Global Perspectives on Neotropical Migratory Bird Conservation in the Northeast: Long-Term Responsibility Versus Immediate Concern

Kenneth V. Rosenberg
Jeffrey V. Wells

Abstract—We assessed the conservation priorities of Neotropical migratory bird species in the Northeast Region (USFWS Region 5) using the most up-to-date information available on distribution, abundance, and population trends. Priority rankings were developed using the percent of the total population in the Northeast as a measure of the importance of the region to each species' long-term persistence. We identified 34 species with at least 15% of their total population in Region 5. Species for which the Northeast Region is particularly important include Bicknell's Thrush, Scarlet Tanager, Worm-eating Warbler, Louisiana Waterthrush, and Wood Thrush. The importance of adjoining USFWS Regions, states and Canadian provinces, and physiographic areas to each species was established using the same measure. Eastern Canada and the Southeast Region are particularly important to consider as partners in any regional planning for high-priority species. Important Geographic Areas were identified by developing a weighted ranking based on the Atlas-block concentration of the 34 priority species in each state/ physiographic area unit. Important Geographic Areas identified included (1) much of New England, especially northern Vermont and New Hampshire; (2) West Virginia and western Maryland; and (3) the Allegheny Plateau of New York. A separate list of species, because of a combination of high proportion of total population and declining Breeding Bird Survey population trend, may be considered of immediate conservation concern. These included Henslow's Sparrow, Golden-winged Warbler, Worm-eating Warbler, Cerulean Warbler, and Louisiana Waterthrush.

We then identified "hot spots"—regions of immediate conservation concern, based on the Atlas-block concentrations of these high-concern species. The highest-priority "hot-spot" is the Ohio Hills and Cumberland Plateau portion of West Virginia and southwestern Pennsylvania; next in priority were the Allegheny Plateau, Great Lakes Plain, and Ridge and Valley areas of New York, Pennsylvania, and western Virginia. Our prioritization procedure highlights a dichotomy in bird conservation from a global or regional perspective. On the one hand, species with high proportions of their total population in the Northeast are important because the region has a large share of the *responsibility* for conserving the entire species. On the other hand, species whose populations are declining are important because we are *concerned* about their immediate welfare. Responsibility for important populations leads to long-term conservation planning, especially in the most important geographic areas, whereas concern for declining populations leads to immediate conservation action, especially in "hot-spot" areas.

Setting regional conservation priorities is an important step in the Partners in Flight (PIF) planning process. At the regional level, prioritization may represent a conflict between global needs of the entire population of a species and local concerns or pressures. The PIF species prioritization scheme (Carter and others, this proceedings) provides an objective means for assessing the relative conservation concern for bird species throughout the United States. Applying these priority rankings to local or regional conservation planning efforts requires detailed knowledge of species' distributions and relative abundances, so that the geographic areas most important to high-priority species in each region can be identified.

The Northeast Region is relatively small and homogeneous, compared with other PIF planning regions. Largely covered with deciduous and mixed conifer forests, this region comprises all or part of 16 physiographic areas, and supports substantial populations of many Neotropical migratory landbirds (NTMB) typical of eastern forests. The earliest studies suggesting that certain species of NTMBs were declining originated in the northeastern United States near Washington, DC (Johnston and Winings 1987; Robbins 1980; Briggs and Criswell 1978; Lynch and Whitcomb 1978). Since that time, a host of studies throughout the region have examined the question of whether population declines have occurred and why (Askins and others 1990; Hagan and Johnston 1992; Askins 1993). Except for reviews by Askins and others (1990) and Smith and others (1993), no studies have attempted to establish conservation priorities for NTMBs from the perspective of the entire Northeast Region. None have considered populations in the Northeast in relation to their entire ranges or total population. None have incorporated up-to-date, region-wide databases (Breeding Bird Survey [BBS]; Breeding Bird Atlas [BBA]) to develop region-wide priorities or conservation recommendations. Consequently, land managers remain confused about which species are of greatest concern or conservation priority, and in which areas our efforts should be concentrated.

Building upon the work of Carter and others, we present a scheme for prioritizing NTMBs and determining which geographic areas in the northeastern U.S. are most important for their conservation. The need for a document

summarizing the status of NTMBs in the Northeast and outlining regional priorities grew out of: (1) formalization of the Northeast regional planning process of PIF; and (2) the common need, expressed by many states in the Northeast, for assistance in implementing regional priorities at the state level. This paper summarizes our prioritization process; the complete results of these efforts may be found in Rosenberg and Wells (1995).

Our scheme differs from PIF's national prioritization database in that it explicitly considers the importance of *the entire region* to the total population of each species as the primary criterion for establishing conservation priority. We then consider each species' population trend and local distribution *within* the region to assess degree of regional concern and to identify areas of greatest importance for high-priority species. This information will serve as the framework behind a Northeast regional conservation plan.

Methods

The Northeast Region of PIF, defined as U.S. Fish and Wildlife Service (USFWS) Region 5, includes the states of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and West Virginia. This region also includes portions of 16 physiographic areas (fig. 1), derived from BBS Physiographic Strata and used in PIF conservation planning.

Our basic approach is to draw together and integrate several existing databases on NTMBs in the region, roughly following the procedure outlined by Smith and others (1993) in their preliminary assessment of NTMB status in the Northeast. This "regional-filter" approach integrates abundance and trend data from the BBS with state-level BBA data to identify species of regional importance and concern, based on the proportion of total species populations that are supported in the region and their population trends. For those species with relatively high proportions of their populations in the Northeast, we then determine areas of most concentrated occurrence, based on distribution of occupied atlas blocks. Important geographic areas are defined as those with the highest concentrations of the highest-ranking species. We next identify which of these species also are declining, and identify areas with the highest concentrations of declining species.

This information ultimately will be combined with land-classification programs, such as GAP Analysis, to simultaneously assess the status of bird populations and their habitats. We believe that synthesizing available data on NTMBs using the resources at hand is important now, in anticipation of GAP analysis completion. Our analysis is intended to be a working document that will provide the raw materials for conservation planning in the Northeast.

