Bird Feeding and Irruptions of Northern Finches: Are Migrations Short-Stopped?

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ABSTRACT

The provision of seed at feeders improves the survivorship of birds, facilitates range expansions, and influences habitat choice. In this paper, I examine the notion that bird feeding in northern parts of North America can short-stop the irruptive migrations of fringillids. Indirect data to support an increase in bird feeding over the past 25 years are provided. Using an area bounded by the Appalachian Mountains to the west and the Atlantic Ocean to the east, I examined band re-encounter data for six fringillids and found that the study area seems to be neither a sink nor a source of irruptive birds. Using Christmas Bird Count data for the study area (1975-1994), I show that greater irruptions tend to occur earlier in the study period. However, the data show no statistically significant increase in birds wintering in northern latitudes as predicted if migrations are short-stopped. The analysis does not provide compelling evidence of a short-stopping effect.

INTRODUCTION

North American interest in birds has grown steadily over the past 25 years. Several lines of evidence can be used to bolster this assertion. Subscriptions to birding magazines have grown significantly. The American Birding Association began in 1969 with a handful of members and now boasts over 20,000 members. The ABA's magazine *Birding* has been joined by other birding publications (*Wild Bird, Birder's World* and *Bird Watchers' Digest*), each with at least 80,000 paid subscribers. Stores devoted to wild birds continue to increase. In 1981, the first Wild Birds Unlimited store opened; now there are more than 240 stores in the United States and Canada (http://www.wbu.com/). Similarly, the first Wild Bird Center opened in 1985 and currently there are 100 stores in North America (http://www.wildbirdcenter.com/). Wild Bird Marketplace has increased from a single store in 1990 to 31 in 1999 (http://wbm-bird.com/).

The increase in birders certainly translates into an increase in the number of people feeding birds. A U. S. Fish and Wildlife Service survey (Caudill and Laughland 1998) conducted in 1996, found that 63 million U.S. citizens are wildlife watchers. The amount of money spent on bird seed, binoculars, and other equipment in 1996 is 21% higher than the corresponding amount in 1991. Data on the amount of sunflower seeds sold as bird feed over the past 25 years are not available as the end-use of sunflower seeds is typically not reported. However, even between 1995 and 1996, the amount of bird seed purchased in the United States increased by 14% (Wild Bird Feeding Institute, pers. comm.). I believe it is reasonable to believe that there has been a steady increase in bird feeding over the past 25 years.

The impacts of supplemental food on birds are manifold. Supplemental food is known to increase survivorship in Black-capped Chickadees (*Poecile atricapillus*) (Desrochers et al. 1988; Egan and Brittingham 1994; Brittingham and Temple 1988, 1992). Grubb and Cimprich (1990) demonstrated with ptilochronology that the physiological status of birds is improved with supplemental food. Wilson (1994) showed that the habitat preference of some wintering birds can be changed if supplemental feeders are placed in less preferred habitats.

On a broader scale, the provision of food has been implicated in the range expansion of birds. Tufted Titmice (*Baeolophus bicolor*) have extended their wintering range into New England in the past 20 years (Kricher 1981). The northward range extension of Northern Cardinals (*Cardinalis cardinalis*) and eastern House Finches (*Carpodacus mexicanus)* may have been facilitated by the provision of seed at bird feeders.

A possible, but unstudied, impact of supplemental food may be a short-stopping of the winter migrations of irruptive northern finches. Common Redpolls (*Carduelis flammea*) only migrate south from their high-latitude breeding grounds when their food supplies fail (Bock and Lepthien 1976). Irruptive behavior is also driven by food availability in Pine Siskins (*Carduelis pinus*), Evening Grosbeaks (*Coccothraustes vespertinus*), Pine Grosbeaks (*Pinicola enucleator*), and Purple Finches (*Carpodacus purpureus*) (Bock and Lepthien 1976). If supplemental food at feeding stations has increased over the past 25 years, these irruptive finches may not have needed to migrate as far south in recent years to find sufficient food.

To address this possibility, I analyzed data from Christmas Bird Counts from an area bounded latitudinally by southern Georgia (30°N) and central New Brunswick (48°N). The study area was bounded on the east by the Atlantic Ocean and on the west by the physiographic barrier of the Appalachian Mountains. If supplemental food is producing a short-stopping effect, the incursion of finch irruptions should not penetrate as far south in recent years.

