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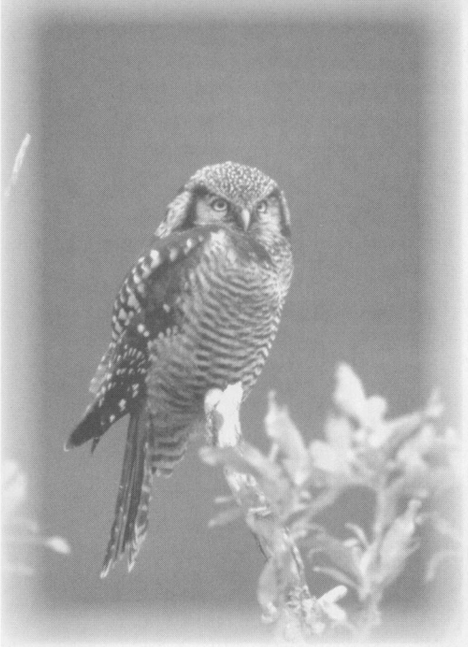

Sustaining biological diversity in early successional communities: the challenge of managing unpopular habitats

by Robert A. Askins

Between 1750 and 1940, a wave of forest clearing swept across the eastern United States (Williams 1989, Pimm and Askins 1995). Its pace accelerated in the nineteenth century as settlers moved westward from the Atlantic coastal plain. The tall deciduous forests of the Ohio Valley were felled and burned to create farmland, and northern coniferous forests were converted to stumps and logging debris. In the late nineteenth century, large-scale timber harvesting shifted to the pine woodlands and bottomland hardwood forests of the Southeast. Only small woodlots remained in the wake of logging and settlement in many parts of the East. Given this history of widespread forest clearing, it is not surprising that propagation of trees and protection of forests became almost synonymous with conservation in eastern North America. Wetlands received protection much later, and natural shrublands and grasslands (habitats that resembled the fields and pastures that had replaced the forests) were largely ignored.

One of the most dramatic examples of the low priority given to open habitats was the destruction of the Hempstead Plains of Long Island, a 20,000-ha little bluestem prairie with a great diversity of specialized grassland plants and birds (Askins 2000). Most of this grassland was developed in the 1940s and 1950s without notable opposition from conservation organizations or ecologists. By the 1960s, this bluestem prairie had been reduced to a 240-ha patch at Mitchel Field, a military airfield. After the airfield was decommissioned in 1968, conservation groups led by The Citizens for the Hempstead Plains were able to save only 2 tiny relict patches of native grassland (both less than 25 ha). Other open habitats, such as coastal scrublands, oak savannas, and pine savannas, have met a similar fate in virtually every region of eastern North America. Of the ecosystems in eastern North America that have declined by >98%, 55% are grassland, savanna, and barren communities and 24% are shrubland communities (Noss et al. 1995, Thompson and DeGraaf 2001). Even open habitats that have not been decimated to this extent have been greatly reduced. For example, >90% of the coastal heathlands of Long Island and New England and 69% of the pocosins (evergreen shrub bogs) of the southeastern coastal plain have been destroyed (Noss et al. 1995).

The identification of conservation with woodlands remained strong in eastern North America long after many of the forests had grown back. Forest now covers more than 81% of New England and 54% of the Middle Atlantic states (Trani et al. 2001). The amount of forest in these regions and in the Southeast has increased progressively since the late 1800s, primarily because of farm abandonment (Pimm and Askins 1995). As Williams (1989: 471) points out, although abandonment of farmland was one of the predominant patterns of land-use change in eastern North America during this period, it was largely ignored because it conflicted with notions of

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progress and the advance of civilization: "In a society imbued with the frontier ideals of development, progress, and the virtues of forest clearing, [farm] abandonment was retrogressive, difficult to comprehend, and even sinful to contemplate."

Many species that thrived during the period of farm abandonment because of the prevalence of abandoned pastures and old fields have subsequently declined to dangerously low levels (Askins 1998, Hunter et al. 2001). Many of these species are probably native to the eastern forest region, originally depending on open habitats that were widespread before European settlement (Hunter et al. 2001, Lorimer 2001). These species are in trouble not only because of the intensification of farming and declining numbers of pastures, hay meadows, and abandoned fields, but also because of the suppression of natural disturbances—fires, beaver (*Castor canadensis*) activity, and floods—that generate natural grasslands and shrublands.

