Are Forest Songbirds Declining? Status Assessment from the Southern Appalachians and Northeastern Forests

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Reported declines in populations of migratory songbirds in the eastern United States (Robbins et al. 1989, Askins et al. 1990, Hagan and Johnston 1992) have created a great deal of concern among researchers, land managers and conservationists, resulting in the formation of the large bird-conservation consortium, Partners In Flight. Among the causes implicated in these declines are destruction of habitat on tropical wintering grounds, urban development on migratory stopover habitat, and fragmentation and loss of breeding habitat in North America. Much confusion remains, however, concerning which species of birds are declining, the significance of those declines and whether declines are occurring throughout a species' range (e.g., Askins 1993, James et al. 1996, Villard and Maurer 1996).

Although much of the initial concern, especially in the popular press, was for forest-breeding species, especially forest-interior specialists (e.g., Wilcove and Terborgh 1984, Terborgh 1989), most recent analyses concluded that species inhabiting early successional habitats, especially grassland, may be experiencing more consistent declines than are most forest birds in the East (Robbins et al. 1989, Vickery 1992, Askins 1993, Hunter 1995). Given the massive, landscape-level changes in forest cover over much of eastern North America during the past two centuries, it is not surprising that bird populations have shifted and fluctuated accordingly. Fortunately, very few species have been lost from the regional avifauna. From a conservation perspective, potential conflicts exist between local concerns for declining species and the long-term responsibility for conserving entire species throughout their ranges (Rosenberg and Wells in press, Wells and Rosenberg in press). For example, how should land managers balance the needs of early successional species that may be declining locally but are abundant elsewhere, with the needs of common forest birds whose populations are concentrated in the local region (Hunter 1993, 1994)?

In this paper, we summarize the status of forest-breeding and other landbird populations, based on 29 years of data from the Breeding Bird Survey (BBS) in the Southern Appalachians and Northeast regions. These areas support among the highest diversities of breeding Neotropical migratory birds of any region of the U.S. and, therefore, forest managers in these regions have a great responsibility for the long-term conservation of these bird populations (Rosenberg and Wells in press). First, we address two broad questions: (1) what types of bird species (in terms of migratory status and breeding habitat) are exhibiting decreasing, increasing or stable population trends; and (2) what are the geographic patterns of these trends among physiographic areas. We then focus on forest-dependent species that are declining in all or part of their ranges, discussing the geographic pattern of these declines and their implications for forest management and conservation.

Methods

Study Area

The Southern Appalachians and Northeast regions include 13 physiographic areas (Figure 1), following the boundaries used by the U.S. Fish and Wildlife Service for the Breeding Bird Survey (Robbins et al. 1986). (Note that some physiographic area boundaries [e.g. ridge and valley] have been changed recently by Partners In Flight to reflect ecological conditions and bird distributions more accurately.) Several physiographic areas (notably Great Lakes plain and northern spruce/hardwoods) extend outside our primary study area in Canada or the midwestern U.S.

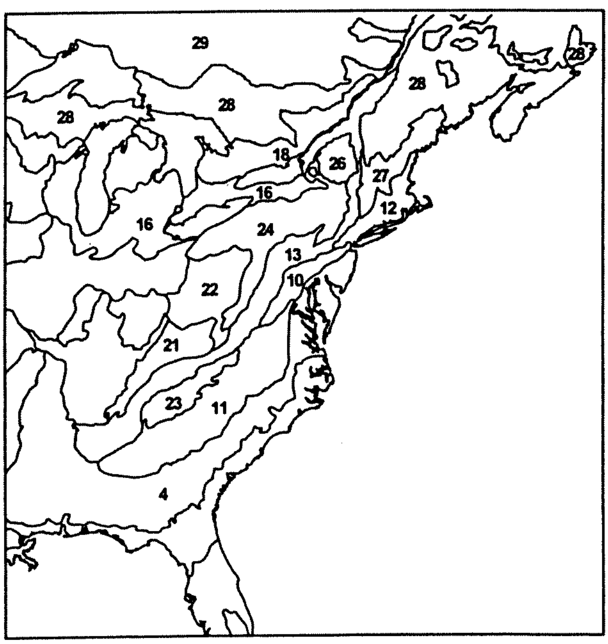

Figure 1. Physiographic areas in the southern Appalachian and Northeast regions. Southern Appalachians: 10 = northern Piedmont; 11 = southern Piedmont; 13 = ridge and valley; 21 = Cumberland Plateau; 22 = Ohio Hills; 23 = Blue Ridge Mts. Northeast: 12 = southern New England; 16 = Great Lakes Plain; 18 = St. Lawrence River Plain; 24 = Allegheny Mts.; 26 = Adirondack Mts.; 27 = northern New England; 28 = northern spruce/hardwoods.

