An Evaluation of Sampling Methods for White-winged Dove Surveys in Urban Areas

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Abstract: Texas Parks and Wildlife Department (TPWD) has used auditory call counts annually since 1949 to monitor white-winged dove *(Zenaida asiatica)* populations in the Lower Rio Grande Valley of Texas. Recently, white-winged doves have been expanding their distribution, and now the largest populations occur in urban areas north of their historic south Texas range. It has become necessary to develop an urban survey method to better monitor these populations. We compared two call count sampling methods for surveying white-winged doves in urban environments (i.e., transects vs. grid-points in Austin during 1999–2002 and San Antonio during 2001–2002). We also determined the percent annual population change we were able to detect for each year with the current sample size using the grid-point survey method. Estimates of white-winged dove breeding density were higher using the transect method compared to the grid method each year. Power analysis indicated that with current sample sizes in each city, we were able to detect between a 20% and 30% annual change in mean population density in both Austin and San Antonio. We conclude the grid method can be more effective at reflecting the spatial distribution of white-winged doves in urban areas than the original transect approach. The grid method should be improved to reduce variance if it is to be used in the future. Accuracy of survey methods were not evaluated here. To obtain more reliable estimates of density, other methods such as distance sampling should be evaluated.

Key words: White-winged dove, urban, survey, call-count

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Texas Parks and Wildlife Department (TPWD) has used auditory call counts to index long-term white-winged dove *(Zenaida asiatica)* population trends in the Lower Rio Grande Valley (LRGV), Texas, since 1949 (Uzzell 1949, Cottam and Trefethen 1968). The procedure involves counting calling white-winged doves at predetermined stops and extrapolating that number and estimated calling intensity to an estimated breeding pair density (Uzzell and Kiel 1950, Rappole and Waggerman 1986). TPWD personnel conduct call counts throughout Texas during the first three hours of daylight during late May and early June.

In the late 1900s there was pronounced northward range expansion of the white-winged dove, primarily into urban areas. By 1993, the largest known nesting colony in the United States, estimated at >1 million individuals (George et al. 1994, Waggerman 2001), was within the city limits of San Antonio, Texas. It has been suggested that ornamental trees, bird feeders, and bird baths may be important components of urban white-winged dove breeding habitat (Small et al. 1989, George 1991, West 1993, West et al. 1993). White-winged dove breeding surveys that have been used for the past 50 years in rural areas of south Texas no longer provide a comprehensive picture of white-winged dove breeding trends throughout their range (J. Roberson, TPWD, unpub. report). Current survey methods need to be evaluated for applicability in urban areas to successfully monitor white-winged dove populations and measure the impact of management actions.

An urban road survey was initially implemented by TPWD in San Antonio in 1989 and Austin in 1990 to monitor breeding population trends. Call counts were systematically conducted along driving routes placed in residential areas that appeared to be white-winged dove habitat. This method seemed inadequate because of potential biases with limited line placement. A uniform grid of points throughout the urban area was later implemented in both cities to provide more complete coverage of each city.

Point counts are preferred for monitoring white-winged dove populations because they can be effective in estimating relative abundance of birds during the breeding season and to monitor long-term trends. Sanders (1999) suggested that point counts were a more effective method to detect annual population change of band-tailed pigeons *(Columba fasciata)* in Oregon than call-count routes suggested by McCaughran and Jeffrey (1980). Sanders (1999) evaluated precision of the point-count method but did not evaluate the relationship of number of cooing pigeons to population size. He assumed there was a relationship based on the studies by Sisson (1968) and Keppie et al. (1970).

We evaluated both sampling methods, the traditional transect method and the grid-point method, for use in urban environments. Our objectives were to: (1) compare white-winged dove density estimates between sampling methods; and (2) calculate the annual change in white-winged dove populations we were able to detect with the current sample size using the grid-point method. With the expansion of white-winged dove into urban areas north of their historic range, these results will help provide managers with an understanding of the effectiveness and potential problems with current survey methods.

Methods

Transect Survey Protocol

Transects were approximately 8 km (N = 4 Austin; N = 6 San Antonio) and placed along roads in residential areas that visually appeared to be white-winged dove nesting habitat. A small number of transects were used because of limited time and manpower to conduct the annual surveys. Standard call counts were conducted every 0.8 km along each transect (Rappole and Waggerman 1986). Each year, TPWD personnel surveyed 64–65 points in Austin and 71 points in San Antonio.

