

## USING CHRISTMAS BIRD COUNT DATA TO DETERMINE POPULATION TRENDS OF FIVE BIRD SPECIES

by Thomas R. Hamilton

The annual Christmas Bird Count (CBC) of the National Audubon Society represents a wealth of data. Formerly published annually in *American Birds* and now published in the *National Audubon Society Field Notes*, CBC data provide a useful way to measure long-term avian population trends (Butcher et al. 1990). During each CBC, participants fan out over an area within a radius of 7.5 miles from a central point (458 square kilometers) and record the number of birds of each species seen and the time spent seeking birds in the field or at feeders. Because the areas in which each count occurs are clearly defined, the same areas can be monitored each year. Although many variables such as weather conditions and participant numbers and enthusiasm may affect count totals, long-term population trends can be detected if short-term factors are ignored and the data are treated in a way which allows year-to-year comparisons.

The effect of inconsistencies in the way CBCs are conducted on the reliability of CBC data has been the focus of much analysis. Arbib (1981) analyzed the data from eighty-three counts in California and found that an increase in the number of observers and parties correlated with an increase in the number of species observed. He also found evidence that compilers, who are responsible for reporting CBC findings to the editors of *American Birds*, tend to underestimate total party hours and the number of participants. Root (1988) found that CBC data could yield a good estimate of population densities of passerines. More recently Butcher et al. (1990) compared population trends for seven species (including House Finches) based on CBCs with population trends based on the North American Breeding Bird Survey (BBS). They concluded that most of the population trends estimated from CBC data correlate with trends from BBS data. The study by Butcher et al. (1990) is an important validation of CBC data because it showed that the rather informal CBC survey technique was generally as reliable as the more rigorous and highly structured BBS. If the CBC data are reasonably well standardized and include an area that is representative of the region, then it is a reliable method of estimating long-term population trends.

### Methods

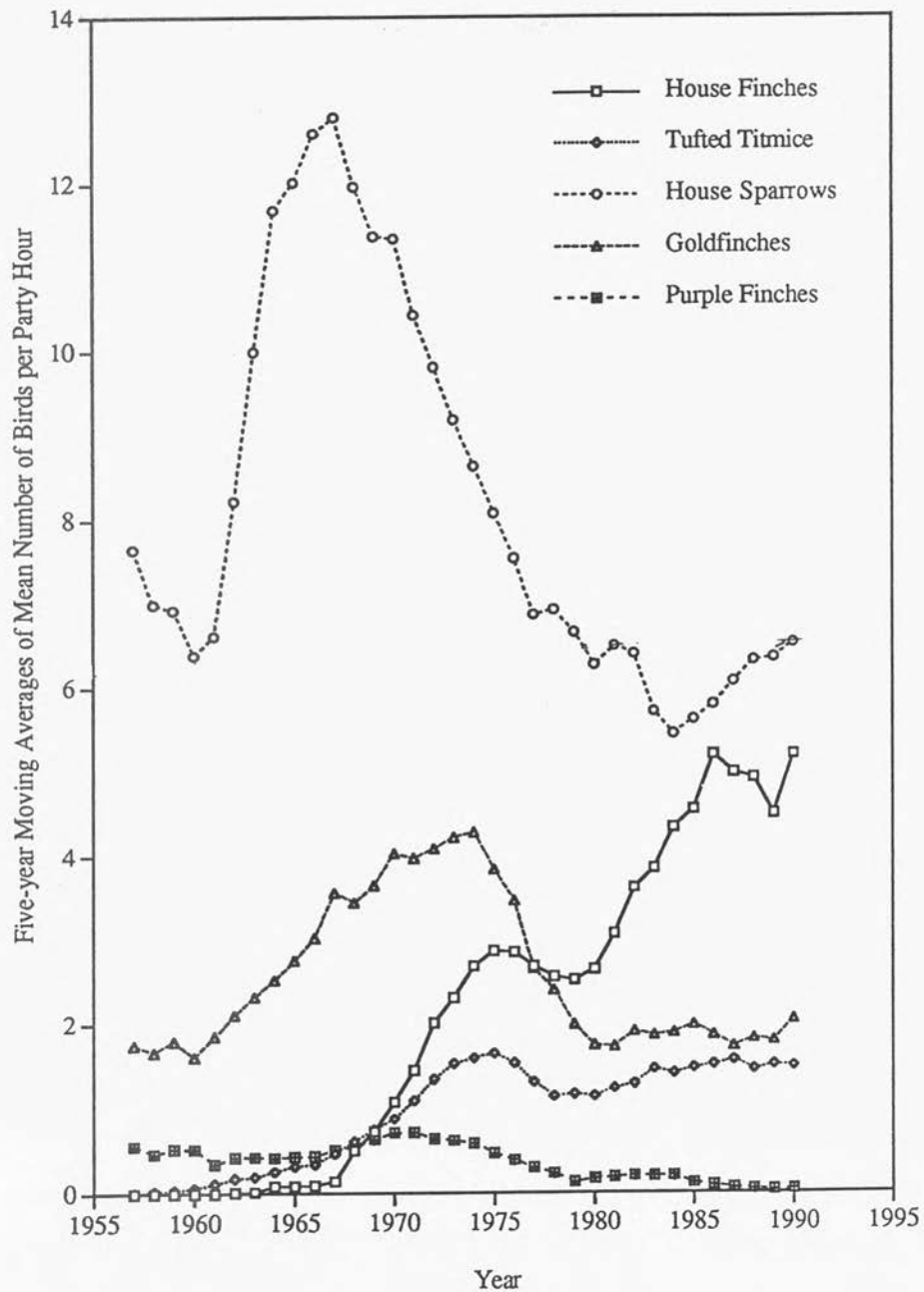
In order to look at changes in winter populations of Tufted Titmice, Purple Finches, House Finches, American Goldfinches, and House Sparrows, I analyzed data from six CBC locations in Massachusetts: Springfield, Cape Cod, Cape Ann, Marshfield, Quincy, and Worcester. I chose these areas because they had been surveyed consistently (with very few exceptions) since 1955. I chose

