

SPECIES ACCOUNTS: 50-year Population Trends

Assessing avian population changes is inherently difficult, especially without strict data collection procedures. Observational records in the database contain no sampling controls; consequently, the following approach was developed to compensate for this shortcoming. This procedure uses annual bird numbers reported during the interval 1950 through 2004; although these data cover 55 years, it is termed the 50-year population trend. For each of these years the annual totals of 292 avian species (140 passerines and 152 non-passerines) were extracted from the statewide database (criteria used in species selection are appended). These data were combined into an "Average Curve" to which individual species could be compared.

Data Normalization

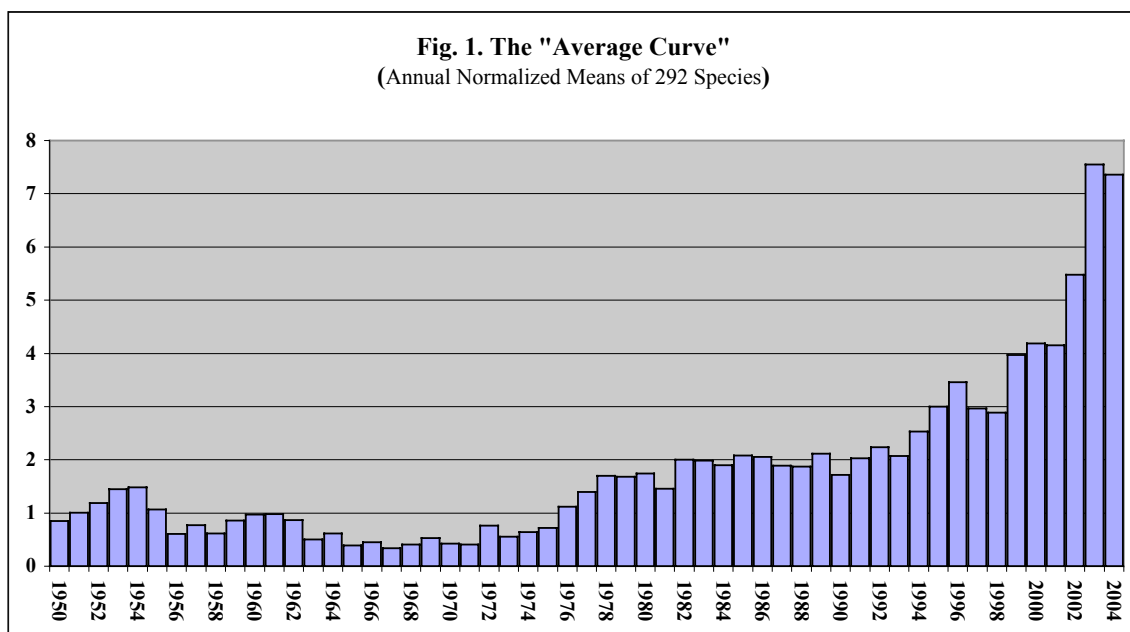
When combining the data of species with markedly different abundances, it is necessary to compensate for magnitude differences. That is, adding together numbers of American Robins and Nelson's Sharp-tailed Sparrows completely overwhelms the sparrow's contribution. Accordingly, the data for each species were normalized as follows:

**The annual totals of each species were summed from 1950 through 2004, inclusive.
Using this sum, the percentage of individuals recorded each year was calculated.
These annual percentages constitute the normalized values.**

This procedure effectively weights the contribution of each species equally.

The Average Curve

For each year the normalized values of all 292 species were summed and divided by 292 (i.e., the annual mean was calculated). The final result is plotted in Figure 1; each bar in the graph represents the mean of 292 normalized bird totals for that year. The curve



reveals that 50 percent of the last half-century's birds were reported after 1992 and some 25 percent after 2000.

The "Average Curve" also reveals a half-century of Indiana ornithological history. The plot clearly shows the abrupt increase of information following advent of IN-BIRD in late 1998. Also visible is an Indiana ornithological renaissance that occurred in the 1950s. The greater observational effort that emerged in the 1980s is also evident.