METHODS

Six species of irruptive finches were analyzed in this study: Evening Grosbeak, Pine Siskin, Common Redpoll, Purple Finch, Pine Grosbeak and White-winged Crossbill. The first four species visit bird feeders regularly in the winter. I also analyzed two sedentary species—Downy Woodpecker (*Picoides pubescens*) and Hairy Woodpecker (*P. villosus*)—that occur throughout the geographic area studied. Insufficient data precluded analysis of Hoary Redpoll (*Carduelis hornemanni*).

Physical barriers on the east (Atlantic Ocean) and west (Appalachian Mountains) determined the study area. The southern limit is the extreme southern limit of finch irruptions. The northern limit was determined by the latitude of the most northerly Christmas Bird Counts in eastern North America.

Before gathering Christmas Bird Count data, I analyzed banding re-encounter data, provided by the Bird Banding Laboratory, to identify patterns of irruption. Re-encounters are captures of banded birds outside the 10-minute block in which they were banded. Restricting the analysis to eastern North America can be problematic if there is a tendency for eastern North America to be either a sink or a source for irruptive birds, compared to the rest of North America. I analyzed all of the banding re-encounter data for Common Redpoll, Purple Finch, Pine Siskin and Evening Grosbeak. The data were separated into recaptures within a year of banding and recaptures more than a year after banding. Recaptures (repeats) by the same bander in the same location in the same year were excluded from the analysis. Each recapture was cross-classified according to area of banding (eastern or western North America where western America is the entire area west of the Appalachian chain) and area of recapture (eastern or western North America). Contingency analysis was used to determine if each species was more likely to disperse east or west.

To measure the irruptions of the six finches as well as the dynamics of the two woodpeckers, I gathered Christmas Bird Count data for the study area. I divided the study area into one degree blocks of latitude. Within each latitude block, I chose at least 30 Christmas Bird Counts to analyze. These were chosen primarily on the basis of continuous coverage from 1975 through 1994. For each count, the numbers of each species were normalized by dividing each species total by the number of party-hours to remove the problem of differential effort among counts.

To analyze the distribution of birds, I divided the 20-year interval from 1975 to 1994 into four five-year intervals (1975-1979; 1980-1984; 1985-1989; 1990-1994). For each latitudinal block, I averaged the number of birds seen/party-hour for all of the Christmas Bird Counts available in a given year. A grand mean within each latitude was obtained by averaging five years of data for each five-year interval.

To test statistically for differences in the limits of southern irruptions through time, I tested for the numbers of individuals /party-hour of each species in the area between 30° and 38° N. A single-factor ANOVA was used with the four five-year time intervals serving as the levels of the factor of time. If the ANOVA indicated a significant difference ($p < 0.05$), then pair-wise Bonferroni contrasts were used to find where significant differences lay. In like fashion, I tested for differences in abundance for each species in the area between 40° and 48°N.

RESULTS

Table 1 provides a compilation of banding re-encounter data for four of the fringillids studied. Too few data for analysis were available for Pine Grosbeak and White-winged Crossbill.

Contingency analysis of the data in Table 1 reveals a remarkable concordance between sides of the continent. For Purple Finches recaptured within a year of banding, 89% of birds banded in the east were recaptured in the east while 91% of birds banded in the west were recaptured in the west. Similar results were obtained for recaptures greater than a year after banding with 84% of eastern birds banded in the east and 83% of western birds banded in the west. Continency analysis reveals that the two proportions for the two recapture intervals are not statistically different ($p > 0.05$).

The lowest number of re-encounters for these four species was for Common Redpoll. For birds re-encountered within a year of banding, there is no significant difference in the proportions of birds banded, with 91% of eastern birds recaptured in the east and 99% of western birds recaptured in the west. However, there is a significant difference for recaptures over a year after banding. Only 46% of eastern birds were banded in the east while 79% of western birds were re-encountered in the west ($p < 0.01$ in contingency analysis). However, the small number of re-encounters (only 28 birds banded in the east) compromises the power of the analysis, reducing confidence in the results.

