Harvest Parameters of Mourning Doves in the Chenier Plain of Southwestern Louisiana

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Abstract: Mourning doves (*Zenaida macroura*) are an important webless migratory game bird in North America, with more doves harvested than all other game birds combined. To understand mourning dove population status and inform harvest and land management decisions at local and regional scales, there is a need to evaluate annual survival and changes in population size. To provide estimates of dove survival and associated harvest parameters at our study area in Cameron Parish Louisiana, a popular area for dove hunting, we initiated a banding study at two sites on and near the Rockefeller Wildlife Refuge, Louisiana. From 2010 to 2018, we banded 957 mourning doves. We used 174 recaptures from our study area with 46 band recovery reports to model annual survival probabilities, recapture probabilities, recovery probabilities, and fidelity to our study area. Our point estimates of survival and recapture probabilities were greater for after hatch year birds vs. hatch year birds and as expected based on previous studies, but our estimates had wide confidence intervals and results were therefore inconclusive. Recovery probabilities were slightly greater for hatch year doves (0.101, SE = 0.022) vs. after hatch year birds (0.038, SE = 0.010), and site fidelity, estimated only for hatch year doves, was 0.358 (SE = 0.139). Overall, our point estimates were not substantially different from those elsewhere in the Eastern Management Unit (EMU), although all were limited in precision. Like other studies on mourning doves, site fidelity was high. Most (89.1%) reported recoveries of our banded doves occurred in Louisiana, especially within the region of our study area. Our findings support the importance of managing, conserving, and recovering the species at the local scale.

Key words: banding, harvest, mark-recapture, recovery, *Zenaida macroura*

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The mourning dove (*Zenaida macroura*; hereinafter, dove) is an important webless migratory game bird throughout the United States with approximately 11.5 million individuals harvested nationwide each year (U.S. Department of Interior et al. 2016). Approximately 709,000 dove hunters take to the field annually, where they spend more than 2 million days afield and spend an estimated $86.9 billion on hunting related items, generating an estimated $11.8 billion in tax revenues (U.S. Department of Interior et al. 2016). In Louisiana and other southern states, mourning doves are abundant year-round and even more so during migration and throughout winter (Beckwith 1959). Despite their year-round abundance, mourning dove populations are declining regionally in some southern states, including Alabama, Georgia, and possibly Mississippi (Sauer et al. 2017).

Large-scale studies of mourning doves between the 1950s and 1980s were focused on migration patterns (Kiel 1959), survival and harvest rates (Hayne 1975, Dunks et al. 1982, Tomlinson et al. 1988), and recruitment rates (Ruos and Tomlinson 1967, Geissler et al. 1987). Historically, mourning dove population estimates were based primarily on Call Count surveys, an annual roadside index to dove abundance (Miller 2009, Otis et al. 2008). To improve survey efforts and develop a long-term strategy for harvest, a national strategic harvest management plan was implemented in 2003 (U.S. Department of Interior et al. 2016). The plan established monitoring programs to evaluate mourning dove survival and reproduction (Miller 2009). As part of this plan, three management units (Eastern, Western, and Central) were established to aid with monitoring and managing dove populations. The current national dove banding program involves landscape level, multi-state banding efforts aimed at improving our understanding of dove population biology and estimating effects of harvest on dove populations (Seamans 2020).

There is a need to conserve mourning dove populations because of their economic importance and for recreational opportunities, including hunting. To maintain stable long-term population densities, credible harvest management plans must require a

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long-term commitment to monitoring the focal dove populations (Otis 2002). Moreover, data collected through banding programs are necessary to inform habitat management decisions, particularly at the local and regional scales (Bonnot et al. 2011). Therefore, to evaluate mourning dove survival and recovery probabilities in southern Louisiana, part of the Eastern Management Unit (EMU), we initiated a mark-recapture study from 2010 to 2018. The goal of our study was to use recaptures from our study sites in combination with band recoveries to estimate annual survival probabilities, recapture probabilities, recovery probabilities, and fidelity to the study area.