Resource managers who are responsible for extensive wilderness areas can manage for early successional habitats in a straightforward way by permitting or re-introducing natural disturbances.

Certainly the loss of old-growth forests and the degradation and fragmentation of second-growth forests in eastern North America are major concerns, but another legitimate concern is the decline of early successional habitats dominated by grass, shrubs, or young trees. Frank Thompson, Richard DeGraaf, and Margaret Trani organized this special section to address this concern. The papers in this special issue demonstrate convincingly that without active management we will lose some of the most interesting and diverse natural communities in eastern North America.

Perceptions of beauty and conservation priorities

A major barrier to actively sustaining or restoring open habitats is the common perception that these habitats are uninteresting or even unappealing. This is less true of meadows and other grasslands, which are associated with wildflower displays and a diversity of conspicuous and colorful butterflies and birds. As Gobster (2001) points out, however, shrublands and young forests are typically closed and monotonous, without the open views and coherent patterns that people generally prefer in landscapes. Compounding this problem, most of the animals associated with shrublands are reclusive and well hidden, so only experienced hunters and birders are likely to seek out these habitats to find animals (Gobster 2001). In addition, many contemporary shrublands and regenerating forests are produced by activities that conservationists often oppose. Species that depend on low, woody vegetation tend to be concentrated in powerline corridors, abandoned pastures, and clearcuts. In preserved areas, maintaining shrubland habitat is frequently controversial because it requires removing trees to favor vegetation associated with human disturbance.

Regional variation in shrubland declines

Trani et al. (2001) present a thorough analysis of trends in abundance of early successional woody habitats in different regions of eastern North America. The percentage of timberland in the "seedling–sapling" stage (areas dominated by young trees <12.7 cm in diameter) ranges from 16% in the Northeast to 32% in the coastal Southeast. The amount of young, regenerating forest has declined steadily in regions such as southern New England and the Middle Atlantic states, where the rate of farm abandonment has slowed in recent decades and where large-scale timber harvesting is infrequent. As Trani et al. (2001) point out, however, young woody vegetation is widespread in Maine and the Great Lakes states because of forest harvesting and in Ohio because of recent abandonment of farmland. Hence, trends in the availability of early successional habitat vary greatly in different regions.

Not surprisingly, some of the most severe declines in shrubland-dependent species have occurred in the Northeast (Witham and Hunter 1992, Askins 1993, Litvaitis 2001), where previously common shrubland specialists, such as New England cottontail (*Sylvilagus transitionalis*), golden-winged warbler (*Vermivora chrysoptera*), and yellow-breasted chat (*Icteria virens*), now appear on state lists of endangered and threatened species. In contrast, populations of some of the shrubland species associated with the boreal forests of Maine and the Great Lakes states, such as Nashville warbler (*Vermivora ruficapilla*) and Lincoln's sparrow (*Melospiza lincolnii*), have increased significantly in recent decades (Hunter et al. 2001), probably because they thrive in forest openings resulting from timber harvesting. Superficially, it would appear that shrubland species should show a similar pattern in the coastal Southeast because 35% of the timberland is in the seedling–sapling stage

(Trani et al. 2001), but many shrubland specialists are declining in this region (Krementz and Christie 2000). Many of the young forests in the Southeast are intensively managed pine plantations. Intensive timber management reduces the duration and diversity of the vegetation of low-stature, regenerating forest and consequently may diminish its value as habitat for early successional species of animals (Dickson et al. 1995, Hunter et al. 2001). We therefore need to be attuned to the different types of early successional habitat encompassed in the "seedling–sapling" and "non-stocked" categories in forest inventories.

Types of early successional, woody habitat

Lorimer (2001) makes an important distinction between "successional habitat" dominated by pioneer species and "young forest habitat" dominated by young stands of late successional species. Successional habitat occurs where plants colonize treeless areas created by river action, glaciation, or abandonment of cleared land. When people abandon farmland or beavers abandon impounded streams, the resulting old field or beaver meadow is eventually colonized by pioneer species of vines, shrubs, and trees (Figure 1, Thompson and DeGraaf 2001). In contrast, disruption or destruction of the forest canopy by fire, insect outbreaks, wind storms, or logging results in a young forest dominated by short sprouts and seedlings of mature forest trees, along with surviving shrubs and herbs from the original forest understory. Both types of habitat are dominated by low, woody vegetation, but they differ greatly in vegetation structure. Also, young forest habitats usually are more transitory than are early successional habitats because tree saplings and sprouts grow up quickly, spreading their crowns to form a closed canopy that shades out many plants in the herb and shrub layers (Thompson and DeGraaf 2001).

