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A STUDY OF MOURNING DOVE MORTALITY IN THE SOUTHEAST

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This paper examines the evidence of winterkill of the mourning dove (*Zenaidura macroura*) in the southeastern states during an exceptionally severe snow and ice storm during the winter of 1950-51 and its possible reflection on the dove population during the ensuing year.

Only a few reports of the winter killing of doves are available in the literature. Wayne (1899) mentions seeing dead doves in South Carolina during the cold wave of February 13 and 14, 1899, while Rice (1924) referring to the same storm mentions "strings of dead doves . . . only scattered individuals remained the vast flocks of mourning doves." Errington (1936) published a short note on winter mortality of doves in Central Iowa during the winter of 1934-35. Winterkill in the Southeast during the winter of 1940-41 has been considered a factor in the reported declining dove population in this region.

Whether or not catastrophes of this type result in a reduced huntable dove population has often been speculated but adequate data do not accompany such speculations. The uniqueness of the dove mortality to be discussed, not only its extent, but that it occurred when extensive data were being collected on dove populations, offers an opportunity to speculate on the effect of this pre-hunting season mortality on the huntable population.

METHODS

Extent of Mortality—It is exceptional when a study of unusual game mortality over an extensive region can be integrated immediately with a current study based on modern sampling procedures. The winterkill of mourning doves in Tennessee during the winter of 1950-51 occurred while a statewide wildlife survey was in progress. The survey employed a method of sampling known as "area sampling" (Schultz 1952, 1954a). The sampling method consisted of dividing the State of Tennessee into many small areas of land, each containing approximately equal numbers of farm dwellings. A proportionate stratified random sample of 1,000 of these areas was selected (a sampling rate of approximately 1:50.5) and the 3,560 heads of farm households on these areas were interviewed concerning personal observations of mourning dove mortality during the year preceding interview. Interviewing commenced in the fall of 1950 and was completed approximately 13 months later.

Following the severe snow and ice storm which occurred

during the winter of 1950-51, 1,740 of these farmers, on a stratified random sample of 503 sampling areas (i.e., 1/2 of the areas in each county), were interviewed in regard to: (1) personal observations of dove mortality on their farm during the storm period and (2) mortality observed during the remainder of the year. Although two separate questions on dove mortality were asked, respondents reporting a noticeable winterkill of doves might have neglected reporting inconspicuous dove mortality during other portions of the year. It is also conceivable that mortality observed in East Tennessee during January 14, 15, and 16, a period of heavy snowfall preceding the ice storm by about two weeks, might have been reported as having occurred during the ice storm.

Only heads of farm households were considered eligible respondents in the personal interview survey; therefore, reported observations are restricted to this group. This restriction prevented collecting duplicate observations in the same household and permitted calculation of sampling errors and estimates of total observed mortality by this group.

Additional information on dove mortality was obtained from personnel of a coordinated mourning dove study being conducted in the Southeast.

Effect of Mortality—During this period of dove mortality the coordinated mourning dove study was being conducted in the Southeast, but unfortunately not in the northern breeding range of the species. Data utilized from this study were primarily of two types: (1) hunter bag check, and (2) "census" data. Data from these two sources were used to evaluate the effect of the dove mortality on the huntable population. The hunter bag check data consist of the bag composition and hours of hunting effort. "Census" data in the coordinated study were obtained by four primary methods: (1) "random" road, (2) "controlled" road, (3) rural mail carrier, and (4) call counts. Unfortunately, the effort expended collecting the data varied so between states that except for Kentucky and Florida, only the "random" road count data are usable. In tabulating the original data the project did not consider possible future analysis, failed to keep observations distinct, and to supply measures of variation with its tabulations. The data were combined in the form of totals, e.g., individual hunter bag check data such as number of hours hunted and number of birds bagged were simply totalled, thus information on variability of the observations was lost. As the data leave much to be desired, it should not be construed that they are of a high caliber. The data are used because they furnish the only information available on dove populations during the study period.