Grid Point Protocol

With the grid-point method, we overlaid a 1-km^2 grid of points over a map of each city with the city limits as the boundary. Each point was moved to the closest road or accessible point within 50 m of the original point to ensure consistent sampling and access each year. We then randomly selected points from the grid for surveying. Each year, we surveyed the maximum number of points that could be completed with the available time and number of observers. We surveyed between 122–204 points in Austin and 219–241 points in San Antonio.

Call-Count Protocol

The transect method and the grid method both were conducted in Austin during 1999–2002, and in San Antonio during 2001–2002. Each year, sampling was conducted from 15 May–1 June and daily from 30 minutes before sunrise until 0930 hours. Each survey was conducted using a 2-minute call count at each sample point where number of birds heard calling and calling intensity was measured and breeding-pair density was estimated (Uzzell and Kiel 1950, Rappole and Waggerman 1986).

Statistical Analyses

We compared the mean estimated breeding-pair density between the transect method and grid method for each city and each year and calculated 95% confidence intervals. It has been argued that confidence intervals can be useful for comparing means rather than statistical tests and P-values (Johnson 1999).

We determined what sample sizes would be necessary to detect a 10%, 20%, or 30% annual change in the mean population density at $\alpha = 0.10$ and $\beta = 0.20$ for the grid method for each city and each year. The sample size calculation was used as described in Zar (1999) for a one-sample t-test.

Results

Mean population estimates from the transect sampling method were higher than estimates from the grid point sampling method for each city and each year. Table 1 compares the two methods each year and lists 95% confidence limits for each mean.

The practical sampling effort, given manpower and time constraints, of 177 sur-

Table 1. Comparison of the mean density estimates of white-winged dove (pairs/ha) of transect and grid-sampling methods in Austin (1999–2002) and San Antonio (200–2002), Texas. The sample size, estimated mean population densities (mean ± standard deviation) and 95% confidence limits for each method are given.

City	Transects				Grid points			
Year	Transects	x̄ ± SD	Lower limit	Upper limit	Survey points	x̄ ± SD	Lower limit	Upper limit
Austin								
1999	4	26.4 ± 10.7	9.4	43.4	194	9.4 ± 14.1	7.4	11.4
2000	4	27.7 ± 6.2	17.8	37.6	204	16.1 ± 19.7	13.4	18.8
2001	4	27.4 ± 8.1	14.5	40.3	187	16.6 ± 19.6	13.8	19.4
2002	4	27.9 ± 5.9	18.4	37.4	122	10.1 ± 14.5	7.5	12.7
San Antonio								
2001	6	41.3 ± 5.3	35.7	46.9	241	18.3 ± 22.7	15.4	21.2
2002	6	42.5 ± 19.7	21.8	63.2	219	16.3 ± 21.2	13.5	19.1

Table 2. Estimated sample size of random survey points required to detect a 10%, 20%, or 30% annual change in the estimated mean population density of white-winged doves (pairs/ha) in Austin, Texas, for years 1999–2002 and San Antonio, Texas, for years 2001–2002 at alpha = 0.10 and beta = 0.20. The mean estimated population density (pairs/ha) and standard deviation are given for each year.

				Estimated sample size		
City	Year	Survey points	x̄ ± SD	10%	20%	30%
Austin	1999	194	9.4 ± 14.1	1379	345	155
	2000	204	16.1 ± 19.7	925	233	105
	2001	187	16.6 ± 19.6	877	221	99
	2002	122	10.1 ± 14.5	1,262	317	142
	Mean	177	13.0 ± 3.7[a]	1,110	279	126
San Antonio	2001	241	18.3 ± 22.7	984	248	111
	2002	219	16.3 ± 21.2	1057	266	119
	Mean	230	17.3 ± 1.4[a]	1021	257	115

a. The mean of means is represented as mean and standard error.

vey points in Austin and 230 points in San Antonio would be able to detect between a 20% and 30% annual change in population density ($\alpha = 0.10$ and $\beta = 0.20$). To detect an annual change in population density of 10%, a sample size of 1,110 survey points in Austin and 1,021 points in San Antonio would be required ($\alpha = 0.10$ and $\beta = 0.20$) (Table 2).