Study Area

We live-trapped mourning doves on, and directly adjacent to, Rockefeller Wildlife Refuge (Figure 1). Rockefeller Wildlife Refuge lies within the southeastern portion of the Chenier Plain Region of southwestern Louisiana in Cameron and Vermilion parishes between approximately 92°54' E and 92°30' E longitude. The Chenier Plain, located near the southwestern corner of Louisiana's Acadiana triangle parallel to and approximately 8 km north of the present Gulf Coast, is readily identifiable by its unique cheniers, relict beach ridges that run east and west from sedimentation formed by historic fluctuation in the Mississippi River delta (Crowell 2015). Today, cheniers are recognizable by their narrow strips of forests characterized primarily by live oak (*Quercus virginiana*) and hackberry (*Celtus laevigata*). The 9136-ha Rockefeller Wildlife Refuge

Figure 1. Trapping locations used in a banding study of mourning doves (*Zenaida macroura*) to assess harvest parameters for our study sites at Rockefeller Wildlife Refuge and Nunez Woods, Cameron Parish, Louisiana, 2010 to 2018.

is managed by the Louisiana Department of Wildlife and Fisheries agency's Coastal and Non-Game Resources Division.

We conducted trapping and banding at two locations approximately 2.5 km apart: Chevron and Nunez (Figure 1). The Chevron site was an oil pad that was abandoned in 2014, and during our study, was predominantly bare ground with a few sparse scattered forbs and minimal amounts of loose gravel/grit. The surrounding landscape consisted of pastureland with plant communities dominated by longtom (*Paspalum lividum*). Our Nunez trapping location was directly north of the Rockefeller Wildlife Refuge boundary and characterized by bare ground with scattered forbs and, like the Chevron site, had loose gravel/grit patchily distributed amongst trapping locations. The surrounding area primarily consisted of live oak and hackberry trees and bahiagrass (*Paspalum notatum*) and Johnson grass (*Sorghum halepense*). There were no agricultural dominated landscapes within 50 km of either site. There was no dove hunting on Rockefeller or on any public lands within 50 km.

Methods

Field Techniques

We live trapped and banded mourning doves from June–August 2010 through 2018 following the national banding program except for 2011, due to tropical disturbances that occurred that summer. We placed our trapping grids at areas where doves were known to historically congregate. We cleared all trapping locations of vegetation via lawnmower, weed eater, and herbicide prior to the trapping season. Trapping locations remained the same for all trapping seasons.

We used a polyvinyl chloride coated metal walk in style confusion trap (approximately 91.44 × 60.96 × 27.94 cm in size; similar version to the Kniffin modified funnel traps) for dove trapping efforts (Reeves et al. 1968, Dyer 1973). The polyvinyl chloride coated material was used to reduce trapping injuries and mortality. We placed 26 traps at the Chevron site equally spaced 18 m from each other and 21 traps at the Nunez site equally spaced 5 m from each other (Figure 1). We baited traps at each site with equal quantities of either browntop millet (*Urochloa ramosa*), Japanese millet (*Echinochloa esculenta*), milo (*Sorghum bicolor*), or other grain-based baits depending upon bait availability; different bait types were being used concurrently as part of a bait preference study (Whitaker et al. 2020). We randomly selected a bait type for each trap using a random number generator (Lewis and Morrison 1973). We meticulously maintained 226.8 g of bait per trap and replenished bait after each banding effort to maintain consistency. We placed bait on the ground in the interior center of the trap. We baited traps before dawn and checked traps every 2–3 h to reduce risks of trapping related injuries or mortality (Keeler and Winston 1951). We did not operate traps during inclement weather to ensure the safety of birds and staff. We trapped Monday–Thursday and left traps open Friday–Sunday. We cleaned any residual bait from our trapping areas following our final trapping effort of each week to prevent sprouting or spoiling of bait.