The expressions, "population," "nesting season," and "nesting success" are used loosely in this paper. When discussing effects of winterkill on winter, spring, and fall populations in various

states, the writer does not wish to imply that these populations are identical. Reduction of the wintering population of Tennessee may have little or no effect on Tennessee's spring population, though it might conceivably affect the spring population of some northern state, thereby possibly affecting the fall population in Tennessee or in some other southern state. Similarly, a discussion of a good nesting season, as *indicated* by age ratios from the hunter's bag, does not necessarily refer to nesting in any particular state.

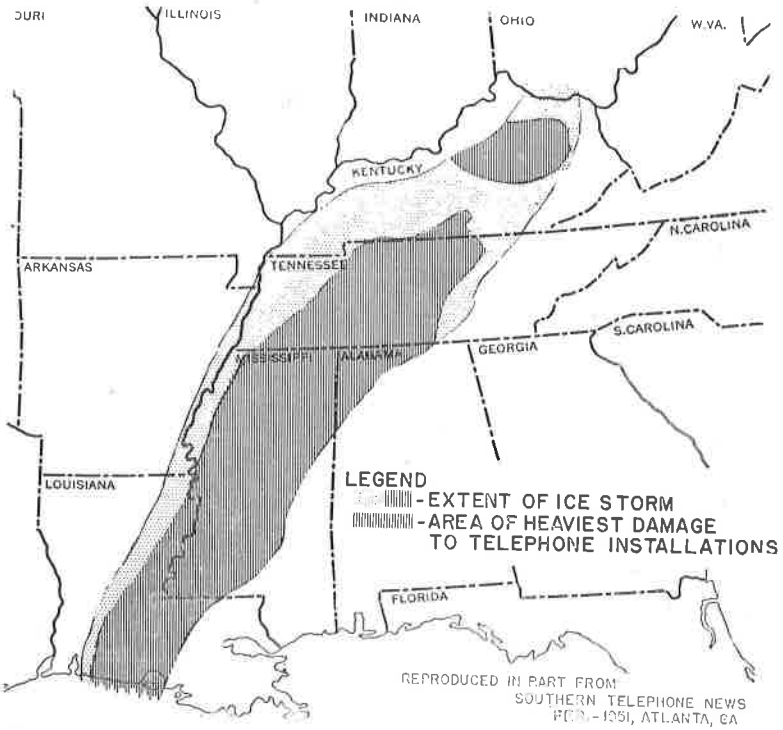

Figure 1. Extent of January-February, 1951, ice storm in the southeastern states.

Climatological Data

The ice storm occurred in six southern states, beginning in late January, 1951. In the southeastern states it extended in a wide band southwestward across Kentucky, Tennessee Mississippi, Louisiana, and portions of Arkansas and Alabama. Figure 1 delineates the principal ice storm area, but the effects were felt east and west of the boundaries shown. Less severe effects (e.g., low temperatures) of the storm were felt in Georgia, North Carolina, South Carolina, and Texas. Various states in the ice

Table 1. Tennessee survey results and estimates, January-February, 1951, ice storm.

	No. of Areas in Sample	Sample Total	Estimate[1]	Relative Sampling Error (percent)[2]	95 percent Confidence Limits[3]
Number of farmers:					
East Tennessee	171	560	56,560	3.55	52,544-60,576
West and Central Tenn.	332	1,180	119,180	2.09	114,198-124,162
State Total	503	1,740	175,740	1.82	169,343-182,137
Number of frozen doves:					
East Tennessee	171	99	9,999	31.73	3,654-16,344
West and Central Tenn.[4]	332	526	53,126	16.07	36,051-70,201
State Total	503	625	63,125	14.54	44,768-81,482

[1] Obtained by multiplying the sample total by the sampling rate. For this study, the 1,000 areas used on the statewide wildlife survey were sub-sampled at 1/2 rate. This resulted in a sample of 503 areas and a sampling rate of twice that of the initial sample, i.e., 1:101.

[2] Computed by use of analysis of variance, with computations by the Iowa State College Statistical Laboratory.

[3] Limits are ± 2 x relative sampling error x estimate.

