DETERMINATION OF AGE AND SEX RELATED DEMOGRAPHIC DIFFERENCES IN PROPORTIONS OF WHITE-WINGED DOVES AVAILABLE FOR HARVEST VERSUS INDIVIDUALS HARVESTED

THESIS

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ABSTRACT

Determination of Age and Sex Related Demographic Differences in Proportions of White-winged Doves Available for Harvest Versus Individuals Harvested

by

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I compared various methodologies for gathering demographic data for White-winged Doves (*Zenaida asiatica*) in the Lower Rio Grande Valley, Texas. My study was conducted between 11 May and 13 September 2009. I used distance sampling to obtain weekly density estimates and estimate recruitment rates (indirectly) from births. I used trapping and banding to estimate sex and age ratios, weekly birth rates, and weekly hatching-year survivability. I estimated productivity and density from nest surveys. Also, age and sex ratios for harvested doves were determined. I concluded nest surveys are an unreliable and inefficient method for collecting demographic data, however,

distance sampling, trapping and banding, and harvest data provided reliable and time efficient demographic parameter estimates for White-winged Dove populations.

CHAPTER I

INTRODUCTION

White-winged Doves (*Zenaida asiatica*) are mid-size columbids (~150 g) with an overall grayish brown coloration and a prominent white wing bar across the outer wing coverts (Schwertner et al. 2002). The distribution extends from the southernmost U.S. to Central America and the West Indies (Schwertner et al. 2002) where they are an important game species.

The geographical distribution of White-winged Doves in Texas has shifted substantially northward over the last 60 years, most likely as a result of associated changes in land use practices (Purdy and Tomlinson 1991). These changes predominantly occurred from 1950 to the present and involved an increase in the abundance of White-winged Doves (Small et al. 2006). Prior to 1950, White-winged Doves in Texas nested in brush and riparian habitats, usually in large colonies, as far north as Bee County (Oberholser 1974). However, the majority of these individuals nested in a four-county (Cameron, Willacy, Hidalgo, and Starr) region at the southernmost tip of Texas referred to as the Lower Rio Grande Valley (LRGV) (Jahrsdoerfer and Leslie 1988).

In Texas, changes in the White-winged Dove distribution have occurred at both the population and local levels (Small and Waggerman 1999). At the population level, the distribution increased by about 200%, almost exclusively as a result of a northward expansion and colonization. On the local scale, newly colonized northern populations became urbanized, with some proportion of these sub-populations becoming year-round residents (Schwertner et al. 2002).

The Texas Parks and Wildlife Department (TPWD) is currently using distance sampling (Buckland et al. 2001) and mark-recapture banding to census doves throughout the state. The goals of this effort is to collect large quantities of statistically robust data for determining the best method(s) for monitoring dove populations, determine information deficiencies, and develop an adaptive management plan (Walters 1986).

As part of that overall goal my primary objective was to determine differences in demographic parameters using distance sampling, trapping/banding, nest surveys, and harvest data. Identification of differences in these biological parameters is critical for developing and implementing management strategies. Age and gender demographics drive White-winged Dove productivity and recruitment. However, adult to juvenile and male to female ratios during the breeding season are unlikely to equal adult to juvenile and male to female trap and harvest ratios because breeding and hunting season are separated in time and influenced by immigration, emigration, mortality, and recruitment. As such, adaptive management, in the sense of setting bag limits based on actual demographic parameters, cannot be implemented without a better understanding of how harvest during a given season is likely to affect the following year's population. This is particularly true as related to White-winged Doves productivity and recruitment.

I tested the following hypotheses:

1. The ratios of adult to juvenile and male to female White-winged Doves available for harvest at the start of the hunting season can be reliably estimated.
2. The ratio of adult to juvenile and male to female White-winged Doves trapped (and banded) and differences (i.e., bias) relative to objective 1 can be measured.
3. The ratio of adult to juvenile and male to female White-winged Doves harvested can be measured and differences (i.e., bias) relative to objective 1 identified.