For Pine Siskins banded within a year of banding, 95% of birds banded in the eastern region were re-encountered in the east compared to 93% of western birds banded in the west. For siskins re-encountered over a year after banding, 69% of eastern birds were re-encountered in the east while 72% of birds banded in the west were re-encountered in the west. Contingency analysis reveals these proportions are not significantly different in both cases ($p > 0.05$).

Finally, for Evening Grosbeaks re-encountered within a year of banding, 89% of eastern birds were recaptured in the east and 89% of western birds were recaptured in the west. For recaptures more than a year after banding, 75% of re-encounters of eastern birds were in the east and 77% of recaptures of western birds were in the west. These pairs of percentages do not differ statistically by contingency analysis ($p > 0.05$).

Figures 1 and 2 present data for the abundance, measured as numbers of birds/party-hour on Christmas Bird Counts, of eight bird species. I first analyzed two sedentary species, Downy Woodpecker and Hairy Woodpecker, predicting little difference in abundance among time intervals at each latitude. Visual inspection of the dynamics of these birds (Fig. 1) reveals similar patterns for all four intervals as expected. Pine Grosbeak (Fig. 1) shows some variation among intervals but it is evident that members of this species only rarely venture below 43° N. Purple Finch (Fig. 1) shows complex dynamics. For latitudes below 41°N, the fewest numbers of Purple Finches are seen in the most recent time interval.

White-winged Crossbills (Fig. 2) typically are not found south of 36°N and, except for widespread occurrences in 1975-1979, most of the birds are found north of 43°N. Common Redpolls (Fig. 2) show high abundance in 1990-1994 at high latitudes. Typically this species is not found in significant numbers south of 42°N. Pine Siskins (Fig. 2) show an unexpected bimodal distribution with the higher mode being in the north and relatively low abundance in the middle latitudes.

Table 1. Analysis of band re-encounter data for four fringillid species. Data are divided into recaptures less than or equal to one year after banding and recaptures more than one year after banding. The East is defined as the portion of eastern North America east of the Appalachian mountain chain. West is all of North America west of the Appalachians.

Banding Region: Recapture Region	Recaptures <1 year after banding	Recaptures >1 year after banding
a. Pine Siskin		
East: East	643	100
East: West	35	44
West: West	654	128
West: East	49	49
b. Common Redpoll		
East: East	75	13
East: West	7	15
West: West	248	44
West: East	3	12
c. Evening Grosbeak		
East: East	939	982
East: West	119	324
West: West	445	559
West: East	53	170
d. Purple Finch		
East: East	337	413
East: West	43	77
West: West	523	534
West: East	51	107

The highest incursion of siskins into the south occurred during the 1985-1989 interval. Finally, Evening Grosbeaks (Fig. 2) are relatively uncommon south of 41° N. Highest numbers in the south occurred during the 1980-1984 interval.

Table 2 presents the results of a more quantitative analysis of the changes in abundance through time. The mean numbers of birds/party-hour are analyzed for areas south of 38°N in Table 2(a). Downy Woodpeckers show a significant increase in both 1980-1984 and 1990-1994 compared to 1975-1979. Hairy Woodpecker shows no significant changes in abundance. Pine Grosbeaks, rare south of 38°N, do not differ in abundance across the 20-yr period. The ANOVA for Purple Finches showed many significant changes; five of the six possible pair-wise combinations were statistically different. The highest abundance was in the 1980-1984 interval.

White-winged Crossbills rarely occurred in these southern areas and showed no significant differences through time. Similarly, Common Redpoll is quite rare south of 38°N and no significant differences among intervals were found. Pine Siskin was significantly more common in 1985-1989 compared to each of the remaining three intervals. Evening Grosbeaks were significantly more abundant in 1980-1984 compared to both 1985-1989 and 1990-1994.

Some of these results are consistent with the prediction that irruptions are weaker into the southern part of the study area. Highest incursions of Purple Finches, Pine Siskins, and Evening Grosbeaks occurred either in 1980-1984 or 1985-1989.

Examination of the numbers of these species north of 40°N did not mirror these changes. Analysis of variance revealed that none of the species shows any change in abundance in the northern latitudes from year to year (Table 2).

