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Research Papers

Endangered Species, Provincialism, and a Continental Approach to Bird Conservation

Espèces en voie de disparition, provincialisme et proposition d'une approche continentale de conservation des oiseaux

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ABSTRACT. I examined lists of endangered species from northeastern and midwestern United States to assess the extent to which they were dominated by species considered rare due to their vulnerability to anthropogenic stressors or, instead, by species whose rarity might be explained otherwise. Northeastern states had longer species lists than midwestern states, and more species associated with locally rare prairie habitats. More species at the edge of their geographic range appeared on lists from the Northeast than the Midwest. About 70% of listed species overall have shown either no significant population trend, or increases, at the continental scale, but wetland and prairie species were frequently listed, consistent with the generally acknowledged, widespread loss of these habitats. Curiously, midwestern states tended to list fewer forest species, despite evidence that forest fragmentation there has had strongly deleterious effects on regional bird populations. Overall, species appear to be listed locally for a variety of reasons not necessarily related to their risk of extinction generally, potentially contributing to inefficient distributions of limited resources to deal effectively with species that legitimately require conservation attention. I advocate a continental perspective when listing species locally, and propose enhanced criteria for characterizing species as endangered at the local level.

RÉSUMÉ. J'ai inspecté des listes d'espèces en voie de disparition du nord-est et du Midwest des États-Unis afin d'évaluer la proportion d'espèces considérées rares en raison de leur sensibilité aux facteurs anthropiques versus celles dont la rareté s'explique par d'autres facteurs. Les listes étaient plus longues pour les États du nord-est que pour ceux du Midwest, et plus d'espèces en voie de disparition étaient associées aux prairies, un type d'habitat qui est rare dans cette région. De plus, les listes du nord-est comprenaient plus d'espèces à la limite de leur aire de répartition que celles du Midwest. Environ 70% des espèces comprises dans ces listes ne montraient aucune tendance significative dans leurs populations à l'échelle continentale, mais les espèces des milieux humides et des prairies étaient fréquentes dans ces listes, conformément avec le phénomène généralement accepté de perte globale de ces types d'habitats. Curieusement, les listes du Midwest avaient tendance à compter moins d'espèces forestières, en dépit du fait que la fragmentation des forêts a eu des effets négatifs majeurs sur les populations d'oiseaux de cette région. Dans l'ensemble, les espèces semblent être incluses dans les listes pour diverses raisons qui ne sont pas nécessairement reliées à leur risque général d'extinction, ce qui contribue possiblement à la distribution inefficace des ressources limitées qui devraient plutôt supporter la protection d'espèces chez qui un réel besoin de conservation existe. Je propose l'adoption d'une perspective continentale lors de la préparation de ces listes régionales, ainsi que l'application de critères plus rigoureux afin de classer les espèces comme étant en voie de disparition.

Key Words: *conservation; endangered species; geographic distributions; peripheral species; populations; United States*

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INTRODUCTION

Extinction is a lucidly chilling concept for researchers who have worked with endangered bird species. This concept of endangerment has in recent decades been extended to include species that are subject to regional extirpation. However, designations of endangerment at the local level may be strongly influenced by local perceptions. For example, conservationists in the midwestern United States, among others, have documented the agriculture-related fragmentation of their forests and its negative effects on bird species' richness and the ability of forest bird species to sustain themselves in such systems (Ambuel and Temple 1982, Bollinger and Linder 1994, van Horn et al. 1995, Robinson et al. 1997). Conversely, northeastern U.S. researchers have noted the expansion of forest at the expense of birds that were largely associated with disappearing agricultural and other anthropogenic landscapes (Vickery et al. 1997, Jones and Vickery 1997, Askins 2000). Although such perspectives may highlight important regional concerns in need of conservation action, they might also yield local conservation assessments that neither reflect nor contribute toward resolving larger continental conservation issues (Dunn et al. 1999, Bunnell et al. 2004).

In order to examine whether regional designations of endangerment reflect large-scale issues or, instead, focus attention on species for which local efforts are unlikely to produce substantive conservation effects, I pose the following questions for investigation: 1) Do state lists of endangered species reflect large-scale threats, such as patterns of continental population loss and degradation of natural habitats? 2) Are state endangered lists instead dominated by bird species that are not in conservation difficulty, but are locally rare because of factors such as being at range limits or being associated with anthropogenic habitats? Because of their potential for varying viewpoints, I focus on the northeastern states, where reforestation has been occurring and agriculture and early successional landscapes have been declining (Dickson and McAfee 1988, Ward and Barsky 2000), and the midwestern states, once associated with tallgrass prairie, but now heavily agricultural and with forest and other natural landscapes highly fragmented (Schwartz 1997).

To evaluate these questions, I document state designations of bird species considered endangered; consider whether these designations highlight any conservation issues of continental significance (continent-wide population declines, widespread destruction of natural habitats); assess the validity of such designations with continent-wide data on present distributions, population trends, habitat affinities, and historic populations; and examine whether regional differences emerge in the designation of endangered status that suggest local biases impact the way endangered status is conferred. In studying these questions, I combine analysis of empirical data with a review of literature to present a commentary on local designations of bird species as endangered. I comment in light of an evolving perspective gained from my work in this field, which began in 1975 (e.g., Dowhan and Craig 1976, 1979, 1992, Craig et al. 1988, Craig and Taisacan 1994).

METHODS

I collected from 20 web sites of the northeastern and midwestern states their 2002 lists of endangered species and the criteria used for listing species as endangered. Most states sampled also included lesser categories of concern, such as Threatened or Species of Special Concern. Although definitions of these other categories varied, the definition of Endangered as species in imminent peril of local extirpation was consistent. Hence, in my analyses I focused on species with State Endangered status, so that I might examine lists that were directly comparable. Except in the case of species receiving federal designation as Threatened or Endangered, most State Endangered listings referred to breeding populations (although some states list species for which they provide migratory habitat). I followed state conventions on listing species as endangered even when they may be extinct (i.e., Eskimo Curlew, *Numinius borealis*) or locally extirpated.

Wherever possible, I examined each listed species in light of 15-yr (1982–1996) composite maps of breeding bird distributions and density patterns, and computed 39-yr (1966–2004) population trends using data from the North American Breeding Bird Survey (Sauer et al. 2005). For analysis of trends, I followed Peterjohn et al. (1997) and used the linear route regression procedure based on estimating equations, which tends to produce the most precise results. Breeding Bird Survey (BBS) data cover much of the North American continent, and although BBS data have some weaknesses in quality

and interpretation (James et al. 1996, Thomas 1996), they are the most extensive source of quantitative information on North American breeding bird populations.

For species detected poorly by the methods of the BBS (e.g., rails, owls), I used published descriptions of regional populations and distributions to examine status. These sources are listed in the Results and Discussion sections of this paper in evaluations of species status. I also evaluated the status and historic distributions of all listed endangered species in light of other published reports, particularly those of breeding bird atlases and published books on birds of individual states. Examining BBS and other data sources permits assessment of whether local designations of endangered status correspond positively with such phenomena as large-scale population declines. Moreover, they may be used to identify listed species that appear to have populations not in danger, or that appear to have gained listing primarily due to such local phenomena as reaching range limits.

Examining the habitat affinity of listed species also permits assessment of the degree to which species occupy major habitat types experiencing conservation difficulties, such as undergoing continent-wide destruction. Alternatively, examining affinities may reveal that species are associated with habitats naturally absent within a state. In order to assess such affinities, I categorized species as occupying one of four general habitat associations, using habitat designations in the Birds of North America (Poole and Gill 1992–1997) as a reference: prairie, forest, successional, and wetland. In several instances where species inhabited wetlands or prairies, e.g., Short-eared Owl (*Asio flammeus*), I listed them under both headings. Moreover, I found that nine species, e.g., Peregrine Falcon (*Falco peregrinus*), did not fit well into these groups, either because they were habitat generalists or occupied habitats not considered here, such as tundra. Occurrences of such species on state lists produced samples too small to draw substantive statistical inferences, so I did not categorize them or examine their habitat affiliation further.

