INTRA-ANNUAL VARIATION IN WHITE-WINGED DOVE DENSITY IN THE TEXAS HILL COUNTRY

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ABSTRACT.—White-winged Dove populations in Texas have extended their range over the past 50 years. Concurrent with this range expansion has been the establishment of new, urban populations which usually include some proportion of non-migratory residents. We conducted distance sampling point counts for White-winged Doves on 17 occasions between February 2006 and February 2007. We obtained White-winged Dove density estimates for all 17 distance sampling occasions. In addition, we trapped and banded White-winged Doves from January through August 2006 and recorded ages (hatching year or after hatching year). Winter population size was about 30% smaller than summer peak population size. The peak in summer population size also corresponds strongly with peak numbers of HY captures, indicating population growth is most likely the result of reproductive recruitment and not immigration.

Prior to the early 20th Century, eastern White-winged Doves (*Zenaida asiatica asiatica*) in Texas had a breeding range restricted to the lower Rio Grande Valley (LRGV) (Cottam and Trefethen 1968). White-winged Doves predominantly nested in large colonies of riparian habitat along the terminal reach of the Rio Grande. As mechanized agriculture became more prevalent in the 1920s, large tracts of riparian habitat were destroyed for crop production (Purdy and Tomlinson 1991). About that time White-winged Doves in Texas began expanding their range northward to areas with suitable, alternative nesting habitat (Small et al. 2006).

During the 1950s, habitat destruction in the LRGV increased from growth of agricultural, municipal, and industrial land use (Jahrsdoerfer and Leslie 1988, Lonard and Judd 2002). Subsequently, the northward range expansion of White-winged Dove breeding populations accelerated and continues today. White-winged Doves remaining in the LRGV began using mature citrus groves as nesting habitat, however, periodic freezes killed mature trees and consequently this habitat proved unreliable over time (Schwertner et al. 2002).

Currently, more White-winged Doves in Texas occur outside the traditional breeding area than within (George et al. 1994). In addition, concurrent with this range expansion, White-winged Doves which established breeding populations outside the LRGV did so almost exclusively in urban and suburban areas. Also, a portion of these northern Texas populations have become year-round residents, foregoing the annual migration to southern Mexico typical of traditional populations.

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White-winged doves now breed in all 10 ecoregions of Texas (Gould et al. 1960, Small et al. 2006).

Very little information exists for urban populations of White-winged Doves. In particular, the migratory versus resident make-up of urban populations has not been investigated. The objectives of this study were to (1) document changes in White-winged Dove density over the course of a calendar year, (2) determine when peak and low densities occur as reference points in delineating the proportion of individuals that are resident and, (3) trap and leg-band White-winged Doves to assess the relationship in total density over time to number of hatching-year (HY) individuals captured (i.e., recruitment).

METHODS

Study area.—We conducted our study in and around Mason, Texas (Mason County, 30.75° N, 99.23° W) of the Edwards Plateau ecoregion (Gould et al. 1960). Mason encompasses 958.3 ha with a population of about 2,211 (City-data.com 2005). Our study was conducted continuously from January 2006 through February 2007.

Distance sampling protocol.—We used the 1992 National Land Cover Data Set (US Geological Survey 1999) to delimit urban land classification for Mason, Texas and global information systems (GIS) ArcView (Environmental Systems Research Institute, Inc., Redlands, California, USA) to buffer this area by 500 m (Schwertner and Johnson 2006). Thus our sample area encompassed 998 ha.

We used distance point transect sampling methodology (Buckland et al. 2001, Buckland 2006) to estimate White-winged Dove density on 17 occasions from February 2006 to February 2007. To establish a sampling transect, we first used GIS to create a pool of 125 random points within the study area, and the snap-to-layer function in GIS to move each point to the nearest road. From this pool, we randomly selected 100 points as a sampling transect. Because an entire transect of 100 points could not be completely sampled within a morning or evening period of just a few hours, we randomly divided each transect into 5 sets of 20 points each. Variation in protocol occurred during the first sample period, which required more than 5 d to complete.

We sampled mornings beginning shortly after official sunrise (Best 2001) with some variation occurring depending on weather conditions (overcast days required a slightly later starting time to allow enough light to make accurate counts) (Shields 1977, Robbins 1981). We followed Texas Parks and Wildlife Department sampling guidelines (Schwertner and Johnson 2006) with some modification.

