Winter Population Trends of Six Species of Sparrows

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Introduction

Christmas Bird Counts (CBCs) are single-day surveys of winter bird populations that are conducted annually during the period from approximately one week before to one week after Christmas day. Each local count surveys a circle fifteen miles in diameter with a fixed center, ensuring that the same area is surveyed every year. Organized by the National Audubon Society and conducted by teams of volunteers, the CBC seeks to provide long-term data on winter bird populations on a continent-wide scale. In addition to reporting the number of birds they see, count participants record the time they spent in the field, miles traveled, and the conditions under which the count was conducted, facilitating year-to-year comparisons. A report on each year's CBC is published by the National Audubon Society; also, data from the years 1959-1994, plus other relevant data, are now available on the Internet at <www.mp1-pwrc.usgs.gov/birds/cbc.html>.

The strengths and limitations of CBCs as a standardized method of tracking populations have been well documented (see Butcher et al. 1990, and Bock and Root 1981 for comprehensive discussions). The greatest virtue of the CBC is the wealth of data that has been accumulated over the 100 years of the count's existence. CBC results are commonly normalized by the calculation of a figure called "birds per party-hour," to adjust for the fact that each CBC involves different numbers of parties in the field for varying amounts of time. This manipulation of the data is not perfect, since it doesn't take into account the number of members of each party, or other important variables such as the weather, the skill levels of the participants, or the level of effort involved in a given year. However, the concept of "birds per party-hour" addresses the largest variable involved in the collection of CBC data, allowing valid region-to-region comparisons and reliably revealing long-term population trends. This method of normalization was applied to the data used in this paper.

Methods

Massachusetts had thirteen regional CBCs in 1959. By 1997, thirty-two counts were being conducted in the Bay State, involving 1,165 observers and surveying an area of 5,655 square miles (14,656 km^2) — approximately 68 percent of the total land area in the state. A look at CBC circles superimposed on a map of Massachusetts (see Rines and Stymeist 1998) shows that the coastal area of the state is now "saturated" with CBCs, since the rules governing the count do not permit overlapping circles.

Using data from Massachusetts CBCs taking place from 1959 to 1997, I examined the population trends for six sparrow species: American Tree Sparrow (*Spizella arborea*), Field Sparrow (*Spizella pusilla*), White-throated Sparrow (*Zonotrichia albicollis*), Song Sparrow (*Melospiza melodia*), Swamp Sparrow (*Melospiza georgiana*), and Dark-eyed Junco (*Junco hyemalis*). I separated the counts into

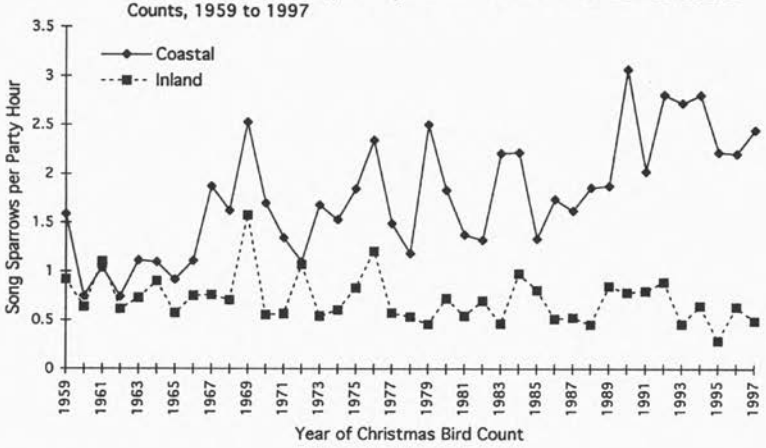
"coastal" and "inland," to permit comparison between population sizes and trends in the two areas. The data for coastal populations were derived from the following CBCs: Buzzards Bay, Cape Ann, Cape Cod, Greater Boston, Marshfield, Mid-Cape Cod, Newburyport, Plymouth, Quincy, and New Bedford. Because of the special nature of Tuckernuck Island, Martha's Vineyard, Nantucket, and Stellwagen Bank, these counts were not used in my analysis. The inland counts used were Athol, Central Berkshire, Greenfield, Northampton, North Berkshire, Quabbin, Springfield, Uxbridge, Westminster, Worcester, and South Berkshire.