Based on findings for population trends, distributions, habitat affinities, and historical populations, I further evaluated whether each designated species could be termed a peripheral member of that state's avifauna. To be termed peripheral, I made yes or no decisions using the following general criteria: 1) the species was at the fringes of its range (the place beyond which the species was not recorded by BBS and other regional data), where it existed at its lowest densities compared with more central portions, and/or 2) the geographic zone of major natural habitat (e.g., prairie, forest; as mapped for North America by Ricketts et al. 1999) for the species was outside the state's boundaries.

I did not consider species with federal "Threatened" or "Endangered" status to be peripheral anywhere in their range. In some states, federally protected species clearly were at range limits and perhaps best thought of as peripherally occurring, but I retained their endangered status to make my peripheral designations as conservative as possible, and to emphasize the conservation importance of species in catastrophic continental decline.

Where species had a discontinuous rather than continuous continental breeding distribution (based on Sauer et al. 2005), I did not consider them to be peripheral. Even though arguments might be made that species of discontinuous continental occurrence should be considered peripheral in some states, I again chose not to classify them as such to keep my designations conservative. Furthermore, where literature evidence suggested that present ranges had receded due to such human-caused phenomena as loss of natural habitat (habitat present in the absence of human disturbance) and environmental pollution, I also did not define species at the present fringes of their range to be peripheral.

I intentionally defined peripheral status in this conservative manner, because there is some inherent subjectivity to making such decisions due particularly to factors such as individual perspective about historical events. By choosing conservative criteria, any patterns still uncovered should provide clear evidence that states have listed as endangered species of questionable conservation importance within their region. Future researchers might work toward developing criteria for defining peripheral status that reduces sources of individual bias.

To compare regional patterns in listing of species, I examined total species listed from a state and land area perspective. I carried out land area comparisons by computing species listed/10–000 km^2 for each state. I further compared regions by examining regional habitat affiliations of listed species, and extent of listing species that may be termed

peripheral. I used nonparametric Mann-Whitney U tests to make comparisons in all cases.

RESULTS

Official lists of endangered species (App.) showed that of 65 total listed species, 36 (55%) were designated in the Northeast, compared with 50 (77%) in the Midwest. Individual northeastern states reported 9.7 ± 3.9 species, compared with 10.3 ± 2.0 species in the midwestern states (Table 1), a difference that was not statistically significant (Mann-Whitney U = 38.0, P = 0.38). However, when I considered state area, the Northeast listed significantly more species (5.7 ± 6.7 species/10 000 km^2) as endangered than the Midwest (0.7 ± 0.8 species/10 000 km^2 (Mann-Whitney U = 10.0, P = 0.003). In seven states (35%), endangered status was evaluated using the NatureServe protocol (Wilcove and Master 2005). In the remainder (65%), NatureServe criteria played a role in determining endangered status, although endangered status was based principally on the single criterion that a species was in danger of becoming extinct within state boundaries.

Of 52 listed species for which population trends could be computed, 15 (29%) showed statistically significant population declines, 13 (25%) showed significant increases, and 24 (46%) showed no significant population trends (App.). In the Northeast, 10 (37%) of 27 listed species with trend data showed significant declines and 5 (19%) showed significant increases, whereas in the Midwest 12 (29%) of 42 listed species with trend data had significant declines and 12 (29%) had significant increases. For individual states, the Northeast had 30.8 ± 14.7% and the Midwest 16.4 ± 21.5% declining species, a statistically significant difference (U = 23.0, P = 0.04). The Northeast also had 14.0 ± 9.7% and the Midwest 20.0 ± 13.5% increasing species, a difference not significantly different (U = 32.5, P = 0.19).

Examination of habitat affiliations showed that of all listed species, 34 (52%) were associated with wetlands, 12 (18%) with prairies, 8 (12%) with forests, and 4 (6%) with successional habitats (App.). However, only two wetland, four prairie, and one forest species were also experiencing significant BBS-wide declines, although the paucity of declining wetland species may have been in part a consequence of not all being adequately surveyed by BBS methods (Appendix 1). For example, roadside surveys such as the BBS may miss substantial areas of wetland habitat because roads rarely traverse such areas. In the Northeast, there were 20 (56%) wetland, 6 (17%) prairie, 4 (11%) forest, and 2 (6%) successional species, whereas in the Midwest there were 29 (58%) wetland, 10 (20%) prairie, 4 (8%) forest, and 3 (6%) successional species. More than half the species termed endangered were associated with wetlands (Table 1) among states in both the Midwest (65.3 ± 14.3%) and Northeast (59.9 ± 18.6%). Regional differences were non-significant (U = 31.0, P = 0.16). Prairie species were the next most frequently encountered group (Table 1) among states in both the Northeast (21.2 ± 12.6%) and Midwest (12.1 ± 21.3%), with regional differences significant (U = 24.0, P = 0.05).

Using my intentionally conservative criteria for determining which species were peripheral, I still found that 19 listed species (53%) in the Northeast and 17 species (34%) in the Midwest could be reasonably termed peripheral in at least one state when present continental distributions, historic distributions, and population trends are considered (App.). I found that for the individual northeastern states, 41.2 ± 19.3% of species were peripheral, whereas for the midwestern states, 13.6 ± 15.9% were peripheral. This difference between regions was significantly different (Mann-Whitney U = 14.5, P = 0.01), and the westernmost states examined (North Dakota, South Dakota, Nebraska, Kansas, and Oklahoma) listed no peripheral species as endangered (App.). When I also considered state area, the northeastern states again had significantly more peripheral species (2.1 ± 2.6/1000 km^2) than those of the Midwest (0.08 ± 0.09/1000km^2; U = 12.5, P = 0.004).

In order to show how I used data from distributions, population trends, habitat affiliations, and historical occurrence to determine whether designated endangered species were, in fact, peripherally occurring, I select examples below that provide representative demonstrations of my status decisions for 1) northeastern forest birds, 2) northeastern wetland birds, 3) northeastern prairie birds, 4) midwestern wetland bird, and 5) midwestern prairie birds (see also App.):

1. Black-throated Blue Warbler (*Dendroica caerulescens*), Rhode Island: peripheral. Although considered endangered in Rhode

Table 1. Endangered species totals for the northeastern and midwestern United States.

	Northeast								
	ME	NH	VT	MA	CT	RI	NY	PA	NJ
Total endangered	10	9	7	14	18	7	10	8	4
Total peripheral	5	5	4	6	8	2	3	5	0
Wetland	6	4	3	9	9	3	6	6	4
Prairie	1	2	1	3	4	2	1	1	2
Successional	0	0	0	1	1	0	0	0	0
Forest	0	0	1	0	2	1	1	0	0
Not defined	3	3	2	2	3	2	3	2	0

	Midwest										
	ND	MN	WI	SD	NE	IA	IL	IN	KS	MO	OK
Total endangered	4	7	13	4	6	8	25	28	6	9	3
Total peripheral	0	1	6	0	0	2	8	3	0	2	0
Wetland	3	2	7	3	5	5	18	19	4	6	2
Prairie	0	5	0	0	0	1	6	4	0	1	0
Successional	0	0	1	0	0	0	1	3	0	0	0
Forest	0	0	2	0	0	1	0	0	0	0	1
Not defined	1	0	3	1	1	2	2	4	2	2	0

Island, 25 km away in northeastern Connecticut the Black-throated Blue Warbler is a fairly common constituent of the summering avifauna (Craig et al. 2003). The higher elevations of northeastern Connecticut become dominated by northern hardwoods and conifers (Dowhan and Craig 1976), a principal habitat of this species. With the maturation of northeastern forests, the Black-throated Blue Warbler has increased its local (Zeranski and Baptist 1990, Craig et al. 2003) and continental populations through 1998 (+2.17 birds/route ± 0.73, $P = 0.01$) although population growth has since slowed (Sauer et al. 2005, Craig unpubl. data).