[4] Two observations of 100 doves each were not utilized by the Laboratory.

storm belt reported a southward gradient of minimum temperatures. On February 2, the following Fahrenheit temperatures were reported: Paducah, −12°, and Murray, Kentucky, −23°; Dover, −21°, and Paris, Tennessee, −21.5°; Little Rock, −5°, and Fort Smith, Arkansas, −9°; Corinth, −6.5°, and Booneville, Mississippi, 8°; Huntsville, 3°, and Scottsboro, Alabama, 4°. The greatest amount of ice formation in the storm belt was not in all instances accompanied by the lowest temperatures in the storm area.

A detailed discussion of the ice storm in Tennessee has been presented by Schultz (1954b). In general, the eastern limit of the storm in Tennessee coincides with a line bisecting the Cumberland Plateau (Figures 1 and 2, Farming-type 12) and running parallel to its eastern edge. The weather was nearly as severe east of Chattanooga, but the East Tennessee Valley

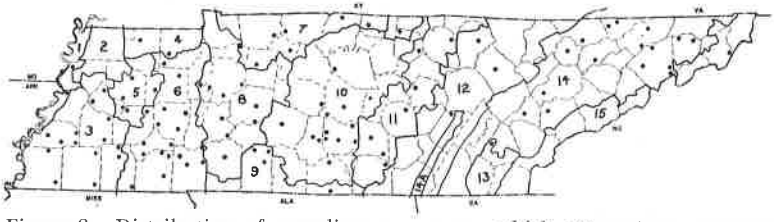

Figure 2. Distribution of sampling areas upon which respondents reported dove mortality during the January-February, 1951, ice storm in Tennessee.

did not have the ice and extreme depths of snow that occurred in West and Central Tennessee. Temperatures throughout the State were below normal for the first ten days of February. Snow and ice melted slowly over the area of greatest snow depth and, with additional light snow flurries, traces remained on the ground until February 12. With few exceptions, the rest of the month was unseasonably warm.

During the winter of 1950-51, severe weather was not restricted to the January-February ice storm. The western half of the Tennessee Valley (*probably all of West Tennessee*) had been experiencing its most severe weather since 1939-40 (Smallshaw, 1950). In 17 years of T.V.A. records, the November, 1950, snowfall was the heaviest recorded for this month. It occurred the week following Thanksgiving and was known as *The Big Snow* in East Tennessee.

Evaluation of Tennessee Mortality Data

Ice Storm (January, 1951)—In Tennessee, 143 farmers from nearly all counties in the ice storm area as well as from East Tennessee reported dove mortality during the storm (Fig. 2).

* Two observations of 100 doves each were not utilized by the Laboratory.

Four and one tenth percent of the 560 farmers in East Tennessee and 10.2 percent of the 1,180 farmers in West and Central Tennessee reported observations of dead doves (Table 1). The frequency distribution of these observations has been tabulated (Schultz, 1954b). The estimated total of dead doves observed in Tennessee by heads of farm households is 63,125, with 9,999 in East Tennessee and 53,126 in West and Central Tennessee (Table 1). Undoubtedly the actual mortality was many times the estimated observed mortality. Although reports of dove mortality were obtained in 15 counties outside the ice storm area, the number of reports for each county was, in general, less than the number of farmers observing dove mortality in counties located in the ice storm belt.

Big Snow (*November*, 1950)—Another marked period of mortality occurred during a snow storm commencing the last week

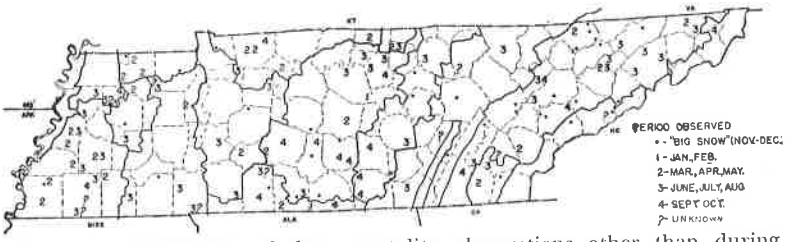

Figure 3. Distribution of dove mortality observations other than during the January-February, 1951, ice storm.