Population Trend Analysis

We examined population trends for all migratory and resident landbird species, excluding game species and raptors. Population trends were based on the North America Breeding Bird Survey (BBS) data base for 1966 to 1994 for each physiographic area, as provided on the BBS World Wide Web site (Sauer et al. 1996). The BBS is an annual survey of birds conducted during the breeding season following specific guidelines and is currently administered by the Biological Resources Division of the U.S. Geological Survey and the Canadian Wildlife Service. The survey consists of randomly located survey routes throughout the continental U.S. and southern Canada. Fifty stops, each 0.8 kilometer (0.5 mile) apart are made along each 39.4-kilometer (24.5 mile) route. At each stop, all birds are recorded that are detected within 0.4 kilometer (0.25 mile) during a three-minute period. The total number of individuals counted along the route is used as an index of relative abundance for each species. Robbins et al. (1986) provide details of the BBS methodology and Sauer and Droege (1990) and Sauer et al. (1994) give an insight into some of the potential biases associated with the survey.

The population trend for a species from 1966 to 1994 was estimated by BBS staff using the route-regression procedure described in Geissler and Sauer (1990), and modified through the use of estimating equations (Link and Sauer 1994), to test the null hypothesis that there was no population change (i.e., change = 0) for the time period 1966 to 1994. Significance was defined as $P < 0.10$. The relative abundance (RA) of each species and the number of routes within each physiographic area were evaluated. RA reflects the number of individuals detected on a route. We considered the sample size to be adequate to evaluate population trends if the species occurred on 14 or more routes within the physiographic area and if the RA value was 1.0 or higher. A species was regarded as "stable" with relation to population trend if the population change was not significant at the $P < 0.10$ level, the RA was at least 1.0, and the species was detected on at least 14 routes in the physiographic area. A species was considered to have an increasing population trend if the change was significantly different from 0 and was positive, the RA was at least 1.0, and the species appeared on at least 14 routes. A declining species was similarly defined but with a population trend value less than 0. The status of a species was considered "unclear" if the RA was less than 1 or the number of routes was less than 14, even if the trend analysis indicated a significant difference (B. Peterjohn personal communication: 1996). This represents a conservative approach in that many species that occur naturally in low population densities, are difficult to detect, or have undergone substantial population declines and do not appear on at least 14 routes with an RA of at least 1.0 will be underrepresented. The above criteria were designed to provide an adequate sample size to enhance reliability of the population trend conclusions.

We segregated population trend data by physiographic area, breeding-habitat group and migratory form. For most species, we accepted the classification of species done by BBS staff (Peterjohn and Sauer 1993) and available at the BBS World Wide Web site. Categories for breeding-habitat groups were grassland, wetland, successional-scrub, forest (including open and closed forest), urban and other (for those species occurring in several habitat groups and not appearing to be primarily seen in any particular group). Temperate (or short-distance) migrant status was assigned to those species breeding in North America and for whom all or most of their populations migrate to other temperate areas north of the Mexico/U.S. border. Neotropical migrants are species whose breeding populations are primarily north of the Mexico/U.S. border and who spend the nonbreeding season in Latin America (including southern Texas) and the West Indies (including southern Florida). A species was deemed a permanent resident if it appears at all times of year throughout its range. Movement of individuals or populations within the range does occur for some permanent resident species.

To test the hypothesis that the number of declining species differed among breeding-habitat or migratory-status groups, we used the log-linear model approach for multiway frequency distributions (Sokal and Rohlf 1981: 747), including physiographic area as a covariable. These tests therefore considered the 13 regions as replicates, and took into account the variability across the regions when testing for differences among the species groups. A significant interaction term (region-by-species group) would indicate that degree of difference between species groups, in terms of number of declining species, was dependent on which region was considered. We performed a separate analysis for breeding-habitat and migratory-status groups.