During each trap check we removed doves and placed them in a catch crate for transportation to a central banding location on site. We recorded date, weather, location, age, sex, and bait for each newly banded and recaptured bird. We assigned age based on presence or absence of buffy-tipped wing coverts (Pearson and Moore 1940) and progression of primary molt (Swank 1955, Wight et al. 1956, Allen 1963, Sadler et al. 1970, Haas and Amend 1976). We assigned sex according to plumage based on the color of the nape, crown, and breast and whiteness on the tips of the outer three rectrices as well as eye ring color (Reeves et al. 1968, Cannell 1984). We banded all doves with a standard U. S. Geological Survey (USGS) aluminum size 3A butt-end leg band and handled all birds following safe handling guidelines to minimize risk of injury (Gaunt et al. 1997).

Data Analysis

We constructed yearly capture histories indicating marking occasions, live recaptures (including mourning doves that died upon recapture), and hunter recoveries (Table 1). We classified birds by age at banding (i.e., hatch-year, HY; or adult, i.e., after hatch year, AHY). We obtained band recovery data from the USGS Bird Banding Laboratory in Laurel, Maryland. Years began with initiation of the marking period.

We used the Joint Live and Dead Encounters model type (Burnham 1993) in program MARK v9.0 (White and Burnham 1999) to estimate survival probability (*S*; the probability of surviving be-

Table 1. Number of bandings and recoveries of mourning doves (*Zenaida macroura*) by year and age class banded in southwestern Louisiana, 2010–2018.

Year	Hatch year	After hatch year	Total banded	Recaptures[a]	Recoveries[b]
2010	27	14	41	–	2
2011	–	–	–	–	–
2012	6	22	28	0	2
2013	16	35	51	0	2
2014	5	36	41	6	3
2015	144	269	413	17	17
2016	41	84	125	41	15
2017	30	83	113	37	3
2018	57	88	145	73	2
Total	326	631	957	174	46

a. Recaptures are defined as the number of individuals banded on study areas in previous years.
b. Recoveries are defined as individuals harvested and reported for the current year.

Table 2. Models considered for joint live and dead encounters analysis of mourning doves (*Zenaida macroura*) banded at Rockefeller Wildlife Refuge and Nunez Woods, Cameron Parish, Louisiana, 2010 to 2018. For each model, we provide Akaike's Information Criterion adjusted for overdispersion (QAICc), arithmetic difference in QAICc (ΔQAICc) between a model and the model with the lowest QAICc Akaike weight (w_i), number of parameters (K), quasi-deviance (QDeviance), and –2 log-likelihood. Parameters include survival probabilities (S), recapture probabilities (p), recovery probabilities (r), and fidelity to the study area (F).

Model[a]	QAICc	ΔQAICc	w_i	K	QDeviance	–2log(L)
S(age), p(age), r(g), F(age)	1167.961	0.000	0.648	7	152.995	1493.093
S(age), p(.), r(g), F(age)	1169.406	1.446	0.314	6	156.467	1497.585
S(age), p(age), r(.), F(age)	1174.392	6.431	0.026	6	161.452	1504.036
S(age), p(.), r(.), F(age)	1176.000	8.040	0.012	5	165.082	1508.734

a. All parameters were modeled without yearly variation. Parameters were modeled to vary by age groups (i.e., hatch year and after hatch year), where hatch year birds were treated as having age structure for survival, recapture, and site fidelity, with birds transitioning into after hatch year the year after banding. Recovery probabilities were modeled as being time invariant and constant (.) or different between age groups (g).