2. Black Rail (*Laterallus jamaicensis*), Connecticut, New York: peripheral. This species is at the northern limit of its coastal breeding range in Connecticut and Long Island, New York, where it has been known historically only as an erratic breeder (Bull 1974, Craig 1990), a characteristic situation for populations at range limits (Thompson and Nolan 1973). Its tidal and riverine marsh habitat becomes restricted north of the coastal plain states (Teal 1986), so natural habitat limitation and perhaps physiological constraints contribute

to its local rarity. There is evidence that tidal marsh ditching may have adversely affected certain of the Black Rail's populations (Post and Enders 1969), but it remains an uncommon to locally common breeder of fairly continuous range in coastal marshes from New Jersey to Florida (Bull 1974, Potter et al. 1980, Leck 1984).

The species also is listed as endangered in Missouri, Indiana, and Illinois, although I did not consider it peripheral in these states because its inland distribution is spotty and poorly understood (Eddleman et al. 1988). Moreover, efforts at surveying other populations have yielded unclear results (Spear et al. 1999), midwestern losses of its wetland habitat have been great (Havera et al. 1997), and these losses have been linked to declines of the species in its midwestern range (Bohlen 1989).

3. Upland Sandpiper (*Bartramia longicauda*), New Hampshire, Connecticut, Massachusetts, Rhode Island: peripheral. In the Northeast, this prairie species is associated with anthropogenic habitats (Bull 1974, Jones and Vickery 1997, Vickery et al. 1997), with even grasslands described as natural (Askins 1997) being demonstrated to be unsustainable without active manipulation (Winne 1997, Dunwiddie et al. 1997, Askins 2000). Its eastern populations have indeed declined as forest has reclaimed agricultural land (Bull 1974, Zeranski and Baptist 1990), but it has a vast continental distribution centered in the plains and agricultural provinces of the continent (Sauer et al. 2005). Continental populations have shown a significant long-term increase ($+0.69 \pm 0.10$, $P = 0.03$; Sauer et al. 2005), a trend supported by observations in the Great Plains (Johnson and Igl 1995, Igl and Johnson 1997). The Upland Sandpiper is also listed as endangered in Illinois and Indiana, but in these instances I did not consider it to be peripheral because both states had extensive areas of "natural" tallgrass prairie (but see Robertson et al. 1997) where it was common before mechanized "clean" farming replaced these and more forgiving agricultural habitats (Bohlen 1989).

4. Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*), Indiana: peripheral. The marsh-dwelling Yellow-headed Blackbird has an extensive continental distribution in western North America (Sauer et al. 2005), but is at the extreme eastern limit of its breeding range in this state, where historically it has had a very limited distribution (Mumford and Keller 1984). Despite loss of wetlands throughout the continent (Frayer et al. 1983, U.S. Fish and Wildlife Service 1989), its populations underwent a long-term increase through 1998 ($+1.38 \pm 0.60$, $P = 0.02$) although population growth has since leveled off (Sauer et al. 2005).

The species is also listed as endangered in adjacent Illinois. Although it could be considered peripheral there as well, as available evidence does not indicate it being appreciably more common there historically (Bohlen 1989), I did not define it as such because it occurred over more extensive areas of the state (Sauer et al. 2005). Moreover, wetland losses in the region have been great (Havera et al. 1997). However, in neighboring Iowa, the species is locally abundant (Dinsmore et al. 1991).

5. Baird's Sparrow (*Ammodramus bairdii*), Minnesota: not peripheral. Although this species could be called peripheral here based on its present range (Sauer et al. 2005), it and other State Endangered grassland species (Sprague's Pipit, *Anthus spragueii*, and Chestnut-collared Longspur, *Calcarius ornatus*) once were widespread in western Minnesota, and continental populations have undergone a significant, long-term decline (-3.96 ± 1.25, $P < 0.001$; Sauer et al. 2005). The extensive prairies of this region have been virtually eliminated (Janssen 1987). Although I follow here the convention of considering these habitats natural, the validity of considering endangered all such species at the edge of their prairie range is debatable. For at least the past 5000 years, eastern portions of the tallgrass prairie have been maintained in part by human activity, and would succeed to woody vegetation without such activity (Robertson et al. 1997).

DISCUSSION

Comparison of endangered lists in the northeastern and midwestern states revealed that these regions listed species with similar frequency. The regions also had similar proportions of their endangered lists with species showing BBS-wide increases. Both regions had ca. half their listed species showing no clear population trend. Moreover, in both regions, endangered lists categorized most species as associated with wetland and prairie habitats. Comparatively few species were associated with forest or successional habitats (Table 1).

A difference between regions was that, when I took state area into account, the northeastern states tended to produce longer lists/10 000 km^2 than the midwestern states. Moreover, the Northeast listed significantly more species associated with prairie habitats, despite the geographic distribution of this habitat being outside the boundaries of this region. Furthermore, significantly more peripheral species appeared on endangered lists of the Northeast than the Midwest. Hence, the Northeast appeared to be more liberal in conferring the designation of endangered status than the Midwest.

Although state lists from both regions showed little relationship with large-scale threats such as continental population declines, they did highlight several key continental conservation issues related to habitat loss. Notably, the preponderance of wetland species on endangered lists reflects the wetland destruction that has occurred across the continent (Frayer et al. 1983, U.S. Fish and Wildlife Service 1989). Indeed, local authorities cite wetland destruction as the principal cause of the decline of wetland species (Bohlen 1989, Mumford and Keller 1984, Brauning 1992, Jackson et al. 1996). The near obliteration of tallgrass prairie systems (Robertson et al. 1997) is similarly reflected in the comparatively high percentage of prairie species on endangered lists in the Midwest. Local authorities cite it as the principal cause of population declines in prairie species (Mumford and Keller 1984, Janssen 1987, Bohlen 1989). Hence, state endangered lists successfully focused on species associated with some habitats of continental conservation concern, even though most of the species associated with these habitats were not clearly undergoing long-term population declines.

In contrast, state lists failed to focus on other habitats of demonstrable conservation concern. The midwestern states have largely ignored forest species despite overwhelming evidence that forest fragmentation has had strongly deleterious effects on the region's bird populations (Ambuel and Temple 1982, Bollinger and Linder 1994, van Horn et al. 1995, Robinson et al. 1997). Such a finding suggests that listing processes do not adequately take into account threats to populations that may appear stable, but are not self-sustaining due to destruction of natural habitats once widespread in eastern parts of the Midwest (Delcourt and Delcourt 2000). I speculate that because forest species are still widespread regionally, local perception of endangerment is low even though such species are in conservation difficulty.

Comparatively few species listed as endangered in either region were experiencing demonstrable BBS-wide population declines. In fact, ca. 70% of listed species showed no significant trends or population increases. Such patterns as these and others cited above suggest that states, particularly those of the Northeast, produce endangered lists that include species only locally rare, and rare for reasons unrelated to major conservation issues.

Examples given of peripheral occurrences further demonstrate that endangered designations based on arbitrary state boundaries may have their validity compromised by including species for which local conservation efforts can yield little substantive benefit. For example, the rarity of the Black-throated Blue Warbler in Rhode Island is clearly a result of this state's unsuitable geographic location south of preferred habitat, and not a consequence of population difficulties as implied by the term endangered. In the case of the Black Rail, if Connecticut, Long Island, and New Jersey were parts of the same state, still a small total area compared with most states, this species would vanish from consideration as a Connecticut endangered species.

Furthermore, with respect to natural habitat distributions, the Upland Sandpiper cannot be considered a viable member of the northeastern avifauna without human manipulation of the landscape. Its persistence in the Northeast may be better considered a testament to its adaptability than as a conservation concern. Notably, those prairie species still persisting in the Northeast are often those with wide continental distributions and large populations (Sauer et al. 2005). Grassland bird species in general inhabit an inherently variable

environment, and appear to have evolved mechanisms for responding to such variation, including undergoing considerable annual change in distribution and abundance, and being able to locate habitat opportunistically (Wiens 1974, Cody 1985, Igl and Johnson 1997). Moreover, we cannot always presume that continental North American phenomena are responsible for limiting populations of this and others of our neotropical migrant species (Rappole and McDonald 1994, Sherry and Holmes 1996).