Correction Procedure

If all 292 bird populations used to calculate the "Average Curve" were stable and the observational effort constant all bars in Figure 1 would have the same height, yielding a flat plot. The obvious variations in bar height result from several factors: observer effort (which has clearly increased in recent years and is a dominant factor), improved identification information (better field guides), more detailed knowledge about bird distribution and habits, better optical equipment, and greatly enhanced communication. These factors are collectively referred to as "observational effort."

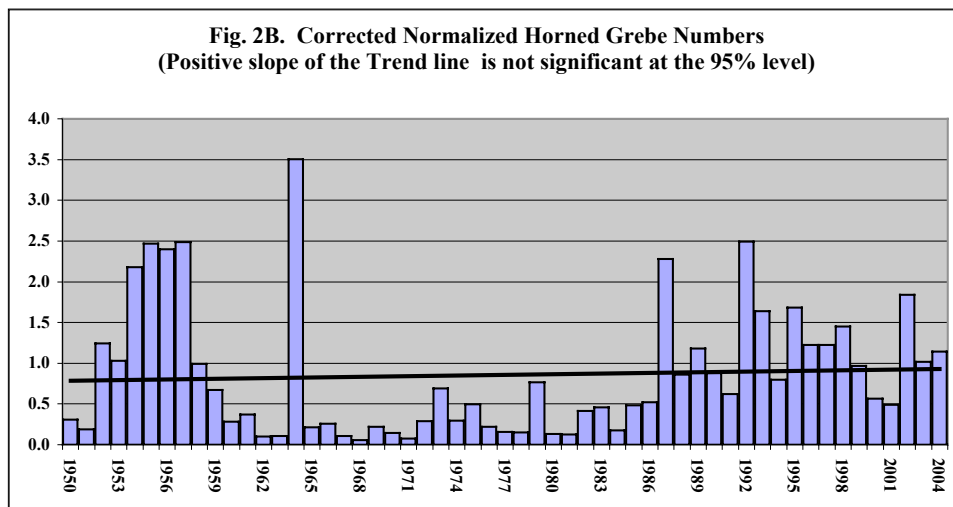
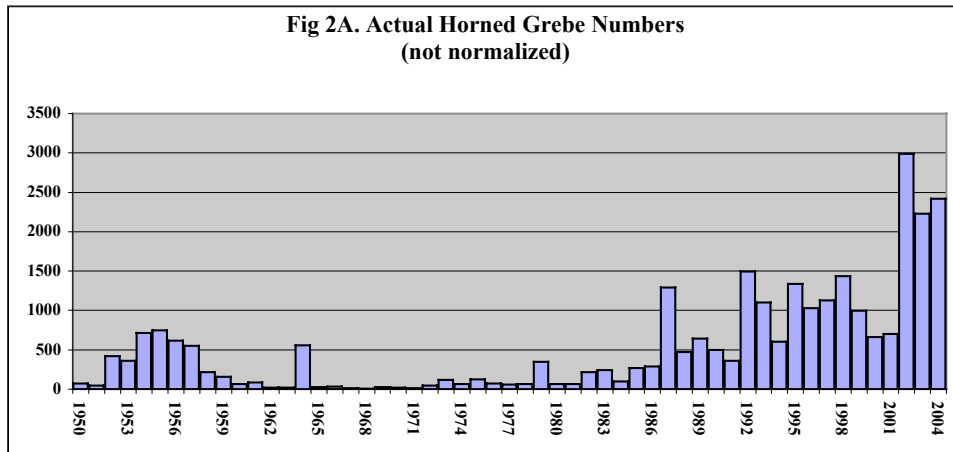
If the value of each bar in Figure 1 were divided by itself a flat curve would clearly result. Similarly, dividing the annual values of any single species by the corresponding Figure 1 values provides a measure of that species' deviation from the 292 species average curve. Therefore, the "Average Curve" serves as a yardstick by which the observational data of any species collected over the past half century can be measured.