Our sampling protocol used 2-min sample periods at each point. We used only visual counts to avoid bias associated with estimating distances using only auditory cues. Distances to White-winged Doves were determined to the nearest meter using a Bushnell™ Yardage Pro Legend laser range-finder (Bushnell, Inc, Overland Park, KS, USA). We also used cluster protocol (observations may consist of $\geq$1 dove) with doves considered to be clustered (dependent) when observed in a tree or when flying in flocks. Doves perched on artificial structures (i.e., power lines) or on the ground were counted as individuals (independent). All data were recorded on a standardized data sheet and recorded into a database upon completion of each survey. Data from all sampling efforts were originally combined into a single data set and imported into program DISTANCE. Individual sample periods were stratified at the region level. Two observation categories, cluster size and radial distance, were designated. All observations were made in meters with hectares as the unit of area.

The combined data were analyzed in program DISTANCE using detection functions for half normal with a cosine adjustment key, uniform with a cosine adjustment key, and hazard rate with a hermite adjustment key. All models were restricted to two terms, strictly monotonic, and data were right-truncated for outliers. Akaike Information Criterion corrected for sample size (AICc) was used to select the most parsimonious model (Burnham and Anderson 2003) for each density estimate.

Capture-recapture sampling protocol.—We trapped White-winged Doves between 18 January and 11 December 2006 using standard wire funnel traps (92 $\times$ 60 $\times$ 15 cm) (Reeves et al. 1968) baited with a mixture of commercial chicken scratch, black oil sunflower seeds, sorghum, and commercial wild bird feed (Purina Corp, St. Louis, Missouri) (Fig. 1). We set 12 to 18 traps each trap day on 160 d. Variation in number of traps used was contingent on landowner permission at available trap sites.

We marked all captured birds with U.S. Fish and Wildlife Service numbered aluminum butt-end bands on one leg and a colored band on the other and recorded all captures and recaptures.

All activities were conducted in accordance with Texas State University – San Marcos IACUC approval #06-05CC59736D, state permit #SPR-0890-234, and federal permit #06827.

Figure 1. White-winged Doves in a walk-in trap. Photo Michael Small

RESULTS

We calculated 17 density (Table 1) and population size estimates (density × 998 ha; Fig. 2) between February 2006 and February 2007. Low and high density estimates occurred from 8 to 19 February 2006 (0.93 doves/ha) and 24 to 28 July 2006 (3.25 doves/ha), respectively, although density estimates were essentially identical between 24 July and 31 Aug 2006. Coefficients of variation never exceeded 20% and was >13.02% on only one occasion. Distance sampling estimates indicated White-winged dove density peaked near the end of July and was lowest in mid-February. White-winged Dove density estimates were lowest for mid-February 2006 with density only 28.5% (95% CI = 27.6 to 29.5%) of estimated peak density obtained in late July 2006 (Fig. 2).

Table 1. White-winged Dove density estimates (per hectare) with corresponding 95% confidence intervals (CI) and associated coefficients of variation (CV) derived from distance sampling in Mason, Texas.

Sample Date	Density (95% CI)	CV
8–12, 15-19 Feb 2006	0.93 (0.736 – 1.167)	11.72
8–12 Mar 2006	1.45 (1.173 – 1.784)	10.63
30 Mar–2 Apr 2006	1.19 (0.955 – 1.482)	11.16
27 Apr–1 May 2006	1.43 (1.161 – 1.767)	10.64
17–20 May 2006	1.52 (1.254 – 1.846)	9.82
5–8 Jun 2006	1.73 (1.391 – 2.156)	11.11
26–30 Jun 2006	2.06 (1.254 – 1.846)	13.02
17–21 Jul 2006	2.36 (1.911 – 2.923)	10.78
24–28 Jul 2006	3.25 (2.672 – 3.961)	9.99
7–11 Aug 2006	3.25 (2.614 – 4.029)	10.98
27–31 Aug 2006	3.12 (2.538 – 3.844)	10.53
20–24 Sep 2006	2.40 (1.958 – 2.951)	10.41
18–22 Oct 2006	1.92 (1.490 – 2.469)	12.82
8–12 Nov 2006	2.31 (1.807 – 2.965)	12.56
7–11 Dec 2006	2.14 (1.725 – 2.667)	11.05
9–13 Jan 2007	1.18 (0.949 – 1.470)	11.10
10–14 Feb 2007	1.03 (0.695 – 1.520)	19.94

