U. S. Fish and Wildlife Service

Mourning Dove

Population Status, 2003

Suggested citation:

Dolton, D.D., and R.D. Rau. 2003. Mourning dove population status, 2003. U.S. Fish and Wildlife Service, Laurel, Maryland. 27 pp.

MOURNING DOVE BREEDING POPULATION STATUS, 2003

DAVID D. DOLTON, U.S. Fish and Wildlife Service, Division of Migratory Bird Management, PO Box 25486 DFC, Denver, CO 80225-0486
REBECCA D. RAU, U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Patuxent Wildlife Research Center, 11500 American Holly Dr., Laurel, MD 20708-4016

Abstract: This report includes Mourning Dove Call-count Survey information gathered over the last 38 years within the conterminous United States. Trends were calculated for the most recent 2- and 10-year intervals and for the entire 38-year period. Between 2002 and 2003, the average number of doves heard per route decreased significantly in the Eastern Management Unit. No change was detected in the Central and Western Units. Over the most recent 10 years, no trend was indicated for doves heard in any management unit. Over the 38-year period, all 3 units exhibited significant declines. In contrast, for doves seen over the 10-year period, a significant increase was found in the Eastern Unit while no trends were found in the Central and Western Units. Over 38 years, no trend was found for doves seen in the Eastern and Central Units while a decline was indicated for the Western Unit.

The mourning dove (*Zenaida macroura*) is a migratory bird, thus, authority and responsibility for its management is vested in the Secretary of the Interior. This responsibility is conferred by the Migratory Bird Treaty Act of 1918 which, as amended, implements migratory bird treaties between the United States and other countries. Mourning doves are included in the treaties with Great Britain (for Canada) and Mexico. These treaties recognize sport hunting as a legitimate use of a renewable migratory bird resource. In recent years, less than 6% of the fall population of mourning doves was estimated to have been harvested annually. As one of the most abundant species in both urban and rural areas of North America, it is familiar to millions of people. Maintenance of mourning dove populations in a healthy, productive state is a primary management goal. To this end, management of doves includes assessment of population status, regulation of harvest, and habitat management. Call-count surveys are conducted annually in the 48 conterminous states by state and federal biologists to monitor mourning dove populations. The resulting information on status and trends is used by wildlife administrators in setting annual hunting regulations.

The primary purpose of this report is to facilitate the prompt distribution of timely information. Results are preliminary and may change with the inclusion of additional data.

George Andrejko, Arizona Game and Fish Department, provided the cover photo for this report.

DISTRIBUTION AND ABUNDANCE

Mourning doves breed from the southern portions of Canada throughout the United States into Mexico, Bermuda, the Bahamas and Greater Antilles, and scattered locations in Central America (Fig. 1). Although some mourning doves winter throughout most of the breeding range, except for central Canada and the north-central U.S., the majority migrate south, wintering in the southern United States and south throughout most of Mexico and Central America to western Panama (Aldrich 1993, Mirarchi and Baskett 1994).

The mourning dove is one of the most widely distributed and abundant birds in North America (Peterjohn et al. 1994, Fig. 1). Although not known precisely, the fall population has been estimated to be about 475 million (Dunks et al. 1982, Tomlinson et al. 1988). However, as there is evidence of population decreases since this estimate was made from data collected in the 1970's, we believe that the mourning dove population has declined to slightly more than 400 million in the United States.

POPULATION MONITORING

The Mourning Dove Call-count Survey was developed to provide an annual index to population size (Dolton 1993). This survey is based on work by McClure (1939) in Iowa. Field studies demonstrated the feasibility of the survey as a method for detecting annual changes in mourning dove breeding populations (Foote and Peters

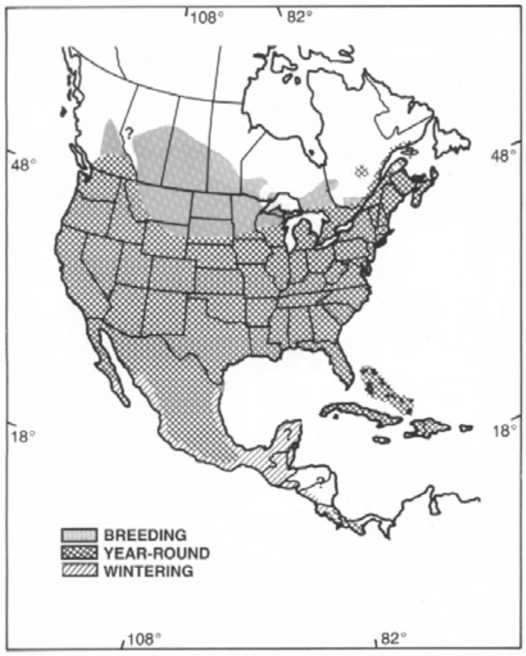

Fig. 1. Breeding and wintering ranges of the mourning dove (adapted from Mirarchi and Baskett 1994).

1952). In the United States, the survey currently includes more than 1,000 randomly selected routes, stratified by physiographic region. The total number of doves heard on each route is used to determine trends in populations and provides the basis for determining an index to population size during the breeding season. Indices for doves seen are also presented in this report, but only as supplemental information for comparison with indices of doves heard. Even though both the numbers of doves heard and seen are counted during the survey, they are recorded separately.

Within the United States, there are 3 zones that contain mourning dove populations that are largely independent of each other (Kiel 1959). These zones encompass the principal breeding, migration, and U.S. wintering areas for each population. As suggested by Kiel (1959), these 3 areas were established as separate management units in 1960 (Kiel 1961). Since that time, management decisions have been made within the boundaries of the Eastern (EMU), Central (CMU), and Western (WMU) Management Units (Fig. 2).

The EMU was further divided into 2 groups of states for analyses. States permitting dove hunting were combined into one group and those prohibiting dove hunting into another. Additionally, some states were grouped to increase sample sizes. Maryland and Delaware were combined; Vermont, New Hampshire, Maine, Massachusetts, Connecticut, and Rhode Island were combined to form a New England group. Due to its small size, Rhode Island, which is a hunting state, was included in this nonhunting group of states for analysis.

METHODS

The Call-count Survey

Each call-count route is usually located on secondary roads and has 20 listening stations spaced at 1-mile intervals. At each stop, the number of doves heard calling, the number seen, and the level of disturbance (noise) that impairs the observer's ability to hear doves are recorded. The number of doves seen while driving between stops is also noted.

Counts begin one-half hour before sunrise and continue for about 2 hours. Routes are run once between 20 May and 5 June. Intensive studies in the eastern United States (Foote and Peters 1952) indicated that dove calling is relatively stable during this period. Surveys are not made when wind velocities exceed 12 miles per hour or when it is raining.

Estimation of Population Trends

A population trend is defined as the ratio of the dove population in an area in one year to the population in the preceding year. For more than 2 years of data, the trend is expressed as an average annual rate of change. A trend was first estimated for each route by numerically solving a set of estimating equations (Link and Sauer 1994). Observer data were used as covariables to adjust for differences in observers' ability to hear or see doves. The reported sample sizes are the number of routes on which a given trend estimate is based. This number may be less than the actual number of routes surveyed for several reasons. The estimating equations approach requires at least 2 non-zero counts by at least one observer for a route to be used. Routes that did not meet this requirement during the interval of interest were not included in the sample size. State and management unit trends were obtained by calculating a mean of all route trends weighted by land area, within-route variance in counts, and density (mean numbers of doves counted on each route). Variances of state and management unit

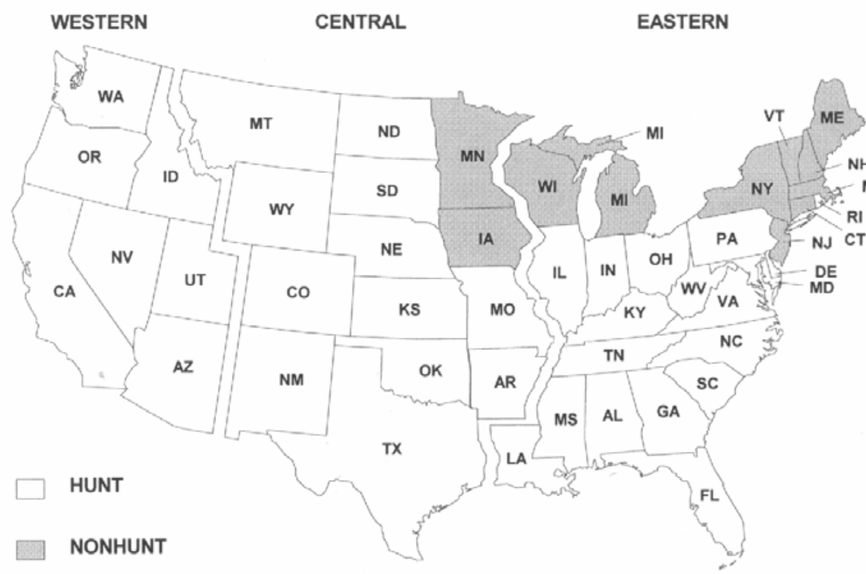

Fig. 2. Mourning dove management units with 2002 hunting and nonhunting states.

trends were estimated by using route trends and a statistical procedure known as bootstrapping (Geissler and Sauer 1990).

The annual change, or trend, for each area in doves heard over the most recent 2- and 10-year intervals and for the entire 38-year period were estimated. Additionally, trends in doves seen were estimated over the 10- and 38-year periods as supplemental information for comparison.

For purposes of this report, statistical significance was defined as $P<0.05$, except for the 2-year comparison where $P<0.10$ was used because of the low power of the test. Significance levels are approximate for states with less than 10 routes.

Estimation of Annual Indices

Annual indices show population fluctuations about fitted trends (Sauer and Geissler 1990). The estimated indices were determined for an area (state or management unit) by finding the deviation between observed counts on a route and those predicted on the route from the area trend estimate. These residuals were averaged by year for all routes in the area of interest. To adjust for variation in sampling intensity, residuals were weighted by the land area of the physiographic regions within each state. These weighted average residuals were then added to the fitted trend for the area to produce the annual index of abundance. This method of determining indices superimposes yearly variation in counts on the long-term fitted trend. These indices should provide an accurate representation of the fitted trend for regions that are adequately sampled by survey routes. Additionally, only data from within an area are incorporated into the area's index. Since the indices are adjusted for observer differences and trend, the index for an area may be quite different from the actual count. In order to estimate the percent change from 2001 to 2002, a short-term trend (2 years) was calculated. The percent change estimated from this short-term trend analysis is the best estimator of annual change. Attempts to estimate short-term trends from the breeding population indices (which were derived from residuals of the long-term trends) will yield less precise results. The annual index value incorporates data from a large number of routes that are not comparable between the two years 2002 and 2003, i.e., routes not run by the same observers. Therefore, the index is much more variable than the trend estimate.

In a separate analysis, the mean number of doves heard calling per route in 2003 was calculated for each state or groups of states. In contrast to the estimated annual indices presented in Table 2 (which illustrate population changes over time based on the regression line), the estimated densities shown in Figs. 3, 7, and 11 illustrate the average *actual* numbers of doves counted in 2002 and 2003.

Fig 3. Mean number of mourning doves heard per route by state in the Eastern Management Unit, 2002-2003.

RESULTS

Eastern Management Unit

The Eastern Management Unit includes 27 states comprising 30% of the land area of the United States. Dove hunting is permitted in 18 states, representing 74% of the land area of the unit (Fig. 2).

2002-2003 Population Distribution.—North Carolina had the highest count in the Nation with 38 actual doves heard per route over the 2 years (Fig. 3). Delaware/Maryland, Pennsylvania, West Virginia, New Jersey, and New York averaged < 10 per route. All other states had mean counts in the range of 10-20 doves heard per route.

2002 to 2003 Population Changes.—The average number of doves heard per route decreased significantly between years in the combined hunting states and in the Unit as a whole (-5.6% and -6.4%, respectively) (Table 1). The index for the combined nonhunting states did not change significantly (-9.4%).

The 2003 population index of 16.2 doves heard per route for the Unit, is slightly above the predicted count based on the long-term estimate of 15.8 (Fig. 4, Table 2). In the hunting states, the index of 16.9 is only slightly below the predicted estimate of 17.0 while, in the nonhunting states, the index of 14.1 is above the predicted estimate of 12.8.