Geographic Patterns of Declines

Finally, to investigate geographic patterns of population declines for selected forest species, we estimated the percentage of the total population of those species supported in each physiographic area, following the methods of Rosenberg and Wells (1995, in press). With this method, we first estimate the percentage of a species' range occupied in each physiographic area, then multiply these percentage-of-range estimates by the BBS relative abundance estimates for each area, and then divide by the cumulative total to derive the percentage of total population. It is important to note that BBS relative abundances used in this analysis were calculated as the mean abundance over the entire 29-year period. Therefore, for species that have undergone large changes in abundance over this period, our estimates of percentage of population may overestimate "importance" of a given area if current populations are greater than the long-term mean; conversely, we may underestimate true importance if abundances have declined greatly over this period (B. Peterjohn personal communication: 1997). For each species, we plot percentage of population in each area against population trend, to evaluate the importance of regional declines to the species' global population. In this analysis we include, for comparison, data from several eastern physiographic areas that are outside the main study areas.

Results

Overall Pattern of Population Trends

The number of nonraptorial and nongame landbird species recorded on the BBS per physiographic area ranged from a low of 43 in the Blue Ridge Mountains to a high of 130 in the northern spruce/hardwoods (Table 1). In general, larger physiographic areas had more species than smaller areas, although the large physiographic areas also had the largest proportion of species with unclear status (i.e., too uncommon to compute a population trend). Among the species that met our criteria for analysis, the proportion of species with declining trends differed significantly across the 13 physiographic areas (chi-sq. = 21.92, d.f. = 12, p = 0.033). The highest percentages of species that were declining were in the Blue Ridge and Adirondack mountains, whereas the St. Lawrence plain had the smallest percentage of declining species (Table 1). The Blue Ridge Mountains also had the smallest percentage of species with increasing trends; the Great Lakes plain and two Piedmont physiographic areas showed the largest proportion of species that were increasing. On average, the 13 physiographic areas had about the same proportion of species showing stable populations as they had with declining trends.

Table 1. Overall population trends of nonraptorial and nongame landbirds among 13 physiographic areas in the Appalachian and Northeast regions. Number of species in each category are given (percentage of total species for that physiographic area). See Figure 1 for map of areas.

Physiographic area	Increasing	Declining	Stable	Unclear	Total
Northern Piedmont (10)	18 (22.8)	21 (26.6)	17 (21.5)	23 (29.1)	79
Southern Piedmont (11)	19 (23.8)	17 (21.2)	24 (30.0)	20 (25.0)	80
Ridge and valley (13)	16 (14.6)	30 (27.3)	25 (22.7)	39 (35.4)	110
Cumberland Plateau (21)	10 (14.9)	19 (28.4)	35 (52.2)	3 (4.5)	67
Ohio Hills (22)	13 (14.6)	26 (29.2)	27 (30.3)	23 (25.9)	89
Blue Ridge Mountains (23)	2 (4.6)	23 (53.5)	18 (41.9)	0	43
Southern New England (12)	12 (14.0)	29 (33.7)	18 (20.9)	27 (31.4)	86
Great Lakes Plain (16)	22 (25.6)	21 (24.4)	14 (16.3)	29 (33.7)	86
St. Lawrence Plain (18)	14 (15.9)	14 (15.9)	28 (31.8)	32 (36.4)	88
Allegheny Plateau (24)	15 (13.2)	25 (21.9)	24 (21.0)	50 (43.9)	114
Adirondack Mountains (26)	11 (14.1)	28 (35.9)	31 (39.7)	8 (10.3)	78
Northern New England (27)	12 (13.3)	19 (21.1)	37 (41.1)	22 (24.5)	90
Northern spruce/hardwoods (28)	17 (13.1)	36 (27.7)	25 (19.2)	52 (40.0)	130
Mean number of species	13.9	23.7	24.9	25.2	87.7
Mean percentage	15.7	28.2	29.9	26.2	

Population Status in Relation to Breeding Habitat and Migratory Status

We found no significant difference in the distribution of species among breeding habitat or migratory status groups, across the 13 physiographic areas. The difference in proportion of declining species between forested and nonforested (grassland, wetland, shrub and urban) habitats was highly significant, however (chi-sq = 31.13, d.f. = 1, p < 0.001). On average, 26.6 percent of forest species in each area were showing declines, whereas an average of 46 to 70 percent of grassland and successional-shrub species in each area were declining (Table 2). Physiographic areas with relatively high percentages of declines among forest species included the Blue Ridge Mountains, southern New England, northern spruce/hardwoods and Adirondack Mountains.

More than two-thirds of the grassland species were declining in 10 of 13 physiographic areas, whereas declines in successional-shrub species were most prevalent throughout New England, the Adirondack and Blue Ridge mountains, Cumberland Plateau, and ridge and valley areas. Similarly, an average of 37.4 percent of urban-associated species in each area showed declines. The status of the few wetland-associated species varied greatly from region to region (Table 2).