We captured a total of 2,071 doves comprising 1,745 individuals (909 adults, 779 young, 57 age unknown). We recaptured 326 White-winged Doves for an overall recapture rate of 15.74%. Recaptures involved 250 individuals: 198 recaptured once, 37 twice, 9 three times, 5 four times, and 1 seven times for an extremely high individual recapture rate of 14.33% (Schaeffer et al. 2006). Captures indicated a shift in the age composition of the population from AHYs to HYs beginning in June with HYs as the dominant cohort in the population (Fig. 3).

DISCUSSION

Techniques for monitoring avian populations have improved dramatically in recent years (Bibby et al. 2000, Rosenstock et al. 2002, Conway et al. 2004). In addition, as habitat fragmentation increases (Fletcher et al. 2006), urban populations have become the focus of more research (Klump 1996, Marzluff et al. 2001, Brum 2004, Blewett and Marzluff 2005). Comparative studies of avian populations in different habitats (Grue et al. 1981) and factors affecting results have also elucidated the need to tailor techniques to species (Pagen et al. 2002, Norvell et al. 2003, Howell et al. 2004).

Because White-winged Doves are expanding their breeding range in Texas, the need to effectively monitor populations is necessary to begin understanding intra- and inter-specific interactions in newly colonized areas. As populations increase and

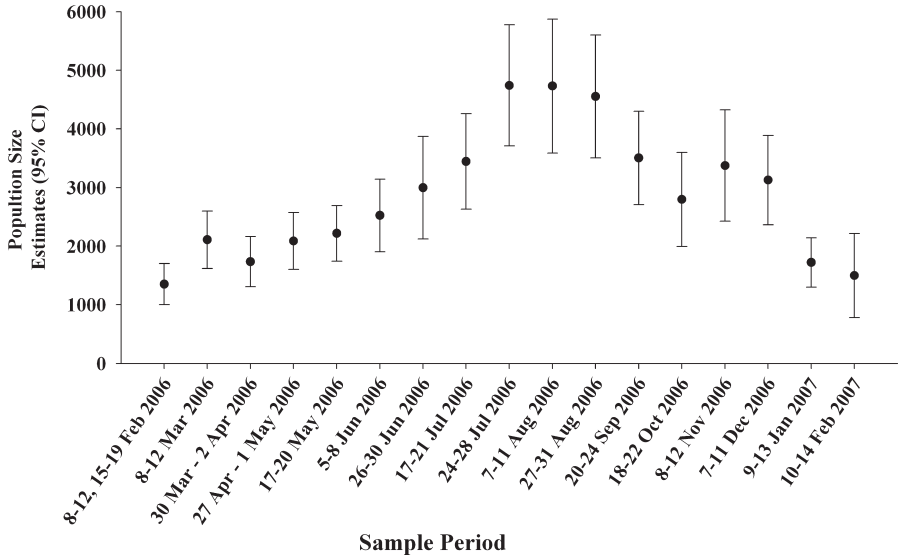

Figure 2. Population size estimates (95% confidence intervals) for White-winged Doves in Mason, Texas derived from distance sampling for 17 periods between February 2006 and February 2007.

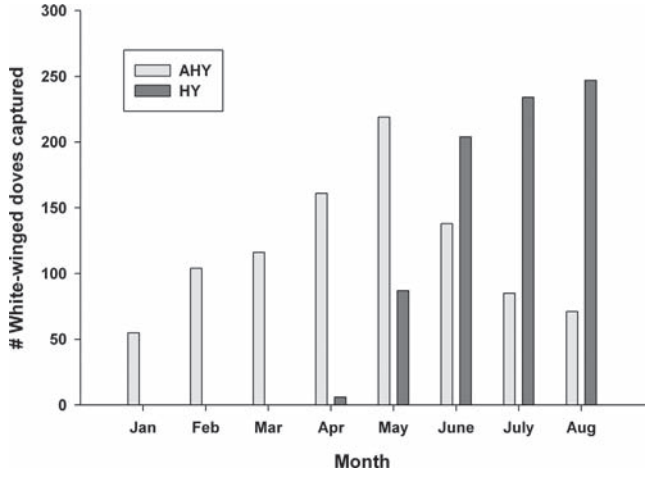

Figure 3. Number of new hatching year White-winged Doves captured during the summer breeding season in Mason, Texas, 2006.

new populations become established consequences are inevitable. The presence of White-winged Dove populations outside their traditional breeding range is likely to affect other avian species as competition for resources occurs. In particular, niche partitioning with other species is likely to become a demonstrative selective pressure in newly colonized areas.