One problem with a survey of this nature is that the number of CBCs did not remain constant during the thirty-eight-year period I examined. Some CBCs were not established until after 1959, while some that existed as of 1959 have not been conducted continuously since then (counts taking place in 1959 and used in this analysis were Northampton, Springfield, Worcester, Ware, Greenfield, Cape Cod, Marshfield, Quincy, Cape Ann, and Newburyport). In general, the number of CBCs has increased with time, although some counts had data that were incomplete and hence not usable. Moreover, I excluded surveys that provided only a few years of data. For these reasons, the number of counts included in my analysis did not stay constant from year to year. Since my main purpose was to compare coastal and inland populations, I excluded counts that were intermediate in location — generally those centered around Interstate 495. After calculating birds per party-hour for each subject species on each count used, I calculated the mean number of birds per party-hour for the combined inland counts and the combined coastal counts. While the results of any given count can be influenced by the weather conditions on the day that count takes place, averaging results from throughout the two-week count period should tend to even out each year's results on a regional scale. The results of these calculations are plotted in figures 1-6.

Results and Discussion

Song Sparrows (Figure 1) are one of the most common passerine species in Massachusetts, and the species is frequently found at backyard feeding stations as well as in more natural settings. Early-successional growth, and the type of shrubbery typically used for suburban landscaping, probably benefits this species. In winter, Song Sparrows often occur as members of mixed-species sparrow flocks, which may be quite large, in brushy areas offering adequate food supplies (see Pelikan 1998). The winter population of Song Sparrows in Massachusetts generally contains both resident birds and migrants (Veit and Petersen 1993). CBC data from the last thirty-eight years show that this species is appreciably more common in winter along the coast than inland; the winter coastal population appears to be generally increasing while the inland population remains fairly stable. While the pattern is by no means inviolable, year-to-year results for inland and coastal counts are parallel, suggesting that winter Song Sparrow populations inland and on the coast respond to some of the same factors. Interestingly, annual Breeding Bird Surveys (BBSs) that have been conducted since 1966 show a decreasing trend (-2.3 percent per year) in the breeding population of Song Sparrows in Massachusetts (Sauer et al. 1997). Presumably increasing numbers of migrants are wintering in the state, accounting for the stable or increasing numbers

Figure 1. Song Sparrows per Party-Hour in Coastal and Inland Christmas Bird Counts, 1959 to 1997



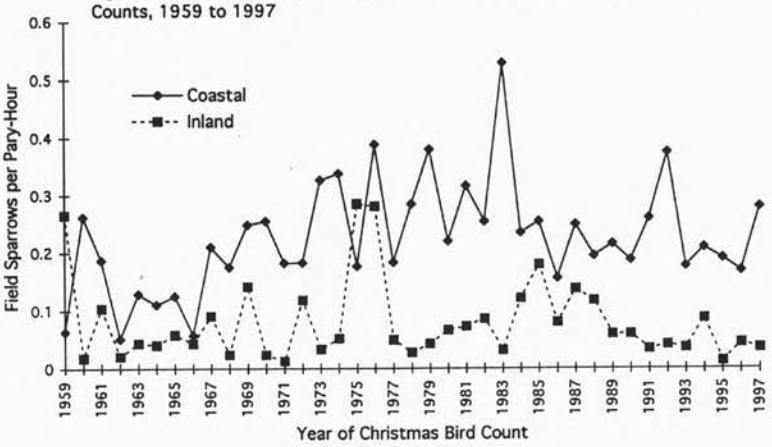
of Song Sparrows noted during CBCs. Such an increase could reflect either a growth in the populations that migrate to Massachusetts, or favorable changes in habitat, climate, food supply, or other variables within the state that encourage a higher percentage of migrants to remain here.

Although BBS data show a decreasing population (-6.6 percent per year) of breeding **Field Sparrows** in Massachusetts, perhaps the result of the gradual succession of the old agricultural fields this species prefers (Veit and Petersen 1993; Carey et al. 1994), the winter population of this species in the state appears to be fairly stable over the long term. The data from CBCs show no obvious positive or negative trend, although in most years the species is appreciably more common in coastal areas. The contrast between BBS and CBC results suggests that there are significant differences between the breeding-season and wintertime ecology of this sparrow in the state.