Prioritizing Species: Importance of Area

Percent of Range—We began the process of determining importance of area by considering the percentage of each species' range lying within Region 5. Because of PIF's early emphasis, we consider only Neotropical migratory species;
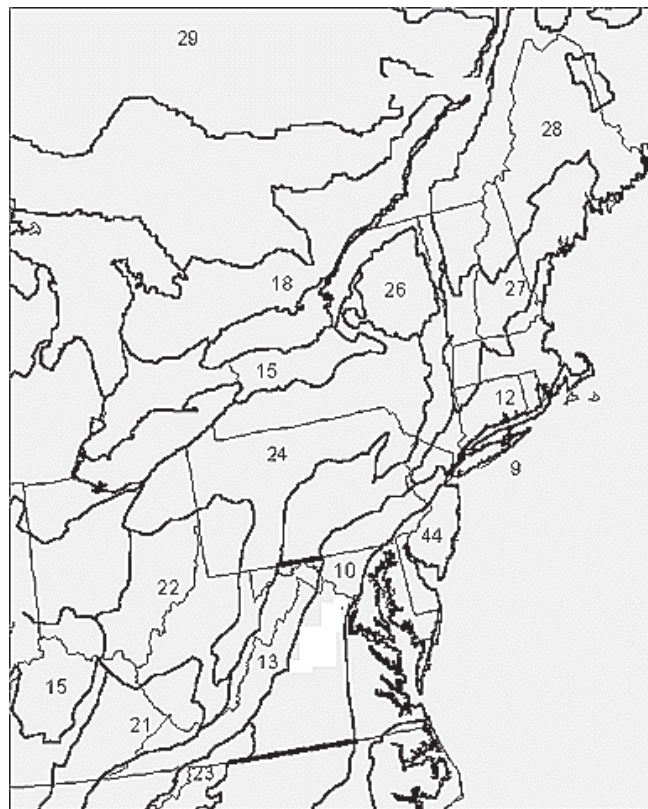

Figure 1—Map of physiographic areas of eastern North America, showing the 16 areas represented in the Northeast Region. Note: Some physiographic area boundaries and numbers have changed after 1996.

future revisions will include all landbird species. After reviewing many existing published range maps, we determined that the most up-to-date, detailed, and readable maps available for all species are those in the Peterson (1980, 1990) field guides. From these range maps, we estimated the percent of each state or province occupied by each bird species. We then multiplied these percentages by the area (sq. mi) of each state. By summing these areas we derived an estimate of total range size for each species. We then summed the areas for the states within Region 5 and divided by the total range area to determine the percent of range in the Northeast (see Rosenberg and Wells 1995, appendix 1). Because this method does not compare portions of the entire range to one another, it protects against biases caused by map projection distortions.

Percent of Population—A more accurate measure of the importance of an area to a species' long-term probability of persistence is the percent of the total *species population* (Wells and Richmond 1995) that occurs within that region. Although in practice this measure is difficult to obtain, an index that reflects percent of population can be formulated by weighting range areas derived from the above procedure with relative abundances from BBS data. We multiplied the range area occupied in each state and province by the relative abundance for that area. We then summed the values for states within the Northeast Region and divided by

the sum for all areas occupied to determine the percent of total population in the region. Note that this procedure also yielded an index of total population size for each species.

We obtained BBS relative abundances for all states, provinces, and physiographic areas directly from the BBS database (Sauer and others 1996b). These values represent average numbers of birds counted on all BBS routes in each geographic area from 1966 through 1994. Note that we make several assumptions when using BBS relative abundances that could bias our estimates of population sizes (B. Peterjohn, personal communication). First is that detectability of a species does not vary across all the geographic areas in our analysis. Also, large changes in relative abundance over the 29 year period could result in overestimates or underestimates of percent of population, and therefore importance, in a given area. For example, if a species has declined greatly in a physiographic area, using the long-term average abundance may greatly underestimate the true importance of that area to the species' total population. Our estimates of total populations are probably most accurate for those species that occur primarily in the continental U.S. and southern Canada, and are least accurate for those species with extensive portions of their range in Canada above the region covered adequately by the BBS.

Regional Importance of Geographic Areas

BBAs provide the most detailed and up-to-date information on the distributions of species within individual states or provinces. To incorporate this finer scale resolution into our importance of area rankings, we estimated the percent of BBA blocks occupied in portions of physiographic areas within each state. Atlas data for this analysis were available in published form or were made available from Connecticut (Bevier 1994), Delaware, Maine (Adamus, no date), Maryland, Massachusetts, New Hampshire (Foss 1994), New York (Andrle and Carroll 1988), Pennsylvania (Brauning 1992), Rhode Island (Enser 1992), Vermont (Laughlin and Kibbe 1985), Virginia, and West Virginia (Buckelew and Hall 1994). We also used published Atlases or atlas data from adjacent regions (Kentucky, Ohio [Peterjohn and Rice 1991], Michigan [Brewer and others 1991], Ontario [Cadman and others 1987], and the Canadian Maritimes [Erskine 1992]) to complete our analysis of physiographic areas that extend beyond the borders of Region 5.

We computed an "area importance score" to identify areas within the Northeast Region with highest concentrations of the highest-priority bird species. First, for each bird species, we "normalized" the percent Atlas-block occupancy across the 44 state/physiographic area units (see Rosenberg and Wells 1995, appendix 4); the area with the highest percent occupancy was set to 100, and each other area unit was expressed relative to the maximum occupied unit. Then, for each of the 44 areas, we summed the importance rankings of each bird species, divided by its relative percent occupancy of Atlas blocks, to compute an overall importance score:

$$\text{area importance score} = \sum \frac{\text{species rank}}{\left(\dfrac{\text{\% occupancy}}{\text{max. \% occupancy}} \right)}$$

These scores also were normalized (i.e., the highest score set to 100) to reflect relative importance of each of the 44 areas in the Northeast.

Incorporating Population Trends

We used population trend estimates to identify those species that have high proportions of their total populations in the Northeast and that are declining (or increasing) significantly in geographic areas of interest. We obtained estimates of population trends for NTMBs in Region 5, and for each state and physiographic region, directly from the BBS Lab (Sauer and others 1996b). These trend estimates were updated in spring 1995 and are based on BBS data from 1966 through 1994. They therefore represent the most up-to-date estimates available, and supersede any previously published BBS results (e.g., Robbins and others 1986; Peterjohn and Sauer 1993, 1994). Trends were calculated (by BBS Lab) using the Linear Route-Regression method, modified with estimating equations (Link and Sauer 1994), and are expressed as a percent change per year. We combined estimates of regional trends with our previously determined percent of total population to compute a "species concern score" for each declining species. This score was calculated as:

$$\text{species concern score} = \sum \frac{(\text{\% of population}) \, (\text{trend})}{\text{total population size}}$$

where the total population size was estimated by summing relative abundances times the area occupied for each state and province.

Finally, to identify geographic areas with the highest concentrations of high-concern species, we calculated an "area concern score" based on the percent Atlas-block occupancy of each declining species in each state/physiographic area unit:

$$\text{area concern score} = \sum (\text{species concern score}) \, (\text{\% Atlas-blocks})$$

These area concern scores were then normalized (i.e., highest score set to 100) to represent relative concern among the 44 areas in the Northeast.

Results _____

Percent of Population and Range in the Northeast

We estimate that 34 species have 15% of their population in the Northeast Region (table 1). This analysis identified three species (Bicknell's Thrush, Scarlet Tanager, Worm-eating Warbler), for which the Northeast supports >50% of the population; ten other species have >25% of their population in the region. Our cut-off of 15% is somewhat arbitrary; an additional 15 species have between 10 and 15% of their populations, in the Northeast. These include mostly widespread species such as Song Sparrow, Common Yellowthroat, and Chimney Swift, which happen to be abundant in the Northeast. These species may be considered of moderate priority in regional planning.

Table 1—Priority rankings of Neotropical migrant bird species, based on percent of total population in the Northeast Region. Range sizes in millions of sq. mi; relative abundance and trend (1966-1994) in Region 5 based on Breeding Bird Survey (Sauer and others 1996).