Assuming that, despite the waxing and waning of individual bird populations, Indiana's total avifauna remained more or less constant over the past half century, the plot in Figure 1 provides a method for determining trends in Indiana's bird populations. That is, if the combined variations of individual bird populations average to zero, the true normalized means of 292 species should create a flat plot (i.e., show no change). That being the case the deviations from horizontal in Figure 1, result from "observational effort."

It follows, therefore, that for any single species the "observational effort" can be removed by dividing annual totals of that species by corresponding numbers from the "Average Curve." This procedure then corrects reported data for "observational effort." Note that even if the constant avifauna assumption is not valid, the trend line for any individual species still provides a trend relative to Indiana's average avifauna.

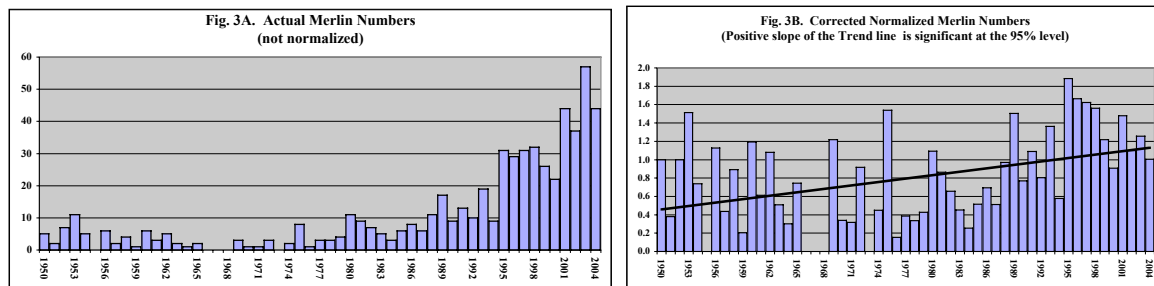
Example

Application of this procedure is demonstrated using Horned Grebe data. For reference Figure 2A shows unaltered Horned Grebe annual totals for 1950 through 2004. Yearly data in Figure 2A were normalized and divided by the corresponding annual values from the "Average Curve;" the results are plotted in Figure 2B, with a trend line added. In this graph the vertical axis plots the annual ratio of percentage of total Horned Grebes to the average percentages of 292 species. It is difficult to assign a meaningful interpretation to these ratios; however, the trend of these values reflects population changes. In the Horned Grebe case slope of the trend line is not statistically significant at the 95 percent level, indicating no significant change in Horned Grebe numbers over the past 50 years.



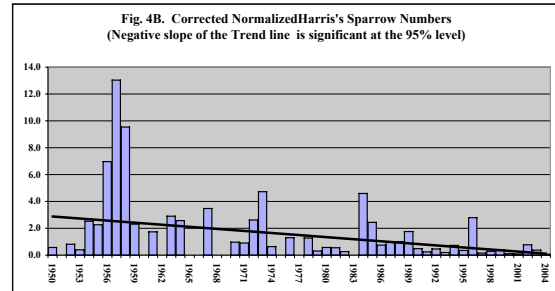
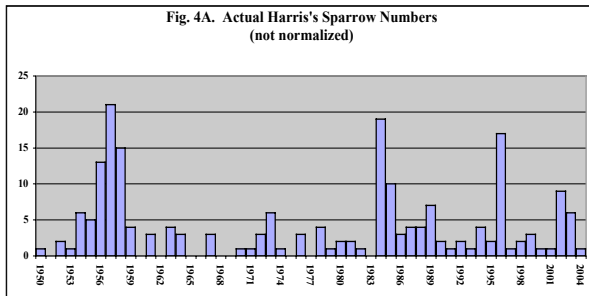
Test of the Method

Using Christmas Bird Count data collected between 1965-66 and 2003-04, Niven et al. (2004) found a statistically significant regional increase in the Merlin population and a corresponding decline in Harris' Sparrow numbers. Accordingly, these species were selected to test the "Average Curve" procedure using Indiana data.