CHAPTER II

METHODS

Study Area

My study was conducted in Cameron and Hidalgo counties in the LRGV Texas 11 May – 13 September 2009. The primary study site was the Anacua Unit (N 26.07 W -97.84) (Fig. 1) of Las Palomas Wildlife Management Area (hereafter Las Palomas WMA). The Anacua Unit is 89.8 ha in size and located in western Cameron County south of Santa Maria, Texas. In some instances additional sites near the primary site were added to increase sample size. Nest surveys were conducted at the Anacua Unit of Las Palomas WMA and the La Gloria Unit (N 26.07 W -97.81) of the Lower Rio Grande Valley National Wildlife Refuge (hereafter LRGVNWR) in western Cameron County south of Blue Town, Texas. Estero Llano Grande State Park (N 26.13 W -97.95, located in eastern Hidalgo County south of Weslaco, Texas) was used as an additional trapping and banding site and the Carricitos Unit (N 26.18 W -97.58, located in Cameron County northeast of San Benito, Texas) and Taormina Unit (N 26.11 W -98.04, located in Hidalgo County south of Donna, Texas) of Las Palomas WMA, and Resaca de La Palma State Park (N 25.99 W -97.56, located in Cameron County southwest of Olmito, Texas) were used to collect harvest data during the Special White-winged Dove Hunting Season (5-6 and 12-13 September 2009) (Fig.1).

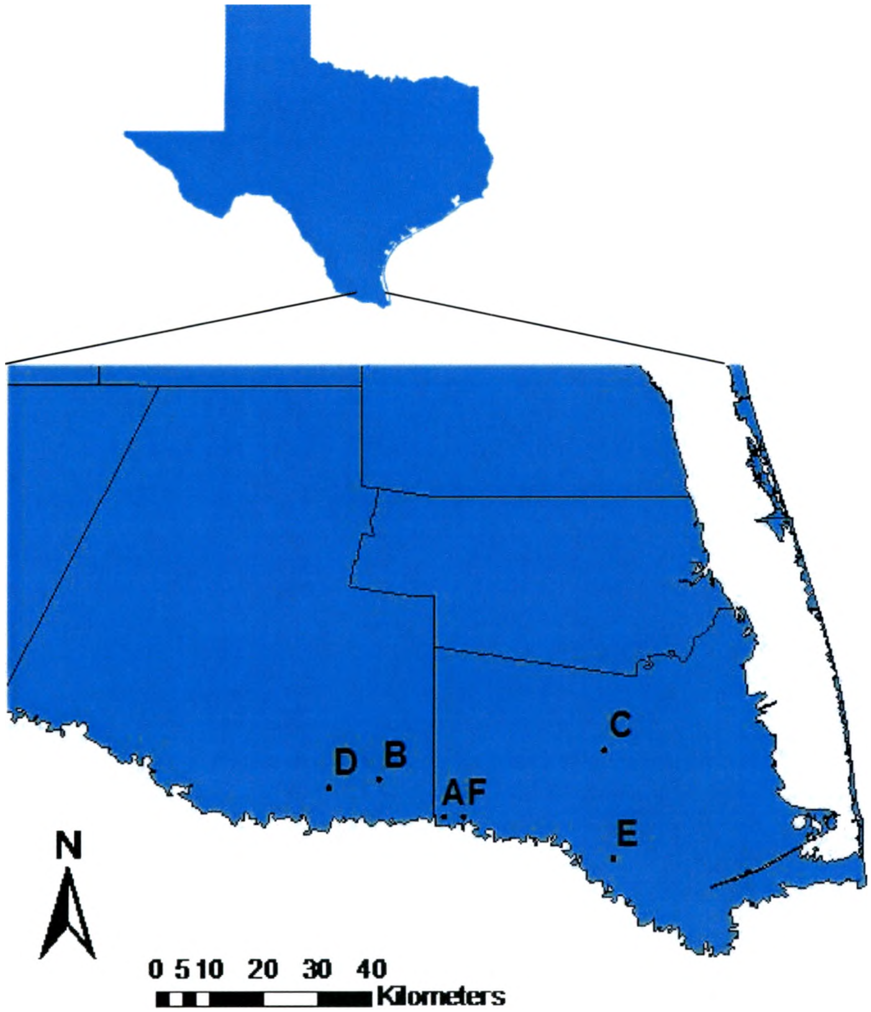

Figure 1. Location of study sites in the Lower Rio Grande Valley. Sites were: A - Anacua Unit of Las Palomas Wildlife Management Area; B – Estero Llano Grande State Park; C – Carricitos Unit of Las Palomas Wildlife Management Area; D – Taormina Unit of Las Palomas Wildlife Management Area; E – Resaca de la Palma State Park; F – La Gloria Unit Lower Rio Grande Valley National Wildlife Refuge.