Also, the status of White-winged Doves as a game species and its affinity for urban habitats in range expansion areas pose an especially delicate problem for management. White-winged Doves in urban habitats have shown a high degree of reliance on anthropogenic food and water resources making them unpredictable as a game species in the field in relation to established hunting seasons. Further, difficulty in establishing hunting season dates, length, and bag limits are exacerbated because a portion of these new populations are non-migratory residents. As a result, reliable estimates of population density, age composition of populations and movement are critical for sustainable management of this species.

Our study demonstrates that important demographic and natural history information can be effectively obtained for urban White-winged Dove populations. Additional testing should be conducted to determine the degree of bias (if any) present in sampling from roads as opposed to completely random sampling. Also, if further research to determine whether proportions of migratory to resident White-winged Doves vary temporally and spatially is still required. Additionally, there is no information on whether the same individuals comprise the resident winter population over time or what factors (i.e., individual age, gender) influence winter populations. Until a more complete understanding of White-winged Dove populations in Texas is reached, fully informed management and policy decisions regarding this unique species can not be made.

ACKNOWLEDGMENTS

We wish to thank J. Stayor and T. W. Schwertner for their assistance on this project. Funding was provided by the Texas Parks and Wildlife Department White-winged Dove stamp fund.

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FRANK B. ARMSTRONG'S TRADE IN LIVE BIRDS

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ABSTRACT.—Frank B. Armstrong and his agents collected live birds, mammals and reptiles in southern Texas and adjacent Mexico from 1900 through 1907. Organizations purchasing birds from Armstrong included the National Zoological Park, New York Zoological Park, New England Forestry, Fish and Game Association of Boston and the Philadelphia Zoo. A large collection of birds for exhibit in the Smithsonian flight cage at the 1904 World's Fair in St. Louis, Missouri, represents Armstrong's most ambitious undertaking.

Frank B. Armstrong (1863–1915, Fig. 1) of Brownsville, Texas, is considered one of the most productive bird collectors ever to work in southern Texas and adjacent Mexico (Oberholser 1974, Casto 1994). He prepared outstanding taxidermy mounts of birds but is best known for the thousands of study skins and egg sets bearing his tag that are found in museums throughout the United States and Europe (Casto 1994). Less known is the fact that Armstrong also traded extensively in live birds, reptiles, and mammals. This paper describes the trade in birds conducted by Frank B. Armstrong from 1900 until the sale of his live animal business in 1907.

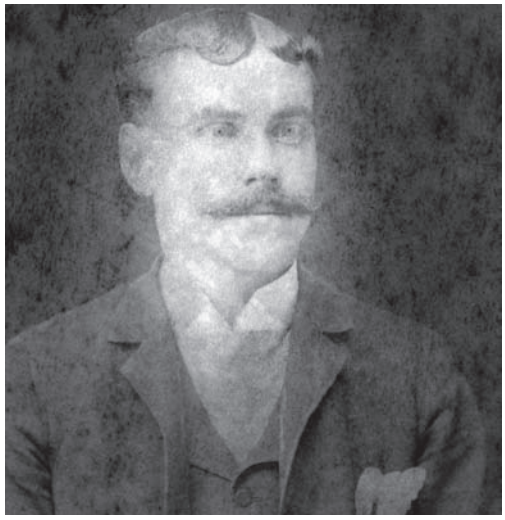

Figure 1. Frank B. Armstrong the "collecting naturalist" from Brownsville, Texas. Photograph courtesy of Frank B. Armstrong, III.

FIRST EFFORTS TO SELL LIVE BIRDS

Armstrong apparently conceived the idea of selling live birds while spending the winter of 1899–1900 at Corpus Christi. His method of advertising involved writing to zoos describing the birds that he could supply. One of his first orders was from William

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