

An Analysis of Colorado Christmas Counts

Carl E. Bock and Rozella B. Smith**

INTRODUCTION

During the past 30 years in the State of Colorado, 3042 Christmas Bird Count observers spent 8440 party-hours in the field on 292 counts, walking and driving 46,166 miles, while sighting over 2.4 million individual birds. Although this represents a considerable expenditure of time and energy, it is but a small fraction of the total North American endeavor beginning in 1900.

A complete set of Christmas Bird Count volumes contains a massive collection of data on the distribution and abundance of winter bird populations; yet these data have been little used by ornithologists. We feel that there are two reasons for this. First, the very bulk of the counts has prevented their being more fully exploited. The worker who is interested in one species or one habitat must sift a relatively small amount of wheat from a much larger amount of chaff. Furthermore the number of birds seen on a particular count varies not only with the size of the bird population but also with the magnitude of the count effort — the more hours afield, the higher the count. Meaningful interpretation must include compensation for differences in count efforts, and while this information is published with each count, the time involved in analysis is great. Finally, it has been argued that uncontrolled variables such as weather and the relative skill of participants could render results erratic and unreliable.

We have attempted an analysis of Colorado counts from 1940 to 1969 as a pilot project to design a system to use the computer as a tool to sort, merge, and plot large quantities of data. We found that counts become relatively accessible with the aid of simple computer techniques, and that results for many of the species

studied were both statistically and biologically significant.

METHODS OF STUDY

Twenty species were chosen which we suspected might show interesting population trends or fluctuations. Then, for all counts in the state since 1940 we tabulated and key-punched on cards for computer processing the following: a code number for each species; the numbers of each species counted; the total number of species and individuals on the entire count; the number of field observers; party-hours and miles traveled on foot and by car; a code number for the locality; and the year. With all of this information read onto a computer tape we could then generate displays of these data arranged or manipulated according to any of the variables originally tabulated. For example, we could compute the sum of all Canada Geese counted per year and tabulate these chronologically.

We realized that simply adding up numbers of birds counted would not give an accurate picture of population fluctuations since the counting effort has varied from year to year. After some experimenting with variables such as miles traveled, party-hours, and numbers of observers, it was found that dividing the number of birds seen by the number of party-hours most nearly compensated for this source of error. Our data then read as numbers of birds counted per party-hour per year (see table and figures). Editor Robert S. Arbib, Jr., has established the same technique for the mapping project outlined in the April, 1971, issue of *American Birds*.

RESULTS

The plot of Hairy and Downy woodpeckers (Fig. 1) is typical of those species whose popu-

*Biology Department, University of Colorado, Boulder, Colorado 80302.

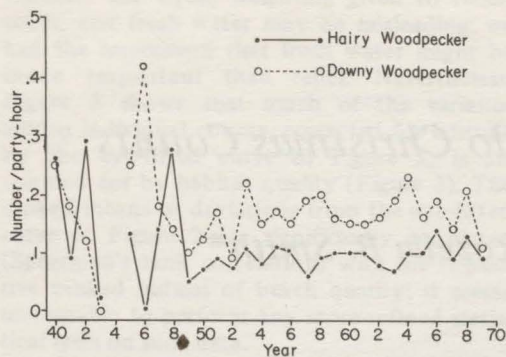


Fig. 1 Hairy and Downy Woodpeckers counted in Colorado from 1940-1969.

lations apparently have been stable since about 1950. It is typical of *all* the species insofar as excessive fluctuations would appear to have occurred in the 1940's. However, this almost certainly is an artifact caused by the low number and irregularity of counts in the state at that time. There were no counts in 1944, one in 1946, and only two in 1942, 1943, and 1945. By way of contrast there were eight counts in 1950, reaching a high of 18 in 1967 through 1969. It is clear that data prior to about 1950 simply are too sparse to be meaningful, and we shall limit the remainder of our discussion to the past 20 years.

Table 1 gives the average counts and general population patterns for the 20 species studied. Several of these deserve some further comment. In contrast to the Hairy and Downy woodpeckers, flickers have shown a decline since 1950 (Fig. 2). Flickers breed largely on the plains, where they compete with Starlings for nest-holes, usually in dead or decayed cottonwoods. Studies in the Boulder area suggest that they fare rather badly in this competition. Since Starlings have increased considerably over the past 20 years in Colorado (Fig. 2) they could well be causing the decline in flickers.

Canada Geese have increased spectacularly since 1950 (Fig. 3). Extensive reservoir construction, hunting restrictions, and management efforts to establish local breeding populations have resulted in a literal population explosion of Canada Geese on the plains of eastern Colorado, especially near the foothills of the Rocky Mountains where most of the suitable habitat lies. The Audubon Christmas Bird Counts have documented this rise admirably (Fig. 3). The all-time high count of 19,208 birds occurred in 1967. Numbers were somewhat lower in 1968 and 1969, indicating a pos-

sible decline and stabilization of the population.

Table 1. Average number of birds counted per party-hour and population trends for 20 species of Colorado winter birds, 1950-1969.