TABLE 1. CHRISTMAS BIRD COUNTS 1955-1992

Numbers are mean numbers of birds per party hour for six CBC sites in Massachusetts.

	<u>House Finch</u>	<u>Tufted Titmouse</u>	<u>House Sparrow</u>	<u>American Goldfinch</u>	<u>Purple Finch</u>
1955	--	--	9.57	2.33	0.82
1956	--	--	5.29	0.87	0.08
1957	--	0.01	10.86	3.09	0.43
1958	--	--	8.87	1.54	1.33
1959	--	--	3.66	0.92	0.13
1960	--	0.12	6.32	1.91	0.36
1961	--	0.06	4.95	1.51	0.37
1962	--	0.12	8.14	2.17	0.40
1963	--	0.29	10.03	2.76	0.46
1964	0.05	0.30	11.68	2.20	0.51
1965	0.05	0.22	15.20	2.99	0.38
1966	0.33	0.37	13.38	2.51	0.32
1967	0.01	0.41	9.81	3.32	0.48
1968	0.03	0.41	12.95	4.09	0.48
1969	0.29	0.92	12.64	4.87	0.89
1970	1.86	0.94	11.04	2.43	0.55
1971	1.44	1.03	10.43	3.51	0.77
1972	1.76	1.08	9.67	5.24	0.88
1973	1.89	1.48	8.38	3.81	0.49
1974	3.11	2.20	9.55	5.42	0.52
1975	3.37	1.86	7.92	3.12	0.44
1976	3.30	1.36	7.65	3.82	0.60
1977	2.67	1.36	6.87	2.99	0.28
1978	1.82	0.89	5.70	1.96	0.10
1979	2.26	1.06	6.20	1.39	0.08
1980	2.75	1.02	8.21	1.85	0.11
1981	3.10	1.47	6.29	1.76	0.08
1982	3.30	1.24	4.93	1.76	0.47
1983	3.94	1.36	6.82	1.87	0.17
1984	4.99	1.34	5.74	2.30	0.19
1985	3.91	1.9	4.76	1.63	0.08
1986	5.54	1.22	4.95	1.89	0.11
1987	4.36	1.55	5.79	2.24	0.05
1988	7.16	1.56	7.72	1.27	0.03
1989	3.95	1.62	7.12	1.62	0.03
1990	3.59	1.34	6.02	2.09	0.02
1991	3.43	1.49	5.11	1.77	0.05
1992	7.85	1.47	6.66	3.52	0.09

