Feeder counts and winter bird population trends

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DO NUMBERS OF BIRDS AT FEEDers reflect their numbers elsewhere? Anyone can detect a finch invasion by casually watching a feeder, but careful observers also note that attendance at feeders is lower during fine weather, when there is no snow cover, or at specific times of day. How reliable, then, could feeder counts be in detecting less obvious population fluctuations of wintering birds? Using the National Audubon Society's Christmas Bird Count data as an independent measure of population levels, we have here attempted to answer that question.

The Long Point Bird Observatory began the Ontario Bird Feeder Survey (hereafter, O.B.F.S.) in 1976, with the goal of monitoring the distribution and movements of wintering birds. The Survey was inspired by, and modelled upon, the pioneering Garden Bird Feeding Survey run by the British Trust for Ornithology.

METHODS

Volunteer observers were recruited for the Survey by extensive advertising through naturalists' clubs and news media. Initially, 350 people participated and the number rose rapidly to 500+ annually. Volunteers register in autumn and are provided with complete instructions and record-keeping forms. At the close of each season, participants are sent a report of that season's results and materials for the following winter's survey.

Observers record the largest number of each species seen in the immediate vicinity of their feeders at any one time during specified two-day count periods. The maximum count does not have to occur concurrently for all species. Estimated numbers are so indicated. There are 10 count periods each season at two week intervals from November through March. Since we are primarily interested in overwintering birds, migration periods are purposely avoided. It is assumed that the large number of participants compensates for several of the biases introduced in individual counts, *e.g.*, by observing only at certain times of the day or by the effects of habitat in close proximity to the feeder.

Can the use of feeder counts of birds accurately reflect population changes in overwintering birds?

For our purposes it makes no difference if an index for one species is based on counting a smaller proportion of the total population than another. (Aggressive species that visit feeders singly or in pairs are under-counted relative to species in which entire flocks feed together.) We seek only standardized indices, and feel this method is the most straightforward for obtaining comparable counts from a wide variety of observers.

For routine annual analysis, Ontario is divided into three regions (North, Central, and South) and eight subregions (Fig. 1). The average recorded count (hereafter, "average number") of each species/feeder in each two-day count period is calculated for each subregion. These are averaged over the 10 count periods to give an annual mean for number of birds/feeder/count period. The average number in a region is obtained by averaging the results for the subregions within