Rank species (code)	% of pop.	% of range	Range size	RE- 5 abund.	RE- 5 trend
1. Bicknell's Thrush (BITH)	>75?	34.0	0.17	?	?
2. Scarlet Tanager (SCTA)	60.1	21.1	1.09	4.6	−0.3
3. Worm-eating Warbler (WEWA)	52.6	22.6	0.57	0.3	−1.4
4. Louisiana Waterthrush (LOWA)	44.3	18.3	0.75	0.4	−0.9
5. Wood Thrush (WOTH)	44.2	17.7	1.26	14.8	−1.8[a]
6. Black-thr. Blue Warbler (BTBW)	44.2	24.3	0.65	1.0	0.6
7. Blue-winged Warbler (BWWA)	39.5	17.0	0.46	0.7	1.0
8. Gray Catbird (GRCA)	38.7	9.9	2.41	11.1	−0.2
9. Golden-winged Warbler (GWWA)	30.8	30.8	0.30	0.2	−7.5[a]
10. Eastern Phoebe (EAPH)	30.6	10.5	2.24	4.7	0.2
11. Acadian Flycatcher (ACFL)	30.2	15.4	0.90	3.1	0.8
12. Cerulean Warbler (CEWA)	30.0	11.7	0.58	0.6	−2.9[a]
13. Blackburnian Warbler (BBNW)	29.4	21.5	0.65	1.4	1.0
14. Solitary Vireo (SOVI)	23.1	10.5	1.42	1.6	6.2[a]
15. Yellow-throated Vireo (YTVI)	22.8	17.4	1.22	0.9	−0.1
16. Veery (VEER)	22.4	12.1	1.48	7.8	−0.7[a]
17. Northern Parula (NOPA)	22.4	17.1	1.27	1.8	0.7
18. Eastern Wood Pewee (EWPE)	22.4	14.8	1.61	4.8	−2.2[a]
19. Henslow's Sparrow (HESP)	21.4	24.4	0.52	0.1	−12.2[a]
20. Whip-poor-will (WHIP)	21.2	17.5	1.32	0.3	−2.0[a]
21. Chestnut-sided Warbler (CSWA)	19.2	23.5	0.76	5.0	−0.6
22. Rose-breasted Grosbeak (RBGR)	18.4	11.9	1.53	3.0	0.0
23. Red-eyed Vireo (REVI)	18.0	7.5	3.15	23.4	1.3[a]
24. Black &White Warbler (BAWW)	17.5	8.6	2.79	2.4	−1.8[a]
25. Field Sparrow (FISP)	17.3	15.0	1.42	6.9	−4.1[a]
26. Hooded Warbler (HOWA)	17.2	16.8	0.77	1.1	1.4[b]
27. Yellow-bellied Sapsucker (YBSA)	17.0	9.6	1.50	2.0	2.2[b]
28. Cedar Waxwing (CWAX)	17.0	8.7	2.62	7.0	1.4[a]
29. American Goldfinch (AMGO)	17.0	8.5	2.76	11.1	−2.6[a]
30. Indigo Bunting (INBU)	16.8	14.0	1.59	14.7	−0.2
31. Northern Oriole (NOOR)	16.3	6.9	3.17	4.5	−1.1[a]
32. Canada Warbler (CAWA)	16.1	16.8	0.94	0.9	−5.5[a]
33. Ovenbird (OVEN)	16.1	10.4	2.29	9.4	1.7[a]
34. American Redstart (AMRE)	15.6	8.0	2.99	4.8	−0.6

Significance of trend estimates:
[a] = $p < 0.01$.
[b] = $p < 0.10$.
[c] = $p < 0.05$.

Initially we had identified 44 species with >10% of their range in the Northeast (see Rosenberg and Wells 1995, table 1). When population size was considered, the importance of the Northeast to several of these species was enhanced (relative to percent of range alone). For example, even though Scarlet Tanager is a widespread species, its high relative abundance in several northeastern states suggests a much higher percent of population in the region than predicted from geographic range alone (60% versus 21%). Other species that gained considerably in importance compared with their percent of range included Gray Catbird (39% versus 10%), Eastern Phoebe (31% versus 11%), Cerulean Warbler (30% versus 12%), Solitary Vireo (23% versus 11%), and Northern Oriole (16% versus 7%). Species with higher relative abundances outside the Northeast dropped in importance rank, however; these included Henslow's Sparrow, Chestnut-sided Warbler, Canada Warbler, and Whip-poor-will. Still others (e.g., Nashville Warbler, Grasshopper Sparrow) dropped off our importance list because the bulk of their populations are outside our region.

The resulting list of 34 top-ranked species (table 1) is diverse, both taxonomically and ecologically, and includes species of both northern and southern affinities. The largest group represented are the wood warblers (14 species); other "typical" NTMBs include 3 flycatchers, 3 thrushes, and 3 vireos. Although most of the list can be considered forest species, several important species of grasslands and successional habitats are represented. Even among the top 10 species are birds of coniferous mountaintops, deciduous bottomland forests, shrubby clearings, and pastures. Clearly, no obvious suite of species associated with a particular habitat type stands out as being of highest conservation priority.

Shared Importance With Adjacent Regions

To determine which regions to consider in collaborative conservation planning for NTMBs, we compared percentages of total populations in the Northeast with those in adjacent USFWS Regions and Canada (appendix). The

clearest result of this analysis is the overriding importance of Canada to NTMBs. Among all NTMBs that breed in the Northeast, 42 species have >50% of their population within Canada, and 29 species have >75% of their population there. For 16 species, Canada supports >90% of the total population. Among the top 34 ranked species in the Northeast, almost half have the largest proportion of their population in Canada. For Black-throated Blue, Blackburnian, and Canada warblers, Ontario and Quebec alone hold 40-70% of the total population (Rosenberg and Wells 1995, table 5). For Bicknell's Thrush, at least $\frac{1}{2}$ of the total range is in Quebec and the Maritime provinces. Clearly, any conservation plan for northern forest birds in the Northeast must seek cooperation with Canadian provinces, although populations may be larger in the U.S.

Among other Regions in the U.S., Region 4 (Southeast) is next in terms of shared importance with the Northeast. Twenty shared species have >50% of their population in Region 4 (recall that only 3 species had >50% in Region 5). Of the 34 top-ranked species, 9 have the highest proportion of their population in Region 4; the most important examples are Hooded Warbler (82%), Yellow-throated Vireo (55%), Northern Parula (52%), Louisiana Waterthrush (51%), Cerulean Warbler (51%), and Wood Thrush (46%).

Region 3 (Midwest) is important for several highly ranked species. Henslow's Sparrow, Golden-winged Warbler, and Whip-poor-will have >50% of their population in this region, which also ranks highest in importance for Blue-winged Warbler, Field Sparrow, and Northern Oriole. For Golden-winged Warbler, Wisconsin and Michigan hold 59% of the total population, and Michigan, Ohio, and Wisconsin support nearly 80% of the total population of Henslow's Sparrow.

This analysis clearly shows that collaboration with Canada, the Southeast, and Midwest regions will be important for the conservation of NTMBs in the Northeast.