Table 2. Number (percentage) of nonraptorial and nongame landbird species with declining population trends in 13 physiographic areas of the Appalachian and Northeast regions, by breeding habitat and migratory status. Percentages are based on species in each group that met our criteria for calculating trends (see Methods).

Physiographic	Breeding habitat					Migratory form		
area	Forest	Shrub	Grassland	Wetland	Urban	Neotropical	Temperate	Resident
Northern Piedmont (10)	3 (16.6)	6 (37.5)	5 (83.3)	2 (50.0)	5 (45.5)	7 (31.8)	11 (47.8)	3 (27.2)
Southern Piedmont (11)	3 (12.0)	5 (33.3)	1 (33.3)	2 (50.0)	6 (50.0)	5 (17.9)	9 (45.0)	3 (25.0)
Ridge and valley (13)	10 (33.3)	10 (58.8)	3 (75.0)	1 (14.3)	5 (41.7)	15 (44.1)	9 (40.9)	6 (40.0)
Cumberland Plateau (21)	6 (18.8)	8 (50.0)	1 (100.0)	1 (25.0)	3 (30.0)	14 (41.2)	4 (22.2)	1 (8.3)
Ohio Hills (22)	9 (29.0)	8 (50.0)	2 (66.7)	2 (66.7)	4 (33.3)	12 (35.3)	10 (52.6)	4 (30.8)
Blue Ridge Mountains (23)	8 (42.1)	8 (61.5)	1 (100.0)	2 (100.0)	3 (42.9)	11 (61.1)	9 (52.9)	3 (37.5)
Southern New England (12)	10 (43.5)	11 (68.8)	3 (75.0)	2 (50.0)	3 (27.3)	14 (51.9)	13 (61.9)	2 (18.2)
Great Lakes Plain (16)	4 (25.0)	3 (25.0)	8 (80.0)	1 (14.3)	4 (36.4)	6 (26.1)	12 (48.0)	3 (33.3)
St. Lawrence Plain (18)	2 (10.5)	3 (25.0)	5 (71.4)	0	3 (30.0)	3 (10.7)	11 (44.0)	0
Allegheny Plateau (24)	7 (25.9)	5 (35.7)	5 (83.3)	1 (20.0)	6 (54.5)	7 (24.1)	15 (57.7)	3 (33.3)
Adirondack Mountains (26)	13 (35.1)	8 (53.6)	1 (33.3)	3 (50.0)	2 (25.0)	18 (51.4)	9 (31.0)	1 (16.6)
Northern New England (27)	5 (15.6)	9 (60.0)	1 (25.0)	2 (33.3)	2 (20.0)	7 (21.9)	12 (41.4)	0
Northern spruce/ hardwoods (28)	14 (37.8)	6 (40.0)	6 (85.7)	4 (50.0)	5 (50.0)	14 (35.0)	21 (61.8)	1 (25.0)
Mean number of species	7.2	6.7	3.2	1.8	3.9	10.2	11.2	2.3
Mean percentage	26.6	46.1	70.2	40.3	37.4	34.8	46.7	22.7

The proportion of species showing declining trends also differed significantly among the three migratory status groups (chi-sq. = 21.52, d.f. = 2, $p < 0.001$). The lack of a significant interaction between migration status and physiographic area indicated that this trend was consistent across the 13 areas. In general, a lower percentage of resident species than either Neotropical or temperate migrants were declining in each area (Table 2). Areas with the highest percentage of declining Neotropical migrants (more than 50 percent) included the Blue Ridge Mountains, Adirondack Mountains and southern New England. The Blue Ridge Mountains and southern New England also had a relatively high proportion of temperate migrants declining, as did the northern spruce/hardwoods, Allegheny Plateau and Ohio Hills areas.

Geographic Patterns of Declines in Forest Species

A total of 34 species classified as forest breeders exhibited significant long-term declines in at least one physiographic area (Table 3). Of these, 16 declined in only one geographic area. Northern flicker (*Colaptes auratus*) showed the most widespread decline, with significantly negative trends in 11 of the 13 physiographic areas considered. Eastern wood pewee (*Contopus virens*) and wood thrush *(Hylocichla mustelina)*

Table 3. Forest bird species with significantly declining population trends in at least one physiographic area in the southern Appalachians or Northeast regions. Declines are reported as percentage change per year, from 1966 to 1994, based on Breeding Bird Survey trends calculated by Sauer et al. (1996). Physiographic area numbers from Figure 1.