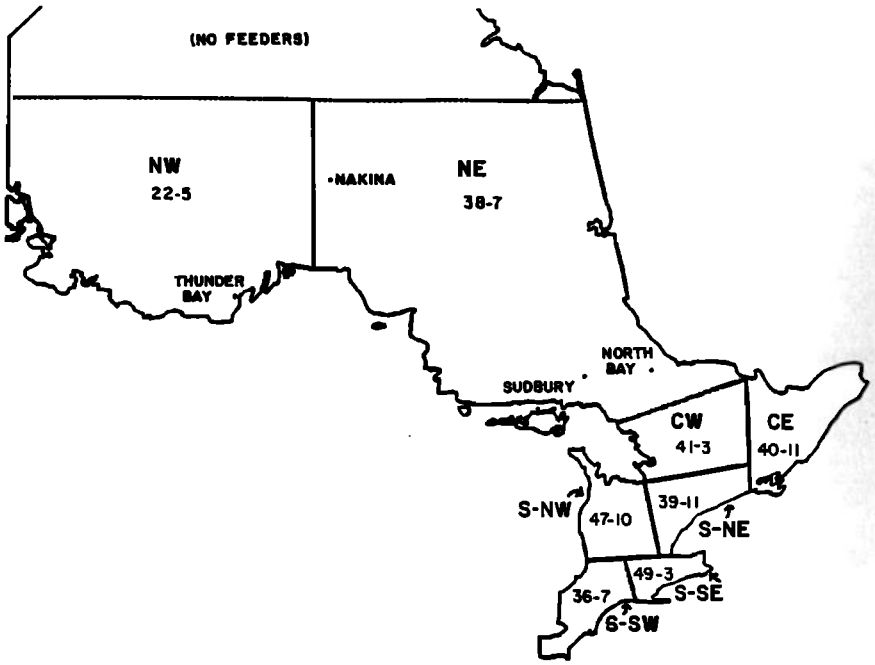

Figure 1. Ontario Bird Feeder Survey regions and sub-regions (first letter of code refers to north, central or south). Numbers show the 7-year average for number of acceptable O.B.F.S. counts and, after the dash, average annual number of Christmas Bird Counts in each subregion.

that region The provincial figures are calculated as the averages for the three regions. No corrections are made for the different sizes of regions or subregions, or the fluctuating number of feeders within them.

The average percentage of feeders visited by a species at least once in a season is also calculated for each subregion. Regional and provincial percentages are calculated as previously described for average numbers/feeder.

The non-parametric Mann-Whitney test is used to determine significance of difference between the average number of birds/feeder/count period in different years. This test weights each feeder equally. Between-year comparisons are made only for feeders providing data in both years.

To learn whether the O.B.F.S. reflects bird abundance elsewhere, comparisons were made with Christmas Bird Counts (hereafter, CBCs). These counts do include birds recorded at feeders, but are the best independent measure available. The averages of birds/party-hour each year were calculated for CBCs conducted within the three O.B.F.S. regions. The average number of birds/feeder in each region from the count period closest in date to CBC dates was compared to the regional CBC birds/party-hour for those species meeting the following criteria: minimum of 0.1 birds present/feeder over the seven-year period (*i.e.*, one bird present per 10 feeders), and an average of at least 25 feeders visited annually by that species in that region. In this analysis, individual feeders and CBCs were weighted equally to ensure that provincial means depended most heavily on areas where counts were most abundant. Both O.B.F.S. and CBCs are similarly distributed throughout the province (Table 1).

Table 1. Percent of 1976-1982 Feeder Survey and Christmas Bird Counts carried out in each O.B.F.S. region (see Figure 1).

O.B.F.S. region	*% of counts*	
	O.B.F.S.	*CBCs*
North	17	21
Central	23	26
South	60	53

RESULTS

For the seven-year period 1976-1982, CBC results from each Feeder Survey region were correlated with O.B.F.S. data from the same year for the 25 most common species at Ontario feeders (*e.g.* Fig. 2). As shown in Table 2, 15 of the 55 regional comparisons showed significant correlations ($P < 0.05$), and five more approached significance ($P < 0.1$). For the entire province, seven of the 25 species showed significant correlations, and three more approached significance.

If there were no relationship between feeder counts and CBCs, one-half of the coefficients in Table 2 should be negative, simply by chance. In fact, Chi square tests showed that there were more positive correlations than expected by chance for each of the three regions (Table 3).

A comparison was made between coefficients of variation for the two types of count for all the data in Table 2. (CV is the standard deviation of the seven-year mean expressed as a percentage of that mean.) The correlation is highly significant ($r = 0.66$, $P < 0.001$), indicating that both counts are measuring similar degrees of fluctuation in most species CV was not correlated to abundance

Regression analysis showed no significant relationship between the correlation coefficient between O.B.F.S. and CBCs and the following factors: species abundance (average number of birds/feeder over the seven-year period), number of feeders visited (seven-year average), range in abundance over the seven years, or ratio of O.B.F.S. to CBC numbers (an index of the degree to which various species come to feeders).