I used nest transects (Rappole and Waggerman 1986, Rivera-Milán 1996, Hayslette et al. 2000, Sepúlveda et al. 2006), mark-recapture (Seber 1982, Skalski and Robson 1992, Thompson et al. 1998, Williams et al. 2001), direct counts (Bailey 1984), and hunter bag checks (Skalski et al. 2005) to evaluate indices used for estimating demographic parameters of a population of White-winged Doves in South Texas. I obtained estimates of demographic ratios of trapped and banded doves for the duration of the breeding season (11 May – 15 August 2009), nest density, nest productivity, survivorship of hatching-year (HY) doves to the start of the hunting season (5 September 2009), the ratio of after-hatch-year (AHY) to HY doves during and after the breeding season, and demographic ratios (age and sex) of harvested doves.

Distance Sampling

Survey Points

I imported Color Infrared (CIR) National Agriculture Image Program (NAIP) Digital Orthophoto Quarter Quads (DOQQ) of the Anacua Unit into geographic information systems (GIS) software package ArcGIS 9.3.1 (Environmental Systems Research Institute, Inc., Redlands, CA, USA). I used Hawths Tools (Beyer, 2004, Hawth's Analysis Tools for ArcGIS, http://www.spatialecology.com) to generate 25 random points on the Anacua Unit access and adjacent roads (Fig. 2).

Figure 2. Survey points used for distance sampling (n = 25) on Anacua Unit of Las Palomas Wildlife Management Area and adjacent roads. Fields and roads in the center are private and inaccessible.

Distance Sampling Protocol and Analysis

I estimated White-winged Dove density using point-count distance sampling surveys beginning 11 May 2009 and continuing until 15 August 2009 (Buckland et al. 2001). I conducted surveys over 5-day periods by surveying 5 points/day. All surveys occurred between 15 min post-official sunrise and no later than 2-h post-official sunrise. Each point was surveyed for 2 min. The distance to all White-winged Doves observed was determined using a Bushnell™ Yardage Pro Legend laser range-finder (Bushnell, Inc, Overland Park, KS, USA). I analyzed these data with Program Distance 6.0 (Thomas et al. 2010) which produce density estimates for each week of the study. At the start of the study, density estimates included only adults because nesting had not commenced. Density estimates later in the study included adults plus young and included any effects of immigration, emigration, mortality, and recruitment. As such, the density estimate at the end of the breeding season minus the density estimate at the beginning of the breeding season provided an estimate of the density of young, non-dispersing, surviving doves recruited into the population (assuming constant adult density).

I compared five candidate models in Program DISTANCE with no data truncation and restricted to no more than two adjustment terms with sample period (5-day survey period) as a covariate. I used the Akaike Information Criterion (AIC) to select the most parsimonious model (Burnham and Anderson 2003) and the most appropriate truncation point. Data were reanalyzed using various truncation points around the original choice until the data satisfactorily fit the probability of detection curve both visually and statistically (i.e., assessed using the Komolgorov-Smirnov test *P*-value calculated by DISTANCE).

Trapping and Banding

Sixty modified Kniffin-funnel traps (Reeves et al. 1968) were set and monitored from 11 May through 15 August 2009 on the Anacua Unit of Las Palomas WMA (Fig. 3). An additional 30 traps were set at Estero Llano Grande State Park and monitored between 1 June and 15 August 2009. I define a trap-day as any day that a trap was set. There were a total of 82 trap-days on the Anacua Unit and 70 at Estero Llano Grande State Park. Traps were standard wire funnel traps with the dimensions of 91.4 x 61 x 25.4 cm with funnels that were 20.3 x 10.2 x 12.7 cm. Traps were baited with a mixture of cracked corn, wild bird seed, and black oil sunflower seeds (Fig. 3).

Figure 3. Modified Kniffin-funnel trap used to trap White-winged Doves.

All captured White-winged Doves were banded with a size 4A United States Fish and Wildlife Service aluminum leg band on the right leg. All captures and recaptures were recorded. Additionally, age class (AHY and HY) was determined by examining external morphological characteristics. After hatching year birds have a blue eye ring, bright orange eye, bright red feet, and black beak, while HY birds have a dull gray eye ring, dull colored eye, pale flesh colored feet and beak. Gender was determined for all AHY birds on the Anacua Unit using cloacal characteristics (Miller and Wagner 1955). The proportion of AHY to HY and male to female doves (for AHY doves only) was determined by direct counts. Goodness-of-fit tests were used to determine if sex and age ratios differed from an expected 1:1 ratio.