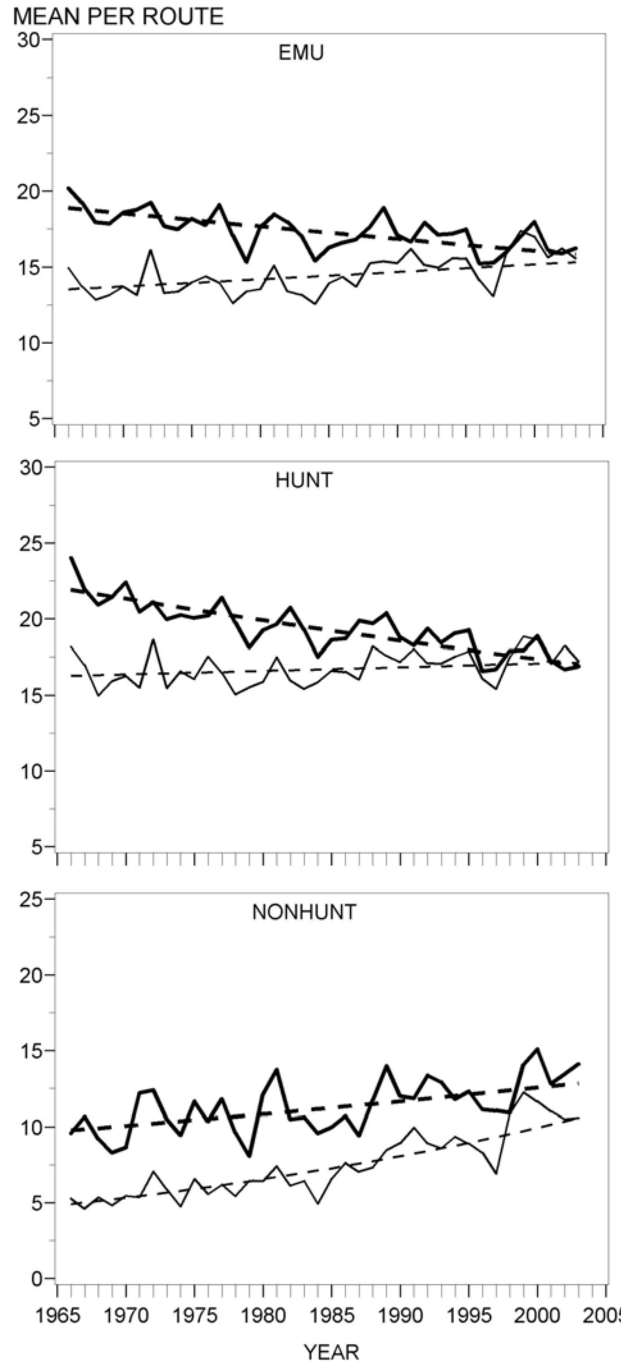

Fig. 4. Population indices and trends of breeding mourning doves in the Eastern Management Unit (EMU), combined EMU hunting states (HUNT), and combined EMU nonhunting states (NONHUNT), 1966-2003. Heavy solid line = doves heard; light solid line = doves seen. Light and heavy dashed lines = predicted trends.

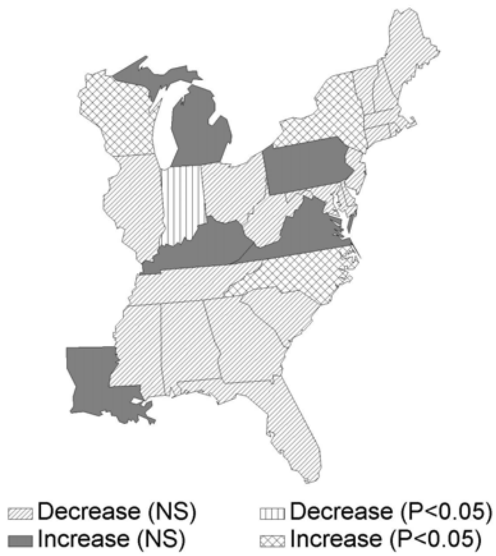

Fig. 5. Trends in number of mourning doves heard per route by state in the Eastern Management Unit, 1994-2003.

The population increased significantly in Kentucky and Wisconsin states while it decreased in Alabama, North Carolina, Virginia, West Virginia, Michigan, and the New England states (Table 1). No significant changes were detected for the other states.

Population Trends: 10 and 38-year.—Analyses indicated significant declines over the most recent 10 and 38-year periods for the combined hunting states (Table 1). In the combined nonhunting states, a significant increase was found over 10 years while no trend was indicated for 38 years. For the Unit, no significant trend was found over 10 years, but a significant decline was indicated for the long-term period. Annual indices both for doves heard and seen are shown in Fig. 4. In contrast to doves heard, an analysis of doves seen indicated a significant increasing trend for the Unit and 2 groups over 10 years. Over 38 years, a significant increase was detected for the combined nonhunting states; no trend was shown for the combined hunting states or the Unit.

State population trends for doves heard are shown in Fig. 5 (10-year interval) and Fig. 6 (38-year interval) and Table 1). Over 10 years, increases were found for North Carolina, New York and Wisconsin while Indiana showed a decline. Between 1966 and 2003, an increase was noted in New England while a downward trend was noted in Delaware/Maryland, Georgia, Indiana, Ohio, South Carolina, and Tennessee.

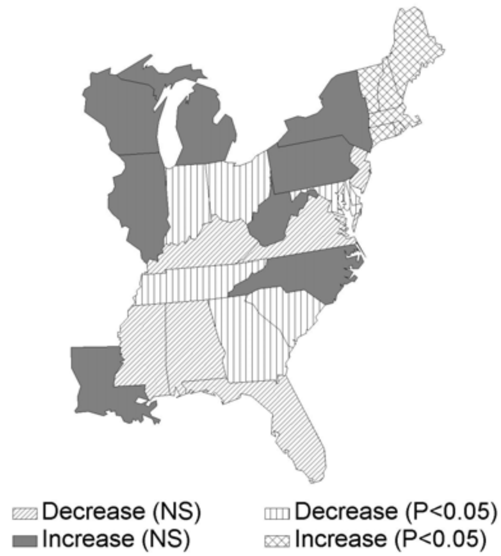

Fig. 6. Trends in the number of mourning doves heard per route by state in the Eastern Management Unit, 1966-2003.

Central Management Unit

The Central Management Unit consists of 14 states, containing 46% of the land area in the U.S. It has the highest population index of the 3 units. Within the unit, dove hunting is permitted in 12 states (Fig. 2).

2002-2003 Population.—Kansas, Nebraska and North Dakota had the highest actual average number of doves heard per route over the 2 years (34, 34, and 38, respectively) (Fig. 7). Historically, North Dakota and Kansas often have the highest average counts in the Nation (Table 2). New Mexico and Wyoming were the only states with less than 10 doves per route. The remaining states had intermediate values.

2002 to 2003 Population Changes.—The average number of doves heard per route in the Unit did not change significantly between the 2 years (+2.7%; Table 1). The 2003 index for the Unit of 21.5 doves heard per route is slightly below the predicted long-term trend estimate of 21.8 (Fig. 8, Table 2). The population increased significantly in Iowa, Nebraska, and Oklahoma (Table 1). A decrease was noted for Minnesota, South Dakota, and Wyoming.

Population Trends: 10 and 38-year.—No significant trend in doves heard was indicated for the Unit over the short term, but a decline was indicated over the long term (Table 1). In contrast, trends in doves seen were

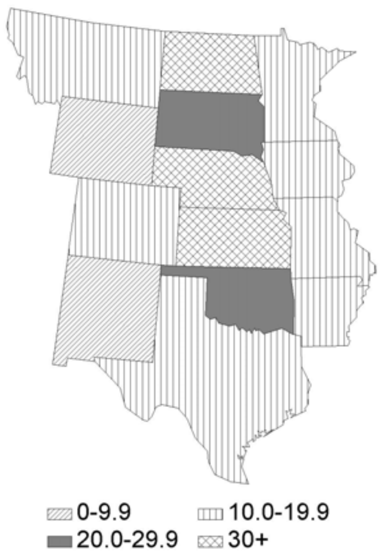

Fig. 7. Mean number of mourning doves heard per route by state in the Central Management Unit, 2002-2003.

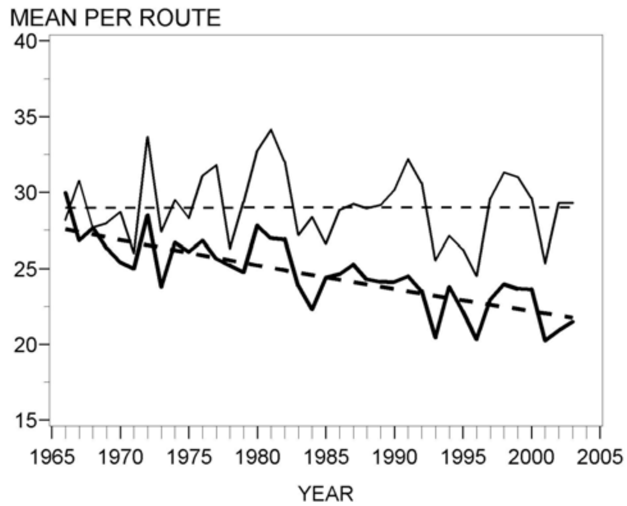

Fig. 8. Population indices and trends of breeding mourning doves in the Central Management Unit, 1966-2003. Heavy solid line = doves heard; light solid line = doves seen. Heavy solid light dashed lines = predicted trends.

not significant for either time period.

State trends over 10 years are illustrated in Fig. 9 and Table 1. Montana showed an increase while Colorado, Minnesota, and Missouri had declines during this time. Fig. 10 portrays trends over 38 years. No significant upward trend was found in doves heard for any state, but a significant downward trend was found in Minnesota, Missouri, Nebraska, and Wyoming (Table 1).

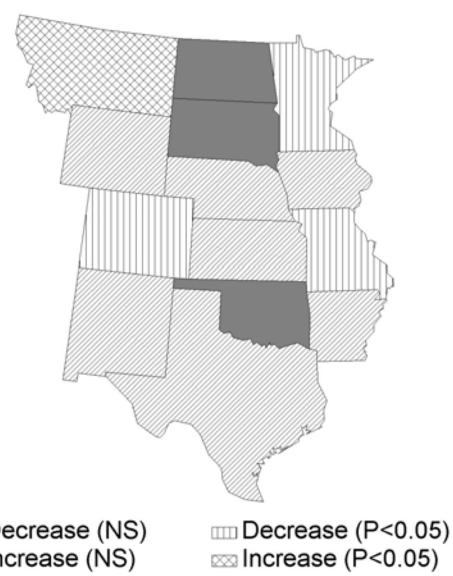

Fig. 9. Trends in number of mourning doves heard per route by state in the Central Management Unit, 1994-2003.

Western Management Unit

Seven states comprise the Western Management Unit and represent 24% of the land area in the United States. All states within the unit permit mourning dove hunting.

2002-2003 Population Distribution.—Arizona and California averaged 14 and 13 actual doves heard per route, respectively (Fig. 11). The other states in the Unit averaged < 10 birds per route.

2002 to 2003 Population Changes.—The average number of doves heard per route did not change significantly between years although the index decreased by 7.4% (Table 1). The 2003 population index of 8.9 doves heard per route is above the predicted count of 8.2 based on the long-term estimate (Fig. 12, Table 2).

The number of doves heard per route decreased significantly in California (Table 1). No significant differences were found in other states.

Population Trends: 10 and 38-year.— No significant trend in numbers of doves heard was indicated over 10 years although a significant decline was apparent over 38 years (Table 1). Analyses of doves seen gave the same results.

Trends by state are illustrated in Figs. 13 and 14, and Table 1. Utah is the only state that shows a decline over 10 years while all states in the Unit except Washington have a decline between 1966 and 2003.

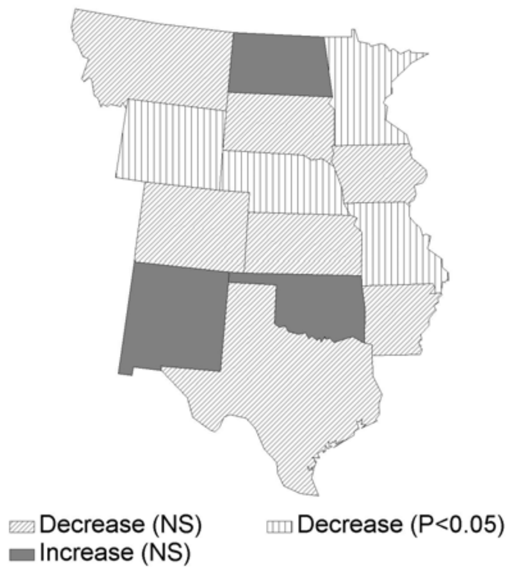

Fig. 10. Trends in mourning doves heard per route by state in the Central Management Unit, 1966-2003.

Fig. 11. Mean number of mourning doves heard per route by state in the Western Management Unit, 2002-2003.

Breeding Bird Survey Results

There has been considerable discussion about utilizing the North American Breeding Bird Survey (BBS) as a measure of mourning dove abundance. Consequently, we are including trend information in this report to enable readers to compare BBS results with the Mourning Dove Call-count Survey (CCS) results from last year's mourning dove status report (Dolton and Holmes 2002). Sauer et al. (1994) discussed the differences in the methodology of the 2 surveys. The BBS is based on 50-stop routes that are surveyed in June. Also with the BBS, data for doves heard and seen are combined for analyses while those data are analyzed separately with the CCS. Unfortunately, BBS data are not available in time for use in regulations development during the year of the survey. Trends calculated from BBS data for the 10-year period (1993-2002) and over 37 years (1966-2002) are presented in Table 3.

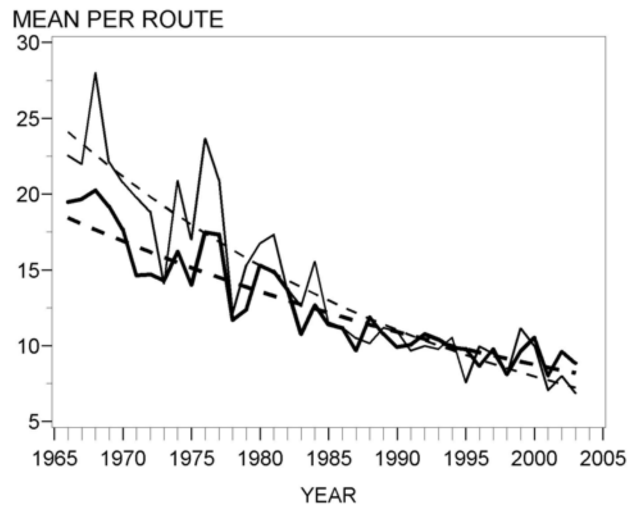

Fig. 12. Population indices and trends of breeding mourning doves in the Western Management Unit, 1966-2003. Heavy solid line = doves heard; light solid line = doves seen. Light and heavy dashed lines = predicted trends.