In the Yellow-headed Blackbird and, in fact, in all peripherally occurring species, we must question whether such populations could ever sustain themselves. Considering the poor reproductive success demonstrated for species in marginal habitat (Thompson and Nolan 1973, Probst and Hayes 1987, Villard et al. 1993, Weinberg and Roth 1998), population fluctuations at their range periphery (Thompson and Nolan 1973, Marti 1997), and characteristic density declines in species toward their range limits (Brown 1984), these populations are likely to be sinks for more robust populations (Pulliam 1988, Brawn and Robinson 1996, Robinson et al. 1997). In another wide-ranging prairie species occurring peripherally in the Northeast, the Grasshopper Sparrow (*Ammodramus savannarum*), a Maine population was found to be unlikely to persist >50 yr without immigration (Wells 1997, see also Ludwig 1999 for a critique of population viability analyses, which tend to underestimate extinction probability). Moreover, although genetic variation present in peripheral populations may be argued to be a reservoir for future evolutionary change, even in sedentary species, such small, isolated populations typically have reduced gene pools and may have reduced fitness. Conservation of gene pools is best accomplished by preserving processes rather than patterns (i.e., conditions that yield species survival rather than the protection of local and often ephemeral populations; Thrall et al. 2000). In the case of peripheral populations that maintain themselves largely though immigration, there are likely to be few genetic benefits accruing from their protection.

The preponderance of peripheral species on state lists demonstrates that a local perspective on endangerment is insufficient for judging conservation concern. Narrowly defining endangered status as species in danger of extinction within state boundaries, without considering the cause of local rarity, appears largely responsible for the appearance of the high proportion of peripheral species encountered. Even such species as the Upland Sandpiper and Grasshopper Sparrow, which have declined regionally, thereby causing conservation alarm (e.g., Hagan 1993, Askins 2000), may not always be appropriate for such concern (Hill and Hagan 1991, Dunn 2002). For example, continental populations of many species show complex regional patterns of decline and increase (James et al. 1996, Villard and Maurer 1996, Sauer et al. 2005). Additional data might show that patterns of local decline reflect a larger conservation issue (e.g., Weimeyer et al. 1975), but they also may simply show dynamic population responses to a dynamic North American environment (James et al. 1996, Bell and Whitmore 1997). For species associated with relatively ephemeral habitats such as grasslands and early successional habitats, regional population declines seem likely to be a characteristic feature of the natural history of such species (Cody 1985, Igl and Johnson 1997), and a pattern typical for them throughout much of their evolutionary history. In the case of early successional species, Beissinger et al. (2000) have suggested that, on a continental scale, we are now witnessing a return to more "normal" population levels for species that had greatly expanded numbers in response to certain previous types of human land use.

In designating a species as endangered, there is an implicit message that conservation action should be undertaken on the species' behalf. However, the present pattern is clear: states list as endangered many species for which, from a continental perspective, little substantive conservation contribution is likely to be achieved. An example illustrates local efforts of questionable value, for which I provide an alternative local approach with clear continental value:

A recent controversy in the Northeast concerned the fate of two "endangered" Connecticut species, the Upland Sandpiper and Grasshopper Sparrow, found inhabiting an airport scheduled for development. Local conservation groups found themselves in the position of declaring airport fields to be critical areas of natural habitat, and put themselves in an adversarial position with state regulatory agencies charged with evaluating airport development plans (Budoff 2000, May 2000, Szantyr 2000). Despite contentious debate, these agencies approved development of a portion of this parcel, but also

committed >$100 000 toward converting another parcel into grassland habitat and annually maintaining it as "mitigation" for the loss of airport lawns (Budoff 2000, May 2000).

Of what consequence to species with vast continental distributions and, in the case of the Grasshopper Sparrow, populations of ca. 15 000 000 (Rich et al. 2004) was the habitat loss for the ca. 40 pairs of birds present at this airport, or to the perhaps dozen pairs that might come to inhabit a created site at the periphery of the species' ranges (see also Bunnell et al. 2004)? We cannot presume that reproductive success in a mowed airport habitat was sufficient to sustain the population. Grassland bird species respond in a complex way to such habitat manipulation, with certain species prospering and others suffering from reduced nesting success and habitat quality (Johnson and Igl 1995, Granfors et al. 1996, Klute et al. 1997). It also must be questioned whether creation of grasslands in this urbanized northeastern state is a prudent expenditure of conservation capital.

An alternative to such efforts would be to consider that, although urbanized, the reforestation of the Northeast has left Connecticut 60% forested. However, forest cover may be expected to decline as the state rapidly urbanizes further (Craig et al. 2003). An increasing proportion of this forest is classified as mature (now 70%) and is beginning to exhibit characteristics of old-growth systems, even though an active selective logging industry exists (Ward and Barsky 2000). Such conditions have been virtually absent from the Northeast for centuries, and are likely to become increasingly rare as short-rotation, plantation forestry is practiced over much of the rest of the continent (Delcourt and Delcourt 2000).

With the present abundance of forest in Connecticut, a principal focus for conservationists should be to use this window of opportunity to protect extensive, contiguous tracts as refuges for forest bird species. Continentally, Eastern Deciduous Forest covers only a fraction of its former range where present physical conditions still favor its growth (Delcourt and Delcourt 2000). Protection here in the heart of the Eastern Deciduous Forest could reduce the disastrous effects of forest fragmentation on bird diversity and productivity experienced particularly in the Midwest (Robinson et al. 1995, Brawn and Robinson 1996, Robinson 1998), but in other areas of the East as well (Galli et al. 1976, Breininger 1999, Roberts and Norment 1999). Even in urbanizing parts of Connecticut, forest birds have declined (Butcher et al. 1981) and recovered only as reforestation occurred (Askins and Philbrick 1987). Moreover, such timely action could ensure the continued prospering of those bird species that have benefited from reforestation (Zeranski and Baptist 1990, Olianyk and Robertson 1996, Heusmann et al. 2000).

Let us reverse the situation. Suppose the conservation agencies of the westernmost of the midwestern states decided to declare the Tufted Titmouse (*Baeolophus bicolor)* endangered, because it occurs in only a handful of planted woodlands in the eastern corner of their states. Certainly this species cannot be as common as it was when its forest habitat was far more widespread (Delcourt and Delcourt 2000), but how would individuals in the Northeast, where it is common and expanding its range (Loery and Nichols 1985), view an attempt by these states to enhance Tufted Titmouse numbers by planting, irrigating, and perpetually managing more extensive forest stands (see also Bunnell et al. 2004)? Would they view this as a prudent expenditure of limited conservation funds (Master 1991), or would it seem more valuable for this prairie state to invest its efforts into restoring native prairie, thereby making these sites again suitable for the state's indigenous prairie avifauna?

Opportunities to secure the future of species such as the Grasshopper Sparrow, which has indeed suffered declines over parts of its range (although also increasing over areas of the Great Plains, Igl and Johnson 1997), would seem greatest in places like South Dakota, where the species reaches among its highest continental densities (Sauer et al. 2005). Moreover, with finite conservation funds available for prairie species like this one, habitat acquisition and restoration would appear far more cost effective in South Dakota, where land values are a fraction of those in urbanized, affluent Connecticut (see also Hunter and Hutchinson 1994, Lomolino and Channell 1995). Should we acquire and perpetually manipulate on behalf of prairie birds a 100-ha grassland island in otherwise forested Connecticut, or acquire 1000 ha of relatively low-maintenance grassland in prairie South Dakota? Making these types of conservation decisions is likely to be assisted by using the types of multivariable (e.g., abundance, range, population trend, fragility of populations) considerations employed in North

America by NatureServe (Wilcove and Master 2005) and Partners in Flight (Dunn et al. 1999, Beissenger et al. 2000, Rich et al. 2004), and in Britain by a similar multivariate approach (Avery et al. 1994).

Another issue raised in support of considering species termed here peripheral to be of conservation concern has been the occurrence in eastern North America of prairie species at the time of first European contact. Proponents argue that grasslands have been present in the Northeast for thousands of years, and that the existence of the Heath Hen (*Tympanuchus cupido cupido*) and other eastern races of grassland birds provide evidence for their long history in this region. Hence, grassland birds are an integral part of the Northeast's indigenous avifauna, and their present local rarity should be of critical conservation concern (Vickery and Dunwiddie 1997, Askins 2000).