**Figure 1.** Mean number of birds per party hour for House Finches, Tufted Titmice, House Sparrows, American Goldfinches, and Purple Finches for six CBC sites in Massachusetts, 1955 to 1992. Five-year moving averages.



these species because they had been the focus of a study that I conducted while a graduate student in Indiana (e.g., Hamilton and Wise 1991). I am not aware of recent population studies of these species in Massachusetts. Because the number of participants and the total number of hours spent searching for birds varied from year to year and site to site, it was important that the data be standardized to enable year-to-year comparisons. Bock and Lepthien (1974) found that CBC data could be standardized to a constant reference value by dividing the total number of birds counted in a CBC area by the total number of party hours spent searching for birds. This produced a unit called birds per party hour for each species in each CBC site. I calculated the mean number of birds per party hour for all six sites for the years 1955 through 1991. I then calculated five-year moving averages for each species by averaging the counts from five years around each date (i.e., the two years before, two years after, and the count on that date). Five-year moving averages smooth the lines illustrated in the graph in Figure 1, thus making it easier to illustrate general trends.

### Results and Discussion

The introduction and subsequent expansion of House Finches in eastern North America have been well documented (Hill 1993; Hamilton 1992). The first Massachusetts CBC to include House Finches was Quincy in 1959. After a few years the population of House Finches in eastern Massachusetts went through a rapid expansion (Figure 1), reaching an average of 7.16 birds per party hour in 1988; however, between 1989 and 1991 the counts were approximately half that value. The 1992 count, however, was at a record high of 7.85 House Finches per party hour for the six CBC sites in this study (Table 1). The type of growth curve generated by the House Finch data is characteristic of a species that is introduced into an environment in which there are few initial restraints on population growth. It is not yet clear how much more the House Finch population in Massachusetts will continue to grow.

Another species that has expanded into New England over the last few decades is the Tufted Titmouse. This species was first included in a Massachusetts CBC in 1955, and the northerly expansion of its winter range was clearly documented by subsequent CBCs (Kricher 1981). The graph shows that the expansion of the Tufted Titmouse population has not been as dramatic as the expansion of the House Finch population; however, they are now a well-established component of the New England avifauna.

The data illustrated in the graph show that the House Sparrow population increased during the 1960s, but since 1970 the population has returned to its pre-1960 levels. Future trends with House Sparrows bear watching because studies have shown that the House Sparrow population decline is correlated with the dramatic increase in House Finches (Kricher 1983) and House Finches are dominant to House Sparrows at winter feeding stations (Hamilton 1993).

Although Purple Finches do not appear to have been very common in eastern Massachusetts before the arrival of House Finches, the species may be in a long-term decline. Prior to 1978 most counts for the six CBCs were between 0.4-0.8 birds per party hour; since 1978, most counts have been less than 0.1 birds per party hour. Shedd (1990), in a study of House Finch-Purple Finch interactions at winter feeding stations in Virginia, suggested that Purple Finches are poor competitors with House Finches and are therefore under serious pressure during severe winters. The correlation between the dramatic increase in House Finches and the decline in the number of Purple Finches adds some credence to this theory.

The data illustrated in Figure 1 show that American Goldfinches went through a population expansion during the period between 1962 and 1974; however, the population returned to pre-1962 levels after 1974 at about the time that the House Finch population was rapidly increasing. The trend for goldfinches is very similar to the trend for House Sparrows discussed above. It is not clear whether House Finches have had an effect on goldfinches in Massachusetts, although the data suggest that the population has remained fairly constant since 1974. In a similar study of goldfinches in the Midwest, these birds experienced a gradual increase during the period of time when House Finches were rapidly expanding (Hamilton and Wise 1991). Perhaps the reason goldfinches in the Midwest increased in population can be attributed to the increasing popularity of backyard bird feeders.

### Conclusions

This study of CBC data shows that over the last thirty-five years the winter avifauna of eastern Massachusetts has experienced several changes. House Finches and Tufted Titmice are now ubiquitous species, especially at winter feeding stations. Purple Finches, already uncommon, appear to have declined since the late 1970s. House Sparrows and American Goldfinches showed similar population trends, with population expansion in the 1960s, followed by a decrease in population to pre-1960 levels.

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