In general, trends indicated by the BBS tend to indicate fewer declines. The major differences occur in the Eastern Unit. This is likely due to the larger sample size of BBS survey routes and greater consistency of coverage by BBS routes in the Unit (Sauer et al. 1994), although additional analyses are needed to clarify some differences in results between surveys within states.

For the 10-year period, 1993-02 the CCS indicated a significant decline (P<0.05) in doves heard for the combined hunting states in the EMU while the BBS showed no trend (P>0.10). For the nonhunting states, the CCS showed a tendency for an increase (P<0.10) while the BBS showed a significant increase (P<0.05). For the EMU as a whole, there was no trend indicated with the CCS (P>0.10) while the BBS showed a significant increase (P<0.05). For the CMU, the CCS showed a significant decline (P<0.05) while the BBS showed no trend (P>0.10). In the WMU, the CCS indicated a significant decline (P<0.01) while the BBS

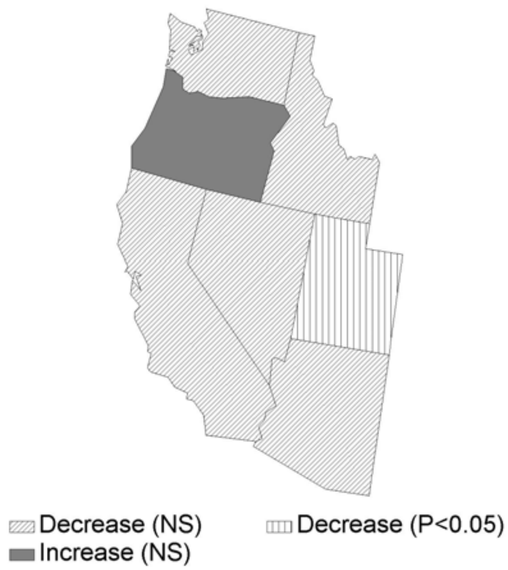

Fig. 13. Trends in number of mourning doves heard per route by state in the Western Management Unit, 1994-2003.

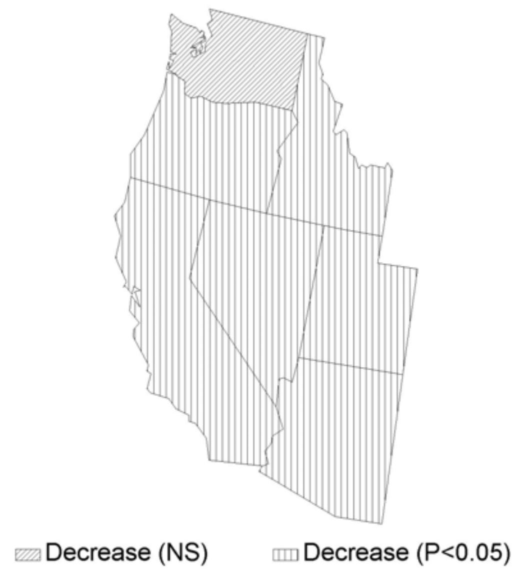

Fig. 14. Trends in number of mourning doves heard per route by state in the Western Management Unit, 1966-2003.

showed no trend (*P*>0.10).

Over 37 years, results were very similar with both surveys for the Central and Western Management Units with both surveys indicating significant declines (CCS: *P*<0.01 for both units; BBS: *P*<0.05 for both Units;). In the Eastern Unit, CCS analyses indicated a significant decline (*P*<0.05) over the period. In contrast, the BBS showed a significant increase (*P*<0.05). For the combined hunting states of the EMU, the CCS showed a significant decline (*P*<0.05) compared with no trend (*P*>0.10) with the BBS. The nonhunting states of the EMU were different also. The CCS showed no trend (*P*>0.10), but BBS data indicated a significant increase (*P*<0.05).

HARVEST ESTIMATES

State Surveys

In past years, a compilation of non-uniform, periodic state harvest surveys has been used to obtain rough estimates of the number of mourning doves killed and the number of dove hunters. Although those data are no longer used, a summary provided by Sadler (1993) is reviewed here for historical purposes. In general, mourning dove harvest in the EMU was relatively constant from 1966-87, with between 27.5 and 28.5 million birds taken. The latest estimate, a 1989 survey, indicated harvest had dropped to about 26.4 million birds shot by an estimated 1.3 million hunters. In the CMU, although hunting pressure and harvest varied widely among states, dove harvest in the Unit generally increased between 1966-87 to an annual average of about 13.5 million birds. In 1989, almost 11 million doves were taken by about 747,000 hunters. Dove harvest in the WMU has declined significantly over the years following a decline in the breeding population. In the early 1970's, about 7.3 million doves were taken by an estimated 450,000 hunters. By 1989, the harvest had dropped to about 4 million birds shot by approximately 285,000 hunters.

In summary, it appears that the dove harvest throughout the United States is on the decrease. However, the mourning dove remains an extremely important game bird, as more doves are harvested than all other migratory game birds combined. A 1991 survey indicated that doves provided about 9.5 million days of hunting recreation for 1.9 million people (U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, Bureau of the Census 1993). A survey conducted in 1996 estimated that doves were hunted about 8.1 million days by 1.6 million people (U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, Bureau of the Census 1997).

Harvest Information Program (HIP)

Wildlife professionals have long recognized that reliable harvest estimates are needed to monitor the impact of hunting. To remedy problems associated with state surveys, the U.S. Fish and Wildlife Service and the state wildlife agencies initiated the national, cooperative Harvest Information Program in 1992. This program is designed to enable the Service to conduct nationwide surveys that provide reliable annual estimates of the harvest of mourning doves and other migratory game bird species. Under the Harvest Information Program, states provide the Service with the names and addresses of all licensed migratory bird hunters each year, and the Service conducts surveys to estimate the harvest in each state. All states except Hawaii are participating in the program.

Preliminary results of the mourning dove harvest survey for the 2001-02 hunting season are presented in Table 4 and preliminary results for the 2002-03 season are shown in Table 5. The total estimated harvest for the 2002-03 season by management unit and for the U.S. are as follows: Eastern: 9,943,600 " 7%; Central: 10,366,500 " 7%; Western: 2,392,000 " 5%; and, U.S.: 22,702,100 " 5%. It is important to note that these estimates do not necessarily indicate that the harvest has declined from past years when harvest estimates were compiled from state surveys. And, they cannot be compared directly with the earlier estimates since they are based on a different sampling scheme. The reliability of these estimates depends primarily upon the quality of the sample frame provided by each participating state. If a state's sample frame does not include all migratory bird hunters in that state, the survey results underestimate hunter activity and harvest for the state.

The Harvest Surveys Section is continuing to work with states to improve the accuracy and precision of the harvest estimates.

ACKNOWLEDGMENTS

Personnel of state wildlife agencies and the U.S. Fish and Wildlife Service (USFWS) cooperated in collecting the data presented in this report. T. Nguyen and H. Bellary (FWS) played vital roles in web site and database development. W. L. Kendall (BRD) and J. R. Sauer (BRD) analyzed the data and provided statistical support. P. I. Padding (USFWS) provided the HIP data and explanation. K. Wilkins (USFWS) assisted with graphics preparation. J. Bladen (USFWS) reviewed a draft of parts or all of this report.

LITERATURE CITED

Aldrich, J.W. 1993. Classification and distribution. Pages 47-54 *in* T.S. Baskett, M.W. Sayre, R.E. Tomlinson, and R.E. Mirarchi, eds., Ecology and management of the mourning dove. Stackpole Books, Harrisburg, PA.

Dolton, D.D. 1993. The call-count survey: historic development and current procedures. Pages 233-252 *in* T.S. Baskett, M.W. Sayre, R.E. Tomlinson, and R.E. Mirarchi, eds., Ecology and management of the mourning dove. Stackpole Books, Harrisburg, PA.

Dolton, D.D. and R. D. Holmes. 2002. Mourning dove breeding population status, 2002. U.S. Fish and Wildlife Service, Laurel, Maryland. 30pp.

Dunks, J.H., R.E. Tomlinson, H.M. Reeves, D.D. Dolton, C.E. Braun and T.P. Zapatka. 1982. Mourning dove banding analysis, Central Management Unit, 1967-77. Special Scientific Report--Wildl. No. 249. U.S. Fish and Wildlife Service, Washington, DC. 128 pp.

Foote, L.E. and H.S. Peters. 1952. Pages 1-2 *in* Investigations of methods of appraising the abundance of mourning doves. U.S. Fish and Wildlife Service, Special Scientific Report--Wildlife 17.

Geissler, P.H. and J.R. Sauer. 1990. Topics in route regression analysis. Pages 54-57 *in* J.R. Sauer and S. Droege, eds. Survey designs and statistical methods for the estimation of avian population trends. U.S. Fish and Wildlife Service, Biological Reptort 90(1).

Kiel, W.H. 1959. Mourning dove management units, a progress report. U.S. Fish and Wildlife Service, Special Scientific Report--Wildlife 42.

____. 1961. The mourning dove program for the future. Transactions of the North American Wildlife and Natural Resources Conference 26:418-435.

Link, W.A. and J.R. Sauer. 1994. Estimating equations estimates of trends. Bird Populations 2:23-32.

McClure, H.E. 1939. Cooing activity and censusing of the mourning dove. Journal of Wildlife Management 3:323-328.

Mirarchi, R.E. and T.S. Baskett. 1994. Mourning dove (*Zenaida macroura*). *In* A. Poole and F. Gill, eds., The birds of North America, No. 117. The Academy of Natural Sciences, Philadelphia and The American Ornithologists' Union, Washington, D.C. 32 pp.

Peterjohn, B.G., J.R. Sauer and W.A. Link. 1994. The 1992 and 1993 summary of the North American breeding bird survey. Bird Populations 2:46-61. Sadler, K.C. 1993. Mourning dove harvest. Pages 449-458 *in* T.S.Baskett, M.W. Sayer, R.E. Tomlinson and R.E. Mirarchi, eds., Ecology and management of the mourning dove. Stackpole Books, Harrisburg, PA.

Sauer, J.R. and P.H. Geissler. 1990. Annual indices from route regression analyses. Pages 58-62 *in* J.R. Sauer and S. Droege, eds. Survey designs and statistical methods for the estimation of avian population trends. U.S. Fish and Wildlife Service, Biological Report. 90(1).

Sauer, J.R., D.D. Dolton, and S. Droege. 1994.Mourning dove population trend estimates from Call-count and North American Breeding Bird Surveys. Journal of Wildlife Management. 58(3):506-515.

Tomlinson, R.E., D.D. Dolton, H.M. Reeves, J.D. Nichols and L.A. McKibben. 1988. Migration, harvest, and population characteristics of mourning doves banded in the Western Management Unit; 1964-1977. Fish and Wildlife Technical. Report 13, U.S. Fish and Wildlife Service, Washington, DC. 101pp.

U.S. Department of Commerce and U.S. Department of Agriculture. 2000a. Weekly weather and crop bulletin. Vol. 87, No. 21. NOAA/USDA Joint Agricultural Weather Facility, Washington, D.C.

U.S. Department of Commerce and U.S. Department of Agriculture. 2000b. Weekly weather and crop bulletin. Vol. 87, No. 22. NOAA/USDA Joint Agricultural Weather Facility, Washington, D.C.

U. S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, Bureau of the Census. 1993. 1991 National survey of fishing, hunting, and wildlife-associated recreation. U.S. Government Printing Office, Washington, DC. 124 pp.

U. S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, Bureau of the Census. 1997. 1996 National survey of fishing, hunting, and wildlife-associated recreation. U.S. Government Printing Office, Washington, DC. 115 pp.

Table 1. Trends (% change[a] per year as determined by linear regression) in number of mourning doves heard along call-count survey routes, 1966-2003.