Such reasoning is not necessarily valid justification. The not grassland but scrub-dwelling Heath Hen (Bent 1932, Johnsgard 1973) likely diverged from prairie populations of the Greater Prairie Chicken during the height of the Wisconsin glaciation, 21 000 years BP, when grasses and sedges covered the middle Atlantic states and appeared to merge with extensive scrublands covering the Atlantic coast (Webb et al. 1987, Parfit 2000). Indeed, the vegetation zones of eastern North America have been continually changing during this time, with principal habitats altering their distributions in response to a variety of changing physical and biotic conditions (Prentice et al. 1991). During this period, plant species have responded individualistically to changing conditions, such that plant associations with no contemporary counterparts have appeared and disappeared (Prentice et al. 1991, Jablonski and Sepkoski 1996), and principal community members have invaded and receded from areas due to a host of ecological factors (Woods and Davis 1989, Davis 1998, Fuller 1998).

The fluidity of North American vegetation zones has certainly also yielded fluidity in bird distributions during post-glacial times. Such range shifts are still apparent in bird species as continental conditions alter (Ellison 1993, Oliarnyk and Robertson 1996, Confer and Larkin 1997). Moreover, with the varying environments that have ebbed and flowed across the continent, we cannot presume that bird species even evolved in precisely the habitats in which we now find them, which in many cases are of comparatively recent origin (Jablonski and Sepkoski 1996). Given this dynamic North American environment, it is difficult to justify choosing a particular point in history as the baseline for making conservation decisions.

If we are to choose a point in history for making such decisions, what should it be? If we select the period of first European settlement, a point in time by which Native Americans had influenced habitat distributions (Delcourt and Delcourt 2000), bird distributions found by European explorers were already anthropogenically related (see also Hunter 1996). If we are concerned about the current distributions of birds in light of present human manipulations, it is unclear why we should choose another period in history when human manipulations influenced bird populations in other ways (including extending the edge of prairie provinces eastward, Robertson et al. 1997).

If we instead select the period just before first human settlement, ca. 12 000 yr BP (Morse and Morse 1983), places of present great conservation concern did not yet exist. For example, the tidal marshes of the Connecticut River have been the site of numerous ecological investigations (e.g., Ames and Mersereau 1964, Wiemeyer et al. 1975, Craig and Beal 1992) and the target of land acquisition by regional land trusts. Yet they did not exist at this time, as the shoreline was 10 m below its present level (Bloom and Stuiver 1963). Until 8000 yr BP, Long Island Sound, into which the Connecticut River drains, was a freshwater lake (Bell 1985). The Great Swamp National Wildlife Refuge and Troy Meadows, New Jersey, the site of major studies on freshwater marsh productivity (Jervis 1969), were beneath an extensive glacial lake (Robichaud and Buell 1973).

In short, that was then, and this is now. A key practical criterion for making regional conservation decisions is what habitats are possible given present climatic, physical, and biotic conditions, and prevailing patterns of human land use. Within this context, a continental view is essential for examining ecological systems and formulating effective conservation policy (Gore 1993, Maurer and Villard 1996, Wilcove and Master 2005).

A continental view of species characteristics is essential to constructing a meaningful view of regional patterns of endangerment, and suggests modified criteria for local endangered species

classification. Local rarity within a state may be an insufficient measure of extirpation risk. To this should be added 1) the region of principal natural habitat distribution, 2) continental distribution, 3) long-term, continent-wide population trends, 4) historic distributions in light of natural and anthropogenic habitats, 5) historic distributions within the context of the extent of ecologically sustainable natural habitat, and 6) the degree of human perturbation of natural systems.

In terms of ranking species according to importance, the probability of substantively impacting species survival through local management efforts also should be considered (see also Carter et al. 2000, Wilcove and Master 2005). To be sure, prioritization schemes such as those employed by NatureServe (Wilcove and Master 2005) have limitations, and it remains for statisticians to review thoroughly the logical validity of these schemes. I urge caution, for example, in using cumulative ranking in decision making, as such an approach has weaknesses (Beissenger et al. 2000), including non-independence of variables and the potential for variables to negate each other in ranking. I recommend instead an individualized assessment made from all available data, in part using considerations such as those applied by NatureServe (Wilcove and Master 2005) and Partners in Flight (Rich et al. 2004), along with additional considerations I list above that are not part of these schemes. Perhaps paramount among these latter considerations is that of practicality.

This discussion has considered whether local assessments of species endangerment translate to conservation policies with significant impacts at the continental scale. Examples presented demonstrate that little substantive conservation contribution is likely to be achieved by focusing on peripheral species receiving endangered status by virtue of arbitrary state boundaries. Moreover, including such species can distract finite conservation resources from issues in which local efforts can yield substantive conservation results. Arguments used to justify conservation efforts on behalf of species termed here peripheral have weaknesses when considered in light of continent-wide population trends, geographic ranges, and historic distributions, as well as the historic dynamism of the North American environment and practical considerations about the present nature of continental environments. A continental perspective in approaching local conservation issues is advocated, where local efforts contribute to the solution of continental problems.

Responses to this article can be read online at:
http://www.ace-eco.org/vol1/iss2/art1/responses/

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LITERATURE CITED

Ambuel, B., and S. A. Temple. 1982. Area-dependent changes in the bird communities and vegetation of southern Wisconsin forests. *Ecology* **64**:1057–1068.

Ames, P. L., and G. S. Mersereau. 1964. Some factors in the decline of the Osprey in Connecticut. *Auk* **81**:173–185.

Askins, R. A. 1997. History of grasslands in the northeastern United States: implications for bird conservation. Pages 119–136 *in* P. D. Vickery and P. W. Dunwiddie, editors. *Grasslands of northeastern North America*. Massachusetts Audubon Society, Lincoln, Massachusetts, USA.

———. 2000. *Restoring North America's birds*. Yale University Press, New Haven, Connecticut, USA.

Askins, R. A., and M. J. Philbrick. 1987. Effects of changes in regional forest abundance on the decline and recovery of forest bird community. *Wilson Bulletin* **99**:7–21.

Avery, M., D. W. Gibbons, R. Porter, T. Tew, G. Tucker, and G. Williams. 1995. Revising the British Red Data List for birds: the biological basis of U.K. conservation priorities. *Ibis* **137**:S232–S239.

Bell, J. L., and R. C. Whitmore. 1997. Eastern Towhee numbers increase following defoliation by gypsy moths. *Auk* **114**:708–716.

Bell, M. 1985. *The faces of Connecticut*. Connecticut Geological and Natural History Survey, Hartford, Connecticut, USA.

Beissinger, S. R., J. M. Reed, J. M. Wunderle, Jr., S. K. Robinson, and D. M. Finch. 2000. Report of the AOU Conservation Committee on the partners in flight species prioritization plan. *Auk* **117**:549–561.

Bent, A. C. 1932. Life histories of North American gallinaceous birds. *U.S. National Museum Bulletin* 162.

Bloom, A. L., and M. Stuiver. 1963. Submergence of the Connecticut coast. *Science* **139**:332–334.

Bohlen, H. D. 1989. *The birds of Illinois*. Indiana University Press, Bloomington, Indiana, USA.

Bollinger, E. K., and E. T. Linder. 1994. Reproductive success of neotropical migrants in a fragmented forest. *Wilson Bulletin* **106**:35–45.

Brauning, D. W, editor. 1992. *Atlas of the breeding birds of Pennsylvania*. University of Pittsburgh Press, Pittsburgh, Pennsylvania, USA.

Brawn, J. D., and S. K. Robinson. 1996. Source–sink population dynamics may complicate the interpretation of long term census data. *Ecology* **77**:3–12.

Breininger, D. R. 1999. Florida Scrub Jay demography and dispersal in a fragmented landscape. *Auk* **116**:520–527.

Brown, J. H. 1984. On the relationship between abundance and distribution of species. *American Naturalist* **124**:255–279.

Budoff, C. 2000. Rare birds nest in path of UConn stadium. *Hartford Courant* **162**(228):A1–A11.

Bull, J. 1974. *Birds of New York State*. Doubleday, Garden City, New York, USA.

Bunnell, F. L., R. W. Campbell, and K. A. Squires. 2004. Conservation priorities for peripheral species: the example of British Columbia. *Canadian Journal of Forest Research* **34**:2240–2247.