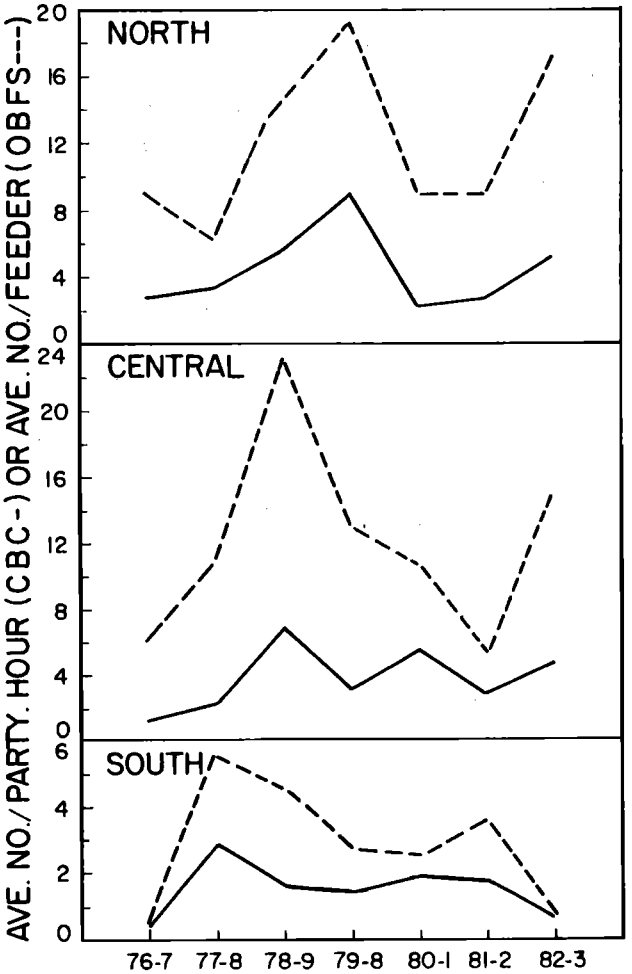

Figure 2. Feeder Survey and Christmas Bird Count results, 1976-1982, for Evening Grosbeak O.B.F.S. results (dashed line) are average birds/feeder (fourth count period) and CBC figures (solid line) are average birds/party-hour.

DISCUSSION

Comparison of O.B.F.S. to CBCs

The number of significant correlations in Table 2 is small, but the correspon-

Table 2. Correlation coefficients of Feeder Survey results and Christmas Bird Counts, 1976-1982

Species	Region			All Ontario[1]
	North	Central	South	
Mourning Dove (*Zenaida macroura*)	—	0.75+	0.48	0.52
Downy Woodpecker (*Picoides pubescens*)	0.41	0.67+	0.73+	0.67+
Hairy Woodpecker (*Picoides villosus*)	0.04	0.45	0.62	0.20
Gray Jay (*Perisoreus canadensis*)	0.13	—	—	−0.66
Blue Jay (*Cyanocitta cristata*)	0.77*	0.89**	0.59	0.84*
Black-capped Chickadee (*Parus atricapillus*)	−0.02	0.58	0.85*	0.80*
Red-breasted Nuthatch (*Sitta canadensis*)	0.52	−0.18	0.02	−0.54
White-breasted Nuthatch (*Sitta carolinensis*)	0.15	0.49	0.85*	0.68+
European Starling (*Sturnus vulgaris*)	0.41	−0.08	0.44	0.10
Northern Cardinal (*Cardinalis cardinalis*)	—	—	0.74+	0.80*
American Tree Sparrow (*Spizella arborea*)	—	0.83*	0.62	0.74+
Song Sparrow (*Melospiza melodia*)	—	—	0.52	−0.46
White-throated Sparrow (*Zonotrichia albicollis*)	—	—	0.45	0.47
Dark-eyed Junco (*Junco hyemalis*)	0.72+	0.20	0.83*	0.87*
Snow Bunting (*Plectrophenax nivalis*)	—	—	0.67	0.48
Red-winged Blackbird (*Agelaius phoeniceus*)	—	—	0.21	0.39
Common Grackle (*Quiscalus quiscula*)	—	—	−0.12	0.28
Brown-headed Cowbird (*Molothrus ater*)	—	0.53	0.46	−0.06
Pine Grosbeak (*Pinicola enucleator*)	0.86*	0.90**	—	0.86*
Purple Finch (*Carpodacus purpureus*)	0.77*	0.76*	0.34	0.06
Common Redpoll (*Acanthis flammea*)	0.62	0.88**	—	0.97***
Pine Siskin (*Carduelis pinus*)	0.07	—	0.96*	0.54
American Goldfinch (*Carduelis tristis*)	0.10	0.50	−0.41	−0.39
Evening Grosbeak (*Coccothraustes vespertinus*)	0.88**	0.85*	0.91*	0.84*
House Sparrow (*Passer domesticus*)	0.62	0.34	0.05	0.25