Perhaps the most striking aspect of the CBC data for this species is the pronounced year-to-year fluctuation in Field Sparrow numbers (Figure 2), with inland and coastal peaks sometimes, but not always, coinciding. The 1975 and 1976 CBCs recorded exceptionally high figures for Field Sparrows per party-hour in inland areas, which may have been the result of food shortages or heavy snow cover elsewhere forcing birds into the region. Along the coast, Field Sparrow numbers echoed the inland peak in 1976, but actually dipped in 1975. The coastal population of Field Sparrows showed an unusually high peak in 1983, a year in which the inland population dropped nearly to zero. I initially expected that differences in snow cover or temperature would explain the striking discrepancy between inland and coastal CBC results in 1983. However, only one inland CBC reported significant snow cover at the time of the count, while three of the coastal CBCs reported snow cover; all coastal and inland CBCs generally reported fair to good availability of wild food.

Probably part of the explanation for the puzzling CBC results for this species has to do with the role played by migrant Field Sparrows, which might be forced into

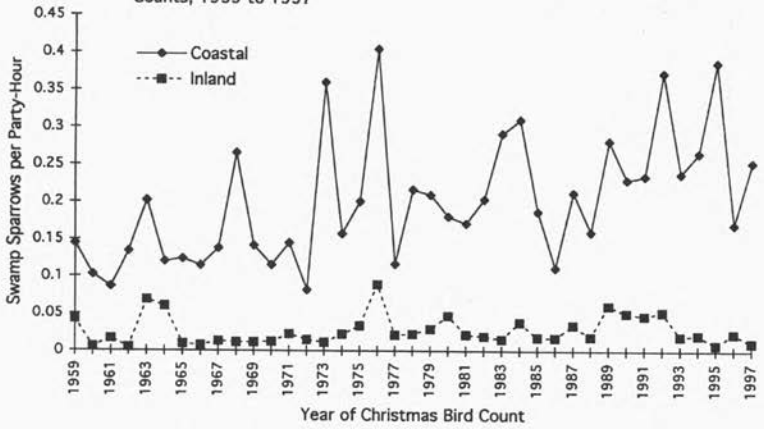
Figure 2. Field Sparrows per Party-Hour in Coastal and Inland Christmas Bird Counts, 1959 to 1997



Massachusetts by conditions that aren't evident within the Bay State. Also, it is important to note that even in their years of greatest abundance, wintering Field Sparrows are present here at a very low density. Typical birds per party-hour figures for inland counts, between 0 and 0.2, represent roughly 0-2 birds observed by each party during the roughly nine hours of birdable daylight during a CBC. At that level of detection, random variations in the density of birds can produce significant anomalies on a single count, or even across an entire region. The potential for uneven distribution of this species was well illustrated by the 1998 Martha's Vineyard CBC (which was not used in this analysis), during which 50 of the count total of 55 Field Sparrows were tallied by a single party, and one flock, alone, contained thirty-five Field Sparrows (M. Pelikan, pers. comm.). Figuring that the count's eleven parties spend about nine hours each in the field, data from that one party raised the count's figure for Field Sparrows per party-hour tenfold, roughly from 0.05 to 0.55! So, taken as a whole, Massachusetts CBC results for this species may reflect complexities of distribution that cannot be adequately described using the available data.

Swamp Sparrows (Figure 3) are found in much greater abundance on CBCs along the coast, where they often form small flocks near open water. As in the case of Song Sparrows, population peaks inland and along the coast sometimes coincide (e.g., 1963, 1976, and less prominently in 1984), suggesting some similarity in the factors governing numbers in the two regions; the relationship is far from perfect, however. As with Field Sparrows, low figures for birds per party-hour and gregarious winter habits (producing uneven distribution) probably account for much of the apparent volatility of CBC data for this species. There appears to be a gradual upward trend in the winter coastal population of Swamp Sparrows, which contrasts with BBS data indicating that no significant change is occurring in the breeding Swamp Sparrow population in Massachusetts (Sauer et al. 1997). This suggests that the winter population of Swamp Sparrows may include birds that migrate from outside the state to coastal Massachusetts for the winter. Nationally, Swamp Sparrows seem to be increasing slightly, and they may be benefiting from the acceleration of wetland protection and