of November, 1950. This storm was, for the period it occurred, the coldest on record for the region. Although the inclement weather extended over all of Tennessee, the most severe weather occurred in East Tennessee; here it was known as *The Big Snow*. Reports of dove mortality during this period are presented in Fig. 3. As the writer was unable to differentiate, particularly in West and Central Tennessee, between observations occurring during *The Big Snow* and other periods in November and December; all observations of mortality during these months were considered as occurring during *The Big Snow*. Of the 18 farmers observing dove mortality in East Tennessee during this period, 13 referred specifically to *The Big Snow*, while of the 20 farmers observing mortality in the remainder of Tennessee four reported observations of frozen doves. Two of these four reports were in counties adjacent to counties in East Tennessee (Fig. 3). One might conclude from these data that the inclement weather had a greater effect on dove population in East Tennessee than it did in West and Central Tennessee as the East Tennessee dove population is generally smaller than the population in the remainder of the State.

Other Periods—Exclusive of observations reported by farmers during the January-February ice storm and *The Big Snow*, 97 farmers reported observing sick or dead doves during other periods of the year (Fig. 3). Although no attempt was made to inquire as to the exact location or cause of death, some information was collected. Many doves were found in hog lots and under power lines, the latter leading to the belief by farmers that birds were electrocuted. In October, a Bedford County poultryman showed the interviewer a dove having what he called "croup." Some of the farmers made specific remarks about sick doves, a cheesey substance in the bird's mouth, strangulation by corn, and poisoning by tobacco, cotton, and white clover poison. Mr. A. J. Meyerriecks (unpublished data) observed the organism, *Trichomonas gallinae,* in two of 200 doves collected in Tennessee primarily during the 1951 hunting season.

In certain portions of the State these reported observations were more or less restricted to definite periods (Fig. 3). In the northeast corner of the Valley of East Tennessee most of the observations occurred during the summer; in the southern Central Basin, during September and October; in the Plateau Slope of West Tennessee during spring and summer. It is posible that the concentration of September-October observations in the Central Basin, a region of relatively heavy hunting pressure, might have been the result of hunter crippling losses. Apparently dove mortality during January, February, and March, other than during the ice storm, was at a minimum, since only four observations were reported—one in January and three in March. It is also possible that the method of obtaining the information might have influenced these results.

Summary — Thousands of doves died in Tennessee during various periods of the year and mortality was especially great during periods of severe winter weather. It is difficult to ascertain whether the exceptional mortality periods during the winter exerted a greater influence on the population than did the non-spectacular mortality during the remainder of the year. As there is no evidence to the contrary, it is assumed that the extreme winter mortality was the only deviation from the "normal" mortality during the period of study.

Mortality in Other Southeastern States

Dove project leaders in all states in the primary storm area reported a substantial loss of doves during the January-February ice storm period. Observations of extensive mortality were quite common, many of which are referred to in quarterly progress reports of the projects. Outside the ice storm area only the biologist in Alabama reported dove mortality during the inclement period. He noted it as slight in northwest Alabama.

The January-February ice storm appears to have reduced the wintering dove population in Kentucky, Louisiana, Mississippi,

Tennessee, and probably Arkansas. Apparently no other "abnormal" mortality, other than that occurring during *The Big Snow* occurred during the 12-month period following the 1950 hunting season, either in the Southeast or in the summer range of the birds wintering in this region. This conclusion is based on the absence of other reports of extensive mortality during this period.

Relationship of Mortality to Huntable Population

Of prime importance to the game technician is the relationship of specific types of dove mortality to the fall population. Establishment of such relationships should be based on analysis of reliable data rather than on opinion.

This study examines road count data in an attempt to determine population changes that might have occurred in the period following the ice storm. Hunter bag check data are used both to compare populations during the hunting periods that preceded and followed the winter mortality, and also to evaluate the

Table 2. Results of analysis of road count (doves/mile) data.