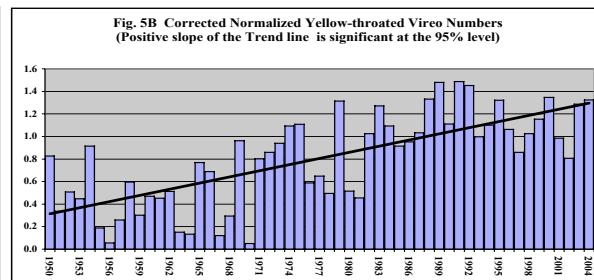
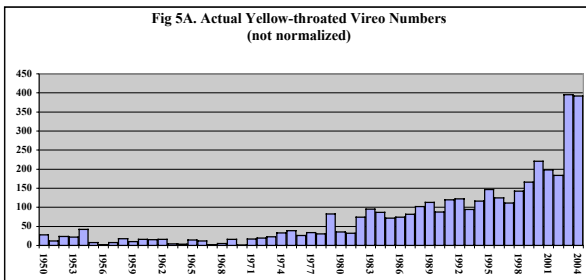
Results of the Merlin test are shown in Figures 3A and 3B. Figure 3A plots observed annual totals of Merlins reported (not normalized). Figure 3B shows the same data after

it has been corrected (normalized and divided by values from the Average Curve). Positive slope of the illustrated trend line is statistically significant at the 95 percent level, which agrees with results from Niven et al. (2004).



The Harris's Sparrow data are illustrated in Figures 4A and 4B. Negative slope of the trend line is statistically significant at the 95 percent level, which again agrees with results reported by Niven et al. (2004).

And finally, Castrale et al. (1998) noted that trends based on 37 Indiana Breeding Bird Survey routes during the 1966-1990 period revealed a statistically non-significant Yellow-throated Vireo increase of 2.2 percent annually. The Yellow-throated Vireo analysis is plotted in Figure 5.



The Yellow-throated Vireo plot in Figure 5B shows a statistically significant positive trend slope at the 95 percent confidence level. This conclusion is in general agreement with Breeding Bird Survey data (Castrale et al., 1998).

Conclusion

Although it is not possible to statistically quantify the trend slope in terms of number of birds per year, it appears that the Average Curve correction technique yields trends consistent with previous workers. In the species accounts population trend curves are included for most breeding species.

Acknowledgements

The author is indebted to Steve Getty for the thoughtful suggestions that led to the fruition of this idea. The assistance of Randy Pals in navigating statistical minefields was invaluable; his wise council was greatly appreciated.

Selection Criteria

An array of species was selected to represent Indiana's avifauna in constructing the "Average Curve." It includes bird groups from all habitat types. The specific guidelines used to include/exclude specific birds were as follows:

1. Only species with more than ten Indiana records were selected.
2. Invading breeders, whose status has changed significantly over the past 50 years, were omitted. These included Mute Swan, Mississippi Kite, Least Tern, Eurasian Collard-Dove, and House Finch.
3. Species often ignored by birders in their daily outings were also excluded as the reported numbers of these birds tend to be highly erratic. Birds in this category included Rock Pigeon, American Crow, Starling, the abundant blackbirds, and House Sparrow.
4. Species of former importance that have declined or disappeared were included. Among these were the Black-backed Woodpecker, Bewick's Wren, and Bachman's Sparrow.

References Cited

Castrale, J.S., E.M. Hopkins, and C.E. Keller (1998) *Atlas of breeding Birds of Indiana*. Indiana Dept. of Nat. Resour. 388 pp.

Niven, D.K., J.R. Sauer, G.S. Butcher, and W.A. Link (2004) Christmas Bird Count Provides Insights Into Population Change in Land Birds That Breed in the Boreal Forest, *American Birds*, 58:10-19.