

DECADAL DECLINE (1992-2002) OF LOGGERHEAD SHRIKES ON CHRISTMAS BIRD COUNTS IN ALABAMA, MISSISSIPPI, AND TENNESSEE

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INTRODUCTION

Most major works discussing the population status of the Loggerhead Shrike (*Lanius ludovicianus*) in North America indicate that this predatory songbird has declined in population numbers at a rate of $>2\%$ /year since at least the mid-1960s (Root 1988, Price *et al.* 1995, Yosef 1996, Lefranc 1997, Pardieck and Sauer 2000). The most recent major works discussing the status of the shrike in Alabama (Imhof 1976) and Tennessee (Robinson 1990, Nicholson 1997) also refer to its declining population numbers. The major work for Mississippi (Toups and Jackson 1987) does not deal with the species' population status as a focal point and so does not mention this matter. Nearly all of the aforementioned works offering discussions about the population status of this species base comments on various population data, mainly from Breeding Bird Surveys (BBS) and Christmas Bird Counts (CBC), acquired no later than the mid-1990s. Only one source (Pardieck and Sauer 2000) provides commentary based on data acquired during the late 1990s, and in this case the data are derived from the BBS. Therefore, an update of the shrike's status in Alabama, Mississippi, and Tennessee based on the most recent CBC data appears warranted, especially in light of the continuing decline in the shrike's population numbers.

METHODS

To provide a basis for statistical analysis, CBC data from Alabama, Mississippi, and Tennessee were obtained from the "Historical Results of CBCs" section of the National Audubon Society (2002) website. Data from counts that were conducted every year from 1992 to 2002 resulted in a dataset derived from 11 sites in Alabama, 11 in Mississippi, and 15 in Tennessee for a total of 407 observation sites for the 11 year time period. The number of shrikes per count and the number of shrikes per party hour per count declined about the same in the three states over the study period, so the number of shrikes per count was used in our analysis.

The statistical objective of this study was to determine if there was a significant downward trend in Loggerhead Shrike population counts on CBCs for the years

1992 through 2002. Although the yearly counts per site resemble a time series both graphically (Figure 1) and intuitively, this time dependent structure was weak enough to avoid the use of a more complicated time series model. Hence, multiple regression analysis was the method of choice because of its simplicity and robustness. Also, combining all the sites from the three states into one dataset increased the power of the resultant hypothesis test, and the diagnostics showed that the assumptions of normality and independence were only slightly violated, if at all. Second, the original count data Y were transformed using the natural log to alleviate the problem of exploding variance and non-normality (Neter *et al.* 1996).

Finally, the multiple regression model used in this study to test for the possible downward trend in Loggerhead Shrike populations is given as

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{1i} X_{2i} + \beta_5 X_{1i} X_{3i} + \epsilon_i$$

where Y_i is the log of the number of shrikes recorded at each site, β_0 is the y intercept, β_1 is the change per year of the average of Y_i , called $E(Y_i)$, β_2 is the change in β_0 for sites in Tennessee, β_3 is the change in β_0 for sites in Mississippi, β_4 is the change in $E(Y_i)$ for sites in Tennessee, β_5 is the change in $E(Y_i)$ for sites in Mississippi, X_{1i} is the year, X_{2i} is 1 if a Tennessee site, 0 otherwise, X_{3i} is 1 if a Mississippi site, 0 otherwise, ϵ_i is the error term for the i^{th} data point, and $i = 1, \dots, 407$.

In the above model it appears that no parameters seem associated with Alabama. This is not the case. If any of the extra parameters ($\beta_2 - \beta_5$) are found to be significant, then β_0 and β_1 would represent the intercept and slope for Alabama. Conversely, if all of the extra parameters are not found to be significant, then β_0 and β_1 simply represent the overall intercept and slope.

RESULTS

The total number of shrikes counted during each year for each state and for the three states combined is shown in Table 1.

TABLE 1. Total Loggerhead Shrike counts recorded from Christmas Bird Counts in Alabama (11 counts), Mississippi (11 counts), and Tennessee (15 counts) 1992-2002.

State	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Alabama	314	288	268	207	249	156	135	207	134	195	173
Mississippi	283	262	250	213	249	237	211	214	173	183	246
Tennessee	144	78	97	81	53	49	57	72	51	52	56
Total	741	628	615	501	551	442	403	493	358	430	475