Important Geographic Areas

Having identified species for which the Northeast is particularly important, our next step was to highlight the most important geographic areas for bird conservation in the Northeast. Based on relatively high atlas-block concentrations of high-priority species among state/physiographic area units (table 2), the most important areas occur in several disjunct blocks (fig. 2). The first includes the *Northern New England* and *Northern Spruce-Hardwood Forest* portions of Vermont and New Hampshire. This area is important because of high concentrations of Bicknell's Thrush, Scarlet Tanager, Wood Thrush, and Black-throated Blue Warbler. Adjacent portions of Maine, Massachusetts, Connecticut, and New York are classified as of secondary importance.

The second major area of high importance includes all of West Virginia, and adjacent highland and *Ridge and Valley* portions of Maryland. Note that the contiguous Ohio portion of *Ohio Hills* also is classified as of highest importance. This area supports among the highest relative concentrations of Scarlet Tanager, Worm-eating Warbler, Louisiana Waterthrush, and Wood Thrush, our 2nd through 5th-ranked species. In addition, the New York portion of the *Allegheny*

Table 2—Relative importance of 44 state/physiographic area units in the Northeast. Regional importance is based on atlas-block concentrations of high-priority species (see table 1). Conservation concern is based on atlas-block concentrations of priority species that show declining population trend (see Methods section).

State / physiographic area	Area importance score	Area concern score
28 - New Hampshire	100	5
27 - Connecticut	87	38
21 - West Virginia	86	100
24 - Maryland	85	76
27 - Vermont	83	24
12 - New York	82	52
13 - Maryland	81	66
27 - New Hampshire	80	12
22 - West Virginia	80	61
28 - Vermont	76	7
12 - Connecticut	75	24
28 - Maine	73	5
24 - West Virginia	73	39
27 - Massachusetts	73	15
13 - West Virginia	71	43
12 - Maine	71	7
23 - Virginia	71	23
27 - New York	70	24
10 - Maryland	70	22
24 - New York	70	42
27 - Maine	70	7
22 - Pennsylvania	68	68
18 - Vermont	67	19
24 - Pennsylvania	66	37
13 - Pennsylvania	66	36
26 - New York	65	4
13 - Virginia	64	31
13 - New York	64	29
21 - Virginia	64	34
10 - Virginia	63	16
4 - Maryland	62	17
4 - Delaware	62	14
12 - Pennsylvania	58	13
16 - New York	57	37
11 - Virginia	55	11
10 - Pennsylvania	53	10
18 - New York	53	15
12 - Rhode Island	51	8
12 - Massachusetts	51	9
9 - New York	44	4
4 - Virginia	40	6
3 - Virginia	33	4
4 - Pennsylvania	32	5
9 - Massachusetts	32	2

Plateau was classified of relatively high importance because of moderate concentrations of many priority species.

Note that in this analysis, very small areas may tend to receive greater importance ranks because Atlas coverage may have been more complete there, resulting in greater percentage occupancy for many species than is shown in larger, more diverse areas. Combining small areas with adjacent portions of the same physiographic area probably would give a more accurate assessment of their importance.
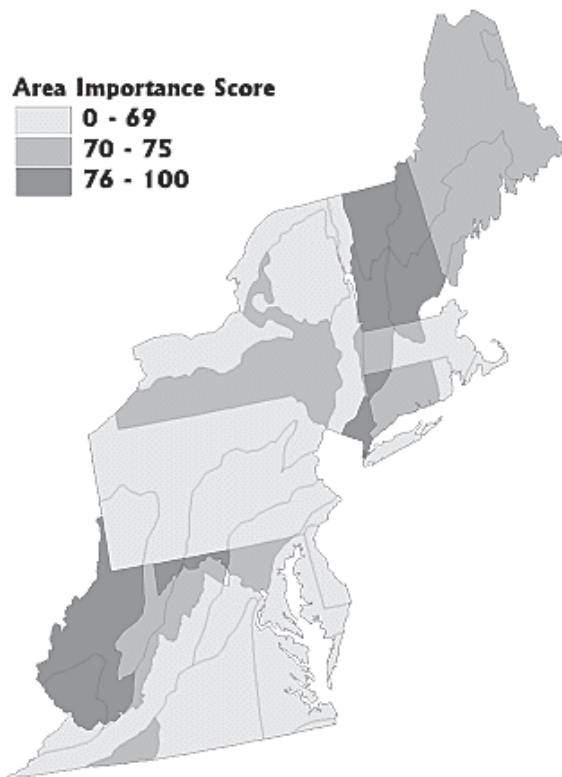
Figure 2—Map of important state/physiographic area units in the Northeast, based on high atlas-block concentrations of high-priority NTMB species. Red areas are those with area importance scores >75 (table 3); pink areas scored 70-75. These areas represent those where long-term planning for regionally important populations is most needed.

Incorporating Population Trends

Overall, it appears that the high-priority species identified in the Northeast are not the same species for which population declines have generated so much concern within PIF. Of the top 12 high-ranked species (other than Bicknell's Thrush) that have at least 30% of their total population in the Northeast, only three show significant long-term declines since 1966 (fig. 3). Of the 6 most important species, only the Wood Thrush has declined. Overall, two-thirds of the 34 priority species are stable or increasing.

Species showing the steepest declines (>5% per year) region-wide are Henslow's Sparrow, Golden-winged Warbler, and Canada Warbler. Of the 11 declining species, about half are species of successional habitats or forest edge. Declining forest birds include Wood Thrush, Cerulean Warbler, Canada Warbler, Eastern Wood Pewee, and Black-and-white Warbler. Solitary Vireo has shown the largest significant increase in the region, and Yellow-bellied Sapsucker and Ovenbird also have increased significantly since 1966.

Among the total list of NTMBs that breed in the Northeast, 35 species (31%) show significant long-term declines of at least 1% per year, whereas 15 species (13%) have increased significantly (table 3). Among this list of declining species, 67% are birds of primarily open (nonforest or successional) habitats. Of the top 10 species with the steepest declining trends, only 2 (Olive-sided Flycatcher, Canada Warbler) can be considered forest species. In contrast, of the top ten increasing species in the region, all but two are forest species. This pattern of greater declines in nonforest species in the Northeast has been noted
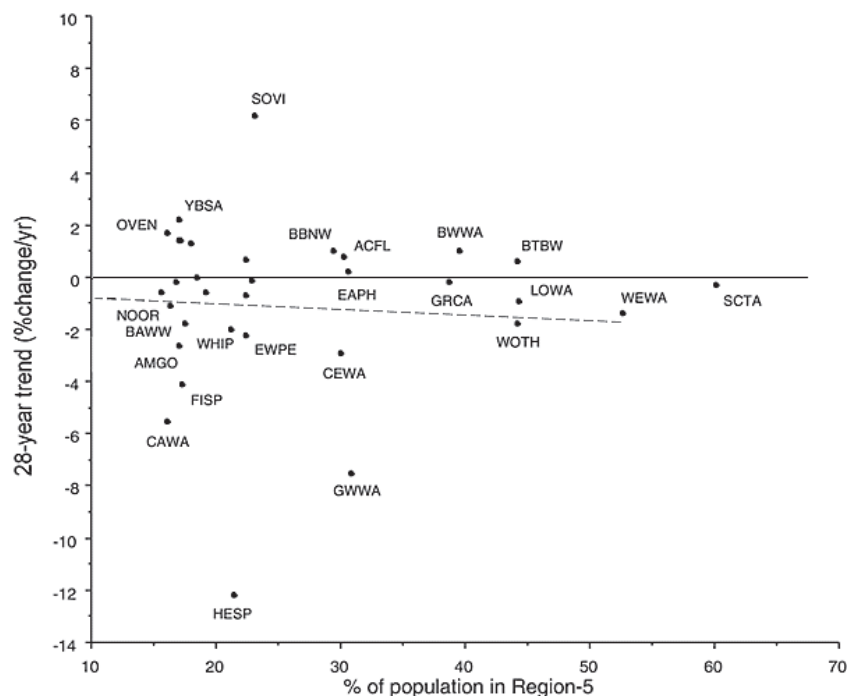