Hatching Year Survivorship

I estimated HY survivorship for Estero Llano Grande State Park at one-week intervals using Program MARK. Four candidate models were evaluated based on survivorship (□) and probability of capture (*p*) for a fully time dependent model and three nested models using the recaptures only function. The most parsimonious model was selected based on the lowest Akaike Information Criterion corrected for small sample size (AICc).

Recruitment was also estimated for the Anacua Unit of Las Palomas WMA by determining the number of new HYs trapped each week. This weekly estimation of recruitment should match the results of the nesting and density estimates.

Nest Surveys

Transects were created by initially importing CIR NAIP DOQQ maps of the study site into ArcGIS 9.3.1 (Environmental Systems Research Institute, Inc., Redlands, CA, USA). I drew lines along the edge of all brush lines on the Anacua Unit large enough to contain a 10 x 100 m (0.1 ha) belt transect. I used Hawths Tools (Beyer, 2004, Hawth's Analysis Tools for ArcGIS, http://www.spatialecology.com) to generate 30 random points on this line $\geq$ 20 m apart. These 30 points were used as the left edge starting point for each transect. I used a Garmin eTrex® GPS unit (Garmin International, Inc., Olathe, KS, USA) to delimit the extent of each belt transect.

Nest surveys were conducted by searching for all nests within transects. Transects were surveyed twice a month beginning 15 May through 15 August 2009. Additionally, I surveyed 10.9 ha on the La Gloria Unit of the LRGVNWR from 2 July through 14 August 2009. Nests were considered active if an adult was present at the nest and the nest contained either an egg(s) or nestling(s). I chose this criterion because both males and females participate in nest attendance; thus, presence of an adult at a nest is ~100% during nesting (Cottam and Trefethen 1968, Schwertner et al. 2002, Small et al. 2006). All nests located on transects were monitored at 2-day intervals to determine the number of nests fledging 0, 1, and 2 young. I used a mirrored pole to view the contents of nests (Parker et al. 1972). I included all active nests in calculating weekly nest densities, and the mean number of young produced per nest.

Harvest Demography

During the Special White-winged Dove hunting season (5-6 and 12-13 September 2009), hunters' bags were examined and the number and proportion of AHY to HY and male to female White-winged Doves harvested were determined by direct counts. I used external morphological characteristics to verify age and sex via internal examination of the gonads. I also collected harvest data from multiple areas (5-6 September 2009 Anacua, Taormina, and Carricitos Units of the Las Palomas WMA as well as Resaca de la Palma State Park; 12-13 September 2009 the Anacua Unit only) in an effort to increase the sample size. I applied goodness-of-fit tests to determine whether sex and age ratios differed from an expected 1:1 ratio. 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.

CHAPTER III

RESULTS

Distance Sampling

During the study period the number of White-winged Doves recorded and the number of observations fluctuated by week (Table 1). The lowest number of doves per observation was during the week of 24 May to 30 May (1.36/observation), while the highest number of doves per observation was during the week of 26 July to 1 August (6.55/observation).

The most parsimonious model selected by Program DISTANCE was a hazard rate with simple polynomial adjustment terms of 4 and 6 and the data truncated at 242 m (D = 0.03, P = 0.44). Density estimated for White-winged Doves ranged from 1.05/ha in Week 4 to 9.79/ha in Week 11 (Table 2 and Fig. 4). By subtracting the estimated density at the beginning of the breeding season (1.37/ha) from the end of the breeding season (5.82/ha), recruitment of new individuals produced an estimated density of 4.45/ha.

Table 1. Summary of the number of White-winged Doves recorded, number of observations, and number of White-winged Doves per observation by week.