	2 year (2002-2003)					10 year (1994-2003)					38 year (1966-2003)				
	N	% Change[b]		90% CI		N	% Change[b]		90% CI		N	% Change[b]		90% CI	
EASTERN UNIT															
Hunt															
AL	23	-21.7	***	-34.6	-8.7	28	-1.7		-3.4	0.0	42	-0.6		-1.5	0.3
DE/MD	11	17.8		-7.9	43.5	14	-2.5		-5.9	0.9	19	-1.9	***	-3.0	-0.7
FL	22	-7.6		-21.3	6.1	23	-2.3	*	-4.6	0.0	28	-0.1		-0.9	0.8
GA	21	6.6		-19.9	33.0	25	-2.5	*	-4.9	-0.1	31	-1.0	**	-1.7	-0.4
IL	14	-0.9		-22.3	20.6	20	-1.6		-4.2	1.0	22	0.3		-0.9	1.5
IN	11	2.5		-13.6	18.6	15	-3.4	***	-5.6	-1.3	18	-1.6	***	-2.5	-0.6
KY	17	10.3	**	2.7	17.9	21	1.7		-0.4	3.8	26	-0.2		-1.5	1.0
LA	19	20.2		-2.9	43.3	19	3.0		-0.1	6.2	23	1.2	*	0.2	2.3
MS	19	7.8		-16.1	31.8	23	-2.9		-6.6	0.8	31	-1.9	*	-3.5	-0.2
NC	21	-11.7	*	-23.2	-0.2	21	1.8	***	0.8	2.8	24	0.0		-0.9	1.0
OH	34	-8.0		-18.7	2.8	37	-1.0		-3.4	1.3	57	-1.1	***	-1.6	-0.5
PA	12	-8.5		-22.3	5.2	17	1.2		-2.8	5.3	17	0.9		-0.9	2.7
SC	18	-10.5		-30.6	9.6	21	-1.8		-3.6	0.1	27	-1.1	**	-2.0	-0.3
TN	16	2.0		-21.2	25.1	24	-2.6	*	-5.1	0.0	32	-1.6	**	-2.6	-0.5
VA	21	-32.5	***	-47.3	-17.7	33	0.2		-1.8	2.3	33	-1.9		-3.9	0.1
WV	10	-39.2	***	-56.8	-21.6	10	-2.6		-6.0	0.8	11	1.4		-0.5	3.2
Subunit	289	-5.6	*	-11.0	-0.1	351	-1.3	***	-2.1	-0.5	441	-0.7	***	-1.1	-0.3
Nonhunt															
MI	12	-23.2	**	-39.4	-6.9	22	2.0		-1.5	5.4	23	0.4		-0.9	1.6
N.England[c]	35	-13.3	**	-24.1	-2.5	42	-0.3		-2.0	1.4	76	1.7	***	0.9	2.5
NJ	10	-12.8		-29.6	3.9	11	-2.5		-6.6	1.5	20	-2.1		-5.0	0.8
NY	8	-16.3		-41.0	8.4	17	6.0	***	3.7	8.3	20	1.7		-0.4	3.8
WI	15	33.3	***	13.4	53.3	22	5.6	***	3.5	7.7	23	0.5		-0.9	1.9
Subunit	80	-9.4		-19.0	0.2	114	2.5	**	0.8	4.2	162	0.7	*	0.0	1.4
Unit	369	-6.4	**	-11.3	-1.6	465	-0.6		-1.3	0.1	603	-0.5	**	-0.8	-0.1
CENTRAL UNIT															
AR	13	20.2		-7.5	47.8	17	-2.7		-5.6	0.2	18	-0.9		-2.2	0.5
CO	13	8.7		-8.1	25.6	16	-3.1	**	-5.5	-0.6	21	-0.9	*	-1.8	-0.1
IA	11	65.1	**	19.3	111.0	16	-0.1		-3.0	2.9	18	0.0		-0.8	0.7
KS	21	14.8		-2.7	32.3	28	-2.1		-6.4	2.1	34	-0.4		-1.0	0.2
MN	9	-46.4	***	-62.4	-30.5	12	-5.6	***	-7.5	-3.7	13	-2.1	**	-3.5	-0.6
MO	16	28.5		-4.9	61.8	20	-6.3	***	-8.3	-4.2	28	-2.2	***	-3.4	-1.0
MT	11	2.2		-29.6	34.0	18	4.0	**	0.7	7.3	28	-2.0	*	-3.9	-0.1
NE	21	16.8	**	4.3	29.3	24	-1.4		-3.2	0.3	27	-0.9	**	-1.6	-0.3
NM	18	11.4		-16.6	39.4	28	-0.1		-4.6	4.5	31	0.5		-0.5	1.5
ND	21	8.7		-6.5	23.9	27	0.1		-1.7	1.9	30	0.1		-1.4	1.5
OK	14	34.1	***	21.3	46.8	16	1.6		-1.8	5.1	25	0.2		-3.4	3.8
SD	12	-22.7	***	-32.0	-13.4	19	1.0		-2.8	4.8	28	-0.7		-2.4	1.1
TX	113	-3.4		-12.1	5.3	143	-1.0		-2.4	0.3	206	-0.4		-1.1	0.3
WY	11	-20.8	***	-33.2	-8.4	16	-4.9	*	-9.3	-0.5	22	-3.5	**	-6.0	-1.0
Unit	304	2.7		-2.8	8.1	400	-1.0	*	-1.9	-0.1	529	-0.6	***	-1.0	-0.3
WESTERN UNIT															
AZ	39	-0.7		-20.7	19.3	55	-0.6		-2.5	1.3	69	-1.2	***	-1.9	-0.4
CA	52	-14.0	**	-24.1	-3.9	59	-1.3	*	-2.5	0.0	82	-2.5	***	-3.6	-1.4
ID	16	-15.3		-40.2	9.7	23	-1.0		-5.1	3.2	28	-2.8	**	-4.8	-0.8
NV	17	5.5		-67.5	78.5	24	-1.3		-5.1	2.6	31	-4.8	***	-6.7	-2.9
OR	13	-1.6		-25.1	21.9	20	2.7		-0.4	5.8	25	-1.9	**	-3.4	-0.5
UT	11	-17.6		-42.0	6.8	15	-4.6	***	-6.9	-2.4	19	-3.7	**	-6.5	-1.0
WA	12	13.7		-21.0	48.4	21	-0.5		-7.5	6.5	26	-2.4	*	-4.5	-0.3
Unit	160	-7.4		-18.2	3.5	217	-1.0		-2.0	0.0	280	-2.2	***	-2.8	-1.6

[a] Mean of route trends weighted by land area and population density. The estimated count in the next year is (%/100+1) times the count in the current year where % is the annual change. Note: Extrapolating the estimated trend statistic (% change per year) over time (e.g., 38 years) may exaggerate the total change over the period.

[b] *P<0.1; **P<0.05; ***P<0.01.

[c] New England consists of CT, ME, MA, NH, RI, and VT.

Table 2. Breeding population indices[a] based on mourning doves heard along Call-count routes, 1966-2003.

Management unit/state	1966	1967	1968	1969	1970	1971	1972	1973	1974
EASTERN UNIT									
Hunt									
AL	25.9	23.1	20.8	21.1	21.4	17.5	25.1	22.0	16.7
DE/MD	17.4	21.2	14.8	15.7	19.4	16.4	17.9	17.7	18.6
FL	12.1	11.6	9.9	10.5	13.3	11.2	11.5	11.6	13.9
GA	30.3	28.4	24.4	26.1	33.0	26.0	24.8	27.2	28.1
IL	23.2	20.0	23.8	20.6	23.8	21.7	22.3	21.9	18.5
IN	37.9	34.9	34.3	33.1	32.0	43.2	37.7	33.7	32.1
KY	23.3	21.1	20.6	21.6	26.0	23.3	19.6	23.3	27.2
LA	10.2	10.4	9.8	11.4	7.7	10.3	11.3	8.8	10.3
MS	41.2	35.4	30.0	27.8	30.5	31.0	34.5	30.9	24.7
NC	34.7	28.1	29.7	42.3	48.8	28.5	23.1	43.9	25.1
OH	24.5	23.0	20.8	23.7	23.5	24.3	25.3	20.1	24.5
PA	8.6	9.2	8.5	8.1	5.3	6.1	8.6	5.6	8.3
SC	33.4	36.5	37.2	35.9	33.8	29.6	26.3	30.0	28.0
TN	32.0	23.3	23.9	23.7	32.1	22.7	28.7	21.8	23.3
VA	25.6	21.4	24.2	21.4	27.4	22.1	13.2	15.6	21.3
WV	6.5	5.5	5.6	6.1	5.6	5.1	6.7	3.9	4.2
Subunit	24.0	21.9	20.9	21.5	22.4	20.5	21.1	20.0	20.3
Nonhunt									
MI	13.7	14.8	9.8	10.0	8.1	16.0	16.6	13.2	11.2
N.England[b]	5.8	6.3	5.8	5.0	5.8	6.1	6.8	8.0	5.1
NJ	20.0	17.1	21.2	19.5	26.3	24.8	26.0	23.0	22.2
NY	6.3	6.4	6.0	6.0	7.4	8.6	6.8	7.0	7.2
WI	10.5	13.5	13.6	10.4	11.2	16.3	17.0	11.2	11.9
Subunit	9.6	10.7	9.2	8.3	8.7	12.2	12.4	10.5	9.5
Unit	20.2	19.2	17.9	17.9	18.6	18.8	19.2	17.7	17.5
CENTRAL UNIT									
AR	22.0	23.0	22.0	21.2	22.9	23.0	21.6	24.3	22.4
CO	24.3	23.8	21.7	29.6	29.6	21.5	27.2	16.8	26.7
IA	31.7	28.5	30.6	27.6	20.0	24.6	32.7	30.8	24.5
KS	50.8	50.8	52.7	53.4	49.0	49.9	55.8	49.1	48.6
MN	32.6	25.9	27.8	20.5	16.2	23.2	26.7	20.1	28.0
MO	40.0	37.8	47.3	28.6	39.4	33.1	44.8	33.6	28.7
MT	29.4	27.1	21.3	23.4	18.7	26.4	21.0	15.1	17.5
NE	46.3	40.6	51.8	50.6	48.9	46.4	44.5	42.6	44.1
NM	15.3	11.3	15.8	12.1	11.8	11.1	12.7	9.1	11.1
ND	38.3	36.8	50.3	41.8	37.1	38.3	39.6	43.7	42.4
OK	20.0	24.7	29.1	28.2	22.1	16.8	27.5	25.9	27.3
SD	50.2	31.4	43.0	36.6	43.5	38.3	38.1	40.2	48.1
TX	26.8	22.2	21.9	19.8	21.0	20.3	27.2	21.8	23.3
WY	23.3	24.5	12.7	20.5	19.5	11.0	14.7	14.6	21.0
Unit	30.0	26.9	27.7	26.3	25.4	25.0	28.5	23.8	26.7
WESTERN UNIT									
AZ	29.8	29.9	26.6	31.7	31.7	21.4	24.0	28.9	25.0
CA	27.5	26.0	24.0	23.7	23.1	17.3	21.1	20.2	21.9
ID	18.3	18.8	16.8	17.6	16.4	12.9	12.3	15.1	12.6
NV	12.4	11.3	26.7	18.2	13.1	7.9	10.6	7.4	9.9
OR	14.6	9.7	11.5	10.5	8.0	7.0	6.9	6.9	12.1
UT	21.7	33.2	16.8	15.9	18.5	25.9	15.1	13.1	14.9
WA	11.0	16.2	15.2	12.1	12.3	14.5	10.3	9.4	11.7
Unit	19.5	19.7	20.3	19.2	17.7	14.6	14.7	14.3	16.2

[a]Annual indices are the predicted value from the trend analysis plus the deviation from the expected value in a year. Large but nonsignificant changes due to small sample sizes produce exaggerated indices over the 38-year period.
[b] New England consists of CT, ME, MA, NH, RI, and VT.

Table 2. Breeding population indices[a] based on mourning doves heard along Call-count routes, 1966-2003.