Figure 3—Relationship between percent of total population in the Northeast and long-term population trend for 34 NTMB species. Species below the dotted line are declining significantly, according to BBS data.

Table 3—Increasing and decreasing species of NTMBs ranked by long-term (1966-1994) trend estimate from Breeding Bird Survey data for USFWS Region 5 (Sauer and others 1996). Habitat defined for simplicity as Forest (including open woodland, mid-successional, and edge habitats) and Open (including early second-growth, grassland, shrub-scrub, and other nonforest habitats).

Most declining species			Most increasing species		
Species	Trend	Habitat	Species	Trend	Habitat
Common Nighthawk	−13.7[a]	Open	Philadelphia Vireo	+8.2	Forest
Henslow's Sparrow	−12.2[a]	Open	Solitary Vireo	+6.2[a]	Forest
Loggerhead Shrike	−8.1	Open	Yellow-thr.Warbler	+5.9[a]	Forest
Golden-winged Warbler	−7.5[a]	Open	Tennessee Warbler	+5.8	Forest
Olive-sided Flycatcher	−7.3[a]	Forest/Edge	Cape May Warbler	+4.0	Forest
Marsh Wren	−5.9[a]	Open	Yellow-rumped Warbler	+3.8[a]	Forest
Vesper Sparrow	−5.8[a]	Open	Pine Warbler	+3.3[a]	Forest
Canada Warbler	−5.5[a]	Forest	Ruby-thr. Hummingbird	+3.3[a]	Open
Eastern Meadowlark	−5.1[a]	Open	Purple Martin	+3.0[c]	Open
Yellow-shafted Flicker	−5.0[a]	Forest/Edge	Chuck-will's Widow	+2.9	Forest
Ruby-crowned Kinglet	−4.8[c]	Forest	Blue-gray Gnatcatcher	+2.9	Forest
Horned Lark	−4.7[a]	Open	Pine Siskin	+2.8	Forest/Edge
Rufous-sided Towhee	−4.7[a]	Open	Orchard Oriole	+2.7[a]	Open
Brown Thrasher	−4.4[a]	Open	Hermit Thrush	+2.7[a]	Forest
Field Sparrow	−4.1[a]	Open	Eastern Bluebird	+2.5[a]	Open
Nashville Warbler	−4.0	Forest	Blue Grosbeak	+2.0[a]	Open
Brown-headed Cowbird	−3.0[a]	Open	Yellow-bel. Flycatcher	+2.0	Forest
Cerulean Warbler	−2.9[a]	Forest	Ovenbird	+1.7[a]	Forest
Red-winged Blackbird	−2.9[a]	Open	Magnolia Warbler	+1.5	Forest
White-thr. Sparrow	−2.9[a]	Forest/Edge	Warbling Vireo	+1.5[a]	Forest/Edge
Savannah Sparrow	−2.7[a]	Open	Cedar Waxwing	+1.4[a]	Open
Grasshopper Sparrow	−2.7[a]	Open	Hooded Warbler	+1.4[c]	Forest
American Goldfinch	−2.6[a]	Open	Red-eyed Vireo	+1.3[a]	Forest
Swainson's Thrush	−2.4[b]	Forest	Wilson's Warbler	+1.2	Open
Yellow-breasted Chat	−2.4[a]	Open	Tree Swallow	+1.2[c]	Open
Eastern Wood-Pewee	−2.2[a]	Forest			
Belted Kingfisher	−2.0[a]	Open			
Whip-poor-will	−2.0[a]	Forest/Edge			
Black-billed Cuckoo	−1.9[a]	Forest			
Bank Swallow	−1.9	Open			
Black-&-white Warbler	−1.8[a]	Forest			
Wood Thrush	−1.8[a]	Forest			
Eastern Kingbird	−1.6[a]	Open			
Chimney Swift	−1.4[a]	Open			
Least Flycatcher	−1.4[a]	Forest			
Bay-breasted Warbler	−1.4	Forest			
Worm-eating Warbler	−1.4	Forest			
Song Sparrow	−1.3[a]	Open			
Kentucky Warbler	−1.2	Forest			
Northern Oriole	−1.1[a]	Forest/Edge			
Northern Waterthrush	−1.1	Forest			
Prothonotary Warbler	−1.0	Forest			
Prairie Warbler	−1.0	Open			

Significance of trend estimates:
[a] = $p < 0.01$.
[b] = $p < 0.05$.
[c] = $p < 0.10$.

previously (Askins and others 1990; Witham and Hunter 1992; Askins 1993; Franzreb and Rosenberg 1997).

These trends highlight the dichotomy between importance of regional populations (and therefore responsibility of the Northeast Region to conserve them) and population declines (which may dictate concern and conservation action). In general, the most important species are not declining, and the most steeply declining species do not have large proportions of their populations in the Northeast. The implications of this dichotomy will be discussed further below.

Species of Conservation Concern

Some species do have important populations in the region and also are declining. Combining information on importance of regional populations and their trends, our concern scores identified four species that stand out as being in need of immediate conservation action (table 4). The Henslow's Sparrow score was much higher than that of any other species because of the small total population of the species, relatively large proportion in the Northeast, and precipitous

Table 4—Conservation concern scores for priority-ranked Neotropical migratory bird species that show declining population trends in Region 5. Concern scores are based on long-term trend, percent of total population in Region 5, and total estimated population size (see Methods section). Trends and significance levels from Breeding Bird Survey (Sauer and others 1996) (see table 1).