tween years), live recapture probability (p; the probability of capture given that the individual is alive and in the sample area), recovery probability (r; the probability that a band is recovered and reported given that the bird has died), and capture location fidelity (F; the probability of remaining in the sampling region) (Cooch and White 2019). Recovery rates differ between mourning dove age classes (e.g., Haas 1978). Additionally, site fidelity is high for AHY mourning doves, while HY birds are more likely to disperse (see discussion). Therefore, we used a combined recapture/recovery analysis where individuals were marked as either HY or AHY birds, with HY birds having a maximum age structure of 2. Specifically, the HY age class spanned the year of capture and those individuals transitioned to adults the following year. Mourning dove band recoveries occur almost exclusively during hunting season (September through January) (Seamans 2020). We defined a direct recovery as a recovery occurring in the hunting season immediately following the banding period, while indirect recoveries occurred in future seasons. We assumed no band loss during the study period and therefore did not include estimates of band loss in our analysis.

We developed a series of models to evaluate difference between groups (AHY and HY) and time (years) in MARK. However, time varying models were overparameterized as indicated by 95% confidence intervals that spanned 0 to 1. Therefore, we limited our candidate set to four models that incorporated only age group differences (Table 2). Because most birds were recovered within the southwestern region of Louisiana and initial models yielded fidelity estimates with point estimates ranging from 0.97–1.0, we fixed the site fidelity parameter to 1 for AHY doves in our final models. We evaluated models using quasi-Akaike's Information Criterion (ΔQAICc) scores adjusted for sample size and a calculated variance inflation factor ($\hat{c} = 1.294$) generated from 1000 bootstrap simulations of our most complex model (Burnham and Anderson 2002, Cooch and White 2019).

Results

Between 2010 and 2018, we banded 957 mourning doves consisting of 631 AHY and 326 HY birds (Table 1). Across years, we recaptured 143 banded individuals (15% of all banded birds) on 174 occasions. Twenty-seven individuals were recaptured multiple times and of these individuals, 26 (18% of all recaptured birds) were recaptured in multiple years of the study. We received 46 band recoveries, and of those, 25 (54.3%) were direct recoveries. Seventeen (68%) of the reported direct recoveries were HY. Forty-one of the 46 (89.1%) band recoveries reported occurred in Louisiana, and most (90.9%) of these occurred in the southwest region (i.e., Cameron, Vermilion, Calcasieu, and Jefferson Davis parishes). Four (8.7%) reports occurred in Texas and one (2.2%) occurred in Arkansas (Figure 2).

All models were within eight AIC units of our top model and had some AICc support (Table 2). Our top model had 65% of the total weight and had survival, recapture, and site fidelity each differing between HY and AHY, and recovery probabilities modeled as constant but different between age classes (Table 2). Because this model had the most support and was also the most biologically meaningful given age-specific differences described in the literature, we report results from this model and did not model average. Based on confidence interval widths, differences between HY and AHY age classes for survival and recapture probabilities were inconclusive. Our recovery probability was greater for HY (0.101, SE = 0.02) compared to AHY doves (0.038, SE = 0.10), and fidelity for HY doves was 0.312 (SE = 0.113) (Table 3).

Table 3. Parameter estimates from our best supported model used to estimate survival, recapture, and reporting probabilities, and fidelity to the study area for hatch year (HY) and after hatch year (AHY) mourning doves (*Zenaida macroura*). Our study was conducted at Rockefeller Wildlife Refuge and Nunez Woods, Cameron Parish, Louisiana, 2010 to 2018. Parameter estimates include standard errors (SE) and lower (LCL) and upper (UCL) 95% confidence limits.