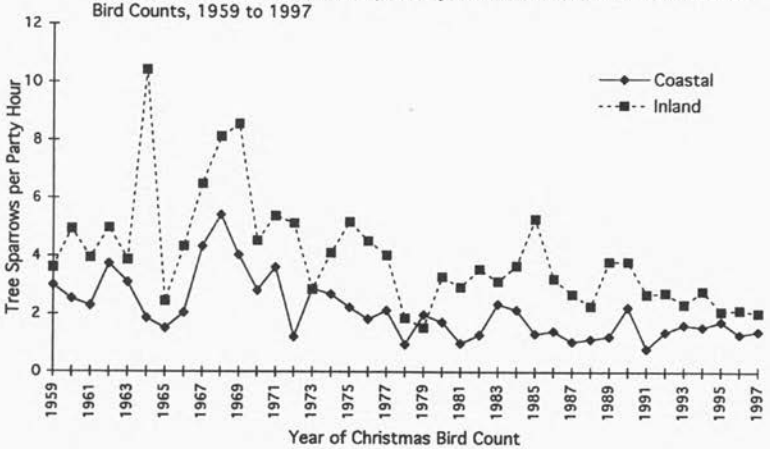
Figure 3. Swamp Sparrows per Party-Hour in Coastal and Inland Christmas Bird Counts, 1959 to 1997



restoration under the North American Waterfowl Management Plan (Mowbray 1997). Certainly, continued protection of wetlands in Massachusetts can only help Swamp Sparrows both as breeding and as wintering birds.

American Tree Sparrows (Figure 4) breed on the tundra and visit Massachusetts in winter, where they often associate with other sparrows in brushy areas; this is the only species involved in this study that does not breed in the Bay State (two others, Dark-eyed Junco and White-throated Sparrow, are largely limited as breeders to the western portion of the state). In winter, Tree Sparrows are frequently in flocks that seem to roam from feeder to feeder. My analysis of CBC data suggests that winter populations of American Tree Sparrows are larger inland, reversing the pattern shown in most years by the other species (except Dark-eyed Junco) in this study. Coastal portions of the state, characterized by fairly mild winters as a result of ocean-moderated temperatures, are effectively near the southern border of the wintering range for Tree Sparrows.

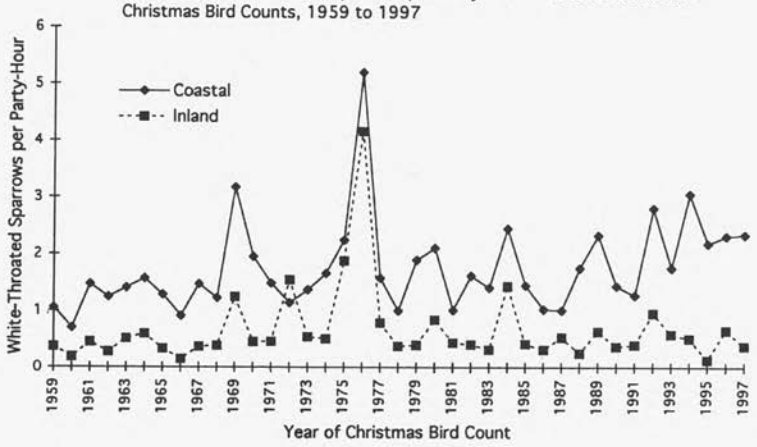
Figure 4. American Tree Sparrows per Party-Hour in Coastal and Inland Christmas Bird Counts, 1959 to 1997



CBC results suggest that Massachusetts winter populations of Tree Sparrows, both inland and along the coast, are declining slowly (although this trend results partly from a few years of exceptional abundance early in the period examined in this analysis). However, Naugler (1993) considers this species abundant in the arctic (he estimates a total population of 10 to 20 million pairs) and suggests that since it breeds in remote, undisturbed areas, its population is likely to remain stable. So a decline in winter Tree Sparrow populations in Massachusetts could stem from either regional changes in habitat that are unfavorable for this species, or could reflect a warming climate and a slight northward shift in the wintering range of the species. It is also possible that overall Tree Sparrow numbers are declining due to some limiting factor that is independent of the breeding biology of the species, and unanticipated by Naugler (1993).