Management unit/state	1975	1976	1977	1978	1979	1980	1981	1982	1983
EASTERN UNIT									
Hunt									
AL	21.3	20.5	22.6	24.8	23.8	23.9	22.8	23.3	23.4
DE/MD	13.2	16.0	14.7	15.3	14.9	14.1	13.5	14.1	10.0
FL	14.4	13.3	14.6	11.4	12.4	9.9	9.0	10.5	12.2
GA	30.6	24.1	25.0	27.5	24.0	24.4	27.0	29.0	25.9
IL	25.7	25.2	26.9	20.6	18.0	18.4	20.7	25.2	25.9
IN	33.8	33.9	37.7	20.4	21.7	27.5	31.6	22.3	19.2
KY	19.3	24.3	22.8	24.5	16.8	16.3	27.9	24.1	13.5
LA	10.8	10.9	9.0	10.6	9.0	12.5	10.8	13.5	12.4
MS	26.1	26.5	27.3	30.7	26.2	24.7	24.8	31.2	26.2
NC	14.1	17.2	46.0	24.6	29.1	28.3	27.8	23.3	27.6
OH	37.4	27.3	26.1	13.9	13.4	16.1	19.5	18.6	19.8
PA	5.7	5.8	4.7	5.8	6.4	7.7	9.1	8.7	8.6
SC	27.7	27.4	23.3	30.8	26.1	32.9	32.0	33.0	31.4
TN	22.2	22.0	24.1	29.7	20.4	22.1	18.6	24.9	19.3
VA	23.8	22.9	30.6	22.6	20.0	19.5	16.9	18.6	18.5
WV	2.4	6.0	5.7	6.5	7.2	8.4	6.7	6.4	6.1
Subunit	20.1	20.2	21.4	19.7	18.1	19.3	19.7	20.7	19.3
Nonhunt									
MI	12.6	12.8	10.8	12.4	7.3	13.4	15.3	11.2	9.9
N.England[b]	4.9	4.6	8.5	7.3	6.1	7.6	9.2	7.5	8.0
NJ	15.9	20.0	21.9	17.4	18.5	17.2	14.2	16.1	19.2
NY	12.8	7.6	7.5	9.1	6.1	10.9	9.3	9.9	9.2
WI	14.9	14.9	19.6	7.9	11.6	14.9	20.2	11.2	13.1
Subunit	11.7	10.4	11.8	9.6	8.1	12.1	13.7	10.5	10.6
Unit	18.2	17.8	19.1	17.1	15.3	17.6	18.5	18.0	17.1
CENTRAL UNIT									
AR	21.5	26.1	21.3	15.0	12.2	20.2	22.1	25.7	19.3
CO	19.5	27.7	25.6	28.2	23.3	26.9	30.3	29.3	16.1
IA	22.8	28.0	21.8	24.4	20.8	28.1	31.0	22.4	16.0
KS	46.2	50.7	48.0	37.4	53.9	58.4	55.7	53.0	59.6
MN	30.3	26.3	30.1	29.0	29.5	31.6	27.7	24.3	21.0
MO	33.7	29.8	34.5	22.1	21.0	32.7	27.6	24.3	23.5
MT	23.8	17.2	20.9	20.0	20.0	18.2	17.0	21.6	17.3
NE	41.5	46.8	47.3	38.9	41.7	53.0	50.3	49.1	44.7
NM	13.6	13.3	11.9	11.9	8.1	13.1	12.9	10.1	13.6
ND	31.0	49.8	41.2	44.0	41.2	46.6	47.2	44.2	42.2
OK	24.7	26.1	33.6	25.8	25.2	26.2	26.0	27.2	27.9
SD	40.6	43.6	38.2	41.2	40.3	40.4	36.4	43.3	37.4
TX	21.1	20.6	19.7	20.4	25.3	24.2	22.0	21.3	19.7
WY	18.5	17.0	10.8	17.0	12.8	11.5	12.6	16.2	10.8
Unit	26.1	26.8	25.7	25.2	24.8	27.8	27.0	26.9	23.9
WESTERN UNIT									
AZ	27.4	28.3	25.3	25.3	24.7	22.0	24.8	28.3	22.0
CA	18.5	22.1	17.0	15.3	11.8	20.0	16.6	20.5	12.7
ID	8.7	16.0	19.6	10.8	10.4	10.8	11.9	12.2	9.3
NV	6.2	10.0	10.3	6.1	8.8	12.5	9.0	5.0	4.5
OR	9.2	9.6	10.9	5.8	6.0	9.1	7.8	7.6	5.8
UT	15.9	18.4	21.6	9.5	11.8	14.2	18.8	11.4	11.4
WA	12.7	12.2	13.3	8.6	12.0	8.2	9.8	9.2	7.7
Unit	14.0	17.5	17.4	11.7	12.4	15.3	14.9	13.7	10.8

[a]Annual indices are the predicted value from the trend analysis plus the deviation from the expected value in a year. Large but nonsignificant changes due to small sample sizes produce exaggerated indices over the 38-year period.
[b] New England consists of CT, ME, MA, NH, RI, and VT.

Table 2. Breeding population indices[a] based on mourning doves heard along Call-count routes, 1966-2003.

Management unit/state	1984	1985	1986	1987	1988	1989	1990	1991	1992
EASTERN UNIT									
Hunt									
AL	19.5	25.0	22.7	20.2	22.3	19.1	17.9	16.7	19.2
DE/MD	11.3	12.4	14.7	12.8	11.8	16.2	7.8	12.0	15.3
FL	8.4	10.8	12.6	11.4	13.7	12.4	11.3	12.1	12.3
GA	21.0	27.0	24.1	25.2	25.4	25.8	26.5	22.0	31.0
IL	21.0	18.1	24.9	24.4	27.5	27.1	26.4	26.7	27.6
IN	20.9	18.3	24.4	24.5	29.5	24.9	27.1	27.3	24.1
KY	21.7	22.6	20.4	25.1	20.0	27.7	23.2	22.0	17.5
LA	11.9	10.7	9.8	14.0	10.4	16.1	11.5	11.8	15.7
MS	19.3	25.6	25.1	22.3	26.4	24.6	20.8	17.2	22.4
NC	30.9	21.5	30.1	29.2	26.9	31.6	28.8	24.4	23.8
OH	18.3	17.2	16.8	18.3	21.0	19.7	18.1	19.4	20.4
PA	7.9	8.6	9.2	10.4	7.0	9.0	9.0	9.1	10.2
SC	28.5	28.6	24.2	35.5	28.0	26.9	29.1	23.6	23.2
TN	16.5	21.2	16.1	19.8	19.4	17.6	15.5	18.6	18.2
VA	18.0	16.9	13.7	14.5	15.8	15.4	13.1	13.8	12.2
WV	5.4	6.7	6.3	6.6	7.6	8.2	10.8	9.2	7.4
Subunit	17.5	18.6	18.7	19.9	19.7	20.4	18.8	18.3	19.4
Nonhunt									
MI	10.6	11.7	14.9	12.2	14.7	18.4	13.9	11.3	13.2
N.England[b]	6.9	7.7	8.3	7.9	7.4	7.8	8.7	9.5	10.1
NJ	12.1	12.4	14.6	13.3	12.9	15.8	12.6	15.2	9.7
NY	9.0	8.3	6.9	9.2	7.4	11.5	10.0	12.6	10.8
WI	10.3	10.6	11.4	7.5	17.8	17.8	14.2	12.7	19.4
Subunit	9.6	10.0	10.7	9.4	11.8	14.0	12.0	11.9	13.4
Unit	15.4	16.3	16.6	16.8	17.7	18.9	17.1	16.7	17.9
CENTRAL UNIT									
AR	13.7	13.6	14.7	13.7	15.2	21.4	16.6	15.0	18.2
CO	20.1	23.9	22.9	24.5	26.5	29.8	26.8	17.7	13.4
IA	23.5	25.9	23.4	22.5	30.4	27.4	31.4	23.1	31.0
KS	47.0	60.4	41.6	45.0	51.9	46.7	40.7	56.7	55.3
MN	17.9	19.5	17.6	22.5	22.9	17.9	14.5	17.9	20.8
MO	22.3	21.3	22.1	24.9	25.0	24.5	19.8	21.6	22.6
MT	13.1	17.9	18.6	17.8	14.6	18.6	20.2	13.2	14.1
NE	42.6	43.8	36.5	36.0	36.0	40.0	39.8	40.6	38.1
NM	14.6	12.4	14.9	17.9	13.4	14.9	16.3	14.9	9.8
ND	33.2	43.4	40.1	46.0	43.4	45.2	43.8	48.3	51.8
OK	21.0	20.5	23.0	25.5	22.5	17.0	22.3	22.6	25.3
SD	41.6	39.0	36.3	31.7	37.6	40.5	41.9	43.9	35.5
TX	19.4	20.0	21.6	21.3	21.9	16.8	17.8	24.7	22.6
WY	9.8	11.2	13.7	11.0	7.1	8.4	8.4	8.9	9.1
Unit	22.3	24.4	24.6	25.3	24.3	24.1	24.1	24.5	23.5
WESTERN UNIT									
AZ	27.0	21.7	25.7	17.3	19.3	23.9	18.2	23.2	24.9
CA	17.6	12.5	14.4	11.0	14.8	10.9	10.9	10.7	11.6
ID	10.9	10.0	7.1	7.2	9.4	9.3	10.0	9.1	8.4
NV	4.4	5.5	3.6	4.2	5.7	4.9	3.4	4.5	3.8
OR	7.4	8.1	6.6	6.0	7.5	6.2	7.1	4.4	7.0
UT	12.8	8.4	11.7	10.2	10.5	11.0	9.4	8.5	10.9
WA	6.7	8.5	10.1	8.0	8.0	6.9	7.2	9.0	7.9
Unit	12.7	11.4	11.2	9.7	11.9	10.8	9.9	10.1	10.8

[a]Annual indices are the predicted value from the trend analysis plus the deviation from the expected value in a year. Large but nonsignificant changes due to small sample sizes produce exaggerated indices over the 38-year period.
[b] New England consists of CT, ME, MA, NH, RI, and VT.

Table 2. Breeding population indices[a] based on mourning doves heard along Call-count routes, 1966-2003.

Management unit/state	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
EASTERN UNIT											
Hunt											
AL	20.9	21.7	22.9	17.8	16.6	18.4	17.7	18.9	18.2	21.1	16.9
DE/MD	10.4	12.6	11.2	10.5	8.7	12.1	8.7	8.2	8.1	7.0	10.9
FL	11.0	10.3	12.0	11.2	10.4	12.9	13.6	13.1	10.0	10.5	11.1
GA	19.1	22.0	26.3	22.1	19.1	18.3	18.5	16.4	22.5	12.3	19.3
IL	24.1	26.9	27.7	21.9	22.2	22.3	20.5	26.9	22.4	24.1	24.6
IN	25.5	30.3	24.5	21.0	20.7	20.9	21.8	23.5	20.8	19.6	19.9
KY	22.6	21.9	21.4	18.3	17.1	21.8	22.1	23.8	19.4	22.8	22.7
LA	12.0	13.0	14.8	12.0	12.3	13.9	14.6	17.2	18.1	14.3	16.6
MS	24.5	20.6	18.8	17.7	16.8	17.1	20.6	17.8	16.1	13.7	15.4
NC	24.7	24.9	27.1	27.6	30.2	29.5	30.2	35.8	39.9	33.7	32.4
OH	17.3	19.2	17.5	14.1	14.0	16.4	17.1	18.2	14.9	17.1	16.1
PA	11.2	10.6	10.2	9.9	9.2	11.0	9.0	10.5	9.9	10.0	9.2
SC	27.2	24.5	19.7	24.9	23.8	26.9	24.6	23.2	24.4	21.7	23.0
TN	15.9	19.6	18.1	15.4	16.5	15.9	16.0	17.6	14.1	15.1	14.7
VA	13.7	13.6	14.7	11.8	14.9	14.1	14.5	15.5	12.5	14.6	11.3
WV	8.7	9.5	9.8	4.9	10.2	8.4	9.9	9.4	6.4	9.4	5.8
Subunit	18.4	19.1	19.3	16.6	16.7	17.9	17.9	18.9	17.2	16.7	16.9
Nonhunt											
MI	12.2	11.5	12.9	13.2	12.8	14.6	14.3	17.5	14.3	14.6	15.2
N.England[b]	10.7	9.6	12.1	8.3	8.3	9.1	10.5	11.1	9.3	12.0	9.6
NJ	15.6	13.6	10.1	13.1	7.0	11.5	9.3	12.4	6.4	11.4	9.5
NY	9.5	9.6	10.7	10.1	10.9	9.5	12.6	14.4	12.0	12.0	12.5
WI	18.5	15.3	13.1	11.8	12.3	9.8	18.9	16.5	15.9	14.1	19.2
Subunit	12.9	11.8	12.3	11.1	11.1	10.9	14.1	15.1	12.8	13.5	14.1
Unit	17.1	17.2	17.5	15.2	15.3	16.0	17.0	18.0	16.1	15.9	16.2
CENTRAL UNIT											
AR	16.7	20.0	18.5	18.8	19.3	19.3	17.6	17.3	16.6	13.4	17.5
CO	12.9	22.9	19.1	14.3	19.4	20.2	22.0	22.1	14.3	17.7	17.9
IA	22.9	24.1	25.5	32.5	26.7	29.4	27.2	23.7	22.6	24.6	33.4
KS	38.2	51.0	60.8	32.4	57.7	53.9	65.6	49.9	34.5	44.3	39.1
MN	14.9	18.0	17.5	16.7	17.7	16.5	14.8	15.2	13.0	16.4	9.3
MO	21.8	26.1	22.7	22.3	21.8	19.6	18.0	18.5	15.7	17.2	17.2
MT	10.3	9.5	12.1	12.2	11.3	14.0	12.8	14.0	10.6	12.6	11.8
NE	40.0	37.2	40.6	33.9	31.2	39.5	36.2	36.2	30.3	28.9	37.3
NM	10.9	13.7	12.4	10.7	14.1	11.8	13.8	15.5	16.0	11.6	15.2
ND	45.1	38.9	40.7	42.6	37.8	35.7	46.8	47.0	36.9	31.2	44.5
OK	21.8	28.5	21.5	22.8	21.9	31.5	28.5	23.9	24.9	23.8	30.8
SD	32.0	34.9	36.4	36.5	31.0	33.4	34.9	36.5	33.1	35.5	35.4
TX	20.6	22.8	17.2	14.8	22.1	22.4	22.1	19.5	19.5	18.9	19.0
WY	6.6	8.6	6.3	7.2	7.0	7.3	5.5	7.7	5.0	6.0	4.9
Unit	20.5	23.8	22.2	20.4	23.0	24.0	23.7	23.6	20.3	20.9	21.5
WESTERN UNIT											
AZ	27.0	22.3	21.1	12.4	19.0	21.8	23.8	24.9	17.1	18.1	16.7
CA	14.1	11.7	11.4	11.6	10.2	10.6	11.0	10.2	9.7	11.5	9.1
ID	7.3	7.2	6.5	6.2	8.8	5.2	6.9	6.3	5.0	8.0	6.2
NV	3.1	2.8	4.7	4.3	3.9	3.3	4.0	3.2	2.8	3.0	3.0
OR	5.8	6.8	5.7	5.6	5.6	4.3	4.4	7.1	5.1	5.6	6.6
UT	9.2	9.6	6.2	7.1	8.9	5.2	8.2	13.1	5.6	7.9	7.2
WA	6.8	7.0	7.8	5.2	6.4	4.6	6.2	7.1	6.7	6.7	7.4
Unit	10.4	9.9	9.8	8.7	9.8	8.1	9.6	10.5	8.0	9.6	8.9

[a]Annual indices are the predicted value from the trend analysis plus the deviation from the expected value in a year.
Large but nonsignificant changes due to small sample sizes produce exaggerated indices over the 38-year period.
[b] New England consists of CT, ME, MA, NH, RI, and VT.