Week	Doves Recorded	Observations	Doves/Observation
5/10 - 5/16	90	50	1.80
5/17 - 5/23	50	32	1.56
5/24 - 5/30	64	47	1.36
5/31 - 6/6	56	32	1.75
6/7 - 6/13	86	50	1.72
6/14 - 6/20	126	57	2.21
6/21 - 6/27	174	50	3.48
6/28 - 7/4	181	65	2.78
7/5 - 7/11	180	57	3.16
7/12 - 7/18	308	89	3.46
7/19 - 7/25	601	102	5.89
7/26 - 8/1	596	91	6.55
8/2 - 8/8	268	63	4.25
8/9 - 8/15	487	80	6.09

Table 2. Summary of White-winged Dove densities per hectare (ha) by week. The coefficient of variation, 95% lower and upper bounds, and lower and upper confidence intervals for weekly densities.

Week	Density	%CV	95%lb	95%ub
5/10 - 5/16	1.37	16.17	0.99	1.87
5/17 - 5/23	1.17	16.92	0.84	1.66
5/24 - 5/30	1.37	15.24	1.01	1.84
5/31 - 6/6	1.05	18.29	0.73	1.50
6/7 - 6/13	1.41	16.35	1.03	1.94
6/14 - 6/20	2.08	17.02	1.49	2.90
6/21 - 6/27	1.57	21.67	1.03	2.39
6/28 - 7/4	2.96	18.43	2.07	4.24
7/5 - 7/11	3.31	19.67	2.25	4.86
7/12 - 7/18	5.25	17.19	3.75	7.33
7/19 - 7/25	9.79	19.02	6.76	14.18
7/26 - 8/1	8.62	21.84	5.64	13.19
8/2 - 8/8	3.86	21.01	2.56	5.81
8/9 - 8/15	5.82	21.62	3.82	8.87

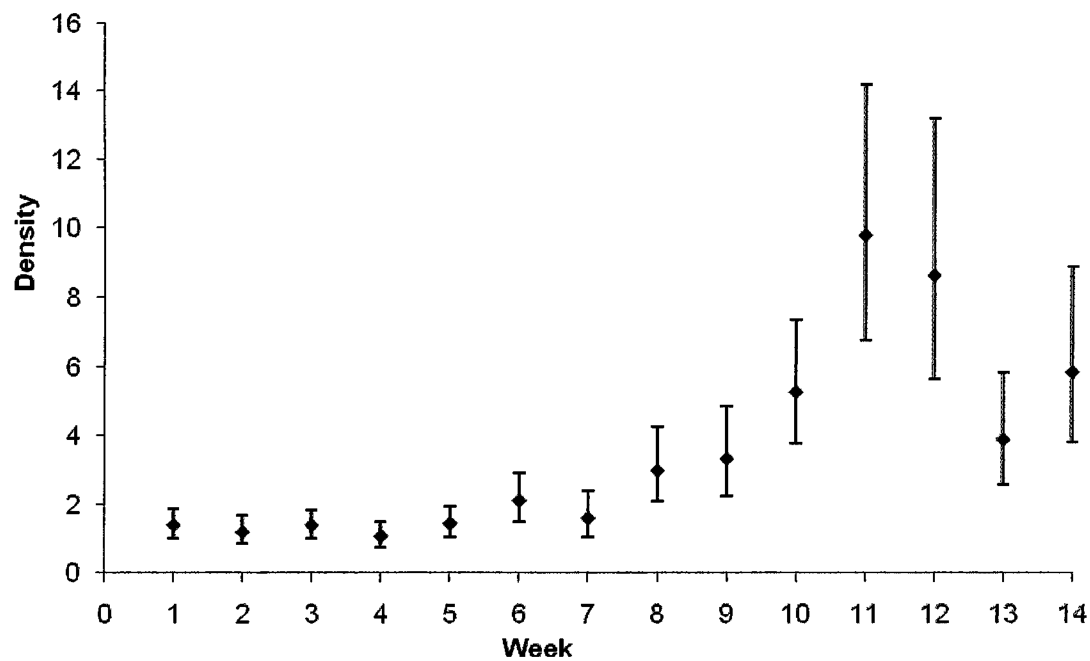

Figure 4. Weekly estimates of White-winged Dove densities with 95% CI's.

Trapping and Banding

At the Anacua Unit 734 White-winged Doves were banded with 56 recaptured. The ratio of HY:AHY doves was 8.28:1 with 654 HY and 79 AHY(one individual was of unknown age). There was a significant difference between the HY:AHY ratio ($\chi^2 = 451$, $p < 0.05$). The AHY male:female ratio was 4.21:1 with 59 males and 14 females (there were 6 of unknown sex). There was a significant difference between the AHY male:female ratio ($\chi^2 = 27.7$, $p < 0.05$). There was also a large increase in the number of new HY White-winged Doves captured from 11 in Week 9 (5 July - 11 July) to 279 in Week 11 (19 July -25 August). This increase was followed by a sharp decrease (Fig. 5).