White-throated Sparrow (Figure 5) is a woodland species that is more common in winter along the coast than inland. The winter population throughout the state appears to be remaining fairly constant, with perhaps a slight upward trend along the coast, especially in recent years. BBS data indicate a substantial decrease (-8.2 percent

Figure 5. White-Throated Sparrows per Party-Hour in Coastal and Inland Christmas Bird Counts, 1959 to 1997



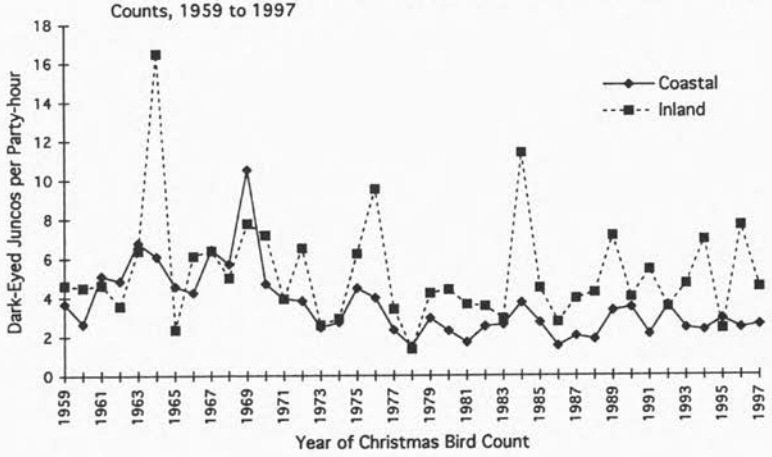
per year) in the state's breeding population between 1966 and 1995 (Sauer et al. 1997), but the breeding distribution of the species (mostly north of Massachusetts) suggests that the state's wintering population of White-throated Sparrows consists largely of migrants. One hypothesis to explain this situation comes from the work of Falls and Kopachena (1994), who suggest that White-throated Sparrow populations change in response to changes in forest composition: the birds become more abundant as forests open up, and less abundant as they close in from regeneration. The species prefers forest edge habitat, and may benefit from forestry practices that leave some conifers standing. It is possible that the decline in the state's breeding population reflects maturing forests, while the increase in numbers of wintering birds reflects the implementation of more benign management practices farther north.

Interestingly, some of the years (e.g., 1976) in which White-throated Sparrows were most abundant were also years in which December was unusually cold (Figure 7; from National Climatic Data Center, 1999). However, the correlation is not reliable, and there have been many Decembers with below-average temperatures without a corresponding increase in White-throated Sparrow numbers. Perhaps more important is the fairly close parallel between inland and coastal numbers for this species; the pattern breaks down in a few years, notably 1972, but such lapses are surprisingly infrequent. If our winter population of White-throated Sparrows does indeed consist of migrants from outside the region, this statewide pattern of abundance would suggest that large-scale variations in either total numbers of this species, or at least in its movements in a given year, determine how many White-throats are present during a CBC period.

Dark-eyed Junco (Figure 6) is another woodland species that is common during the winter in Massachusetts. Juncos breed in New England at higher elevations, descending to lower elevations as winter approaches. They are usually one of the first "winter" birds to arrive near the coast, and they are frequent visitors to suburban backyards, where they scurry about in shrubbery near feeders. CBC data show that the winter population of juncos is highly variable from year to year, especially inland (note the astounding drop from about 17 to 2 birds per party-hour from 1964 to 1965); the long-term trend appears to be fairly stable statewide, and numbers inland and along the coast seem to move roughly in tandem, especially if you look at periods of several years at a time (for example, from 1966, through a statewide peak in 1970, to a statewide decline through 1974). BBSs in Massachusetts indicate that the breeding population of Dark-eyed Juncos in the state may be increasing; however, since the data come from only six survey routes, it is difficult to say for certain.

It is interesting to note that in 1964, inland numbers of Dark-eyed Juncos and American Tree Sparrows peaked sharply, increasing roughly two-and-a-half times from the preceding year, while other sparrows (including coastal juncos and Tree