	Physiographic area												
Species	10	11	13	21	22	23	12	16	18	24	26	27	28
Yellow-billed cuckoo			2.4		4.0								
Black-billed cuckoo													2.1
Chuck-wills-widow			3.1										
Northern flicker	1.3	2.9	4.3		3.2	6.6	3.2	3.0	2.2	7.2	4.4	3.2	
Red-headed woodpecker								7.7					
Downy woodpecker			1.1			2.9				2.8			
Eastern kingbird		2.5					2.9	1.6		1.2	2.6		
Great crested flycatcher	2.5				3.8		2.0				3.3		
Eastern wood pewee			3.0	2.3	3.4	7.2				2.7	3.6		2.5
Least flycatcher							3.6			1.2	1.4	2.7	2.3
Acadian flycatcher						3.1							
Tufted titmouse					1.3								
Blue-gray gnatcatcher						2.8							
Ruby-crowned kinglet													1.5
Eastern bluebird					1.8								
Veery									1.2		2.3	0.8	1.9
Swainson's thrush													2.2
Wood thrush		2.3	2.4			4.2	2.1			2.3	3.4		4.3
Warbling vireo					4.4								
Red-eyed vireo												0.9	
Yellow-throated vireo			1.3										
Cerulean warbler				4.7	2.9								
Black-and-white warbler				2.4	5.7	6.8	1.4			3.4	1.5		
American redstart				5.0							3.0		
Louisiana waterthrush				2.0									
Hooded warbler						1.6							
Canada warbler											5.0		2.2
Summer tanager			2.4	4.7									
Scarlet tanager							1.4				2.4		1.3
Rose-breasted grosbeak							2.0				2.9		1.6
Orchard oriole			5.5										
Northern oriole	1.5		2.6				2.8	1.0			3.7		
Purple finch							4.2					3.5	2.8
Evening grosbeak													3.7
Number of declining species	3	3	10	6	9	8	10	4	2	7	13	5	12

each declined in 7 of the 13 areas, and black-and-white warbler declined in 6 areas. Among the physiographic areas, the Adirondack Mountains (Area 26) had the most declining forest species (13 species), followed by the northern spruce/hardwoods with 12 species, and ridge and valley and southern New England with 10 species each. Overall, 22 forest-breeding species declined in at least one area of the southern Appalachian region, and 21 species declined in at least one area in the Northeast.

Several geographic patterns of decline were evident among these species (Figure 2). One pattern is illustrated by the eastern wood pewee and wood thrush, two species with widespread distributions in both the southern Appalachian and Northeast regions. In both these areas, the largest proportions of the total population occur in the Upper Coastal Plain and southern Piedmont physiographic areas, and both species are exhibiting significant declines in nearly every area (Figure 2). The Blue Ridge Mountains stand out as an area of especially steep population declines in both species and, curiously, both species are increasing in the Great Lakes Plain. The primary difference in these species' population status is in the Ohio Hills, where wood thrush populations are increasing and wood pewees are declining. The northern flicker, which also is declining throughout the study areas, has a very large distribution and is showing stable populations in midwestern areas and across the northern forest where a large proportion of the total population occurs.

A second pattern is illustrated by cerulean warbler (*Dendroica cerulea*), in which a large proportion of the total population is concentrated in the southern Appalachian physiographic areas, and many of the steepest declines are in these regions of highest abundance (Figure 2). This species is expanding its range toward the northeast and shows stable or increasing populations at the periphery of the range in the Great Lakes Plain and northern portions of the ridge and valley. The worm-eating warbler (*Helmitheros vermivorus*) shows a very similar pattern, with large and declining populations in the southern Appalachian region and expanding populations in the Northeast; this species was not common enough on BBS routes to be included in our analyses, however.

A third pattern is seen in the veery (*Catharus fuscescens*) and Canada warbler (*Wilsonia canadensis*), in which the bulk of the total population is in the northern spruce/hardwood forest. Both species are declining significantly in this region of greatest abundance, and both species also show very steep declines in the Adirondack Mountains (Figure 2).

A fourth pattern is seen in several species, in which trends are stable or increasing in areas that support the largest populations, and most or all of the declining trends are in areas with very small percentages of the total population. For example, more than 50 percent of all black-and-white warblers (*Mniotilta varia*) breed in the northern spruce/hardwoods and boreal forest regions, where populations are stable or increasing. This species is declining significantly, however, in the Blue Ridge Mountains, ridge and valley, and Ohio Hills physiographic areas, that together support less than 5 percent of the total population. Similarly, the largest declines in American redstart (*Setophaga ruticilla*), scarlet tanager (*Piranga olivacea*), rose-breasted grosbeak

(*Pheucticus ludovicianus*) and northern oriole (*Icterus galbula*) are in areas that support only small proportions of the total populations of these species.