DISCUSSION

In this study, I address the possibility that the provision of food at northern latitudes causes irruptive finches to overwinter at higher latitudes than they would without the largesse from bird feeding stations. I begin with the claim that bird feeding has increased significantly over the past 25 years. Unfortunately, it is impossible to collect irrefutable confirmation of this assertion because of the way that sunflower seed sales are reported. Nevertheless, as detailed in the Introduction, the proliferation of wild bird stores, the rapid growth of the subscriptions to birding magazines and the establishment of Project FeederWatch by the Cornell Laboratory of Ornithology in 1988 are all indicative of growth in interest in birds by the general populace.

Elucidation of population dynamics of migratory birds requires the concerted work of many individuals. For this study, I used the substantial

Table 2. Abundance of species (total/party hour) in the southern and northern portion of the study region. Data reported are means and standard errors in parentheses. The results of a one-way ANOVA to test for differences among intervals are given in the right-hand column. Bonferroni contrasts were used to identify significant pair-wise differences. These differences are keyed to letters below each interval.

a. Latitudes 30°N to 38°N

	1975-1979 (A)	1980-1984 (B)	1985-1989 (C)	1990-1994 (D)	Results of ANOVA
Downy Woodpecker	0.36 (0.030)	0.48 (0.038)	0.44 (0.205)	0.46 (0.027)	A,B, A<D
Hairy Woodpecker	0.08 (0.005)	0.07 (0.007)	0.07 (0.007)	0.07 (0.006)	NS
Pine Grosbeak	0.001 (0.001)	0.005 (0.005)	0.002 (0.002)	0.004 (0.004)	NS
Purple Finch	0.52 (0.056)	0.72 (0.074)	0.40 (0.049)	0.14 (0.026)	A<B,A>D,B>C, B>D, C>D
White-winged Crossbill	0.19 (0.146)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	NS
Common Redpoll	0.00004 (0.00003)	0.00002 (0.00002)	0.00002 (0.00002)	0.00008 (0.00005)	NS
Pine Siskin	0.09 (0.032)	0.20 (0.053)	0.46 (0.115)	0.07 (0.035)	A<C,B<C,D<C
Evening Grosbeak	0.14 (0.045)	0.23 (0.047)	0.08 (0.023)	0.05 (0.028)	B>C, B>D
b. Latitudes between 40°N and 48°N					
Downy Woodpecker	0.46 (0.48)	0.63 (0.093)	0.49 (0.046)	0.54 (0.044)	NS
Hairy Woodpecker	0.20 (0.016)	0.22 (0.012)	0.20 (0.012)	0.21 (0.017)	NS
Pine Grosbeak	0.36 (0.069)	0.33 (0.051)	0.34 (0.071)	0.25 (0.074)	NS
Purple Finch	0.38 (0.108)	0.25 (0.054)	0.11 (0.015)	0.26 (0.082)	NS
White-winged Crossbill	0.19 (0.146)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	NS
Common Redpoll	0.56 (0.201)	1.18 (0.372)	1.02 (0.204)	2.45 (1.350)	NS
Pine Siskin	0.30 (0.087)	0.32 (0.071)	0.59 (0.147)	0.61 (0.193)	NS
Evening Grosbeak	3.22 (0.342)	3.30 (0.359)	2.56 (0.298)	2.47 (0.502)	NS

Figure 1. Population abundance (number of birds/party-hour) of Downy Woodpeckers, Hariy Woodpeckers, Pine Grosbeaks and Purple Finches by latitude for four 5-yr. time intervals.