Species	Concern score	Significant declining trend?
Henslow's Sparrow	767.89	yes
Golden-winged Warbler	248.39	yes
Worm-eating Warbler	96.77	no
Cerulean Warbler	88.76	yes
Louisiana Waterthrush	25.39	no
Whip-poor-will	14.42	yes
Canada Warbler	9.24	yes
Scarlet Tanager	1.01	no
Wood Thrush	1.01	yes
Black-and-white Warbler	1.00	yes
Eastern Wood Pewee	0.91	yes
Field Sparrow	0.69	yes
American Goldfinch	0.28	yes
Northern Oriole	0.27	yes
Yellow-throated Vireo	0.24	no
Chestnut-sided Warbler	0.23	no
Veery	0.13	yes
American Redstart	0.13	no
Gray Catbird	0.11	no
Indigo Bunting	0.02	no

Figure 4—Map of conservation "hot-spots," based on high atlas-block concentrations of Neotropical migratory bird species with high species-concern scores. Black areas represent state/physiographic areas with area concern scores >60 (table 2); gray areas scored >30. These areas are those where immediate conservation action for regionally declining bird populations can best be implemented.

declining trend. Immediate planning and active management for this sparrow should be a high regional priority. Golden-winged Warbler was second in terms of regional concern, followed by Worm-eating and Cerulean warblers. Although the declining trend for Worm-eating Warbler was not statistically significant, any potential declines are of concern because of the small population of this species and its high importance in the region. Louisiana Waterthrush, Whip-poor-will, and Canada Warbler were ranked as species of moderate concern. Other species such as Wood Thrush, which receive attention because of their declining trend, scored much lower—indicating less of an immediate concern from a global perspective.

Conservation "Hot-Spots"

Our final procedure was to identify geographic areas that support high concentrations of species designated as high concern. This process identified only one highest-priority "conservation hot-spot" within the region (table 2; fig. 4). This area encompassed the *Ohio Hills* portions of West Virginia and Pennsylvania (and also Ohio), and the adjacent *Cumberland Plateau* portion of West Virginia. All four of the highest concern species occur in relatively high concentrations in this area. Surrounding areas formed a "second-priority hot-spot" (fig. 4). Areas to the north on the *Allegheny Plateau* and *Great Lakes Plain* ranked highly because of high concentrations of Henslow's Sparrow and Golden-winged Warbler, whereas areas to the east (*Ridge and Valley*) have high concentrations of Worm-eating and Cerulean Warblers.
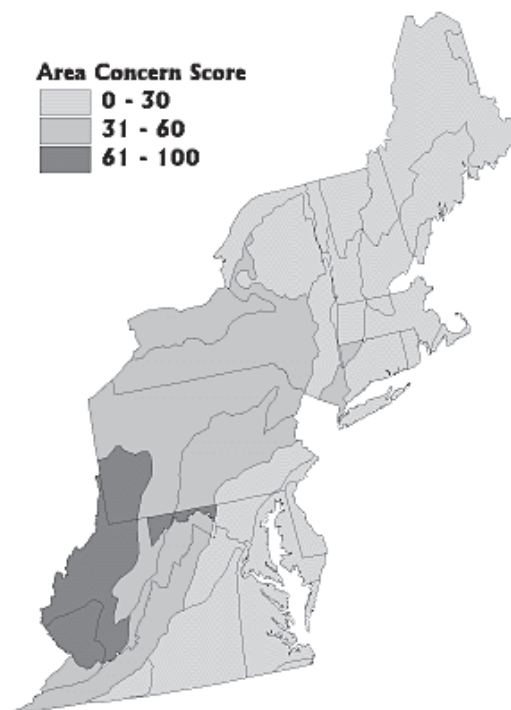
Note that the highest priority area also is one of the two areas identified as regionally important in terms of concentrations of highly ranked species (regardless of trend). The other high importance area in northern New England was not identified as an area of high immediate conservation concern (table 2). Realize, however, that we lack population trend estimates for Bicknell's Thrush; a declining trend for that species would elevate northern New England to highest-concern status. Most coastal areas from Virginia to southern New England did not rank highly in terms of either regional importance or concern for declining species. These coastal areas, however, may be extremely important as migration stopover sites for birds breeding to the north, and they support important communities of widespread grassland species that independently have been recognized as a conservation priority (Askins 1995; Wells and Rosenberg 1999).

Discussion

Any scheme to assign conservation priorities to species or sites necessarily is based on a number of assumptions and must be interpreted with caution. The numbers, scores, and ranks that we have generated are not absolute; rather they are intended to illustrate relative importance from a regional or global conservation perspective. Because our results may appear to differ from the widely accepted scheme of Carter and others (this proceedings), and because the

critical reader may question certain aspects of our analysis, we will address several issues and concerns related to prioritization. In the end, we want to stress that there is no one "best list" of priority species; each approach will generate a list that should elicit particular conservation actions. In this regard, our analysis has highlighted a dichotomy between species of long-term regional responsibility and those of immediate conservation concern, which we discuss below.

Importance of Area: The "Regional Filter" Approach

By considering importance in the entire Northeast Region as a means of selecting species for further consideration in conservation planning, we have employed a "regional filter" approach to species prioritization. Species with high proportions of their total population in the region initially rank highly in our analysis, regardless of their population trend or threats to their habitats. Highly ranked species that also show declining population trends are of greatest immediate conservation concern. We believe that conservation actions and dollars can be directed most efficiently at those species for which the region can significantly influence global population status or trends.

The PIF prioritization scheme (Hunter and others 1993a; Carter and others, this proceedings) is intended to inform managers at state and local levels about the global significance of their lands and to give federal and international policy makers the information needed to preserve *entire* species. In its most recent form, the prioritization scheme ranks species according to a variety of factors, some of which are considered global factors (e.g., threats on nonbreeding grounds) and some of which are area specific. Among the latter, the *Area Importance* score reflects the abundance of a species within an area relative to its rangewide abundance. For example, if a species was relatively abundant on BBS routes in a given state, then the state would receive a high *Area Importance* ranking for that species. Although this scheme will provide an overall priority ranking based on equal consideration of all factors, it may be preferable to give greater initial weight to particular factors that reflect local status. For example, by first listing species with high *Area Importance* scores in a particular state or physiographic area, managers can focus on those species that they can effectively conserve.

Small states in the Northeast face a particularly difficult dilemma in trying to prioritize conservation strategies for NTMBs. We understand that state fish and wildlife agencies have a mandate to preserve the species found within their state borders. Therefore, each state must consider the importance of its own lands for the persistence of the species within their state. A state such as Rhode Island could opt to put efforts either into preserving species at high risk of extirpation within the state, without consideration of their global status, or into managing species that are widespread and abundant within the state (i.e., with high *Area Importance* scores), but that are exhibiting regional or global population declines. Ideally, Rhode Island could enter into partnerships with other New England states to help conserve bird populations on a larger scale.

Prioritization of species and habitats at the regional level will facilitate this process by providing a larger perspective for local decisions.

One of our goals in this analysis was to provide a quantitative evaluation of *Area Importance* at regional, state, and physiographic-area scales that incorporates both the percentage of the total range and various measures of relative abundance (see Rosenberg and Wells 1995 for discussion of species' status in individual states and physiographic areas). Basing conservation strategies on the total species population usually is not considered feasible for small, migratory landbirds. The analogy of waterfowl management in North America, however, illustrates the importance of a global perspective. The successful North American Waterfowl Management Plan (USDI 1986) explicitly considers the total population of each species, including breeding potential, limiting factors, and seasonal and geographic variation in habitat use. Strategies for management (providing habitat, setting harvest limits) are then apportioned among the migratory flyways, USFWS regions, states, and individual wildlife refuges. Provisions for state and local needs exist, and conflicts between local and national goals may arise, but the ultimate goal of conserving waterfowl populations is accomplished at an international scale.

