.58	20.5	−5.00	<0.01	House Sparrow

[*] The Bonferroni adjustment was calculated by dividing α = 0.05 by 4 comparisons performed, resulting in α = 0.0125.

consistent food supply provided by bird feeders in urban areas may have performed an important function in survival, successful reproduction, and population growth. Even with other species present, White-winged Doves and Great-tailed Grackles typically spent more time at feeding stations than other species. House Sparrows also spent significant amounts of time at feeding stations. This species is one of the most "urban-adapted" of all bird species in North America. All three of these species feed in large flocks, which may allow them to dominate bird feeders; thus, limiting access to bird feeders by other species. However, competitive ability is just one of many factors that determine how well and quickly bird species can adapt to urban environments (Moller 2009).

TABLE 5. Percentage of conspecific displacements and interspecific aggression ratio calculated for species visiting feeding stations in San Marcos and San Antonio, Texas in summer and winter 2010.

Species	Sample Size (Displacement events)		Conspecific Displacements (%)		Interspecific Aggression Ratio	
	Summer	Winter	Summer	Winter	Summer	Winter
White-winged Dove	237	269	67.9	43.9	0.58	1.53
Great-tailed Grackle	305	141	73.8	62.4	3.48	2.41
Mourning Dove	21	34	23.8	23.5	3.20	0.70
Inca Dove	0	12	0	50.0	0	0.40
Northern Cardinal	58	30	5.17	23.3	2.12	2.56
Blue Jay	14	5	7.14	80.0	0.76	1.00
House Sparrow	37	20	67.6	65.0	0.11	0.04

While the relatively large-bodied Great-tailed Grackle was aggressive in both seasons, aggression of White-winged Doves toward heterospecifics varied by season. The species had a large number of conspecific interactions and a low heterospecific aggression ratio during summer. However, the ratio changed in winter and White-winged Doves became more aggressive. This may relate to an increased need for energy in winter because of larger body size and mass requiring greater nutrition. In previous studies, supplemental feeding has increased winter survivorship of other avian species (Brittingham and Temple 1988, 1992), providing an energy source when natural food abundance and availability has decreased. Non-migratory doves much farther north than the historical distribution must contend with established, native species to secure these limited food resources. Thus, non-migratory doves may be at a disadvantage in interactions for food and compensate with increased aggression. This may also be reflected by White-winged Doves and Great-tailed Grackles spending similar amounts of time at feeding stations as other species, while House Sparrows were present more often, perhaps because they do not migrate (Lowther and Cink 2006).

Our study suggests White-winged Doves and Great-tailed Grackles are capable of using urban food resources, possibly at the expense of other avian species. Only House Sparrows spent a comparable amount of time at feeding stations, and they also are an invasive species with a long history of spreading throughout North America. Further research is required to determine whether range expansions by White-winged Doves, Great-tailed Grackles, and House Sparrows are limiting food resources sufficiently to adversely affect native species.

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