Butcher, G. S., W. A. Niering, W. J. Barry, and R. H. Goodwin. 1981. Equilibrium biogeography and the size of nature preserves: an avian case study. *Oecologica* **49**:29–37.

Carter, M. F., W. C. Hunter, D. N. Pashley, and K. W. Rosenberg. 2000. Setting conservation priorities for landbirds in the United States: the partners in flight approach. *Auk* **117**:5541–548.

Cody, M. L. 1985. Habitat selection in grassland and open country birds. Pages 191–226 *in* M.L. Cody, editor. *Habitat selection in birds* Academic Press, Orlando, Florida, USA.

Confer, J. L., and J. L. Larkin. 1998. Behavioral interactions between Golden-winged and Blue-winged Warblers. *Auk* **115**:209–214.

Craig, R. J. 1975. *Distributional ecology of marsh birds of the Connecticut River*. Thesis, University of Connecticut, Storrs, Connecticut, USA.

———. 1979. *The rare vertebrates of Connecticut*. U.S. Soil Conservation Service, Storrs, Connecticut, USA.

———. 1990. Historic trends in the distributions and populations of estuarine marsh birds of the Connecticut River. *University of Connecticut Agricultural Experiment Station Research Report* 83.

———. 1992. Territoriality, habitat use, and ecological distinctness of an endangered Pacific island reed-warbler. *Journal of Field Ornithology* **63**:93–110.

Craig, R. J., E. S. Mitchell, and J. E. Mitchell. 1988. Time and energy budgets of Bald Eagles wintering along the Connecticut River. *Journal of Field Ornithology* **59**:22–32.

Craig, R. J., and K. G. Beal. 1992. The influence of habitat variables on marsh bird communities of the Connecticut River estuary. *Wilson Bulletin* **104**:295–311.

Craig, R. J., and E. Taisacan. 1994. Notes on the ecology and population decline of the Rota Bridled White-eye. *Wilson Bulletin* **106**:165–169.

Craig, R. J., M. Altshul, and K. G. Beal. 2003. *Forest birds of the last green valley*. Bird Conservation Research, Inc., Putnam, Connecticut, USA.

Davis, M. B. 1998. Patchy invasion and the origin of a hemlock–hardwood forest mosaic. *Ecology* **79**:2641–2659.

Delcourt, H. R., and P. A. Delcourt. 2000. Eastern deciduous forests. Pages 359–396 *in* M. G. Barbour and W. D. Billings, editors. *North American terrestrial vegetation.* 2nd edition. Cambridge University Press, New York, New York, USA.

Dickson, D. R., and C. L. McAfee. 1988. Forest statistics for Connecticut—1972 and 1985. *USDA Forest Service Resource Bulletin* NE-105.

Dinsmore, J. J., T. H. Kent, D. Koenig, P. C. Peterson, and D. M. Roosa. 1991. *Iowa birds.* Iowa State University Press, Ames, Iowa, USA.

Dowhan, J. J., and R. J. Craig. 1976. Rare and endangered species of Connecticut and their habitats. *Connecticut Geological and Natural History Survey Report of Investigations* 6.

Dunn, E. H. 2002. Using decline in bird populations to identify needs for conservation action. *Conservation Biology* **16**:1632–1637.

Dunn, E. H., D. J. T. Hussell, and D. A. Welsh. 1999. Priority-setting tool applied to Canada's landbirds based on concern and responsibility for species. *Conservation Biology* **13**:1404–1415.

Dunwiddie, P. W., W. A. Patterson, III, J. L. Rudnicke, and R. E. Zaremba. 1997. Vegetation management on coastal grasslands on Nantucket Island, Massachusetts: effects of burning and mowing from 1982 to 1993. Pages 85–98 *in* P. D. Vickery and P. W. Dunwiddie, editors. *Grasslands of northeastern North America*. Massachusetts Audubon Society, Lincoln, Massachusetts, USA.

Eddleman, W. R., F. L. Knopf, B. Meanley, F. A. Reid, and R. Zembal. 1988. Conservation of North American rallids. *Wilson Bulletin* **100**:458–475.

Ellison, W. G. 1993. Historical patterns of vagrancy by Blue-gray Gnatcatchers in New England. *Journal of Field Ornithology* **64**:358–366.

Frayer, W. E., T. J. Monohan, D. C. Bowden, and F. A. Graybill. 1983. *Status and trends of wetlands in deepwater habitats in the conterminous United States, 1950s to 1970s.* U.S. Fish and Wildlife Service, National Wetlands Inventory.

Fuller, J. L. 1998. Ecological impact of the mid-Holocene hemlock decline in southern Ontario, Canada. *Ecology* **79**:2337–2351.

Galli, A. E., C. F. Leck, and R. T. T. Forman. 1976. Avian distribution patterns in forest islands of different sizes in central New Jersey. *Auk* **93**:356–364.

Gore, A. 1993. *Earth in the balance: ecology and the human spirit.* Penguin, New York, New York, USA.

Granfors, D. A., K. E. Church, and L. M. Smith. 1996. Eastern Meadowlarks nesting in rangelands and Conservation Reserve Program fields in Kansas. *Journal of Field Ornithology* **67**:222–235.

Hagen, J. M. III. 1993. Decline of the Rufous-sided Towhee in the eastern United States. *Auk* **110**:863–874.

Havera, S. P., L. B. Suloway, and J. E. Hoffman. 1997. Wetlands in the Midwest with special reference to Illinois. Pages 88–104 *in* M. W. Schwartz, editor. *Conservation in highly fragmented landscapes.* Chapman and Hall, New York, New York, USA.

Heusmann, H. W. , T. W. Early, and B. J. Nikula. 2000. Evidence of an increasing Hooded Merganser population in Massachusetts. *Wilson Bulletin* **112**:413–415.

Hill, N. P., and J. M. Hagen, III. 1991. Population trends of some northeastern North American landbirds: a half-century of data. *Wilson Bulletin* **103**:165–182.

Hunter, M. L. Jr. 1996. Benchmarks for managing ecosystems: are human activities natural? *Conservation Biology* **10**:695.

Hunter, M. L. Jr., and A. Hutchinson. 1994. The virtues and shortcomings of parochialism: conserving species that are locally rare, but globally common. *Conservation Biology* **8**:1163–1165.

Igl, L., and D. H. Johnson. 1997. Changes in breeding bird populations in North Dakota. *Auk* **114**:74–92.

Jablonski, D. J., and J. J. Sepkoski, Jr. 1996. Paleobiology, community ecology, and scales of ecological patterns. *Ecology* **77**:1367–1378.

Jackson, L. S., C. A Thompson, and J. J. Dinsmore. 1996. *The Iowa breeding bird atlas*. University of Iowa Press, Iowa City, Iowa, USA.

James, F. C., C. E. McColloch, and D. A. Wiedenfeld. 1996. New approaches to the analysis of population trends in land birds. *Ecology* **77**:13–27.

Janssen, R. B. 1987. *Birds in Minnesota*. University of Minnesota Press, Minneapolis, Minnesota, USA.

Jervis, R. A. 1969. Primary production in the freshwater marsh ecosystem of Troy Meadows, New Jersey. *Bulletin of the Torrey Botanical Club* **96**:209–231.

Johnsgard, P. A. 1973. *Grouse and quails of North America*. University of Nebraska Press, Lincoln, Nebraska, USA.

Johnson, D. H., and L. D. Igl. 1995. Contributions of the Conservation Reserve Program to populations of breeding birds in North Dakota. *Wilson Bulletin* **107**:709–718.

Jones, A. L., and P. D. Vickery. 1997. Distribution and population status of grassland birds in Massachusetts. Pages 187–199 *in* P. D. Vickery and P. W. Dunwiddie, editors. *Grasslands of northeastern North America*. Massachusetts Audubon Society, Lincoln, Massachusetts, USA.

Klute, D. S., R. J. Robel, and K. E. Kemp. 1997. Seed availability in grazed pastures and Conservation Reserve Program fields during winter in Kansas. *Journal of Field Ornithology* **68**:253–258.