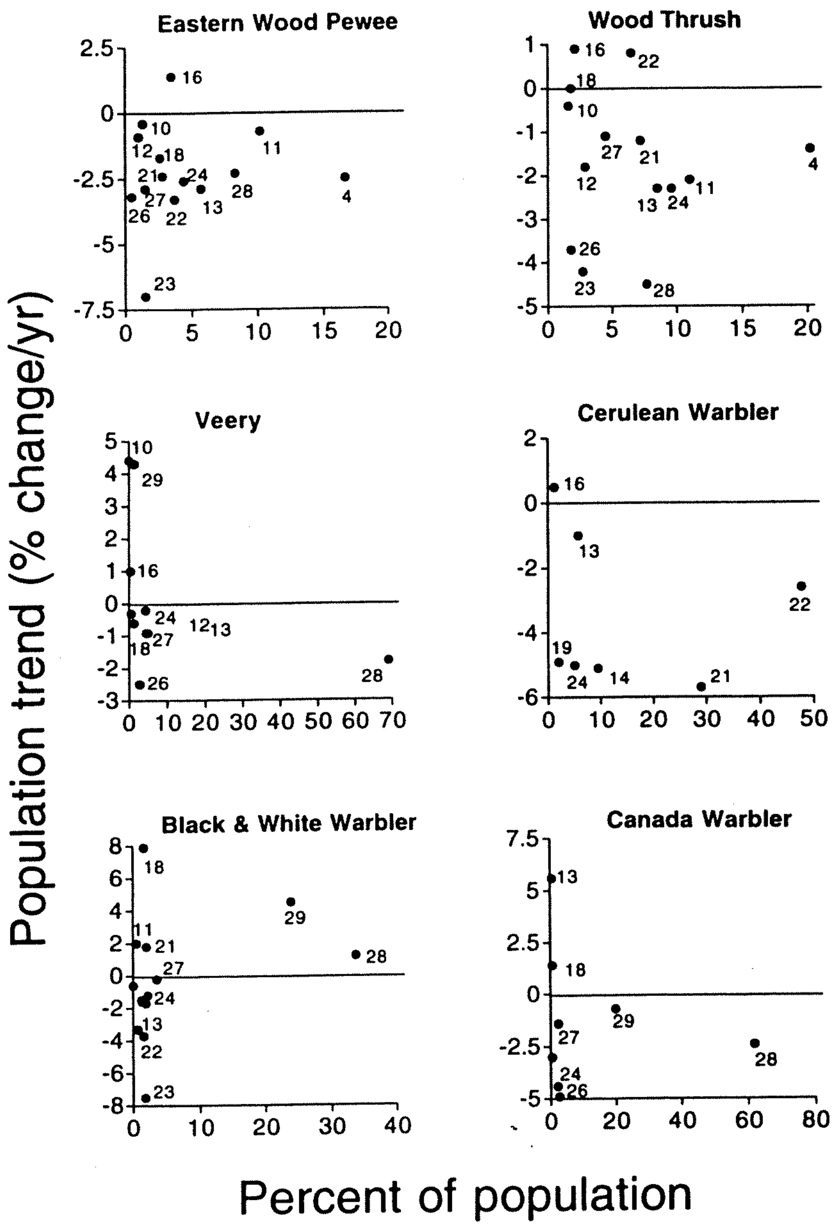

Figure 2. Population trend versus percentage of population by physiographic area for the eastern wood pewee, wood thrush, veery, cerulean warbler, black-and-white warbler, and Canada warbler.

Discussion

Our analyses have confirmed that, in general, bird species associated with wetlands, grasslands and other early successional habitats are suffering greater population declines than forest birds in the southern Appalachian and Northeast regions. This trend is consistent throughout the 13 physiographic areas considered in this study, and it is consistent with other recent summaries of bird population trends in eastern North America (e.g., Askins 1993, Peterjohn and Sauer 1993). Our finding of significantly fewer declines among permanent resident versus migratory species is also consistent with earlier analyses (e.g., Robbins et al. 1989), although the suggestion that temperate migrants may be suffering proportionately more declines than Neotropical migrants is at odds with earlier conclusions. From a conservation perspective, however, the issue is whether declining early successional species deserve high-priority status in these regions, especially if managing for these habitats is at odds with maintaining habitats for forest-breeding species. To address this issue, we must consider: (1) the historical changes in habitat availability in the southern Appalachians and Northeast regions, and (2) the impact that management efforts in these regions will have on global populations of early successional and forest species. Before discussing these issues, however, we must acknowledge the limitations of the BBS data base used in our analyses.