Table 3. Trends (% change[a] per year as determined by linear regression) in number of mourning doves heard and seen along Breeding Bird Survey routes, 1966-2002.

	10 year (1993-02)					37 year (1966-02)				
	N	% Change[b]		90% CI		N	% Change[b]		90%CI	
EASTERN UNIT										
Hunt										
AL	92	-0.8		-2.3	0.8	97	-1.2	**	-2.0	-0.3
DE/MD	68	-0.7		-2.2	0.9	78	0.5		-0.2	1.1
FL	70	1.3		-0.1	2.7	82	2.7	**	1.8	3.7
GA	60	-2.1	**	-3.5	-0.7	67	-1.3	*	-2.4	-0.2
IL	93	0.5		-0.8	1.9	93	0.6		-0.4	1.5
IN	54	-0.9		-2.7	0.8	58	-0.2		-0.7	0.4
KY	36	2.8	**	1.3	4.2	49	0.5		-0.3	1.2
LA	50	7.0	**	3.7	10.3	66	2.3	**	0.8	3.7
MS	26	-5.1	*	-9.7	-0.5	34	-1.5	**	-2.5	-0.5
NC	64	-0.7		-2.7	1.3	74	-0.3		-1.3	0.7
OH	66	1.6	*	0.2	3.0	77	0.6		-0.1	1.4
PA	101	2.6	**	1.1	4.0	120	2.3	**	1.4	3.2
SC	31	3.3	*	0.3	6.2	37	-0.1		-1.1	1.0
TN	41	0.8		-1.3	3.0	46	-0.6		-1.7	0.4
VA	49	-0.4		-1.8	1.1	55	-0.5		-1.2	0.2
WV	50	6.1	**	3.9	8.2	55	5.7	**	4.6	6.8
Subunit	951	0.4		-0.1	1.0	1088	0.1		-0.3	0.5
Nonhunt										
MI	65	3.6	**	1.8	5.3	78	0.6		-0.1	1.3
N.England[c]	135	1.3	*	0.0	2.6	152	3.5	**	2.6	4.5
NJ	27	0.1		-2.0	2.2	37	0.5		-0.9	1.9
NY	101	3.4	**	1.9	4.9	115	2.9	**	2.4	3.5
WI	89	2.3	**	1.0	3.5	91	1.2	*	0.1	2.2
Subunit	417	2.5	**	1.8	3.2	473	1.8	**	1.3	2.3
Unit	1368	0.8	**	0.4	1.3	1561	0.5	**	0.1	0.8
CENTRAL UNIT										
AR	31	3.1	**	1.1	5.0	34	0.4		-1.1	1.8
CO	118	2.2		-0.3	4.7	126	1.0		-0.2	2.2
IA	34	0.9		-1.5	3.3	37	-0.9		-1.9	0.1
KS	55	-0.9		-2.9	1.2	56	-0.1		-1.1	0.8
MN	59	0.7		-2.0	3.4	67	-1.1		-2.4	0.1
MO	52	-1.2		-2.5	0.1	63	-2.3	**	-3.1	-1.5
MT	49	-0.9		-3.8	2.0	53	-1.1	*	-2.0	-0.1
NE	38	-0.5		-2.2	1.1	45	-0.9	*	-1.6	-0.2
NM	65	1.6		-1.5	4.7	72	-0.5		-2.3	1.3
ND	44	-2.5	*	-4.6	-0.5	46	1.0	**	0.3	1.7
OK	55	1.7		-0.5	3.9	60	-1.5	**	-2.3	-0.7
SD	35	0.8		-0.9	2.6	47	0.6		-0.3	1.6
TX	168	0.5		-1.1	2.1	193	-1.4	**	-2.0	-0.8
WY	78	0.8		-2.0	3.7	99	0.2		-1.5	1.9
Unit	881	0.4		-0.3	1.0	998	-0.6	**	-0.9	-0.3
WESTERN UNIT										
AZ	53	-2.2		-5.3	1.0	71	-1.5		-3.5	0.6
CA	165	1.5		-0.2	3.2	213	-1.0	*	-1.9	-0.2
ID	39	3.6		-0.2	7.4	43	-1.1	*	-2.0	-0.1
NV	21	4.0	**	1.0	7.1	32	3.6	**	1.3	5.9
OR	80	1.9		-1.5	5.4	95	-2.2	*	-4.0	-0.3
UT	82	-0.9		-3.7	1.9	85	-1.8	*	-3.4	-0.2
WA	60	-0.1		-3.3	3.1	65	0.0		-1.8	1.9
Unit	500	0.6		-0.8	1.9	604	-1.2	**	-1.8	-0.5

[a]Mean of route trends weighted by land area and population density. The estimated count in the next year is (%/100+1) times the count in the current year where % is the annual change. Note: Extrapolating the estimated trend statistic (% change per year) over time (e.g., 37 years) may exaggerate the total change over the period.
[b]**P*<0.1; ***P*<0.05; ****P*<0.01.
[c]New England consists of CT, ME, MA, NH, RI, and VT.

Table 4. Preliminary estimates of the number of hunters, days hunted, total bag, and confidence intervals for each from Harvest Information Program surveys for the 2001-02 season.

Management Unit	Hunters	95% CI	Days hunted	95% CI	Birds bagged	95% CI
EASTERN						
AL	53,600	8%	148,800	12%	917,900	14%
DE	3,500	20%	11,800	20%	66,900	19%
FL	17,900	28%	56,600	33%	335,400	45%
GA	66,300	14%	249,900	20%	1,638,300	20%
IL	37,400	10%	118,300	15%	632,800	14%
IN	16,900	15%	52,100	15%	342,500	22%
KY	39,600	12%	117,400	17%	896,000	20%
LA	25,200	21%	78,700	36%	465,400	27%
MD	12,900	23%	36,100	23%	219,800	35%
MS	25,400	14%	79,800	29%	627,000	32%
NC	62,100	14%	166,900	16%	891,100	17%
OH	17,700	33%	64,800	22%	224,900	21%
PA	39,200	17%	155,100	20%	387,700	17%
RI	600	102%	1,100	64%	1,400	58%
SC	36,200	11%	127,200	21%	733,200	11%
TN	37,800	41%	103,500	29%	795,000	38%
VA	24,300	10%	74,900	14%	417,900	16%
WV	1,900	25%	5,100	24%	26,600	37%
Unit	518,500		1,648,100	6%	9,619,800	6%
CENTRAL						
AR	41,600	16%	125,300	20%	932,900	23%
CO	16,700	13%	42,900	16%	206,300	14%
KS	38,200	7%	138,500	11%	636,300	11%
MO	33,700	15%	105,900	22%	475,000	24%
MT	2,400	56%	6,400	67%	31,300	80%
NE	16,400	10%	62,600	13%	294,400	12%
NM	9,200	14%	46,300	23%	232,400	23%
ND	3,900	31%	13,600	21%	66,500	19%
OK	22,300	19%	62,300	30%	327,800	38%
SD	10,100	25%	32,800	25%	159,700	26%
TX	289,400	10%	1,280,400	15%	7,593,000	21%
WY	3,300	35%	8,000	41%	29,200	24%
Unit	487,200		1,925,000	10%	10,984,900	15%
WESTERN						
AZ	47,200	5%	165,200	9%	1,107,900	9%
CA	71,800	6%	214,200	7%	1,136,000	8%
ID	10,400	26%	33,700	38%	126,500	51%
NV	4,800	23%	12,100	30%	37,700	29%
OR	7,400	16%	21,500	19%	66,000	24%
UT	12,800	18%	29,800	22%	76,300	21%
WA	7,900	39%	20,700	42%	66,100	20%
Unit	162,300		497,300	6%	2,616,600	6%
U.S.	1,168,000 [a]		4,070,400	5%	23,221,200	7%

[a]This total is slightly exaggerated because people are counted more than once if they hunted in more than one state.

Table 5. Preliminary estimates of the number of hunters, days hunted, total bag, and confidence intervals for each from Harvest Information Program surveys for the 2002-03 season.

Management Unit	Hunters	95% CI	Days hunted	95% CI	Birds bagged	95% CI
EASTERN						
AL	57,200	7%	164,900	10%	1,225,400	12%
DE	3,600	19%	12,700	22%	81,600	25%
FL	18,300	22%	70,300	31%	366,900	31%
GA	56,400	12%	192,300	20%	1,249,700	20%
IL	32,900	9%	118,100	15%	687,500	18%
IN	18,200	15%	62,100	17%	362,800	20%
KY	35,700	10%	109,500	17%	730,200	15%
LA	29,300	24%	77,400	23%	499,300	28%
MD	9,300	21%	30,700	32%	179,800	39%
MS	28,400	12%	92,400	15%	816,100	14%
NC	41,300	15%	108,800	21%	688,100	25%
OH	20,000	25%	88,700	31%	300,500	14%
PA	31,500	16%	133,700	18%	451,700	28%
RI	200	118%	500	66%	2,000	88%
SC	42,700	13%	142,700	20%	953,700	23%
TN	62,500	46%	166,500	48%	914,300	54%
VA	27,600	9%	81,400	12%	412,000	14%
WV	1,700	19%	4,600	25%	22,200	22%
Unit	516,800		1,657,400	7%	9,943,600	7%
CENTRAL						
AR	42,700	15%	126,600	17%	919,100	17%
CO	17,600	9%	55,600	15%	254,500	17%
KS	37,400	7%	136,000	10%	853,800	11%
MO	27,800	26%	91,000	29%	520,800	36%
MT	2,100	41%	4,600	38%	16,400	27%
NE	15,800	10%	52,400	11%	290,100	12%
NM	8,700	19%	34,100	25%	251,900	34%
ND	6,100	34%	17,900	39%	89,400	50%
OK	25,600	19%	75,700	33%	423,700	36%
SD	9,100	23%	28,600	21%	135,400	23%
TX	292,400	10%	1,177,300	11%	6,580,700	10%
WY	2,900	29%	6,200	35%	30,800	42%
Unit	488,200		1,806,000	8%	10,366,500	7%
WESTERN						
AZ	35,400	5%	121,500	8%	777,500	9%
CA	80,500	6%	240,300	8%	1,216,200	8%
ID	10,700	17%	28,300	18%	108,100	19%
NV	5,200	21%	17,800	37%	70,700	51%
OR	7,000	14%	20,100	18%	67,000	17%
UT	12,400	14%	35,700	20%	95,300	16%
WA	5,600	29%	14,400	33%	57,100	21%
Unit	156,800		478,000	5%	2,392,000	5%
U.S.	1,161,800 [1]		3,941,300	5%	22,702,100	5%

[1]This total is slightly exaggerated because people are counted more than once if they hunted in more than one state.

CURRENT RESEARCH ACTIVITIES (PROGRESS TO DATE)

Harvest Dynamics of Mourning Doves in South Carolina

JAMES B. BERDEEN, Department of Aquaculture, Fisheries, and Wildlife, Lehotsky Hall, Clemson University, Clemson, SC 29634
DAVID L. OTIS, U.S. Geological Survey, Biological Resources Division, South Carolina Cooperative Fish and Wildlife Research Unit, Lehotsky Hall, Clemson University, Clemson, SC 29634

Call-count surveys indicate the mourning dove (*Zenaida macroura*) populations in South Carolina and in the Eastern Management Unit declined during 1966-2002. Although reasons for this negative trend are not known, annual survival, particularly that of juveniles, appears to have decreased in South Carolina between the 1970s and 1990s. Thus, there was a need to investigate patterns of mortality during periods within the annual cycle when the mortality rate is thought to be particularly high.

The role that various sources of direct mortality and their interactions have played in the population dynamics of mourning doves is sometimes unclear. Because South Carolina is thought to have had a relatively high dove harvest historically and the role of hunting in this decline is unknown, we initiated a study to examine population parameters at 3 Upper Coastal Plain sites thought to have had different levels of hunting pressure. The objectives of this study are to: (1) assess the influence of subcutaneously-implanted radiotransmitters on the health and survival of doves, (2) compare harvest rate estimates derived from banding and telemetry data, (3) determine whether site-, year-, and age-specific differences in period survival rates (PSR) exist, (4) estimate cause-specific mortality rates from July-November, (5) estimate the crippling rate of doves, and (6) examine the influence of various factors on indices of annual production.

We used telemetry and banding data to estimate period and annual survival rates, respectively. Telemetry was also used to estimate crippling rates and the magnitude and timing of various sources of mortality. We collected harvest age ratio data at organized dove hunts within 5 km of the 3 study sites as an index to site- and year-specific reproductive success. This 5-km buffer zone surrounding the core study sites defined the boundaries of each study site.

We elected to attach radiotransmitters to birds using the subcutaneous implantation (STI) method of Schulz et al. (1998) because traditional methods of transmitter attachment have been unsuccessful in doves. In both a cage experiment and in *a posteriori* analyses of the field study data, we assessed possible negative influences of the STI method on the health and survival of doves. In the field study, 16.9% of all post-release mortalities occurred during the first 3 days after release, with the number of mortalities per day decreasing abruptly after that time. We observed that the dehiscence rate in the cage experiment and field study birds were 0% and 9%, respectively. Although STI birds had lost weight at 3 weeks post-implantation in the cage experiment, radiomarked birds that were re-encountered during the field study had gained weight since the day of surgery. There may have been an interaction between captivity and radiomarking that contributed to weight loss in the cage experiment birds.