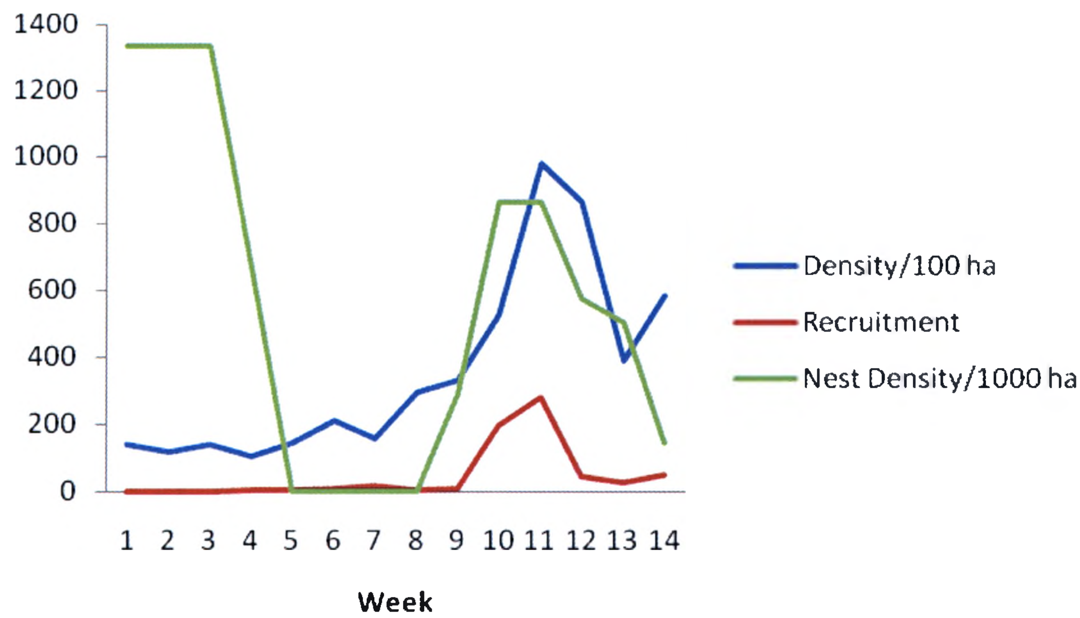

Figure 5. Weekly comparisons of White-winged Dove hatching year (HY) bird recruitment to density/100 ha and nest density/1,000 ha.

The most parsimonious model for HY survivability was one in which survivorship was time dependent with probability of capture as a constant; □ = 1.94 x 10^{-7} and $p = 8.0 \times 10^{-8}$ for the study period.

Nest Surveys

For the entire period, the mean active nest density was 0.58 nests/ha (SE = 0.19). Nest density was the highest 10 May to 30 May (1.33/ha), with another peak occurring 12 July to 25 July (0.86/ha) (Table 3).

Table 3. Weekly summary of active White-winged Dove nests and corresponding densities.

Week	Anacua	La Gloria	Area (ha)	Density (Nests/ha)
5/10-5/16	4	0	3.00	1.33
5/17-5/23	4	0	3.00	1.33
5/24-5/30	4	0	3.00	1.33
5/31-6/6	2	0	3.00	0.67
6/7-6/13	0	0	3.00	0
6/14-6/20	0	0	3.00	0
6/21-6/27	0	0	3.00	0
6/28-7/4	0	0	13.89	0
7/5-7/11	1	4	13.89	0.29
7/12-7/18	2	12	13.89	0.86
7/19-7/25	2	12	13.89	0.86
7/26-8/1	0	8	13.89	0.58
8/2-8/8	0	7	13.89	0.50
8/9-8/15	0	2	13.89	0.14

I monitored 27 nests which fledged 30 young. Nine nests failed completely, 6 fledged one young, and 12 fledged 2 young. Nest productivity was estimated to be 1.11 young per nest for the sample period.