[1]Data from all regions are included in the provincial figure, even if some did not meet the criteria for being included in the analysis singly.
*$P < 0.05$
**$P < 0.01$
***$P < 0.001$
+ = $P < 0.1$

Table 3. Number of positive and negative correlations between O.B.F.S. and CBC, 1976-1982.

	Region			All Ontario
	North	Central	South	
Positive	15	15	20	20
Negative	1	2	2	5
P	<0.05	<0.05	<0.01	0.1>*P*>0.05

dence between count types is much greater than expected if the number of birds coming to feeders bears no relationship at all to regional population size.

One possible explanation for correspondence between count types is that they are not independent. Christmas bird counters may record a significant proportion of certain species at feeders, such that a positive correlation between O B F.S. and CBCs would be expected regardless of whether either is a good index of wild population sizes. As is shown in Table 4, however, those species with reasonable correspondence between count types are not all equally attracted to feeders. Evening Grosbeaks (*Coccothraustes vespertinus*) are disproportionately found at feeders, for example, especially in years of abundance (Fig. 2), while American Tree Sparrows (*Spizella arborea*) are not.

Thus it appears that feeder counts do roughly monitor population levels of certain species overwintering in Ontario. Starting from this premise, we can consider why the correspondence between count types is not larger than it is.

First, note those species showing no correspondence between count types in any region (Table 4). These conspicuously include all of the blackbirds, which are only casual attendants at feeders relative to total abundance. Song Sparrow (*Melospiza melodia*), White-throated Sparrow (*Zonotrichia albicollis*), and Snow Bunting (*Plectrophenax nivalis*) can also be considered as casual visitors. Numbers of these species at feeders appear to vary widely according to weather, chance, and location of feeders registered in the Survey in a given year. Gray Jay (*Perisoreus canadensis*) and House Sparrow (*Passer domesticus*) may also fit into this category. In addition, House Sparrows are probably less accurately counted than any other species in both types of count owing to their abundance. Numbers over 25 are usually estimated by both O.B.F.S. and CBC counters. Arbib (1967) has commented on the potentially large biases introduced to CBCs by estimation, and the same criticism probably applies to the O.B.F.S.

Lack of variation between years can reduce correlation between count types, as random effects exert greater influence For example, Evening Grosbeaks are about as abundant at feeders as House Sparrows, but their annual variations are much greater, and the correlation between count types is much larger. Lack of correlation between count types in Hairy Woodpecker (*Picoides villosus*) is quite likely to be influenced by very low annual variation in numbers, and the same may apply to American Goldfinch (*Carduelis tristis*). The latter is the only irruptive finch showing no correspondence between count types. Flocks are known to range widely, however, visiting feeders up to 15 km apart within a day (A.L.A. Middleton, *pers. comm.*). This could obscure any relationship of feeder counts to true numbers. The same may be true of certain other finches (*e.g.*, Pine Siskins (*Carduelis pinus*), which often travel with goldfinches), but again, larger fluctuations in these species could help overcome the counting problems. (Compare CV of 26% in goldfinches to that of over 100 in Pine Siskins, Table 4.)

The last species showing no correlation between count types is the Red-breasted Nuthatch (*Sitta canadensis*), which appears to have a unique and rather complex pattern of feeder attendance (Dunn and D.J.T. Hussell, *in prep.*).