Region	Sample Size (months)	Average Difference (1951 minus 1950)	t	$t_{.05}$
Storm Area:				
Kentucky	10	—.2143	6.2*	2.0
Tennessee	11	—.0942	2.9*	2.0
Arkansas	3	—.0277	.4	2.0
Louisiana	8	—.0924	2.4*	2.0
Mississippi	5	—.1978	4.1*	2.0
Non-Storm Area:				
Alabama	10	—.0463	1.3	2.0
Georgia	5	+.0524	1.1	2.0
N. Carolina	11	+.0094	.3	2.0
S. Carolina	3	+.1883	3.0*	2.0
Florida	5	+.0968	2.0*	2.0

success of the nesting season following this period of mortality. Data from hunter bag checks must be evaluated with care, as many unsuspected factors may influence the results; e.g., improper sampling, and a change in bag limit during the periods being compared.

"Census" Data—If the period of inclement weather in the ice storm area had an affect on the subsequent dove population, we would expect the monthly number of doves observed per mile of travel to be less following the period of inclement weather than in comparable months in 1950; outside of the ice storm area no such relationship would be expected unless another factor was playing a dominant role. Pairing monthly observation (1951 minus 1950) of doves observed per mile of travel, t—tests were applied to the data to evaluate the statistical

significance of the differences observed. The results of these tests are presented in Table 2. A significant difference was observed in all storm area states except Arkansas. Each of these states showed a significant decrease in the number of observed doves per mile. It should be noted that the Arkansas data consisted of only three comparable months, and that extensive mortality was not definitely established in this State. Outside the ice storm area significant differences were observed only for South Carolina and Florida, both of which showed a significant increase in the observed doves per mile in 1951. Only Alabama in this region had a negative average difference.

Objections could arise to the application of an analytical technique that does not allow adjustments for the different mileage driven during comparable months. An attempt was made to make such an adjustment by an analysis of covariance; however, tests of the hypothesis that the regression coefficients were zero resulted in rejection of the hypothesis only for Georgia. Thus, a simple paired comparisons test was applied using a pooled standard deviation (.1089) based on 61 degrees of freedom, after testing by means of an F—test whether or not the regional pooled variances were significantly different [$F=1.81$; $F_{.05}(30,30)=2.07$ from a 2.5 percent table of F]. The writer does not believe that the data justify a more complex analysis.

These analysis indicate that the dove population in the ice storm area was lower in 1951 than in 1950, and remained about the same in the southern states outside of the ice storm area. Data from some of the states in the latter area indicate a slight increase in the dove population. Quite possibly the real cause of the apparent population differences was a poor 1951 nesting season in the storm area and a satisfactory 1951 nesting season in the non-storm area or in the nesting range of the doves wintering in these regions. An inspection of hunter bag age ratio data should assist in clarifying the relationship.

Age Ratio Data—Age ratio data from the hunter's bag is used as an indicator of nesting success, often with weak assumptions. The comparison of age ratios rather than their estimation requires less assumptions than would be required in an estimation procedure. For age ratio comparisons between years to be valid. data should be from early fall hunting seasons that have not changed materially during the period of study. As a result of the aging technique, data collected during January, December, and possibly November are not reliable. Due to these limitations only age ratio data from Kentucky, Tennessee, Arkansas, North Carolina, and Florida were considered suitable for use in this study.

Applying a chi-square test, with a correction for continuity, to these data resulted in a significant chi-square in all cases

except Arkansas. There was a significant increase in the percentage of juveniles in Kentucky (1,572 birds; $X^2=9.84$) and Tennessee (3,649 birds; $X^2=120.35$), and no significant difference in Arkansas (209 birds; $X^2=2.73$). The two states in the non-storm belt had a significant decrease in the percentage of juveniles in the hunter's bag (Florida, 1,371 birds; $X^2=10.83$; North Carolina, 2,903 birds; $X^2=15.38$).

In summary, it appears that the nesting season was more successful in regions producing doves for the storm area than for the non-storm area. As a result of an increase in the nesting success in 1951, one might expect an increase in the hunting success in the storm area provided *extensive* mortality did not occur following the winter of 1950-51 and the storm had no effect on the huntable fall dove population. Similarly, in the non-storm area, a decrease in hunting success might be expected, provided, of course, that other factors were relatively constant. This leads to an inspection of the hunting success data.