Discussion

The transect method reported greater white-winged dove densities than the grid method in both cities. This was expected because the biased placement of transects in areas of known white-winged dove nesting colonies. The grid sampling method provided more uniform coverage of the study cities and potentially is less biased; however, this method has shortcomings. Power analysis indicated the sample size required to detect a reasonable annual change in population density was not practical for the study cities based on the available personnel and time to conduct surveys each spring. The large estimated sample size was likely due to the high variance in the data (see Table 2), potentially attributable to the relatively high number of survey points with zero counts. In Austin, between the years 1999 and 2002, an average of 47% of the survey points had no calling doves. In San Antonio, between 2001 and 2002, an average of 38% of the survey points had no calling doves.

The grid method should be refined if it is to be used in the future. A possible improvement would be stratification of the habitat based on presence or absence of white-winged doves. Random sampling could then be conducted in each stratum. This would most likely reduce the variance by reducing zero counts, thereby reducing sample size. West (1993) developed an urban sampling design that stratified San Antonio into new residential areas (< 50 years old), old residential (≥ 50 years old), commercial areas, industrial areas, parkland, and rural areas. We believe that stratification of urban habitat should be conducted in a manner that is also meaningful for white-winged doves. For example, white-winged doves might select urban habitat based on specific characteristics such as dominance, density, and/or height of certain tree species. In a study in the Lower Rio Grande Valley Texas, Hayslette et al. (2000) found white-winged dove nesting density was highest in woodlands dominated by Texas ebony *(Pithecellobium ebano)* and Texas sugarberry *(Celtis laevigata)*. They also found mesquite *(Prosopis glandulosa)*-dominated woodlands were the least used for nesting by white-winged doves. West (1993) found that live oak *(Quercus virginiana)* was commonly used for nesting by white-winged dove in San Antonio. Hayslette and Hayslette (1999) also observed this on the Texas A&M University, Kingsville campus. Both studies also indicated use of Texas sugarberry and ash (*Fraxinus* spp.) for nesting by white-winged doves. Further, helpful human activity, such as lawn watering, bird feeding, and the use of bird baths, also might be important. Identifying habitat characteristics mentioned in the above studies and taking in consideration helpful human activity might provide the criteria for stratifying urban habitat.

Most white-winged dove colonies that we observed in the study cities occurred in areas where there was, indeed, a relatively high density of trees described as preferred nesting habitat by West (1993), Hayslette and Hayslette (1999), and Hayslette et al. (2000). If these habitat characteristics are correlates of white-winged dove nesting colonies, then geographic information systems (GIS) software may be used to delineate white-winged dove habitats from aerial photos of the study city. Once habitat is delineated, the grid method can be used to sample strata appropriately.

Management Implications

The grid method may be an appropriate means to sample white-winged dove, but the accuracy of the call-count method itself remains unknown and has been questioned (Waechtler 1977, Rappole and Waggerman 1986, Swanson 1989). It has been argued that index values are rarely closely related to true population size and are untrustworthy, possibly leading to unreliable knowledge (Romesburg 1981; Anderson 2001, 2003; Thompson 2002). Observer differences, environmental variables, and species behavior can influence detectability of birds resulting in biased index values (Anderson 2001). However, index values may be useful in long-term monitoring if steps are taken to evaluate the reliability of the index value (Anderson 2003). Double sampling is a possibility to evaluate index values (Bart and Earnst 2002).

Thompson (2002) argued for the need to conduct bird surveys in a way that accounts for detectability. To address detectability, distance sampling (Buckland et al. 2001) with point transects may be effective to gain a more reliable measure of white-winged dove density (Anderson 2003, Rosenstock et al. 2002). This method would allow a true measure of density rather than an index to base management decisions. There are also potential problems with this method as well. White-winged doves are colonial species and are often present in high densities. This makes it difficult to distinguish individual calling birds and potentially could result in biased estimates of densities. Distance surveys used with the grid sampling method and appropriate stratification possibly could be used to effectively survey urban populations of white-winged doves and warrants evaluation. As white-winged dove continue their northward expansion, an effective survey method that can be easily implemented is necessary.

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