Leck, C. F. 1984. *The status and distribution of New Jersey's birds*. Rutgers University Press, New Brunswick, New Jersey, USA.

Loery, G., and J. D. Nichols. 1985. Dynamics of a Black-capped Chickadee population, 1958–1983. *Ecology* **66**:1195–1203.

Lomolino, M. V., and R. Channell. 1995. Splendid isolation: patterns of range collapse in endangered mammals. *Journal of Mammalogy* **76**:335–347.

Ludwig, D. 1999. Is it meaningful to estimate a probability of extinction? *Ecology* **80**:298–310.

Marti, C. D. 1997. Lifetime reproductive success in Barn Owls near the limits of the species' range. *Auk* **114**:581–592.

Master, L. L. 1991. Assessing threats and setting priorities for conservation. *Conservation Biology* **5**:559–563.

Maurer, B. A., and M. Villard. 1996. Continental scale ecology and neotropical migratory birds: how to detect declines amid the noise. *Ecology* **77**:1–2.

May, D. 2000. DEP defends wildlife policy. *Hartford Courant* **162**(233):A9.

Morse, D. F., and P. A. Morse. 1983. *Archaeology of the Central Mississippi Valley*. Acadamic Press, New York, New York, USA.

Mumford, R. E., and C. E. Keller. 1984. *The birds of Indiana*. Indiana University Press, Bloomington, Indiana, USA.

Oliarnyk, C. J., and R. J. Robertson. 1996. Breeding behavior and reproductive success of Cerulean Warblers in southeastern Ontario. *Wilson Bulletin* **108**:673–684.

Parfit, M. 2000. Hunt for the first Americans. *National Geographic* **198**:40–67.

Peterjohn, B. G., J. R. Sauer, and W. A. Link. 1997. The 1994 and 1995 summary of the North American Breeding Bird Survey. *Bird Populations* **3**:48–66.

Poole, A. R. and F. Gill, editors. 1992–1997. *The birds of North America*. The Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D. C., USA.

Post, W., and F. Enders. 1969. Reappearance of the Black Rail on Long Island. *Kingbird* **19**:189–191.

Potter, E. F., J. F. Parnell, and R. P. Teulings. 1980.

Birds of the Carolinas. University of North Carolina Press, Chapel Hill, North Carolina, USA.

Prentice, I. C., P. J. Bartelin, and T. Webb, III. 1991. Vegetation and climate change in eastern North America since the last glacial maximum. *Ecology* **72**:2038–2056.

Probst, J. R., and J. P. Hayes. 1987. Pairing success of Kirtland's Warblers in marginal vs. suitable habitat. *Auk* **104**:234.241.

Pulliam, H. R. 1988. Sources, sinks, and population regulation. *American Naturalist* **132**:652–661.

Rappole, J. H., and M. V. McDonald. 1994. Cause and effect in population declines of migratory birds. *Auk* **111**:652–660.

Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Iñigo-Elias, J. A. Kennedy, A. M. Martell, A. O. Panjabi, D. N. Pashley, K. V. Rosenberg, C. M. Rustay, J. S. Wendt, T. C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Laboratory of Ornithology, Ithaca, New York, USA.

Ricketts, T. H., E. Dinerstein, D. M. Olson, C. J. Loucks, W. Eichbaum, D. DellaSala, K. Kavanagh, P. Hedao, P. T. Hurley, K. M. Carney, R. Abell, and S. Walters. 1999. Terrestrial ecoregions of North America. Island Press, Washington, D.C., USA

Roberts, C., and C. J. Norment. 1999. Effects of plot size and habitat characteristics on breeding success in Scarlet Tanagers. *Auk* **116**:73–82.

Robertson, K. R., R. C. Anderson, and M. W. Schwartz. 1997. The tallgrass prairie mosaic. Pages 55–87 *in* M. W. Schwartz, editor. *Conservation in highly fragmented landscapes.* Chapman and Hall, New York, New York, USA.

Robichaud, B., and M. F. Buell. 1973. *Vegetation of New Jersey*. Rutgers University Press, New Brunswick, New Jersey, USA.

Robinson, S. K. 1998. Another threat posed by forest fragmentation: reduced food supply. *Auk* **115**:1–3.

Robinson, S. K., F. R. Thompson III, T. M Donovan, D. R. Whitehead, and J. Faaborg. 1995. Regional forest fragmentation and the nesting success of migratory birds. *Science* **267**:1987–1990.

Robinson, S. K., J. D. Brawn, and J. P. Hoover. 1997. Effectiveness of small nature preserves for breeding birds. Pages 154–188 *in* M. W. Schwartz, editor. *Conservation in highly fragmented landscapes.* Chapman and Hall, New York, New York, USA.

Sauer, J. R., J. E. Hines, and J. Fallon. 2005. *The North American Breeding Bird Survey, results and analysis 1966–2004. Version 2005.2*, USGS Patuxent Wildlife Research Center, Laurel, Maryland, USA.

Schwartz, M. W. 1997. Introduction. Pages xii–xvi *in* M. W. Schwartz, editor. *Conservation in highly fragmented landscapes.* Chapman and Hall, New York, New York, USA.

Sherry, T. W., and R. T. Holmes. 1996. Winter habitat quality, population limitations, and conservation of neotropical-neartic migrant birds. *Ecology* **77**:36–48.

Spear, L. B., S. B. Terrill, C. Lenihan, and P. Delevoraves. 1999. Effects of temporal and environmental factors on the probability of detecting California Black Rails. *Journal of Field Ornithology* **70**:465–480.

Szantyr, M. 2000. DEP's stance not for the birds. *Hartford Courant* **162**(230):A19.

Teal, J. M. 1986. The ecology of regularly flooded salt marshes of New England: a community profile. *U.S. Fish and Wildlife Service Biological Report* **85** (7.4).

Thomas, L. 1996. Monitoring long-term population changes: why are there so many analysis methods? *Ecology* **77**:49–58.

Thompson, C. F., and V. Nolan, Jr. 1973. Population biology of the Yellow-breasted Chat in southern Indiana. *Ecological Monographs* **43**:145–171.

Thrall, P. H., J. J. Burdon, and B. R. Murray. 2000. The metapopulation paradigm: a fragmented view of conservation biology. Pages 75–95 *in* A. G.

Young and G. M. Clarke, editors. *Genetics, demography and viability of fragmented populations.* Cambridge University Press, New York, New York, USA.

U.S. Fish and Wildlife Service. 1989. *National wetlands priority conservation plan*. U.S. Fish and Wildlife Service, Washington, D.C., USA.

van Horn, M. A., R. M. Gentry, and J. Faaborg. 1995. Patterns of Ovenbird (*Seiurus aurocapillus*) pairing success in Missouri forest tracts. *Auk* **112**:98–106.

Vickery, P. D., and P. W. Dunwiddie. 1997. Introduction. Pages 1–13 *in* P. D. Vickery and P. W. Dunwiddie, editors. *Grasslands of northeastern North America*. Massachusetts Audubon Society, Lincoln, Massachusetts, USA.

Vickery, P. D., M. L. Hunter, Jr., and S. Melvin. 1997. Effects of habitat area on the distribution of grassland birds in Maine. Pages 137–152 *in* P. D. Vickery and P. W. Dunwiddie, editors. *Grasslands of northeastern North America*. Massachusetts Audubon Society, Lincoln, Massachusetts, USA.

Villard, M-A., P. R. Martin, and C. G. Drummond. 1993. Habitat fragmentation and pairing success of the Ovenbird. *Auk* **110**:759–768.

Villard, M., and B. A. Maurer. 1996. Geostatistics as a tool for examining hypothesized declines in migratory songbirds. *Ecology* **77**:59–68.

Ward, J. S., and J. B. Barsky. 2000. Connecticut's changing forests. *Connecticut Woodlands* **65**:9–13.

Webb, T. III, G. L. Jacobson, Jr., and E. C. Grimm. 1987. Changing vegetation patterns in eastern North America during the past 18 000 years; inferences from overlapping distribution of selected pollen types. Plate 2 *in* W. F. Ruddiman and H. E. Wright, Jr., editors. *North America and adjacent oceans during the last deglaciation.* Geological Society of America, Boulder, Colorado, USA.