Similarly, conservation of migratory songbirds cannot be accomplished in a piecemeal manner, with each local entity solely responsible for setting priorities and carrying out actions. Although the knowledge necessary to craft an analogous conservation plan for NTMBs is fragmentary and difficult to attain, this remains the ultimate goal of PIF. By drawing together extensive, existing data on the distribution, status, and relative abundance of each species, we have made the first attempt to provide such a global perspective for NTMBs in the Northeast.

Assessing Population Trends: Controversy and Consensus

Although importance of area rankings may identify bird species most appropriate for long-term, regional conservation planning, setting priorities for short-term management requires knowledge of species' status or population trends at regional or continental scales. At present, the only dataset available for evaluating changes in abundance of landbird populations at these scales, over a relatively long time period, is the BBS (Robbins and others 1986; Droege 1990; Butcher and others 1993; Sauer 1993).

Like all datasets, the BBS has certain limitations that can complicate trend analysis. The various limitations of the BBS dataset have been discussed by a number of authors (e.g., Droege 1990; Geissler and Sauer 1990; James and others 1990; O'Connor 1992; Butcher and others 1993). Despite these limitations, with proper analytical techniques the BBS dataset can yield important trend information. Recently, much controversy has centered over which analytical techniques are appropriate for studying trends in BBS data. The BBS Lab's statisticians developed a technique called the Linear Route-Regression method (Geissler and Noon 1981; Geissler and Sauer 1990), which was modified with estimating equations estimates (Link

and Sauer 1994). Others have criticized this technique and have applied other methods of analyzing BBS trend data (e.g., James and others 1990; O'Connor 1992; Lauber and O'Connor 1993; Wiedenfeld and others 1992; James and others 1996).

Although much has been made of the controversy between these schools of thought (James and others 1996; Thomas 1996), no comprehensive, quantitative comparison of the results of the different methods has yet been published. A full review of the controversies regarding BBS data and its analysis is beyond the scope of this paper. We believe, however, that problems with data and discrepancies among results of different analytical techniques have been overstated and exaggerated by some authors.

From what we have seen of the various critiques mentioned above, the overall result of determining which species are exhibiting long-term, region-wide trends seems little affected by choice of analytical method. For example, all studies of BBS trends have concluded that Wood Thrushes and Cerulean Warblers have experienced long-term, steady population declines. Although caution must be used when interpreting BBS trends for smaller geographic areas or shorter time periods, a conservative approach to conservation planning suggests that erring on the side of concern for potentially declining species is best. Important, long-term, regional declines, such as those evident in Cerulean Warbler, Golden-winged Warbler, and Henslow's Sparrow, are usually unambiguous, and are verifiable from data other than the BBS.

Responsibility Versus Concern: A Dichotomy in Landbird Conservation

In this paper we have identified bird species and geographic areas that are "important" or "high-priority" for two very different reasons. The reasons behind these priority rankings lead to two very different kinds of conservation action. Some species are important because a high proportion of their total population resides in the Northeast Region. Some areas within the Northeast are important because, from a global perspective, they support high relative concentrations of these same important species. Importance or priority for these species or areas can be interpreted as the *responsibility* of managers in a given state or physiographic area to conserve the populations of those species, or similarly, their *ability* to affect the entire populations of these species through conservation planning or action. As an example, Scarlet Tanager is a widespread species with (mostly) stable populations, but also is a species for which the Northeast Region has a high responsibility for conserving. Conservation planning in areas with high local abundances or concentrations of Scarlet Tanagers (e.g., West Virginia, Pennsylvania, Allegheny Plateau) can have a large effect on the total population of this species.

Another set of bird species can be considered important because their populations are experiencing long-term declines in the region. From a global perspective, declining species are of greatest concern if they also have a large proportion of their population in the region of decline. Geographic areas with high concentrations of these important *and* declining species become conservation "hot-spots." As an example, Henslow's Sparrow has only a moderate proportion of its population in the Northeast (ranked 19 out of 34 species), but its populations are declining precipitously. Concern for this species, therefore, is higher than for any other in our analysis, and areas with relatively high concentrations of Henslow's Sparrows (western Pennsylvania and New York, Great Lakes Plain) become extremely important from a regional or global perspective.

The dichotomy, then, is between concern for declining species, which leads to immediate conservation action, and responsibility for species with high proportions of their population in the region, which leads to long-term conservation planning. The PIF regional landbird conservation plan being developed for the Northeast is considering both types of priority and action.

Acknowledgments

Appendix: Percent of total population in Region 5 and adjacent USFWS Regions (plus Canada) for A- and B-list NTMB species that occur in the Northeast.