Figure 1. Successional habitat on an abandoned pasture in Connecticut. This habitat supports a diversity of shrubland species.

Although the animal communities of these 2 general types of low, woody habitat are similar, there are some differences. Successional habitats typically have a larger proportion of woody vines and shrubs than do young forest habitats, so they attract species that favor dense thickets. For example, in southeastern Connecticut, white-eyed vireos (*Vireo griseus*) were common in the dense early successional habitat on powerline rights-of-way, but were not found in clearcuts that were dominated by young forest (Askins 1990, Askins unpublished data). Other species are more frequently associated with young forests than with early successional, shrub-dominated thickets. For example, ruffed grouse (*Bonasa umbellus*) do best in young, even-age deciduous forests, particularly aspen forests (Dessecker and McAuley 2001). More intensive forestry practices (e.g., tree planting and herbicide spraying) result in faster tree growth and more homogeneous vegetation, exaggerating the distinctive features of young forests and probably making them even less favorable to species associated with early successional thickets. The distinction between early successional thickets and young forest has received little attention from researchers, but it may be a key consideration in regional conservation planning.

Another potential consideration is the size of patches of particular types of shrubland habitat (Hunter et al. 2001, Thompson and DeGraaf 2001). As Noss et al. (1995) point out, in some cases preservation of small representative patches of particular habitat types, what they call the "living museum approach," may not protect all of the species associated with the habitat because many species are sensitive to the negative edge effects and isolation associated with habitat fragmentation. How frequently this applies to shrubland specialists is not clear, however, because many of these species may be adapted to colonizing small disturbance patches in heavily forested landscapes. Many shrubland species occupy and nest successfully in small, isolated shrubland patches (Rudnicky and Hunter 1993, Krementz and Chrisite 2000, Litvaitis 2001). Other species, however, may need large areas of shrubland (Hagan et al. 1997, Litvaitis et al. 2001, Thompson and DeGraaf 2001). Also, in regions with dense white-tailed deer (*Odocoileus virginianus*) populations, large openings may help reduce the impact of heavy browsing on the plant species composition of regenerating forest because deer tend to forage near the forest edge (Litvaitis 2001).

Hunter et al. (2001) emphasize another important consideration for conservationists that has received relatively

little attention: the group of species that are not normally found in large openings but instead depend on small openings (canopy gaps) in the forest. These canopy-gap species are typically associated with mature forest, but they depend on disruption of the canopy to produce patches of low, dense vegetation. For example, Hunter et al. (2001) classify the cerulean warbler (*Dendroica cerulea*), a species known to depend on large expanses of mature forest (Robbins et al. 1992), as a disturbance-dependent species because it is usually found near openings adjacent to tall trees. Openings of this sort are particularly frequent in old-growth forests, where the collapse of a single gigantic tree can tear a sizable hole in the forest canopy (Clebsch and Busing 1989).

Other mature forest species may depend on early successional habitats for cover or food at particular times of the year. Black bears (*Ursus americanus*) feed on forbs and berries in forest openings, but depend on acorns and other nuts found in mature forest during autumn (Litvaitis 2001). Forest openings also are used by fledgling and adult songbirds in late summer, following the breeding season (Pagen et al. 2000, Hunter et al. 2001).

How much disturbance is enough?

The immediate reason for the decline of many shrubland and grassland species is the decline of farming. Before open-field agriculture was introduced into eastern North America, however, these species depended on habitats created by natural disturbances. Suppression of these disturbances ultimately endangers many of these species. If natural grasslands and shrublands were still widely available, then early successional species would not be so dependent on old fields, powerlines, and clearcuts.

Before human settlement, extensive openings were created by fires, beavers, floods, and windstorms. In most contemporary forests, wildfires are suppressed, floodwaters are contained, and beavers have been trapped out or their effects on the environment have been tightly constrained. Even wind storms cause less damage to the forest canopy because most forests are young and densely stocked with trees, making them resistant to blowdowns (Hunter et al. 2001).