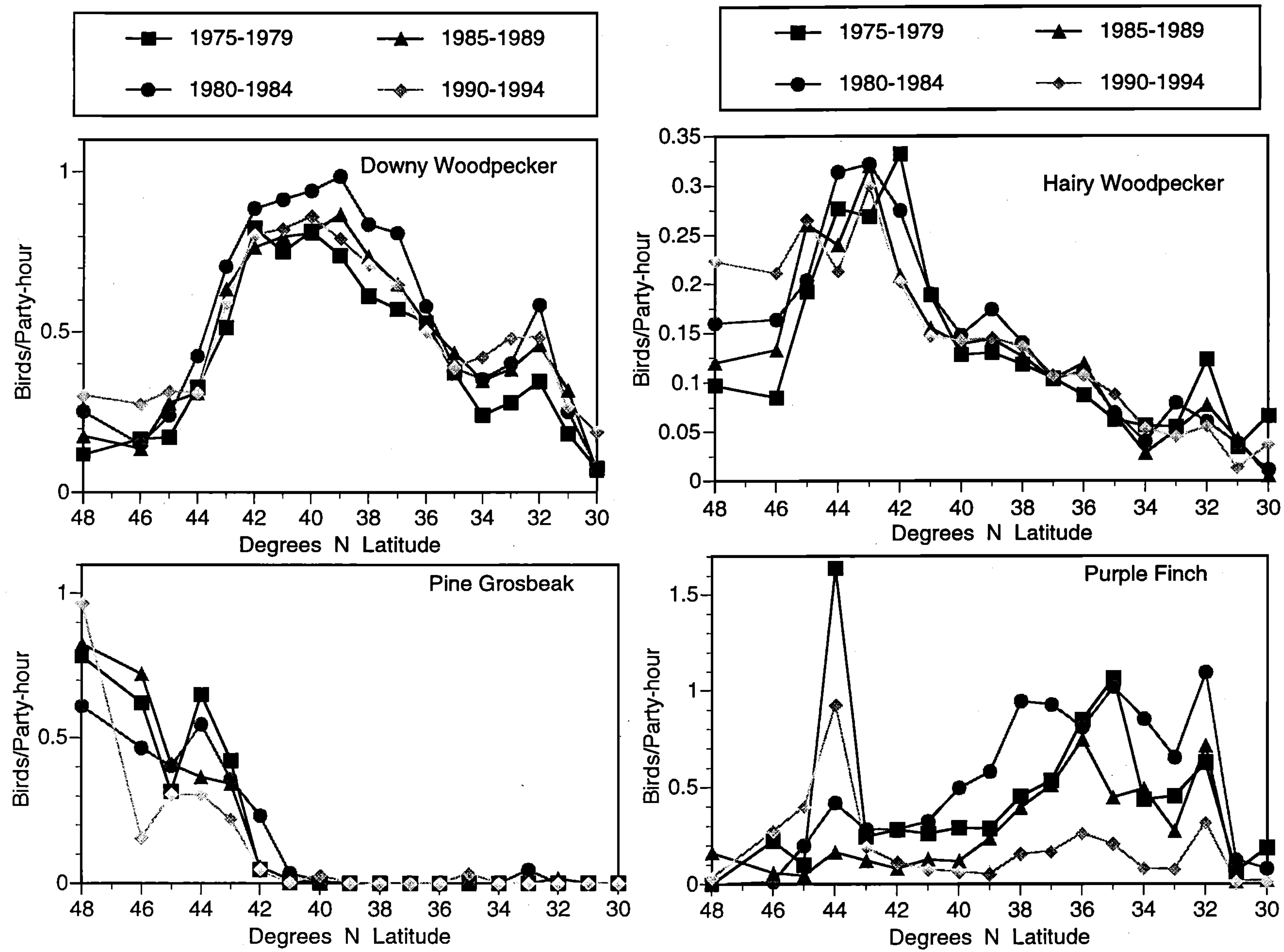