Limitations of the BBS Data Base

Although the BBS provides the only consistent, long-term data on breeding bird populations throughout North America, a great deal of controversy surrounds the methodology used to analyze BBS data and the conclusions that can be drawn from these analyses. Detailed, up-to-date discussions of these problems and limitations are provided by Sauer and Droege (1990), Peterjohn et al. (1995), James et al. (1996) and Thomas (1996). Despite this controversy, results of the various methods prove to be quite similar for species showing marked increases or declines, i.e., the direction of change is usually the same, although the estimated rates of change may differ (B. Peterjohn personal communication: 1997) Because our intent in this paper is to provide a broad picture of the kinds of bird species that may be declining and where these declines might be most prevalent, we believe that our conclusions are not compromised by the controversies associated with analyzing BBS trend data.

One concern that we have with our analysis is that we have excluded species that did not meet our minimum criteria for determining population trend (i.e., species that appeared on fewer than 14 routes per physiographic area, etc.). These species were categorized as having an unclear status and may total up to 44 percent of the species in a given physiographic area (see Table 1). In some cases, these were species that are in low numbers such as the cerulean warbler, worm-eating warbler and whip-poor-will (*Caprimulgus vociferus*), and for which much concern has been expressed. The BBS is limited in its ability to provide us with meaningful trend data on such species. The same applies to species that are difficult to detect either because they are shy, sing softly or infrequently, or are drably colored. The very species that may warrant our greatest concern, therefore, may be inadequately sampled by the BBS. This particular limitation should not bias our overall conclusions, however, because uncommon species are as likely to be associated with early successional habitats (especially wetlands) as with forests.

Historic Changes in Habitat Availability

Details of land-use and vegetation changes in eastern North America may be summarized briefly as follows. Historically, virtually all of the Appalachian and Northeast regions were forested, although successional-scrub habitats were created and maintained by natural disturbance factors, such as fire, insect infestation, grazing by native species, and localized adverse weather features, such as hurricanes, tornados and ice storms. In addition, a compelling argument has been made (Askins 1995) that native grassland and other successional habitats were an integral part of the pre-European landscape, especially on the Atlantic Coastal Plain.

During the late 1800s and early in this century, large-scale clearing of the eastern forests took place for human settlement, agriculture and to provide lumber for the international shipbuilding industry. During this time, many of the small farming operations in the Southeast, with their relatively inefficient practices, inadvertently produced habitat that served as a substitute for successional-scrub habitat that had been depleted by efforts to prevent fire and disease. In recent times, a number of widespread land uses, especially the abandonment of agriculture, tended to favor regeneration of mature forest. In addition, within the agricultural landscape, "old fields" are themselves in decline and are rapidly being replaced by more efficient, larger farming operations.

Initially, these large-scale changes resulted in the tremendous expansion of early successional bird populations throughout eastern North America, including expansions of several species from midwestern regions (e.g., horned lark [*Eremophila alpestris*], brown-headed cowbird [*Molothus ater*]) and expansions into agricultural habitats by populations native to the Northeast (e.g., Henslow's sparrow [*Ammodramus henslowii*]). At the same time, forest bird populations undoubtedly underwent massive retractions and declines, although these are poorly documented. The more recent trends toward regenerating forests and continued reduction in agricultural land uses have resulted in the continued regional declines in early successional bird species seen in the present analysis. Most forest bird populations are undoubtedly larger than they were 100 years ago and, with several notable exceptions (see below), recent declines in forest species are usually local and relatively small in magnitude.

Because of the dynamic nature of land-use and bird-population changes, trend analysis of BBS data from different time periods may yield different results. For example, an earlier analysis found that most physiographic areas had a higher number of declining species from 1978 to 1988 than over the full span of the BBS, 1966 to 1988 (Sauer and Droege 1992). Peterjohn and Sauer (1994) found that woodland species in particular have suffered much greater declines since 1982 than in the earlier periods of the BBS. Although population trends calculated from subsets of the BBS survey period may reflect short-term land-use changes or even recovery of local populations, they also may be more prone to the confounding influences of climatic fluctuation (e.g., drought), sampling variability or intrinsic population cycles.

Declines in Forest Birds: Should We Be Concerned?