Next, we calculated the mid-July - early September (45-day) PSRs of radiomarked juveniles (HY) and adults (AHY) with the Kaplan-Meier product limit estimator method (Kaplan and Meier 1958, Pollock et al. 1989). To facilitate comparisons between our summer survival rates and those of a northcentral Missouri study which attached transmitters with body-loop harnesses (Schulz et al. 1996), we converted all PSR estimates and associated confidence intervals to mean daily survival rates (MDSR) estimates. The AHY and HY doves with transmitter implants had MDSR estimates of 0.9996 (0.9988 - 1.0004, 95% CI) and 0.9977 (0.9952 - 1.0002, 95% CI), respectively. Doves in northcentral Missouri had an estimated MDSR of 0.997 (0.996 - 0.998, 95% CI) during April - August. The slightly higher MDSR of doves with subcutaneously-implanted transmitters suggests that this attachment method may be preferable to body-loop harnesses.

To determine whether radiomarked birds were particularly susceptible to any source of mortality in the field study, we examined the proportion of mortality from each source observed. After 3 days post-release, the sources of mortality for STI birds during the study period in which they were released were hunting (65.3%), predators (22.4%), unretrieved hunter kills (10.2%), and unknown causes of death (2.0%). We then compared the recovery and annual survival rates of STI and leg-band only birds to ascertain whether doves telemetered during the prehunting season were more susceptible to hunter harvest than were leg-banded birds. We fit our 1998-2000 marking and recovery data to a series of models in Program MARK (White and Burnham 1999). We allowed recovery and annual survival rates to vary by age (AHY or HY) and marking method (radiomarked or leg-banded), and used information-theoretic methods (Burnham and Anderson 1998) to select the most parsimonious model. Our best model was that in which recovery and survival rates were constant over age and marking method. Under this model, recovery and annual survival rate estimates were 0.129 (0.093 - 0.178, 95% CI) and 0.215 (0.082 - 0.454). Thus, marking method appears to not have any influence on the susceptibility of doves to hunter harvest.

In our analysis of dead recoveries of marked birds from 1992-2000, recovery and annual survival both varied by age in the most parsimonious model examined. The recovery rate estimates were 0.0933 (0.0740-0.1171, 95% CI) and 0.1467 (0.1212- 0.1764, 95% CI) for AHY and HY birds respectively. The annual survival rates of AHY and HY birds were 0.3957 (0.3141-0.4835, 95% CI) and 0.1128 (0.0579-0.2082, 95% CI), respectively. Preliminary estimates of the mid July - late November PSR estimates (131 days) varied little during each year of the study. Year-specific PSR estimates (all age and site cohorts pooled) were for 0.5258 (0.3554-0.6962, 95% CI), 0.5273 (0.3245-0.7300, 95% CI), and 0.5797 (0.4105-0.7489, 95% CI) in 1998, 1999, and 2000, respectively. Site-specific PSR estimates (all year and age cohorts pooled) were 0.3300 (0.1624-0.4976, 95% CI), 0.6196 (0.4525-0.7868, 95% CI), and 0.7085 (0.52370.8934, 95% CI) for sites with heavy, moderate, and light hunting pressure, respectively. Age-specific PSR estimates (all year and site cohorts pooled) were 0.7110 (0.5884 - 0.8335, 95% CI), 0.4197 (0.2592 - 0.5802), and 0.7991 (0.6226 - 0.9756) for AHY, HY, and unknown age birds, respectively. The PSR of birds of unknown age may have been deceptively high because most of these birds were entered into the population at-risk after a period of high mortality (i.e., the first split of hunting season). The overall PSR estimate was 0.5394 (0.4346-0.6442).

The corrected age ratios ([number of harvested HYs : number of harvested AHYs] / [HY direct recovery rate : AHY direct recovery rate]) of harvested birds were 1.448:1, 1.326:1, and 1.404:1 during 1998, 1999, and 2000, respectively. These ratios are well below most previous estimates from the Carolinas (Haas 1978, McGowan and Otis 1998). To determine whether harvest age ratios varied by study site during 1998-2000, we compared site-specific uncorrected ratios. If doves used a reproductive mechanism to compensate for hunting losses, higher harvest age ratios would be expected at sites at sites with greater hunting pressure. Harvest age ratio varied by site in one year only, when this ratio was greatest at the site with the lowest hunting pressure. It appears that there was little evidence of compensatory natality during this study. We will investigate how biotic and abiotic factors influence variation in corrected harvest age ratios from several studies conducted in the Carolinas in future analyses.

We submitted a manuscript entitled *The Influence of Subcutaneous Transmitter Implants on the Health and Survival of Wild Mourning Doves* to a peer-reviewed journal for review and possible publication. We are finalizing the development of models of PSR estimates and cause-specific mortality rates from telemetry data. Funding for this study was provided by the 1996 and 2000 Migratory Game Bird Research Program (U.S. Fish and Wildlife Service and U.S. Geological Survey - Biological Resources Division), South Carolina Department of Natural Resources, South Carolina Public Service Authority (Santee-Cooper), Safari Club International, Clemson University, and the South Carolina Cooperative Fish and Wildlife Research Unit.

Monitoring the Presence and Annual Variation of *Trichomonas gallinae* in Mourning Dove Populations

JOHN H. SCHULZ, Missouri Department of Conservation, Conservation Research Center, 1110 S. College Ave, Columbia, MO 65201
ALEX J. BERMUDEZ, University of Missouri, Veterinary Medicine Diagnostic Laboratory, Columbia, MO 65211
JOSHUA J. MILLSPAUGH, Department of Fisheries and Wildlife Sciences, University of Missouri,302 Anheuser-Busch Natural Resources Building, Columbia, MO 65211
JOHN FISCHER, University of Georgia, Southeastern Cooperative Wildlife Disease Study, Athens, GA 30602

Trichomonas gallinae is a pear-shaped flagellated protozoan which sometimes causes a fatal disease called trichomoniasis in mourning doves, other columbids, and some raptors. The disease is thought to be transmitted when infected adult doves feed nestlings, and/or contaminate drinking water and food sources (i.e., bird feeders or baths) used by other doves. Weather conditions may contribute to disease transmission; e.g., extended hot dry weather may force birds to use limited but contaminated food and water supplies. Trichomonads are usually found in the oral-nasal cavity, or anterior end of the digestive and respiratory tracts of infected birds. Symptoms include difficulty flying, listlessness, swollen necks, and cheesy yellowish lesions in the oral cavity. Death occurs when the lesions block the trachea and oral cavity making eating and respiration impossible. Our objectives were to determine the presence of *Trichomonas gallinae* in a local mourning dove population using hunter killed-birds on the James A. Reed Memorial Wildlife Area (JARMWA), Missouri, 1998-2002, and to evaluate the practicality of a large-scale program to monitor *Trichomonas gallinae* trends. Our goal was to attempt to sample 1,000 hunter-killed birds annually using the InPouch® TF (BioMed Diagnostics, San Jose, CA, USA) culture system for detecting trichomonads. To help achieve our desired sample, we gave away a limited number of commemorative baseball caps to the first 100 participating hunters. Using 3 captive mourning doves from another study, which died from trichomoniasis, we tested how long trichomonads lived in the dead birds. Viable trichomonads were found >36 hrs after the birds died and were left at ambient temperature showing that hunter killed-birds would prove useful in detecting the presence of the parasite. During 1998-2002, we examined 3,169 hunter-killed mourning doves and found no visible trichomoniasis lesions; however, 5.8% of all birds tested positive for carrying the protozoan parasite. During the 5-year study, we received 156 credible reports of the disease from the general public, most of which were associated with urban/suburban bird feeder stations. Results of the large-scale monitoring program, however, proved problematic for several reasons. Press releases about the project, and request for help from the public, generated an abundance of telephone and email responses, but many were directly unrelated to the project (e.g., many people just wanted to report having observed a mourning dove at their bird feeder). Each time a press released came out we received a pulse of responses that appeared more related to press releases than to observable changes in the disease's presence. Also, different news services and local papers recycled the press releases several times throughout the summer months, and thus generating more small-scale local pulses in responses from the public. Other confounding factors include differing amounts of among volunteers in looking for the disease symptoms, memory bias (e.g., "I just saw your story in the paper, and I remember seeing some dead birds by my bird feeder 2 months ago."), and varying levels of interest in looking for the diagnostic lesion in the oral cavity.

Given the relatively low cost of this study, we are considering continuing the monitoring of hunter killed doves beyond 2002. A longer term monitoring program would provide more insights into annual variation in the presence of the disease, and more certainty concerning factors that relate to causes of the annual variation. These preliminary results represent the fifth year of a 5-year study. The final report for the first 5 years study will be available by June 2003. Funding and assistance for this study was provided by 1998 Webless Migratory Game Bird Research Program (U.S. Fish and Wildlife Service and the U.S. Geological Survey-Biological Resources Division), Missouri Department of Conservation-Conservation Research Center (Federal Aid in Wildlife Restoration Project W-13-R-52), and BioMed Diagnostics (San Jose, CA).

Lead Exposure in Mourning Doves

J. CHRISTIAN FRANSON, **U.S. Geological Survey, Biological Resources Division, National Wildlife Health Center, 6006 Schroeder Rd, Madison, WI 53711**

Final Report

To evaluate lead exposure in mourning doves (*Zenaida macroura*), we examined carcasses of 4,884 hunter-killed doves from Arizona, Georgia, Missouri, Oklahoma, Pennsylvania, South Carolina, and Tennessee. One or more ingested lead pellets were found in 2.5% of 4,229 carcasses collected at hunting areas where the use of lead shot was permitted, with ingestion rates among areas varying from 0% to 20.8%. Ingested steel shot were found in 2.4% of 655 carcasses collected from two areas requiring the use of nontoxic shot. Of the 4,511 dove carcasses for which age was determined, 69.9% were hatch year and 30.1% were after hatch year. All doves, except one, with ingested shot were hatch year birds. The proportions of hatch year males and females (3.4% and 3.0%, respectively) with ingested lead shot did not differ significantly. Doves with ingested lead shot had from one (in 42% of the birds) to 43 pellets in their gizzards, with 3.8% having $\geq$15 lead pellets. Of the birds with ingested steel shot, 25% had $\geq$15 steel pellets in their gizzards. Ingested lead shot were found in gizzards of 2.3% of the doves collected early in the hunting season (September 1 through September 7) and in 3.0% of the birds collected later in the season (September 8 through December 24). From the areas where lead shot was used for hunting, 8.3% of doves had liver lead concentrations $\geq$6 ppm dry weight and 26.8% had $\geq$20 ppm dry weight of lead in their wing bones, concentrations often used as indicators of lead exposure above normal background levels. Where steel shot was required for hunting, 2.0% of doves had liver lead concentrations $\geq$6 ppm dry weight and 11.1% had bone lead concentrations $\geq$20 ppm dry weight. The median liver and bone lead concentrations in doves with ingested lead shot were 36.89 ppm dry weight and 89.33 ppm dry weight, respectively. Median liver and bone lead concentrations in doves without ingested shot were <1.0 ppm dry weight and <3.0 ppm dry weight, respectively. In doves without ingested lead shot, the median concentration of lead in wing bones of after hatch year birds was significantly greater than the median in wing bones of hatch year birds.

This is the abstract from the final report of this study, which was funded by the 1998 Webless Migratory Game Bird Research Program (U.S. Fish and Wildlife Service), U.S. Geological Survey, Arizona Game and Fish Department, Georgia Department of Natural Resources, Oklahoma Department of Wildlife Conservation, Missouri Department of Conservation, Pennsylvania Game Commission, South Carolina Department of Natural Resources, and the Tennessee Wildlife Resources Agency. Additional cooperators included the South Carolina Cooperative Fish and Wildlife Research Unit.

Development and Evaluation of Mourning Dove Population Models for Optimizing Harvest Management Strategies in the Eastern, Central, and Western Management Units

DAVID L. OTIS, U.S. Geological Survey, Biological Resources Division, Iowa Cooperative Fish and Wildlife Research Unit, Iowa State University, Ames, IA 50011

Introduction and Objectives

An informed harvest management process for mourning doves will require development of one or more population models that synthesize existing knowledge of basic life history parameters and how these parameters may be affected by intrinsic and extrinsic factors such as harvest rate, weather, and habitat conditions. Such models allow predictions of effects of different harvest prescriptions on long term population and harvest levels, and can ultimately be used to define decision criteria for implementing alternative harvest strategies. This modeling effort represents an initial step in a process to an improved decision making process for mourning doves, and strives to place mourning dove harvest management in an objective and quantitative framework.

Understanding the effects of harvest on mourning dove populations is a multi-faceted challenge, and this effort is only one of many steps in increasing our knowledge. Upon completion of the project, we expect to have advanced the process of developing an improved system of dove harvest management by 1) improving our understanding of dove population dynamics, 2) prioritizing population monitoring data needs within the context of a long term harvest management system, and 3) recommending surveys and studies to fill information gaps that constrain development of more useful and realistic population models.