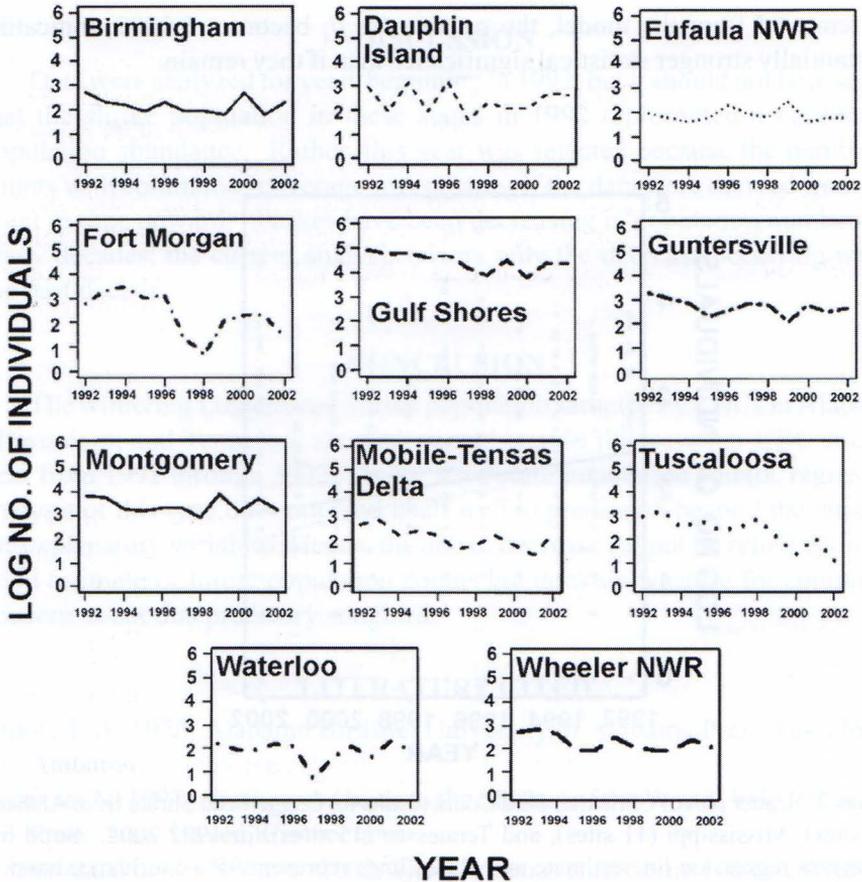


FIGURE 1. Annual Christmas Bird Count results for 11 sites in Alabama for 1992-2002.

Graphically, the data indicate a downward trend in the shrike population sampled by Alabama CBCs (Figure 1). Although similar trends were realized in the graphs for the Tennessee data and slightly less so for the Mississippi data, those figures are not presented here because the Alabama set was a good representative. Data from all three states are plotted along with the line of best fit and a 95% confidence band (Figure 2).

Results from the multiple regression model indicate that for the years 1992 through 2002 there is no significant difference in the population trend among the three states (Table 2). Second, and most importantly, there appears to be a slight downward trend in the average population count, giving an estimated decrease of 6% per year after untransforming the data. In fact, when parameters $\beta_2 - \beta_5$

are removed from the model, the p-value for β_1 becomes 0.0007, indicating substantially stronger statistical significance than if they remain.

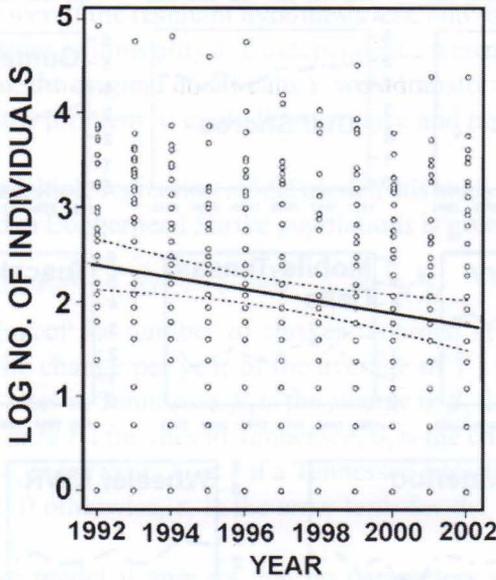


FIGURE 2. Scatter plot of Christmas Bird Count results for Loggerhead Shrike from Alabama (11 sites), Mississippi (11 sites), and Tennessee (15 sites) for 1992-2002. Solid line represents regression line estimate and dotted lines represent 95% confidence band.

TABLE 2. Results of multiple regression model that tested for downward trend in Loggerhead Shrike populations using Christmas Bird Count data from Alabama, Mississippi, and Tennessee for 1992-2002.

Parameter	Estimate	Standard Error	p-value	Dropped from model
β_0	128.46	51.96	0.014	No
β_1	-0.06	0.03	0.016	No
β_2	-41.15	73.48	0.576	Yes
β_3	25.08	68.40	0.714	Yes
β_4	-0.01	0.03	0.700	Yes
β_5	0.02	0.04	0.573	Yes

DISCUSSION

Data were analyzed for years beginning in 1992, but it should not be assumed that the shrike population in these states in 1992 represented a baseline of population abundance. Rather, this year was selected because the number of counts with continuous coverage was greatest if the data were derived from that point in time onward. Shrikes have been decreasing in population numbers for many decades; the current analysis covers only the decrease occurring within the past decade.

CONCLUSION

The wintering Loggerhead Shrike population sampled by CBCs in Alabama, Mississippi, and Tennessee showed, roughly, a 6% decrease per CBC site per year from 1992 through 2002. As for any future population counts, regression analysis of this type does not lend itself well to prediction beyond the range of the explanatory variables. Hence, the above decrease cannot be relied upon as a good estimate of future population counts but does show cause for continuing concern about this predatory songbird.

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