Parameter	Estimate	SE	LCL	UCL
Survival (HY)	0.502	0.106	0.304	0.699
Survival (AHY)	0.594	0.045	0.503	0.679
Recapture probability (HY)	0.487	0.157	0.217	0.765
Recapture probability (AHY)	0.243	0.035	0.181	0.319
Recovery probability (HY)	0.101	0.022	0.065	0.154
Recovery probability (AHY)	0.038	0.010	0.022	0.063
Fidelity (HY)	0.312	0.114	0.138	0.562
Fidelity (AHY)	–	–	–	–

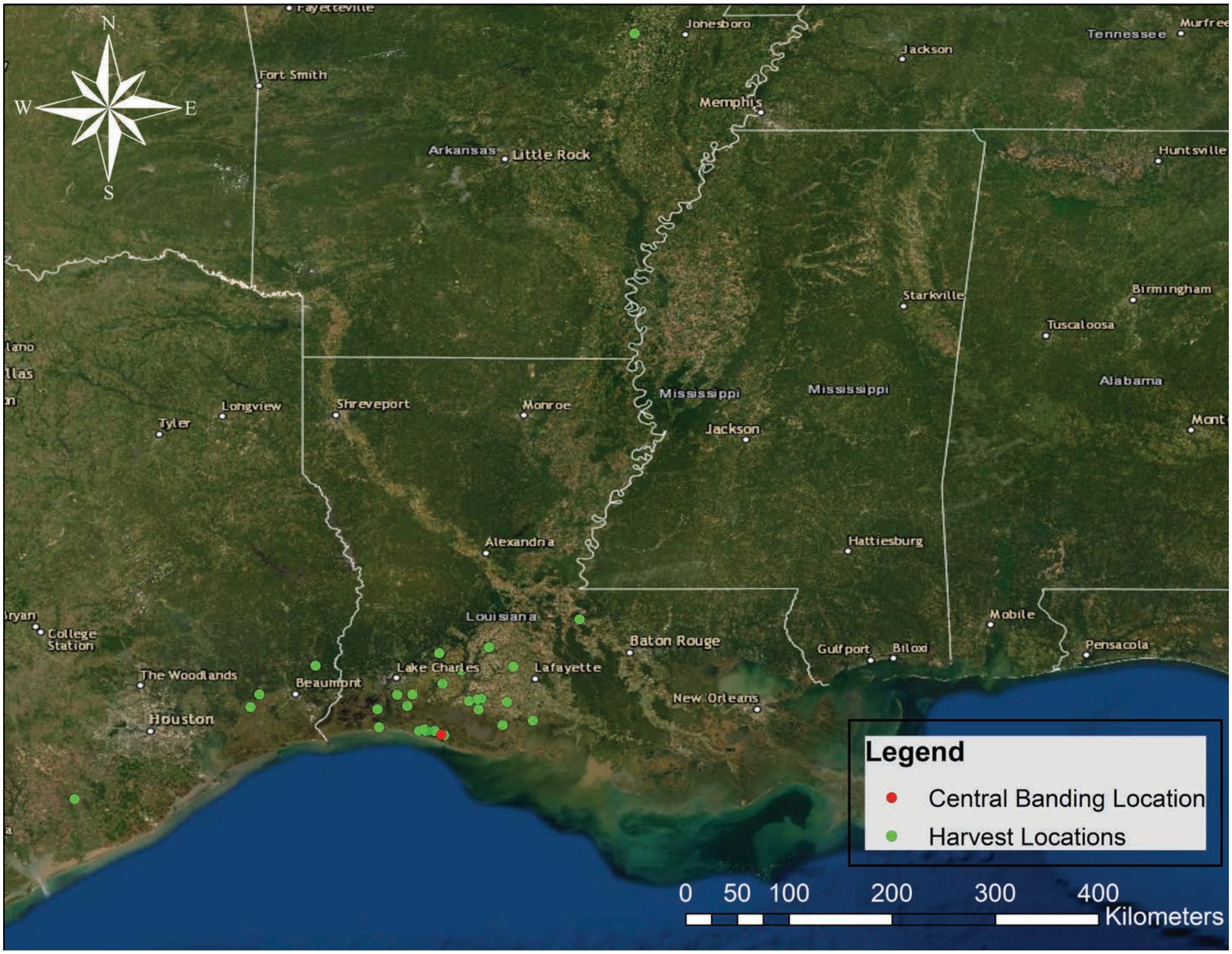

Figure 2. Banding and harvest locations of mourning doves (*Zenaida macroura*) banded at Rockefeller Wildlife Refuge and Nunez Woods, Cameron Parish, Louisiana, 2010 to 2018.