Contemporary information about dove population demographics and the relationship of mortality and reproductive rates to extrinsic and intrinsic factors is clearly inadequate to support sophisticated modeling fitting or adaptive modeling efforts at this point in time. However, it is necessary to begin development and evaluation of rudimentary models that represent a first step toward a long term objective of improved dove harvest management strategies that are grounded in credible population models and that guide improved population monitoring programs that will be necessary to support management efforts.

Progress to Date

Re-analysis of the 1965 -1975 banding experiment on increased bag limits in the EMU has been completed and a manuscript published. The analysis revealed that the increase in bag limits during experimental years did not result in increased harvest rates, and thus the study could not provide any rigorous insight into the relationship between harvest and annual survival. There was a high degree of association between annual survival rates from banding data and harvest rate estimates derived from mail survey data collected during the study. Dove populations from groups of non-hunting states in the Northeast and Upper Mideast had much higher annual survival rates. However, this phenomenon can also be at least partially explained by a hypothesis of an intrinsic latitudinal gradient in annual survival of mourning doves.

Re-analysis of the 1965-1975 banding studies in the EMU, CMU and WMU was completed, and a set of survival models for each management unit was constructed based primarily on these analyses. The models are distinguished by the functional form of the relationship between annual survival and harvest rate, which ranges from completely additive to totally compensatory. A manuscript based on this work has been published.

Published results of studies of various parameters of the breeding cycle of mourning doves date back at least 80 years, and several summaries of these results have been compiled. This collection of small scale, relatively short term studies serves to establish bounds on such parameters as length of the nesting season, young fledged per breeding pair, and nest density. Estimates of annual recruitment, in terms of number of juveniles (HY) per adult (AHY) in the pre-harvest population, can be derived from age ratios observed in the harvest, corrected for differential harvest vulnerability of age classes. Harvest age ratios are usually from collection of wings from surveyed hunters, and long term surveys are conducted by the U.S. Fish and Wildlife Service for waterfowl species and woodcock (Scolopex minor). In the case of waterfowl, age ratio data from wing surveys is a key component in development of reproductive models used in the adaptive harvest management program (Johnson et al. 1997). However, no long term program has been instituted for mourning doves. Thus, no long-term, large-scale monitoring programs or datasets are available to serve as the basis for development of quantitative models that predict annual production as a function of weather, habitat, and/or population density. Based on a review of the dove literature and a more general review of relevant ornithological literature, I derived a predicted range of per capita reproductive rates for each of several large geographical subregions. These estimates are based on a simple model that is a function of breeding season length, nest success, and length of the nesting cycle of successful and unsuccessful nests. A manuscript based on this work has been accepted for publication.

Contemporary and statistically reliable estimates of harvest rates are fundamental in the evaluation of population models and the harvest regulation process. In cooperation with a consortium of 25 states, the U.S. Fish and Wildlife Service, and the USGS Bird Banding Laboratory, a 3-year reward banding study has been designed to be implemented in 2003-2005.

The design involves banding 25,000-35,000 birds in each year, to achieve the following objectives: 1) estimate harvest rates in a representative sample of multi-state regions, 2) estimate current band reporting rates, which can be used to convert direct recovery rate estimates to harvest rates from other regions and presumably for all regions in the foreseeable future, 3) serve as a pilot study for a future coordinated nationwide banding program designed to produce comprehensive estimates of harvest and survival rates, 4) provide information on geographical distribution of harvest, and initial estimates of annual survival and breeding site fidelity from a sample of breeding populations. Estimates generated from this study will be used to update and improve population models developed to support harvest management strategies. A proposal for funding of the project has been submitted to the U.S. Fish and Wildlife Service.

Future Work

Work in the next year will primarily focus on:
1) Integration of survival and reproductive models into population models, and comparison of model predictions to long term Call Count Survey and Breeding Bird Survey trends.

2) Coordination of efforts to obtain funding for the proposed reward banding study. If funding is obtained, banding workshops will be conducted for participating agencies, and direction and coordination of field work for 2003 will be done.

3) Communication of project status and direction to technical committees and working groups in dove management unit and flyways.

These are results from the third year of a multi-year study funded by the USFWS Webless Migratory Game Bird Program and more than 20 cooperating state wildlife agencies.

Evaluation of Physiological and Pathological Effects of Subcutaneously Implanted Radiotransmitters on Captive Wild Mourning Doves

JOHN H. SCHULZ, Missouri Department of Conservation, Conservation Research Center, 1110 South College Avenue, Columbia, MO 65201
JOSHUA J. MILLSPAUGH, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia, MO 65211
BRIAN E. WASHBURN, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia, MO 5211
ALEX J. BERMUDEZ, University of Missouri, Veterinary Medicine Diagnostic Laboratory, Columbia, MO 65211
JAMES L. TOMLINSON, University of Missouri, Veterinary Medical Teaching Hospital, Columbia, MO 65211
TONY W. MONG, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia, MO 65211

Our on-going and long-term research plan is aimed at achieving reliable information for improving harvest management decisions for mourning doves. Part of the information needed for improving the harvest management decision-making process will include regional estimates of demographic parameters (e.g., survival and/or recruitment) used in population modeling exercises for each of the three management units across the United States. Many of the demographic estimates will be obtained from studies using mourning doves instrumented with miniature radio transmitters. It is critical that data obtained from radio marked individuals must be reflective of the overall population of interest. Thus, the impact of attaching and carrying radio transmitters must be thoroughly evaluated so that the resulting data can be used in the proper context.

Our first project showed that subcutaneous transmitters with external antennas were a preferred alternative to intra-abdominal implants with external antennas when comparing heterophil:lymphocyte (H:L) ratios. Note, heterophils and lymphocytes are two types of avian white blood cells, and their relative ratio in the blood stream is considered to be a chronic measure of physiological stress. The H:L ratio data from our second implant evaluation was not as conclusive, however, our data suggested that subcutaneous implants are superior to glue attachment based on retention time, and superior to harnesses based on pathological effects. Due to multiple practical and experimental considerations, the size of the cages used during the first two implant projects were about the size of shoe boxes (24 × 18 × 18 cm in 1996; 24 × 40 × 18 cm in 1998), and the birds were housed indoors with climate controlled rooms. Currently, our third project is evaluating the efficacy of field surgery techniques, and subcutaneous radio-transmitter implants using much larger captive facilities which allow the birds to fly and be exposed to the out-of-doors; compared to previously used cages, current cages are approximately 183 × 183 × 183 cm and 61 cm above the ground. Field work for the third mourning dove radio transmitter implant evaluation has been completed, and we are in the beginning stages of data analysis.

An interesting observation from our preliminary analysis is the dramatic decrease in the relative H:L ratios from the previous two implant evaluations compared to the third implant project. The data dramatically show that birds housed in larger cages, and maintained in the out-of-doors, are under much less stress than birds in small in-door cages. In addition captive doves held outside appear to show different stress levels between summer and winter.

Although there may be experimental difference between implant and control birds during the summer session, it is important to look at the relative scale of H:L ratios from previous projects. For example, due to the statistical power of our study design, we may have been able to detect differences that may not biologically important; however, that is only conjecture at this point. This is only the first attempt to look at the numerous data collected during this project. Other data to look at include body temperature cycles of implanted birds, blood plasma chemistry profiles, changes in fecal glucocorticoid stress hormones levels as an independent and non-invasive measure of physiological stress, and changes in body mass.

Funding for this study was provided by 2001 Webless Migratory Game Bird Research Program (U.S. Fish and Wildlife Service and the U.S. Geological Survey-Biological Resources Division), Missouri Department of Conservation-Conservation Research Center (Federal Aid in Wildlife Restoration Project W-13-R-56), University of Missouri (Department of Fisheries and Wildlife Sciences; Veterinary Medical Teaching Hospital; Veterinary Diagnostic Laboratory), and Advanced Telemetry Systems (Isanti, Minnesota).

Native Columbiformes in Tucson, Arizona, 2000-02

CLAIT E. BRAUN, Grouse Inc., 5572 North Ventana Vista Road, Tucson, AZ 85750

Field investigations for a pilot study of three native columbids in suburban Tucson, Arizona were conducted from 1 January 2000 through 31 December 2002. Species studied through banding, examination of live birds, and observations of free-flying individuals were Inca Dove (*Columbina inca)*, Mourning Dove (*Zenaida macroura)*, and White-winged Dove (*Zenaida asiatica)*. Objectives were to examine timing of breeding, apparent abundance, timing of migration, survival rates, and characteristics of primary feather length and body mass.

Inca Doves occurred in the study area in small numbers within a scattered distribution. Breeding occurred primarily from March through August but may occur earlier and later. Only 41 individuals were banded (12 repeats) with no reported recoveries or recaptures away from the trap site. Site fidelity was high but few individuals were at the trap site from May through September each year. Measurement data were too sparse for comparison and techniques for separation of gender are not reliable. Intensive studies of Inca Doves would need multiple sites over an area of at least 25 km².

Mourning Doves were the most abundant species in the area and may number in excess of 2 million birds within the greater Tucson area. During the 3-year pilot effort, 3,500 individuals were banded using one 1-m² trap at one location. Repeat captures increased each year and totaled > 1,200 for the period. Three recoveries (none reported as shot) and no recaptures elsewhere were reported. Thus, the original hypotheses of multiple populations of Mourning Doves moving to, through, and from the Tucson area were rejected. This resident population began breeding activity between 5 and 10 January each year and continued into late August. Immature doves first appeared in trap samples in late March with numbers captured increasing through September and into October. HY doves could still be identified in trap samples into December. Measurements of primary feathers (10 and 1) appear useful to separate genders and recording of secondary feathers retained was useful in identifying HY and AHY birds into late December. Analyses of all measurement data will be completed in 2003. Future efforts could be directed at measuring the size of foraging areas. Negative data (no recaptures of any of the Mourning Doves banded in this study) from a trap site 8.0 km distant suggest the foraging radius of Mourning Doves in the Tucson area is less than this distance. With numbers banded of 1300, 1100, and 1100 during the three years, apparent densities of Mourning Doves in the Tucson area were high during the study period.

White-winged Doves were seasonally migrant within the area studied. However, a few whitewings were known to winter near Green Valley, 40 km south and an occasional bird was seen each winter at lower elevations in the Tucson city area. Initial movement of White-winged Doves into the Catalina Foothills was in March increasing markedly in April into June. Highest apparent numbers occurred in June and July with marked decreases noted in mid August with departure of most birds from the Foothills before 1 September each year. A few birds lingered at higher elevations into late September unlike the situation in farming areas south and west of Tucson where whitewings remained in some numbers into mid September. Four hundred and eleven White-winged Doves were banded in the 3-year period with only 23 repeats. Trapping was most successful prior to onset of saguaro cactus fruit ripening and after most fruits had dried (prior to 10 June and after 10 July). No recoveries were received but one recapture of a bird banded in this study was reported at a trap site, 8 km distant. This distance may be the maximum foraging radius for White-winged Doves during the breeding season in suburban Tucson. Measurement data have not been analyzed but a reliable technique to separate gender and age classes may be available. Further testing is needed.

Additional fieldwork is being considered only on White-winged Doves.

Landscape Changes as Related to Mourning Dove Call-count Trends in Texas

BRIAN L. PIERCE, Department of Wildlife and Fisheries Sciences, Texas A&M University, Mail Stop 2258, College Station, Texas 77843-2258
NOVA SILVY, Department of Wildlife and Fisheries Sciences, Texas A&M University, Mail Stop 2258, College Station, Texas 77843-2258
MARCUS PETERSON, Department of Wildlife and Fisheries Sciences, Texas A&M University, Mail Stop 2258, College Station, Texas 77843-2258
X. BEN WU, Department of Rangeland Ecology & Management, Texas A&M University, Mail Stop 2126, College Station, Texas 77843-2126
FRED SMEINS, Department of Rangeland Ecology & Management, Texas A&M University, Mail Stop 2126, College Station, Texas 77843-2126

The mourning dove (Zenaida macroura) is recognized as the most important upland game bird species in North America. As such, dove populations are monitored by annual call-count surveys within the continental United States. Texas has the largest number of call-count transects, with 133 transects distributed among 8 physiographic regions. While there has been a significant ($P < 0.05$) decline in the statewide population index over the last 10 years (Dolton and Smith 1999), contradictory trends are evident among transects within the state. These discrepancies may be important if we are to identify which factors influence change in mourning dove populations, particularly at the community and landscape level. Grue et al. (1976, 1983) investigated the biotic and abiotic environment factors that define the realized niche for mourning dove in Texas. Because this historic data set used a standardized method for the evaluation of habitat variables along each of the 133 transects in Texas, a comparison with current habitat conditions is possible. We hypothesize that count trends may correlate with measurable changes in land use and/or environmental factors adjacent to the call-count transects, as measured by the Grue et al. (1983) technique. Our objectives for this study are to: 1) determine if micro and macro habitat variable changes differ among declining and stable transects, 2) identify those micro and macro habitat variables which correlate with the observed differences in count trends, and 3) establish a spatially explicit database that can be used for future data input and investigations at differing spatial scales.

We have completed (summer 2002) data collection for all 133 call-count transects in Texas using the technique of Grue et al. (1983). We are currently in the process of compiling the GIS database for the 2002 results, which will be used to identify spatially congruent sample points from the 1983 study. This is the first year of a 3-year study of mourning dove habitat in Texas.