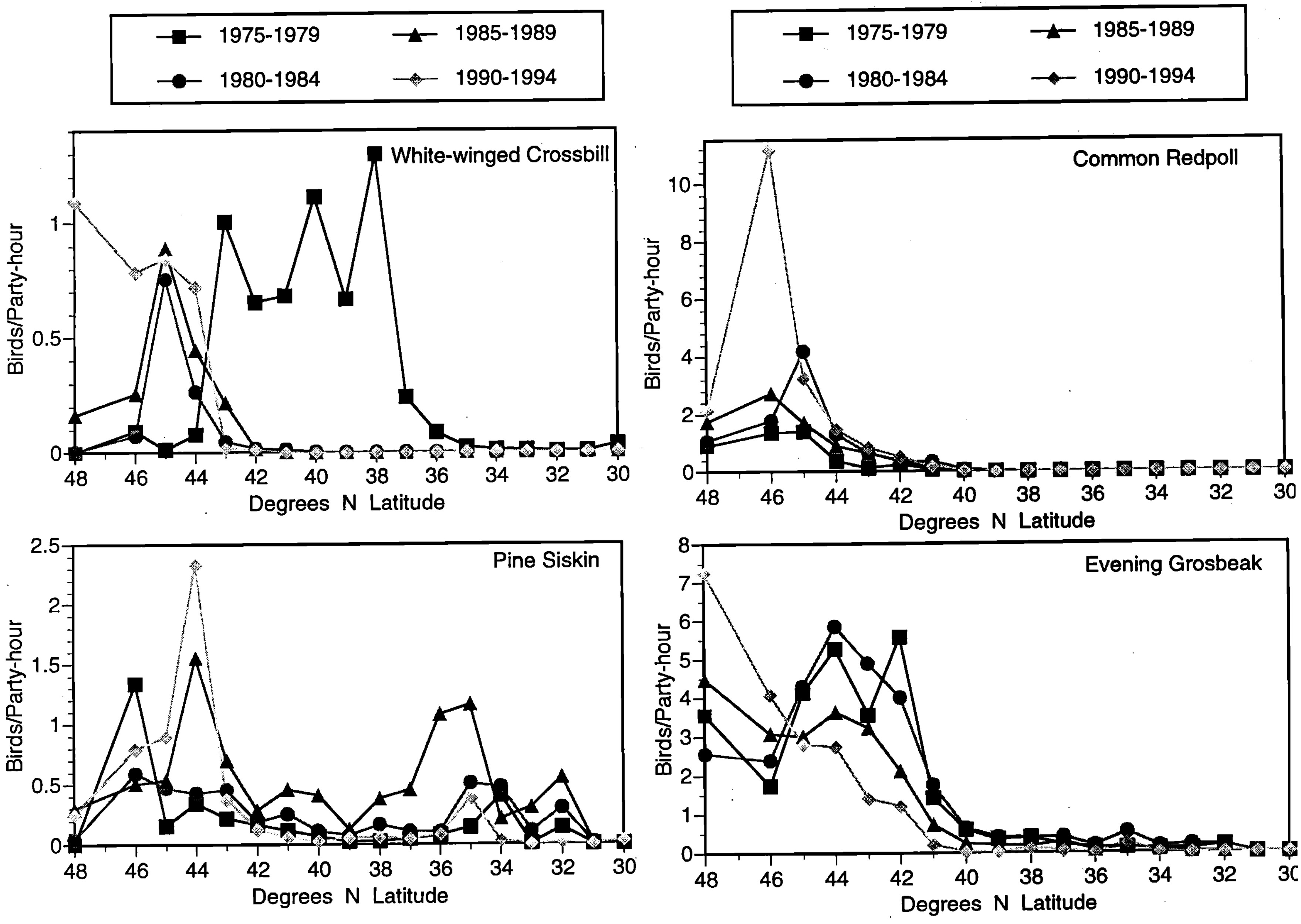