Even for species showing some degree of correlation between the O.B.F.S. and CBCs, it is hardly surprising that correspondence is not especially good. As noted, feeder counts of species attending feeders singly or in pairs (*e.g.*, chickadees), are biased downward when populations are high. Feeder counts and CBCs are not made on the same dates, and weather on the day of a feeder count probably affects results more than it would for a CBC (Falk 1979). For this

Table 4. Ontario Bird Feeder Survey results, 1976-1982.

Species	Average # birds/feeder/count period Region: North	Central	South	All Ontario	CV[1]	OBFS/ CBC[2]
Species showing some correlation to CBCs[3]						
Mourning Dove	—	0.3	2.6	1.0	23.5	1.3
Downy Woodpecker	0.8	1.1	0.9	1.0	9.5	1.8
Blue Jay	3.2	4.7	2.7	3.5	15.6	1.9
Black-capped Chickadee	6.4	6.2	2.8	5.1	10.3	0.8
White-breasted Nuthatch	0.2	1.0	0.6	0.6	26.3	1.5
Northern Cardinal	—	—	1.5	0.6	10.2	1.5
American Tree Sparrow	—	2.4	2.5	1.9	26.7	0.8
Dark-eyed Junco	0.3	0.3	3.0	1.2	10.6	1.2
Pine Grosbeak	2.3	0.2	—	0.8	71.8	0.6
Purple Finch	0.5	0.6	0.2	0.4	92.2	0.6
Common Redpoll	4.7	3.2	—	3.1	133.6	0.2
Pine Siskin	0.6	—	0.3	0.3	103.7	0.6
Evening Grosbeak	13.3	14.6	3.4	10.4	33.4	2.8
Species with no correlation to CBCs[3]						
Hairy Woodpecker	1.2	1.1	0.4	0.9	4.9	2.3
Gray Jay	0.8	—	—	0.3	15.0	3.8
Red-breasted Nuthatch	0.3	0.3	0.1	0.3	40.4	0.8
European Starling	1.9	1.7	5.2	2.9	0.1	0.3
Song Sparrow	—	—	0.2	0.2	62.2	0.5
White-throated Sparrow	—	—	0.2	0.1	38.7	1.2
Snow Bunting	—	—	0.4	1.1	38.8	0.1
Red-winged Blackbird	—	—	0.4	0.4	53.6	0.1
Common Grackle	—	—	0.8	0.4	34.2	0.7
Brown-headed Cowbird	—	0.3	1.8	0.7	38.0	0.7
American Goldfinch	0.3	1.0	3.2	1.5	26.1	1.3
House Sparrow	3.1	6.5	14.8	9.0	7.8	1.2

[1]Coefficient of variation (CV) = standard deviation of 7-year provincial average expressed as percent of the 7-year mean.

[2]O.B.F.S. birds per feeder in fourth count period (that closest to CBC dates), divided by birds per party-hour in average CBC. This is a rough index of the degree to which a species attends feeders. (Note that this index is biased downward in species which attend feeders 1 or 2 at a time, regardless of abundance, such as Black-capped Chickadee).

[3]A species with "some correlation to CBCs" is one with a correlation of $P < 0.1$ or better to CBCs in at least one region.

reason we express O.B.F.S. annual abundance as averages for the entire 20-week season. Further, CBCs with their biases (Bock and Root 1981) may not be the ultimate data base for use in monitoring species abundance.

The small sample size of the O.B.F.S. also affects the results. The same correlations shown in Table 2 would probably show about twice as many significant relationships if 15 years data were compared instead of only seven.

Use of O.B.F.S. data

Because feeder counts tell us something about regional population size, there are many uses to which we can put the results. Table 4 summarizes 1976-1982 O.B.F.S. results for those species monitored to some degree by feeder counts. We can document quantitatively that most species are not equally distributed across the province, and that they vary in degree of attendance at feeders, and in the amount of annual fluctuation (Fig. 3). Variation in irruptive species with large annual fluctuations can be documented without conducting a survey of feeders. However, abundance changes are not so easily detected without cooperative effort in species such as Black-capped Chickadee (*Parus atricapillus*), Dark-eyed Junco (*Junco hyemalis*), Northern Cardinal (*Cardinalis cardinalis*) and Downy Woodpecker (*Picoides pubescens*).