Hunting Success Data—In order to evaluate hunting success, where hunting success is based on doves per man hour of hunting effort, the individual data for the states were considered as observations in a sample from either of the two areas, resulting in four observations within the storm area and five outside it. A more desirable analysis could have been applied had the individual bag checks been kept distinct in each state. Because of the small number of hunters checked in Arkansas (24 and 26) and an apparent selection of hunters, hunting success data from Arkansas were discarded. In attempting to adjust for the difference in hours hunted, an analysis of covariance was applied in a fashion similar to that used for the road count data. Results similar to those obtained from the road count data resulted in the writer selecting a paired comparisons t—test as an acceptable test (Table 3). A pooled standard deviation (.3051) based on seven degrees of freedom was utilized in the test procedure after testing by means of an F—test whether or not the regional variances were significantly different [$F=4.02$; $F_{.05}(3,4)=9.98$ from a 2.5 percent table of F]. There was a significant decrease in hunting success in the storm area while there was no significant difference in the non-storm area. When the Arkansas data are included, the computed t-value is not quite equal to the $t_{.05}$ value.

Summary and Conclusions

Although reliable data accompanied by a suitable analysis to substantiate a population decrease are lacking, mourning dove populations in the Southeast have been reported as decreasing for a few years prior to and during 1951. Technicians and sportsmen have expressed concern over this reported decrease in an important game bird; however, to date no concrete

evidence is available to substantiate various reasons expounded for this reported decrease in the Southeast. Undoubtedly, many agents play a role in reducing dove populations, such as disease, hunter-kill and land-use changes. The extreme rarity of severe inclement winter weather in the Southeast would, in general, eliminate winter-kill in this region from consideration when attempting to explain a population decline. Although winter-kill can, in general, be considered unimportant, it may at times play an important role, especially when populations are low. The January-February ice storm of 1951 occurred when the dove population was reportedly declining and, from evidence available, the storm took a heavy toll of the dove population in the storm area.

There was a significant decrease in dove hunting success, and the number of doves observed per mile of roadside count as compared with similar months in 1950 decreased following the period of mortality in the ice storm area. In the non-storm area there was no significant difference in the hunting success between

Table 3. Results of analysis of hunter success (doves/hour) data.

Region	Sample Size (states)	Average Difference (1951 minus 1950)	t	$t_{.05}$
Storm Area	4	—.4265	2.8*	2.4
Non-Storm Area	5	—.2640	1.9	2.4

the two seasons, and the number of doves observed per mile of travel did not significantly decrease, rather an increase was evident in some states. We have no evidence to support the hypothesis that a period of "abnormal" mortality followed the ice storm which could have resulted in the decrease in hunting success. In fact, the limited amount of data support the contention that no such mortality occurred. It could be postulated that decreased hunting success was the result of a poor nesting season; however, the age ratio data do not support this contention as the nesting success increased apparently in 1951 in the storm area. In the non-storm area there was no significant difference in the hunting success and a significant decrease in the nesting success.

It may be postulated that the extreme winter mortality resulted in a breeding population so low that even good nesting success could not bring the huntable population up to the 1950 level in the ice storm area. It is realized that other unknown factors could have played a major role, such as the method of sampling, analysis, or a delay in migration to the ice storm area.

PHYSIOGRAPHIC REGION	FARMING TYPE
Mississippi Bottoms	1
Plateau Slope of W. Tenn.	2, 3, 4, 5, 6
Highland Rim	7, 8, 9, 11
Central Basin	10
Cumberland Plateau	12
Valley of E. Tenn.	13, 14, 14-A
(14-A—Sequatchie Valley)	
Unaka Range	15

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To all these persons I extend my thanks. They do not necessarily endorse the conclusions arrived at by the writer. All conclusions and decisions on the methods of analysis are entirely his responsibility.

As the coordinated dove study data are available from various sources, I have omitted these data from the manuscript in order to reduce the cost of publication.

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