Weimeyer, S. N., P. R. Spitzer, W. C. Krantz, T. G. Lamont, and E. Cromartie. 1975. Effects of environmental pollutants on Connecticut and Maryland Ospreys. *Journal of Wildlife Management* **39**:124–139.

Weinberg, H. J., and R. R. Roth. 1998. Forest area and habitat quality for nesting Wood Thrushes. *Auk* **115**:879–889.

Wells, J. V. 1997. Population viability analysis for Maine Grasshopper Sparrows. Pages 153–170 *in* P. D. Vickery and P. W. Dunwiddie, editors. *Grasslands of northeastern North America*. Massachusetts Audubon Society, Lincoln, Massachusetts, USA.

Wiens, J. A. 1974. Climatic instability and the "ecological saturation" of bird communities of North American grasslands. *Condor* **76**:385–4000.

Wilcove, D. S., and L. L. Master. 2005. How many endangered species are there in the United States? Frontiers in Ecology and the Environment 8:414–420.

Winne, J. C. 1997. History of vegetation and fire on the Pineo Ridge pine grassland barrens of Washington County, Maine. Pages 25–52 *in* P. D. Vickery and P. W. Dunwiddie, editors. *Grasslands of northeastern North America*. Massachusetts Audubon Society, Lincoln, Massachusetts, USA.

Woods, K. D., and M. B. Davis. 1989. Paleoecology of range limits: beech in the upper peninsula of Michigan. *Ecology* **70**:681–696.

Zeranski. J. D., and T. R. Baptist. 1990. *Connecticut Birds*. University Press of New England, Hanover, New Hampshire, USA.

APPENDIX 1. Listed endangered species of the northeastern and midwestern states. Habitat designations: w = wetland, p = prairie, f = forest, s = successional, n = not defined; status designations: e = endangered, p = peripheral; P = probability.

	Habitat	Trend	P	ME	NH	VT	MA	CT	RI	NY	PA	NJ	ND	MN	WI	SD	NE	IA	IL	IN	KS	MO	OK
Common Loon (*Gavia immer*)	w	2.36	0.00			e																	
Pied-billed Grebe (*Podilymbus podiceps*)	w	1.11	0.24		e		e	e	e			e											
Red-necked Grebe (*Podiceps grisegena*)	w	1.05	0.35												p								
Leach's Storm-petrel (*Oceanodroma leucorhoa*)	w						p																
American Bittern (*Botaurus lentiginosus*)	w	-1.54	0.06				e	e	e			e								e	e		e	
Least Bittern (*Ixobrychus exilis*)	w	-0.55	0.73				e													e			
Snowy Egret (*Egretta thula*)	w	4.90	0.00												p				p			e	
Little Blue Heron (*Egretta caerulea*)	w	-2.48	0.03																p				
Black-crowned Night Heron (*Nycticorax nycticorax*)	w	3.66	0.07																e	e			
Yellow-crowned Night Heron (*Nyctanassa violacea*)	w	-1.07	0.54								p								p	e			
Trumpeter Swan (*Cygnus buccinator*)	w														e					e			
Osprey (*Pandion haliaetus*)	w	6.25	0.00			e													p	p			
Mississippi Kite (*Ictinia mississippiensis*)	n	0.34	0.78																e				
Bald Eagle (*Haliaeetus leucocephalus*)	w	6.13	0.02				e	e			e		e			e	e	e		e	e		
Northern Harrier (*Circus cyaneus*)	p,w	-1.34	0.00					e	e			e						e	e	e			
Sharp-shinned Hawk (*Accipiter striatus*)	f	3.65	0.14					e															

(con'd)

Red-shouldered Hawk (*Buteo lineatus*)	f	2.70	0.00																	p											
Swainson's Hawk (*Buteo swainsoni*)	p	-0.46	0.39																			p									
Golden Eagle (*Aquila chrysaetos*)	n	1.46	0.40	p	p					p																					
Peregrine Falcon (*Falco peregrinus*)	n	6.77	0.06	e	e	e	e	e	e	e	e		e		e	e	e	e			e	e	e								
Spruce Grouse (*Falcipennis canadensis*)	f					p				e																					
Greater Prairie Chicken (*Tympanuchus cupido*)	p	-6.24	0.03																			e			e						
Black Rail (*Laterallus jamaicensis*)	w							p		p												e	e		e						
King Rail (*Rallus elegans*)	w	-7.58	0.00					p			e			e					e	e	e		e								
Virginia Rail (*Rallus limicola*)	w	2.65	0.01																		e										
Common Moorhen (*Gallinula chloropus*)	w	0.21	0.90					e																							
Whooping Crane (*Grus americana*)	w											e				e							e			e				
Sandhill Crane (*Grus canadensis*)	w	6.83	0.00																		e										
Piping Plover (*Charadrius melodus*)	w			e	e					e			e	e		e	e	e	e												
Upland Sandpiper (*Bartramia longicauda*)	p	0.69	0.03		p		p	p	p											e	e										
Eskimo Curlew (*Numenius phaeopus*)	w			e			e			e						e	e					e								
Wilson's Phalarope (*Phalaropus tricolor*)	w	0.78	0.35																	p											
Caspian Tern (*Sterna caspia*)	w	3.29	0.01												e																
Roseate Tern (*Sterna dougallii*)	w			e			e	e		e																					

(con'd)

Common Tern (*Sterna hirundo*)	w	-6.29	0.01		e	p				p			e				e							
Forster's Tern (*Sterna forsteri*)	w	0.62	0.40										e				p							
Least Tern (*Sterna antillarum*)	w	-1.25	0.60	e								e		e	e	e	e	e	e	e	e			
Black Tern (*Chlidonias niger*)	w	-1.48	0.34	p					e	p							e	e						
Barn Owl (*Tyto alba*)	n						e	e					p			p	e	e						
Burrowing Owl (*Althene cuncularia*)	p	-2.33	0.47									p												
Long-eared Owl (*Asio otus*)	f						e																	
Short-eared Owl (*Asio flammeus*)	p,w	-4.85	0.01				p		e	p	e						e	e						
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	n	-2.65	0.00					p																
Red-cockaded Woodpecker (*Picoides borealis*)	f	-1.54	0.31																					e
Bewick's Wren (Thryomanes bewickii)	s	-0.15	0.76										p				e	e						
Sedge Wren (*Cistothorus platensis*)	w	1.87	0.00	p	p		p	p										e						
Marsh Wren (*Cistothorus palustris*)	w	3.31	0.00															e						
Sprague's Pipit (*Anthus spragueii*)	p	-4.45	0.00									e												
American Pipit (*Anthus rubescens*)	n			p																				
Loggerhead Shrike (*Lanius ludovicianus*)	n	-3.82	0.00		p	p	p		p	p			e					e						
Black-capped Vireo (*Vireo atricappilus*)	n																			e				
Golden-winged Warbler (*Vermivora chrysoptera*)	s	-2.47	0.00				e											e						

(con'd)

Black-throated Blue Warbler (*Dendroica caerulescens*)	f	0.97	0.28						p													
Yellow-throated Warbler (*Dendroica dominica*)	f	0.93	0.05												p							
Kirtland's Warbler (*Dendroica kirtlandii*)	s																			e		
Worm-eating Warbler (*Helmitheros vermivorus*)	f	1.21	0.12												p							
Swainson's Warbler (*Limnothlypis swainsonii*)	w	8.62	0.03																p			p
Yellow-breasted Chat (*Icteria virens*)	s	0.02	0.95					p														
Bachman's Sparrow (*Aimophila aestivalis*)	n	-1.97	0.19																	p		p
Vesper Sparrow (*Pooecetes gramineus*)	p	-1.07	0.00					p														
Baird's Sparrow (*Ammodramus bairdii*)	p	-3.96	0.00											e								
Grasshopper Sparrow (*Ammodramus savannarum*)	p	-3.76	0.00	p				p														
Henslow's Sparrow (*Ammodramus henslowii*)	p	-8.68	0.00		p	p	p							e					e	e		
Chestnut-collared Longspur (*Calcarius ornatus*)	p	-2.71	0.00											e								
Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*)	w	0.92	0.14																e	p		