Discussion

Mourning doves have been characterized as having relatively low annual survival and significant hunting mortality (Tomlinson et al. 1994, Otis 2002, Otis et al. 2008, Schulz et al. 2017). Differences in survival each year may reflect local differences in harvest pressure and habitat conditions, including those influenced by weather (Schulz et al. 2017). Estimating annual survival probabilities of mourning dove populations and evaluating population trends are important at both local and regional scales to understand how harvest and habitat management practices (e.g., growing and manipulating lure crops to attract feeding doves) affect local populations (Schulz et al. 2003, Bonnot et al. 2011). Moreover, estimates of demographic parameters are important to inform management decisions and regulatory changes related to harvest management strategies (U.S. Fish and Wildlife Service 2005). Annual survival probabilities for mourning doves typically range between 0.35 to 0.45 (mean = 0.39) for AHY doves and 0.20 to 0.30 (mean = 0.24) for HY doves (Martin and Sauer 1993). Across our 9-year study in southwestern Louisiana, our point estimates of survival and lower confidence limits exceeded those averages and other estimates within the EMU (e.g., Haas 1978, McGowan and Otis 1998, Bennett and Vilella 2012).

Recovery probabilities are important for assessing harvest pressure, survival probabilities, population size, and migratory patterns (Dunks et al. 1982). Mourning doves exhibit age-specific vulnerability to harvest, where immature birds often have increased vulnerability to being harvested compared to adults (e.g., Rice and Lovrien 1974, Haas 1978, Dunks et al. 1982, McGowan and Otis 1998). Although we only received 46 recovery reports, our point estimates of recovery probabilities (HY = 0.101, AHY = 0.038) were nearly identical to mean estimates reported by McGowan and Otis (1998) in South Carolina, with recovery rates generally greater for HY (0.097, SE = 0.028) doves than AHY (0.037, SE = 0.006). Our results were also similar to areas in the Central Management Unit (CMU). For example, in Missouri, Schutz et al. (2017) reported recovery probabilities for AHY at 0.165 (95% CI = 0.105–0.249) and HY at 0.179 (95% CI = 0.121–0.256).

Mourning doves typically have high site fidelity, often staying where they were born or banded. For example, Hayne and Giessler (1977; 6-year study), Haas (1978; 7-year study), Scott et. al (2004; 3-year study), and Bennett and Vilella (2012; 2-year study) reported >80% of band recoveries were obtained within their study areas. Our results were similar, with 89% of our banded individuals being recovered in Louisiana, and 91% of those from the southwest region of the state. Of those individuals that emigrate, movements are often greater by immature individuals dispersing soon after fledging (Rice and Lovrien 1974, Dunks et al. 1982). In North Carolina and South Carolina, Haas (1978) reported that at no time were more than 20% of doves banded on the study area harvested off the study area. Of those that were harvested off site, adults that left the study area were documented moving to other portions of South Carolina, whereas immature individuals were documented in five southeastern states. Additionally, Haas (1978) reported individuals banded in two states contributed to the study area's harvest, whereas immature birds harvested were banded in eight different states.

Over the last decade, estimates of survival and abundance have declined throughout much of the EMU and may indicate the need for a more cautious or conservative harvest management strategy (Schulz et al. 2017, 2019; Seamans 2020). Part of the long-range vision for improving mourning dove management as outlined in the national strategic harvest management plan aims to acknowledge the need to recognize demographic differences among management units (U.S. Fish and Wildlife Service 2005). The sedentary nature of mourning dove populations, including high site fidelity, supports that hunting pressure on local populations is largely determined by local hunters (Scott et al. 2004). Additionally, their life-history strategies further support the importance of managing, conserving, and recovering the species at the local scale.

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