To date, the O.B.F.S. has documented several long-term trends in population size, mostly within specific regions. Ontario-wide trends are shown only for the House Finch (*Carpodacus mexicanus*) and American Tree Sparrow. Despite a rapid spread of House Finches across southern Ontario in recent years, the species did not meet the abundance criteria for inclusion in this paper. According to the Feeder Survey, American Tree Sparrows have decreased in Ontario since 1976-1977 (Fig. 3), but this trend is not confirmed by CBC results.

In addition to measuring abundance, the O.B.F.S. also documents percentage of feeders visited annually. Of the 25 species in Table 2, 19 showed a significant correlation between abundance and percentage of feeders visited as illustrated for the White-breasted Nuthatch (*Sitta carolinensis*) in Figure 3. In about one-half of these (woodpeckers, nuthatches), numbers at individual feeders remain essentially constant, or vary between 0 and 1-2, emphasizing again the need for a cooperative effort to detect population fluctuations over a broad geographic area.

It might be argued that documentation of regional abundance is better done by CBCs, with its wider geographical coverage and historical backlog of data. Why have feeder counts at all? In fact, there are several features of feeder surveys which make them a valuable addition to our roster of cooperative volunteer surveys. First, the fact that there is correspondence between the O.B.F.S. and CBCs at all bolsters confidence that both are measuring real phenomena. Agreement of results from independent sources strengthens the evidence for a given population change.

Second, because the O.B.F.S. covers a 20-week period, it can describe intraseasonal patterns of feeder attendance and movements between regions, something only rarely possible with CBC data. Figure 4 illustrates seasonal variation of Evening Grosbeaks, showing that there are large influxes into central Ontario from the east in some years, but not others, and that timing of influxes may vary. The same phenomenon has been found for the Blue Jay and American Tree Sparrow. Unlike the CBCs, Feeder Surveys also document annual abundance for species that move into an area after January 1, as is often the case with northern finches.

Finally, a large range of topics can be addressed with Feeder Survey results beyond those of population monitoring. For example, manuscripts are in preparation using O.B.F.S. results on the effects of neighborhood habitat on which species attend feeders and in what numbers, differential movement of sexes in wintering Evening Grosbeaks, geographic expansion of House Finch populations in south-