Figure 2. Population abundance (number of birds/party-hour) White-winged Crossbills, Common Redpoll, Pine Siskins and Evening Grosbeaks by latitude for four 5-yr. time intervals.



database from the Christmas Bird Count to examine how the populations of several finches have changed since 1975. The data provided on the Christmas Count summaries were normalized by dividing the number of birds of each species observed by the total party-hours for a particular count. Reporting birds/party-hours has the advantage of being independent of area. Two regions of different areas can be compared using the numbers of birds/party-hour.

For this study, I chose to focus on the eastern seaboard of North America to limit the data that would need to be analyzed and to focus on the area of the United States where bird feeding is most prevalent because of the high human population densities. The area was delimited physiographically to the west by the Appalachian Mountain chain, to the east by the Atlantic Ocean, to the north by the northern limit of Christmas Bird Counts and to the south by 30°N, below which irruptive finches are extremely rare.

A possible bias in the Christmas Bird Count data is that incursions of irruptive finches into the study area may come from areas west of the study area. Alternatively, the eastern seaboard could be a source of irruptive finches in the western portion of the United States and southern Canada. To test for this bias, I analyzed the band re-encounters for four species of irruptive finches (Purple Finch, Common Redpoll. Pine Siskin, and Evening Grosbeak). As shown in Table 1, no such bias exists. The percentage of birds banded in the east and recaptured in the east is statistically identical to the percentage of birds banded in the west and recaptured in the west with the exception of Common Redpolls captured over a year after banding. The majority of these results indicate that analyzing Christmas Bird Count data from the eastern seaboard is not burdened by confounding net gains/losses from areas west of the defined study area.

As a test of the precision of the CBC data, I chose two sedentary species, Downy Woodpecker and Hairy Woodpecker, whose population abundances were analyzed throughout the study area. Although some individuals of both species are known to undertake periodic fall movements, particularly in northern populations (McPeek 1994, Levine et al. 1998), these woodpeckers are one of the few sedentary species whose range includes all of the study area. The abundance data as a function of degree of latitude for Downy Woodpecker and Hairy Woodpecker show largely concordant of patterns across the four 5-yr intervals (Fig. 1) although some variation is evident in that Hairy Woodpecker abundance varies more at high latitudes than at more southerly areas. Both woodpeckers show a local peak at 32°N in the 1980-1984 interval. Nevertheless, the general pattern is remarkable congruity among five-year intervals in woodpecker abundance. These two species have had stable population numbers from 1966-1996 as judged from the Breeding Bird Survey data (http://www.mbr-pwrc.usgs.gov/bbs). These two species provide a test of the efficacy of using Christmas Bird Count data to test for population changes. The consistency of the distributions of both woodpeckers (Fig. 1) agrees with independent evidence that these two species have stable population sizes.

Pine Grosbeak (Fig. 1) and White-winged Crossbill (Fig. 2) were analyzed to provide examples of dynamics of irruptive birds which rarely come to bird feeders. Both species infrequently occur at more southerly latitudes and both show striking variability in abundance as expected for irruptive species.

For finches that frequent feeders, I examined the data for evidence of a short-stopping effect (fewer birds occurring in the southern latitudes) during irruptions in the latter part of the study interval. Inspection of the dynamics for Common Redpoll (Fig. 2) does not suggest any short-stopping effect. However, the remaining three irruptive finches show patterns that suggest that short-stopping may be occurring. Purple Finch (Fig. 1) and Evening Grosbeak (Fig. 2) show lowest incursions in the south in the most recent time interval. Pine Siskin had greatest abundance in the south in the 1985-1989 interval and generally the lowest abundance in 1990-1994.

However, statistical analysis of these patterns gives equivocal results. If short-stopping is occurring, one predicts lower abundance in the southern part of the region in more recent years. Analyzing areas south of 38°N, four of the eight species showed significant changes. Downy Woodpeckers have increased since 1975-1979 (Table 2). Pine Siskins were significantly more abundant in 1985-1989 and Evening Grosbeaks were significantly more abundant in 1980-1984. Purple Finches were least abundant in 1990-1994.

If decreased densities of Purple Finches, Pine Siskins, and Evening Grosbeaks in recent years are real, then one would predict concomitant increases at northern latitudes; northern winter populations would be swelled by individuals which formerly migrated to the south of a given area. Analyzing the region north of 40° N, such increases are not evident. None of the eight species showed significant differences across the 20-yr period. It is possible that the much higher abundances of Evening Grosbeaks and Pine Siskins, north of 40°N might absorb the short-stopped individuals without showing a statistical increase, given the level of accuracy of the Christmas Bird Count data. The lack of increase for Purple Finch is more difficult to explain as the abundance in the southern part of the region is at least as high as that in the northern part.

From a graphical analysis (Figs. 1 and 2), there is some evidence to suggest that short-stopping of irruptive finches is occurring. However, the lack of an increase in irruptive finch abundance in the northern part of the region counters this suggestion. Continued analysis of Christmas Bird Count data will falsify the short-stopping hypothesis if significant irruptions occur in the southern part of the region in the future. Data from Project FeederWatch will also be important in this regard. One drawback of the Christmas Bird Count is that the counts occur early in the winter when many irruptions are just beginning. Project FeederWatch participants record data from November through March, so better resolution of the dynamics of irruptive species is possible. Nevertheless, we cannot with certainty add short-stopped migrations to the impacts that supplemental food has on wintering birds with present information.

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