Species	Average number counted/ party-hour	Population trend
Canada Goose	7.63	dramatic increase*
Rough-legged Hawk	.09	stable
Red-tailed Hawk	.10	stable
Prairie Falcon	.02	too few counted to give reliable data
Sparrow Hawk	.13	stable
Flicker	1.22	declining
Lewis' Woodpecker	.07	slight decline
Hairy Woodpecker	.09	stable
Downy Woodpecker	.16	stable
Blue Jay	.06	sudden increase in mid-to late 1950's
Steller's Jay	1.55	stable
White-breasted Nuthatch	.14	stable
Red-breasted Nuthatch	.11	marked fluctuations
Pygmy Nuthatch	.71	erratic, but no trends
Starling	11.46	increase
House Sparrow	8.89	stable
Western Meadowlark	2.67	stable
Red-winged Blackbird	30.58	stable
House Finch	2.72	stable
Red Crossbill	.21	marked fluctuations

*Increases or declines listed in this table have been found statistically significant at the $p < .05$ level using the Mann-Whitney U test to compare one group of years with another. For example, counts of flickers were significantly lower in 1960-69 than in 1950-59.

To us, the most interesting discovery of the project concerns winter populations of Red-breasted Nuthatches and Red Crossbills. Bailey and Niedrach, in "*The Birds of Colorado*" (1965), noted that both species are subject to periodic fluctuations in winter. Our analysis not only confirms that these fluctuations are quite regular, but also indicates that the two species cycle *together* (Fig. 4). Every "high" of one species has coincided with a "high" of the other since 1950, although the magnitude of the cycles has varied. This remarkable synchrony deserves further study, including analysis of more Christmas Counts in other states. Red Crossbills are known to move opportunistically to areas where food, in the form of conifer cone seeds, is abundant. Red-breasted Nuthatches may do the same. The birds could be migrating into Colorado when cone crops here are good, or when they have failed in other areas. Still a third possibility is that fall invasions of these species into Colorado follow years of unusually successful reproduction in

the extensive breeding ranges of Canada and the Northwest. While the answer requires much more study, the fact remains that without Christmas Bird Count data this interesting relationship *probably would never have been detected.*

DISCUSSION

In conclusion, we feel that this study has shown Audubon Christmas Bird Counts to be both accessible and reliable indices of winter bird populations. However, this optimism should be tempered with some words of caution. First, the counts for Colorado, at least, were useful only when made regularly. Data for the 1940's were poor not only because few counts were made but also because they were not made consistently in any one location.

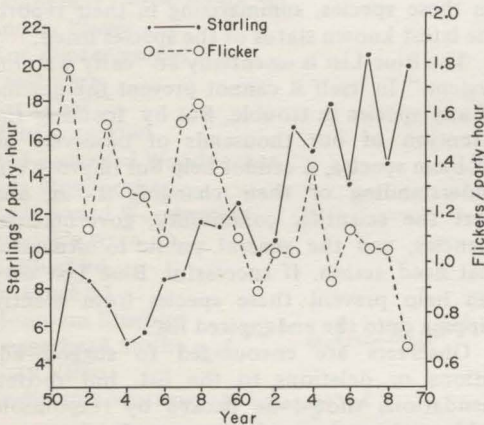


Fig. 2 Starlings and flickers counted in Colorado from 1950-69.

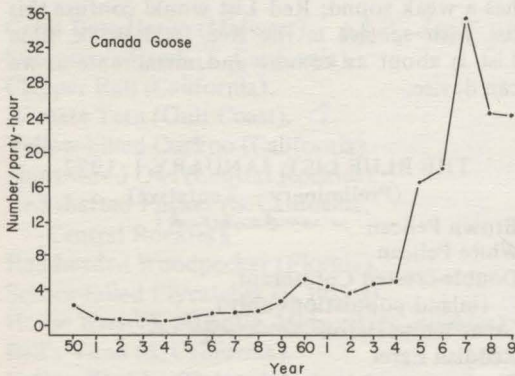


Fig. 3. Canada Geese counted in Colorado from 1950-69.

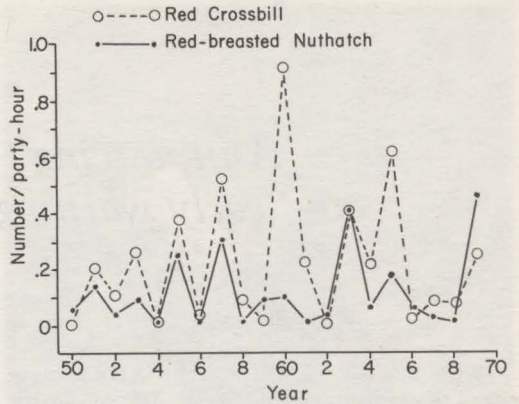


Fig. 4 Red Crossbills and Red-breasted Nuthatches counted in Colorado from 1950-69.

Since about 1950 regular counts in such places as Denver, Fort Collins, Boulder, Longmont, Colorado Springs, Durango, and Idaho Springs have provided repeated censuses of the same areas, revealing important population changes.

Second, we must stress the need to compile data for many years before reaching any conclusions regarding the increase or decline of a species. Examination of our plots will show considerable year to year variations in birds counted per party-hour, not necessarily reflecting significant long-term population trends. These minor fluctuations may represent reality but it seems equally likely that they represent the margin of error inherent in the count technique. For example, the flicker counts have shown yearly increases six times since 1950, while the species was undergoing a general decline (Fig. 2).

We hope to expand our analysis in the near future to include more species and additional states and provinces.

ACKNOWLEDGEMENTS

This work was supported in part by the University of Colorado Computing Center and in part by the Biology Department of the University of Colorado, Boulder, Colorado. The assistance of Mrs. R. Smith was supported in part by publication grant LM 00925 from the National Library of Medicine, National Institutes of Health, US DHEW. For technical assistance, we wish to thank Dr. E. Rex Krueger, Director of the University of Colorado Computing Center; Sam Coleman and Carol Leyner, programmers; and Dr. Gordon Alexander of the Biology Department, University of Colorado.