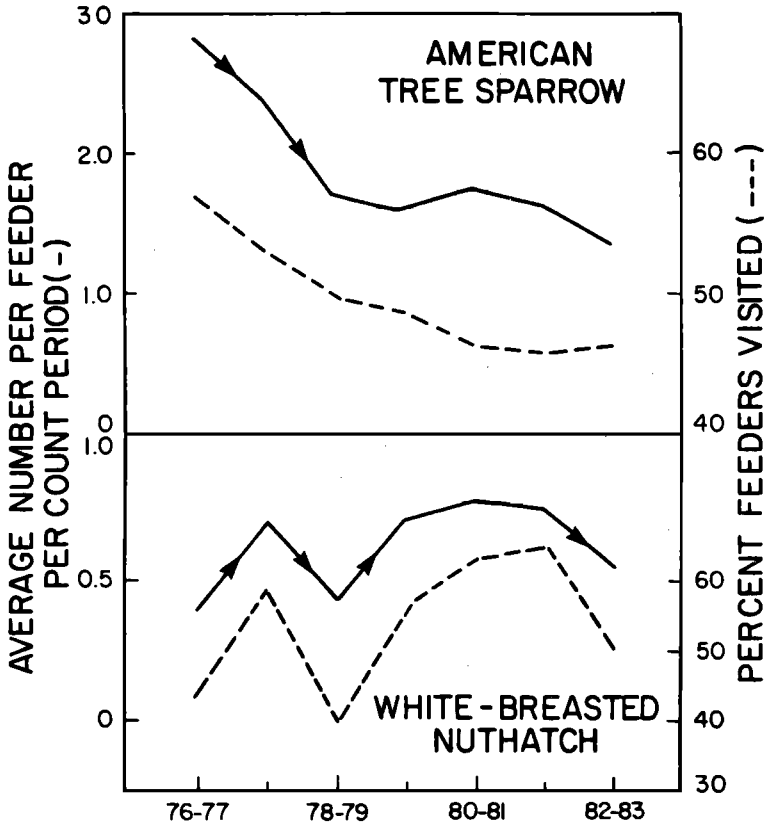

Figure 3. Annual Feeder Survey results for White-breasted Nuthatch and American Tree Sparrow Solid line shows average number of birds/feeder (whole province) and dashed line shows percentage of feeders visited on at least one count during the year. Arrows indicate significant differences ($P < 0.01$) between years.

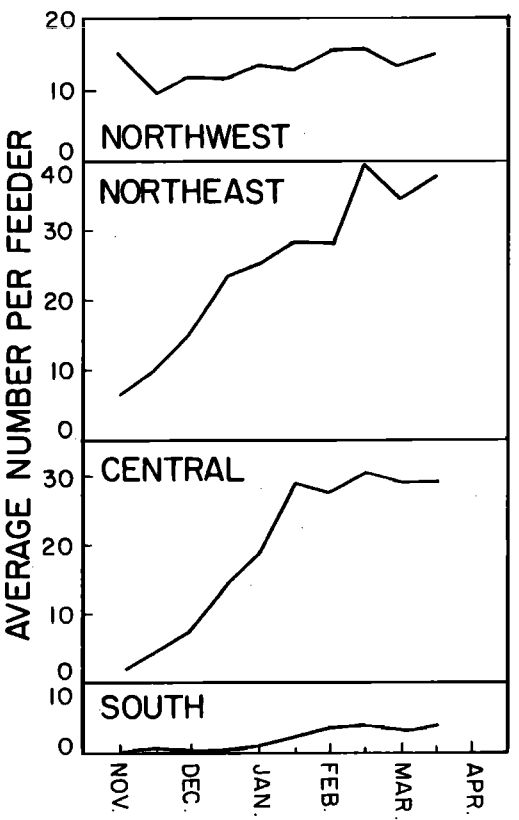

Figure 4. Seasonal abundance (average number of birds/feeder) of Evening Grosbeak for 1982-83.

ern Ontario, patterns of nuthatch irruption, and habitat preferences of the two color morphs of the Grey Squirrel (*Sciurus carolinensis*).

Establishment of simultaneous feeder surveys using the same methods for contiguous areas of Canada and the United States would allow easier analysis of where birds are going and how far south irruptions extend in given years. At present, similar surveys are being run in Michigan and Minnesota. A one-day/winter count is run in the United States, largely in the east, by Sweetbriar College and the Lynchburg Bird Club, and another one-day count is done near Syracuse, New York (Burtt and Burtt 1979). If new counts are to be started, efforts should be made to make the methods and analysis as compatible as possible with those of nearby counts. A practical modification where volunteers are running the survey (as in Ontario) might be to have once-per-month instead of bi-weekly counts. More ambitious counts might cover the whole year to learn more about feeder use by migrating and breeding birds.

SUMMARY

Indices of bird numbers at Ontario feeders in two-day periods in early winter were compared to numbers from Christmas Bird Counts for 1976-1982. Correlations were run for the 25 species most common at feeders. Most correlations were positive, and about one-third were statistically significant. Although there are limitations to the data from both types of count and to the validity of the comparison between them, it appears that feeder surveys can be used to monitor regional population fluctuations in a large proportion of the species regular at feeders. Notable exceptions for Ontario were blackbirds, House Sparrows and American Goldfinches.

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