Among the habitat-species groups we considered, the forest-breeding group appears to have the fewest declining bird populations. Even in this breeding-habitat group, however, a substantial proportion of the avifauna is declining. For example, 8 of the 19 forest-breeding species in the Blue Ridge Mountains and 13 of the 44 species in the Adirondack Mountains were declining, and these represented the worst situations for forest birds in the two study areas. Other studies have found a similar concentration of declining populations (both in terms of number of species and magnitudes of declines) in highland physiographic areas such as the Adirondack and Blue Ridge mountains (James et al. 1992, James et al. 1996). Perhaps this trend reflects a bias of sampling along roads in these areas, which is where new development tends to be concentrated (Hunter 1993, 1995). A more elaborate analysis of land-use patterns and changes is needed to assess whether these changes in population trends of forest birds are a reality or merely an artifact of roadside sampling. However, it should be noted that all groups of birds, including those in the successional-scrub and urban breeding habitat groups, have declined in the Blue Ridge Mountains.

From a regional perspective, it is interesting that a higher proportion of forest bird species are declining in physiographic areas that are largely forested, whereas fewer species are declining, and more are increasing, in areas in which forests are sparse or highly fragmented (Great Lakes Plain, northern and southern Piedmont). Hunter (1995) also noted that BBS trend information may appear to contradict the assumption that the amount of forest cover is related to population stability among vulnerable species. It is also possible that in regions with much recent forest regeneration, declines in forest quality are more important than total acres of forest cover. For example, much new forest growth may be the result of even-aged management and fire suppression, leading to dense, closed-canopied forests with little understory development and little horizontal patchiness. Clearly, we need to explore how these trends in avian populations may be influenced by the historical changes, current practices and planned future activities in the various physiographic areas.

Even though forest birds as a group are not in serious trouble, particular species show consistent and troubling declines in all or part of their ranges in the southern Appalachians and Northeast regions. Widespread declines in wood thrush and eastern wood pewee, for example, may be symptomatic of changes in habitat conditions that are not yet affecting (or not detectable) in less-common species. Notably, a majority of forest birds showing consistent, long-term declines are species associated with forest openings (northern flicker, eastern wood pewee), dense shrubby understories (wood thrush, veery, Canada warbler), or are ground-nesters (veery, Canada warbler, black-and-white warbler, worm-eating warbler). These species may respond positively to forest-management practices that stimulate understory development or create canopy openings. Alternatively, the particular set of species that are declining may be subject to threats on the nonbreeding range that are beyond the control of forest managers in our region. Unraveling the causes of population declines is the subject of much ongoing study (e.g., Rappole and McDonald 1994, Sherry and Holmes 1995, 1996, James and McCulloch 1995) and is beyond the scope of this paper. In a few cases, however, such as cerulean warbler, declines are serious enough to warrant immediate conservation concern and management action (Hamel 1992, Hunter 1995, Rosenberg and Wells in press).

To some extent, deciding on the relative "value" of forest versus early successional bird populations is subjective. By considering a global perspective, however, we recognize the overriding importance of mature-forest species in long-term conservation planning based on three lines of reasoning. First is that the Appalachian and northeastern forests support a major portion of the global population for many forest-breeding species (Rosenberg and Wells in press), whereas, with few exceptions (see Askins 1995, Wells and Rosenberg in press), most early successional species have the bulk of their populations outside this region. Second is that current and future land use ensures the maintenance of some early successional habitats throughout the region, although probably never to the extent that existed at the height of forest clearing. Careful management of existing successional habitats (which are often neglected), through sound agricultural practices and protection from urban development, will be very important to the long-term persistence of grassland and shrub-nesting species in this region. Our third line of reasoning evokes the "unequal trading" principle (Dan Brauning personal communication: 1996) that acknowledges that any critical need for early successional habitats in the future can be reconciled easily and quickly, whereas creating mature forest requires much more time.

Recognizing the importance of forest bird populations does not preclude the need to manage these forests, and we are not advocating a policy of no timber harvesting. Indeed, as noted above, many forest bird species may benefit from wisely planned forestry practices that create more open canopies and promote vertical stratification of vegetation. Large-scale fragmentation of forested areas to benefit early successional species, however, is not appropriate from a regional conservation perspective. In the long term, forest managers in our region have a great responsibility for ensuring the health of global populations of a large number of forest bird species. This responsibility must be balanced with more immediate and local conservation concerns, as well as other constraints on long-term forest planning (Rosenberg and Wells in press). The eastern forest region is vast enough to accommodate a range of habitat conditions that support healthy populations of both mature forest-dependent and early successional birds. The current Partners In Flight planning process is considering all these issues in developing conservation strategies for each physiographic area.

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