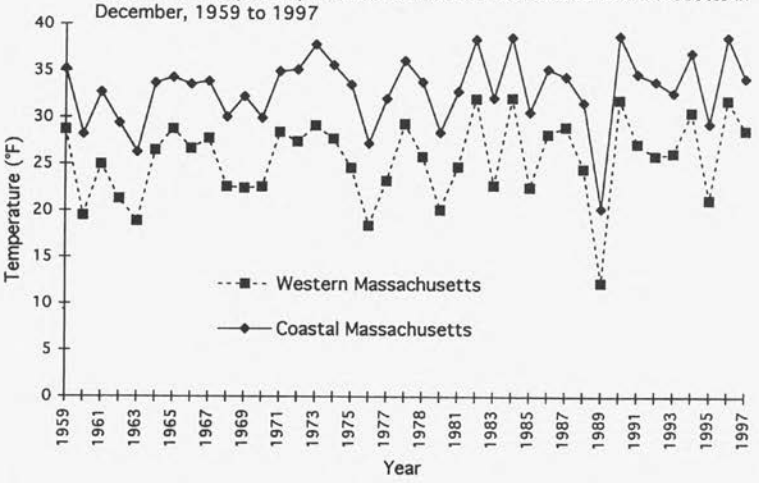
Figure 6. Dark-Eyed Juncos per Party-Hour in Coastal and Inland Christmas Bird Counts, 1959 to 1997



Sparrows) showed declines, steady numbers, or at most modest increases. Perhaps some affinity in the ecology or geographic origin of these two species accounts for this striking event.

In some years (e.g., 1969, 1976, and 1984), it appears that sparrows generally were numerous both inland and on the coast, perhaps indicating that conditions favorable for this group of birds prevailed statewide — or that especially unfavorable conditions elsewhere drove sparrows to the Bay State (Figure 7 suggests that temperature may be part, though not all, of the story). Such widely experienced data peaks could stem from

Figure 7. Average Temperatures for Western and Coastal Massachusetts in December, 1959 to 1997



sampling error — for example from especially good conditions for counting birds in some years — rather than from actual numbers of birds. However, these conditions would have to exist throughout the entire count period to skew results so broadly. Moreover, at least some species or regional populations show contrary results during these "sparrow years." For example, in 1969 Swamp Sparrows had a lackluster year; in 1976 Tree Sparrow numbers dipped statewide; in 1984 coastal Field Sparrow numbers plunged from a high the preceding year, and Tree Sparrows had an indifferent season. If sampling error alone accounted for these "sparrow years," one would expect the results to be homogeneous. A more likely explanation is that the ecology of these related birds is similar enough so that their populations often change simultaneously, but different enough so that one species is sometimes influenced by conditions that do not affect the others. This pattern of not-quite-homogeneous results certainly rings true when compared to a birder's extensive, if scientifically uncontrolled, experience with bird abundance, and it argues that the CBC data used in this analysis bear at least seem connection, even viewed year by year, to real changes in sparrow populations.

Conclusion

In drawing conclusions from CBC data, it is important to remember the fundamental limitations of these surveys. As I pointed out earlier, the numbers of

counts and participants have increased tremendously over the last three decades, and many other variables are not controlled. However, basing an analysis on birds per party-hour minimizes the effect of variable numbers of participants, and averaging the figures for birds per party-hour across multiple counts reduces the impact of a particular count that may be unreliable. The real question is: Are apparent trends in bird populations the result of real changes in the numbers of birds, or the result of increased thoroughness of CBCs generally? I suggest that the number of counts and the large geographical area involved in this analysis yield a credible reflection of long-term changes, and perhaps, to a lesser degree, of year-to-year variations as well.

If we accept that CBC data are valid — that is, reflective of actual changes in winter bird populations — then this study shows important long-term changes occurring in some of the winter populations of sparrows in Massachusetts, especially along the coast. CBC data suggest that, along with such species as American Robin, Northern Mockingbird, Northern Cardinal (Hamilton 1997), and House Finch (Hamilton 1994), Song Sparrows and Swamp Sparrows have increased in numbers over the last three decades. Other species, such as House Sparrow (Hamilton 1994) and Tree Sparrow, have declined. CBC data also offer interesting hints about the winter ecology of individual species, and even of sparrows generally. For some species, like Song and Swamp sparrows, year-to-year numbers tend to change statewide, suggesting that conditions on a broad scale affect the numbers of individuals wintering (or at least detected by CBC observers) in the state; for other species, like Field Sparrows, coastal and inland numbers may follow their own independent logic.

The population dynamics of wintering sparrows in Massachusetts undoubtedly depend on a complex set of interacting factors, including survival rates from the previous winter, breeding-success rates from the past summer, variations in annual movements, long-term changes in habitat and climate, and year-to-year variation in weather. While CBC data alone, especially in the absence of sophisticated statistical analysis, can hardly explain everything about this complicated topic, they nevertheless offer a compelling picture of some regional differences and long-term trends — and they hint at a great deal more about the fascinating complexity of bird ecology.

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