Harvest Demography

A total of 665 harvested White-winged Doves were examined for sex and age. Overall M:F ratio was 1.27:1 with 393 males and 310 females harvested. There was a significant difference between the M:F ratio ($\chi^2 = 9.79$, $p < 0.05$). Overall HY:AHY ratio was 0.62:1 with 254 HY and 411 AHY harvested, this ratio was significantly different ($\chi^2 = 37.1$, $p < 0.05$). Hatching Year M:F ratio was 1.85:1 (165 males and 89 females) and AHY M:F ratio was 1.07:1 (212 males and 199 females). Male HY:AHY ratio was 0.78:1 (165 HY and 212 AHY) and female HY:AHY ratio was 0.45:1 (89 HY and 199 AHY). The sex and age ratios were dependent on each other ($\chi^2 = 11.5$, $p < 0.05$).

CHAPTER IV

DISCUSSION

Distance sampling provided several density estimates important to the management of White-winged Doves as a game species. These include weekly estimated dove densities and observations, both of which peaked during the same weeks. These peaks in dove density and number of observations can be explained by the large number of newly fledged individuals entering the population as evidenced by an active nest-density peak during the weeks of 12 July to 25 July (0.86/ha). Also worth noting, active nest-densities had two peaks (10 – 30 May and 12 – 25 July) which has been documented previously (Cunningham et al. 1997).

Another notable peak in the population was the estimated recruitment of new HY individuals the week of 19 July to 25 July (279). This value is also explained by the nest density peak that occurred during this same period (Fig. 5). There was also a decrease in estimated recruitment following the week of 26 July to 1 August, which can be attributed to a decline in nest density (0.58nests/ha) during the same week (Fig. 5).

Also important to understanding animal populations are sex and age ratios (Petrides 1950). The difference in the ratios of HY:AHY individuals obtained from trapping (8.28:1) and harvest (0.62:1) is probably related to the collection of trapping data during the breeding season when more HY birds were in the population. The reason for the lower numbers of HYs in the harvest was likely attributable to post-fledging mortality and dispersal from the study area. Male:female ratios also differed between trapping (4.21:1) and harvest (1.07:1); which I attribute to males being attracted to traps more than females. When harvest data were evaluated by age cohorts, there was a noticeable difference in M:F ratios. Hatching-year M:F ratio was 1.85:1 and AHY M:F ratio was 1.07:1. This indicates more male HYs were available for harvest than AHY males. Harvest data also showed that regardless of sex more AHY birds were harvested than HYs. This can be attributed to dispersal and post-fledging mortality of HY birds before the hunting season began.

Estimates of production (1.11young/nest) and nest density (0.58/ha) provided by nest surveys were lower than those reported in previous studies in the LRGV (Rappole and Waggerman 1986, Hayslette et al. 2000, Sepúlveda et al. 2006). This low production suggests that nest predation could be high for White-winged Doves. The low value for mean nest density also expresses the need for the conservation of suitable White-winged Dove nesting habitat.

The low HY probability of survivability and recapture could be explained by either high mortality or dispersal from the study area. To curtail this problem the number of nesting adults could be near 100% to keep the population surviving, or adults could be laying multiple clutches during the nesting period which has been noted during other studies (Schaefer et al. 2004).

CHAPTER V

MANAGEMENT IMPLICATIONS

My study verifies that different data collection methods can be used to gather demographic information about White-winged Doves. Nest surveys were time and labor intensive and probably not feasible to conduct on a yearly basis. Harvest, trapping and banding, and distance sampling were the best methods for estimating demographic parameters used in White-winged Dove management.

Currently TPWD collects harvest data by obtaining the number of White-winged Doves harvested on Wildlife Management Areas during the Special White-winged Dove Harvest Season. Trapping and banding is another method that is currently being used. Distance sampling is currently conducted in the spring and only in urban areas. My study shows dove densities can vary greatly depending on time of the year.

To improve the current methods of estimating demographic parameters, I would suggest several changes. I suggest recording age and sex ratios in addition to the numbers of doves harvested on Wildlife Management Areas during the Special White-winged Dove Harvest season. This would require minimal training and additional time to gather important population demographic information. Distance sampling should also be conducted as close to the harvest season as possible. Doing this would ensure that the estimated White-winged Dove densities would reflect the number of individuals available for harvest. Nest surveys should also be conducted on some rotational basis to ensure that other methods for estimating the population demographics are accurate.

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