Species	Region 5	Canada	Region 4	Region 3	Region 6	Region 2
Yellow-billed Cuckoo	4.6	0.1	42.4	14.1	6.6	32.1
Black-billed Cuckoo	9.3	44.6	0.0	27.6	18.3	0.0
Chuck-will's-widow	0.2	0.0	86.4	5.0	0.0	8.3
Whip-poor-will	21.1	3.5	25.1	50.1	0.0	0.0
Common Nighthawk	0.2	9.1	11.7	1.3	13.8	51.6
Chimney Swift	12.4	1.8	45.9	28.7	4.35	6.6
Ruby-thr. Hummingbird	15.7	9.3	46.9	21.6	0.0	6.4
Belted Kingfisher	8.3	51.1	12.9	11.3	5.3	3.2
Northern Flicker	10.6	45.8	12.2	19.6	10.9	0.8
Yellow-bellied Sapsucker	17.0	76.8	0.0	6.1	0.0	0.0
Eastern Kingbird	4.9	27.0	16.0	14.7	32.0	4.4
Great-crested Flycatcher	10.4	10.0	42.0	25.4	3.0	9.0
Eastern Phoebe	30.6	30.6	13.8	19.8	2.0	3.2
Yellow-bellied Flycatcher	0.3	99.6	0.0	0.1	0.0	0.0
Acadian Flycatcher	30.2	0.0	55.6	13.5	0.0	0.6
Willow Flycatcher	8.1	20.3	0.0	11.3	15.2	0.0
Alder Flycatcher	5.2	93.5	0.0	1.3	0.0	0.0
Least Flycatcher	6.7	84.2	0.0	8.1	1.0	0.0
Eastern Wood-Pewee	22.4	6.2	38.8	29.9	0.3	2.4
Olive-sided Flycatcher	0.8	68.2	0.0	0.5	2.9	0.0
Horned Lark	0.1	19.4	0.1	6.0	47.5	13.7
Tree Swallow	6.6	78.1	0.0	7.2	4.0	0.0
Bank Swallow	4.7	74.8	0.0	7.5	7.7	0.0
N. Rough-winged Swallow	3.4	6.4	14.1	14.9	24.8	12.7
Barn Swallow	8.0	33.6	8.0	17.8	17.6	8.5
Cliff Swallow	na	na	na	na	na	na
Purple Martin	4.1	5.2	57.0	17.7	0.9	15.0
Brown Creeper	11.3	47.5	0.0	2.1	0.0	0.0
House Wren	10.4	39.2	0.4	23.9	20.1	0.01
Marsh Wren	0.9	35.7	0.0	16.0	39.5	0.0
Sedge Wren	0.0	32.0	0.0	60.5	7.5	0.0
Gray Catbird	38.6	10.3	14.4	30.7	5.2	0.2
Northern Mockingbird	4.2	0.01	36.6	3.3	2.5	52.5
American Robin	9.0	53.0	3.8	15.2	9.8	1.1
Wood Thrush	44.2	0.6	45.7	9.5	0.0	0.0
Hermit Thrush	4.9	80.4	0.0	2.9	6.8	0.0
Swainson's Thrush	0.4	94.6	0.0	0.1	0.01	0.0
Bicknell's Thrush	75?	25?	0.0	0.0	0.0	0.0
Veery	22.4	56.9	0.0	16.8	2.9	0.0
Eastern Bluebird	10.2	0.6	47.3	22.4	3.2	16.2
Ruby-crowned Kinglet	0.3	94.1	0.0	0.2	3.3	0.0
Blue-gray Gnatcatcher	11.5	0.0	60.0	13.7	0.7	13.7
Cedar Waxwing	17.0	58.8	0.4	16.1	1.3	0.0
Loggerhead Shrike	0.2	1.3	24.4	4.4	22.1	34.9
White-eyed Vireo	5.5	0.0	81.6	4.9	0.0	7.8
Yellow-throated Vireo	22.8	0.1	54.6	20.9	0.0	1.4
Solitary Vireo	23.1	74.1	0.41	2.3	0.0	0.0
Red-eyed Vireo	18.0	61.3	9.0	10.4	0.4	0.5
Philadelphia Vireo	0.4	99.6	0.0	0.0	0.0	0.0
Warbling Vireo	2.3	57.4	0.5	9.1	20.3	0.3
Black-and-white Warbler	17.5	46.1	6.4	29.2	0.0	0.6
Prothonotary Warbler	2.5	0.0	96.4	1.1	0.0	0.0
Swainson's Warbler	1.0	0.0	99.0	0.0	0.0	0.0
Worm-eating Warbler	52.6	0.0	47.3	0.0	0.0	0.0
Golden-winged Warbler	30.7	3.5	0.0	65.6	0.0	0.0
Blue-winged Warbler	39.5	0.0	18.3	42.1	0.0	0.0
Tennessee Warbler	0.3	99.7	0.0	0.0	0.0	0.0
Nashville Warbler	5.3	85.0	0.0	5.9	0.0	0.0
Northern Parula	22.3	20.0	52.1	5.5	0.0	0.0

(con.)

Species	Region 5	Canada	Region 4	Region 3	Region 6	Region 2
Yellow Warbler	8.6	64.3	0.9	5.7	12.5	0.0
Magnolia Warbler	5.1	93.6	0.0	1.2	0.0	0.0
Cape May Warbler	3.5	96.0	0.0	0.5	0.0	0.0
Black-thr. Blue Warbler	44.2	51.5	0.0	4.3	0.0	0.0
Yellow-rumped Warbler	3.6	95.9	0.0	0.8	0.0	0.0
Black-thr. Green Warbler	12.7	84.8	0.0	2.3	0.0	0.0
Cerulean Warbler	30.0	0.0	51.1	18.8	0.0	0.0
Blackburnian Warbler	29.3	62.5	0.0	8.0	0.0	0.0
Yellow-throated Warbler	2.5	0.0	95.6	1.9	0.0	0.0
Chestnut-sided Warbler	19.1	67.6	0.0	13.1	0.0	0.0
Bay-breasted Warbler	3.1	96.8	0.0	0.0	0.0	0.0
Blackpoll Warbler	1.0	99.0	0.0	0.0	0.0	0.0
Pine Warbler	8.4	0.3	89.8	1.4	0.0	0.0
Prairie Warbler	2.5	0.0	96.4	1.1	0.0	0.0
Palm Warbler	na	na	na	na	na	na
Ovenbird	16.0	64.9	2.4	16.5	0.0	0.0
Northern Waterthrush	1.1	98.4	0.0	0.5	0.0	0.0
Louisiana Waterthrush	44.2	0.0	51.4	4.3	0.0	0.0
Kentucky Warbler	13.3	0.0	73.0	13.5	0.0	0.0
Mourning Warbler	1.3	93.5	0.0	5.2	0.0	0.0
Common Yellowthroat	12.2	38.8	15.8	23.0	8.0	0.7
Yellow-breasted Chat	9.70	0.0	70.5	10.4	1.5	5.6
Hooded Warbler	17.2	0.0	81.6	1.2	0.0	0.0
Wilson's Warbler	0.1	83.7	0.0	0.0	0.0	0.0
Canada Warbler	16.0	79.4	0.0	4.52	0.0	0.0
American Redstart	15.6	77.2	0.4	5.4	1.3	0.0
Red-winged Blackbird	5.1	24.1	10.0	24.5	18.8	8.2
Brown-headed Cowbird	3.3	25.8	6.9	14.0	32.0	12.7
Bobolink	13.7	36.5	0.0	32.6	17.0	0.0
Eastern Meadowlark	5.4	0.6	31.9	23.3	3.6	35.1
Orchard Oriole	3.2	0.0	58.5	7.0	17.5	13.7
Northern Oriole	16.2	26.3	2.8	27.7	23.2	3.8
Scarlet Tanager	60.0	3.5	11.0	25.3	0.0	0.0
Summer Tanager	4.3	0.0	78.2	8.4	0.0	9.2
Rose-breasted Grosbeak	18.4	41.5	0.0	39.3	0.8	0.0
Blue Grosbeak	5.7	0.0	55.8	6.0	6.3	26.0
Rufous-sided Towhee	14.0	1.8	51.4	6.7	7.1	5.2
Indigo Bunting	16.8	1.3	47.9	31.2	0.9	1.8
Savannah Sparrow	1.6	81.7	0.0	9.1	5.1	0.0
Grasshopper Sparrow	3.6	0.2	2.2	19.8	70.0	4.1
Henslow's Sparrow	21.3	0.0	0.0	78.6	0.0	0.0
Chipping Sparrow	13.8	49.5	6.9	13.7	6.7	1.2
Field Sparrow	17.3	0.4	32.5	34.5	4.8	10.3
Lincoln's Sparrow	0.1	98.7	0.0	0.0	0.7	0.0
Vesper Sparrow	0.6	46.6	0.0	15.1	31.7	0.0
Swamp Sparrow	5.1	84.2	0.0	10.8	0.0	0.0
Song Sparrow	13.6	49.8	2.3	24.2	3.7	0.0
Fox Sparrow	0.0	96.4	0.0	0.0	0.0	0.0
White-throated Sparrow	2.7	96.2	0.0	1.1	0.0	0.0
Pine Siskin	0.2	81.4	0.0	0.1	11.8	0.0
American Goldfinch	17.0	31.1	4.6	29.3	10.6	0.3
Purple Finch	11.3	78.6	0.0	2.6	0.0	0.0

na = data not available.