Restoration of natural landscapes requires the re-introduction or simulation of these disturbances. Often the goal is to approximate the proportion of each major habitat in the landscape at the time of European settlement. For some regions, initial land-survey data provide reasonable estimates of the percentage of land covered by different habitat types. Extensive agricultural clearing and burning were practiced by people for centuries before the arrival of European settlers, however, so it is not certain that the landscape patterns encountered by early surveyors reflected a natural disturbance regime. As Lorimer (2001) points out, it is usually difficult to determine whether openings resulted from anthropogenic or natural disturbances.

Another approach is to attempt to estimate the frequency of beaver meadows, wildfires, open floodplains, and blowdowns that would characterize a region without human activity. Information on the frequency of wind storms, lightning strikes, and floods, and on potential locations for beaver dams, could be used to model the natural pattern of disturbances, but as Lorimer (2001) emphasizes, the frequency of these disturbances has probably varied over time. Thompson and DeGraaf (2001) suggest that we can compensate for this by estimating the historic range of variation of different habitat types. This could encompass disturbance regimes before and after the period of extensive Native American agriculture and burning and during different climatic periods since the last glacial period. If each habitat type is kept within this historic range of variation, then we should be able to sustain species that depend on particular habitats.

At a minimum we should ensure that every habitat type is well enough represented to sustain viable populations of all native species. Given the strong evidence for the prevalence of open habitats in eastern North America, grassland and shrubland species should be considered native to a region unless there is historical evidence of a range expansion into the eastern forest region after forest clearing by Europeans. Evidence for an eastward range expansion exists for a few species, but not for most shrubland and grassland species (Askins 2000). Range expansion within the eastern forest region, such as the northward extension of the range of the golden-winged warbler (Confer 1992), should not be an issue, however, because disturbance-dependent species have probably always shifted their distributions from region to region in response to the availability of ephemeral habitat created by major disturbances. For conservation purposes, these species should be considered native unless the historical evidence clearly indicates otherwise. This should replace the common (but often implicit) assumption that grassland and shrubland species are interlopers to the eastern forest region that do not warrant much conservation concern.

Emphasizing historic ranges of variability and population viability for early successional species should provide the minimum amount of habitat needed. This will require careful regional planning to balance the needs of these species with other conservation needs (Thompson and DeGraaf 2001).

Managing shrubland habitats

These insights about the habitat needs of disturbance-dependent species indicate that there is no single prescription to manage low, woody habitat. Some species are favored by the dense shrubland on powerline corridors and in beaver meadows. Other species benefit more from the dense growth of small trees in clearcuts and blowdowns. Still other species depend on the small canopy gaps in group selection cuts and tree falls. All of these types of habitat should be available in a region to sustain the full range of native species. Except in regions with immense wilderness preserves, this goal cannot be achieved without coordination by land managers in different nature preserves, wildlife refuges, parks, public forests, and private forests across a region (Thompson and DeGraaf 2001).

Resource managers who are responsible for extensive wilderness areas can manage for early successional habitats in a straightforward way by permitting or re-introducing natural disturbances. The ecological role of wildfires in many natural ecosystems is now widely recognized. Beavers can be allowed to modify the landscape in areas where roads, buildings, and fields will not be flooded. As forests mature, large and small blowdowns should become more frequent. Studying the impact of these natural disturbances can tell us a lot about the habitat requirements of early successional species. In managed forests, timber harvests can be designed to produce favorable habitat for some early successional species.

In wildlife management areas and nature preserves, stable shrublands can be created by selectively removing trees to favor shrubs. This method has been used successfully by utility companies for several decades to maintain relatively stable shrubland communities on powerline corridors (Askins 1998, Thompson and DeGraaf 2001). By favoring some plant species and removing others, the edges of shrublands can be subtly modified to produce the depth and openness that often are missing from unmanaged shrubland habitats and to enhance the visibility of natural floral and fruiting displays (Figure 2, Niering 1975, Gobster 2001). As Gobster (2001:479) argues, it may be possible "to make some early successional landscapes more visually interesting and comfortable for people yet still maintain the importance and integrity of those landscapes for the wildlife and plant species that depend on them." This may be a first step in converting an ignored and even unpopular habitat into a valued resource that people are willing to protect and sustain.

Figure 2. Forest opening managed with naturalistic landscaping methods in the Connecticut College Arboretum. Fast-growing trees and other woody plants are selectively removed to create an attractive shrub community.

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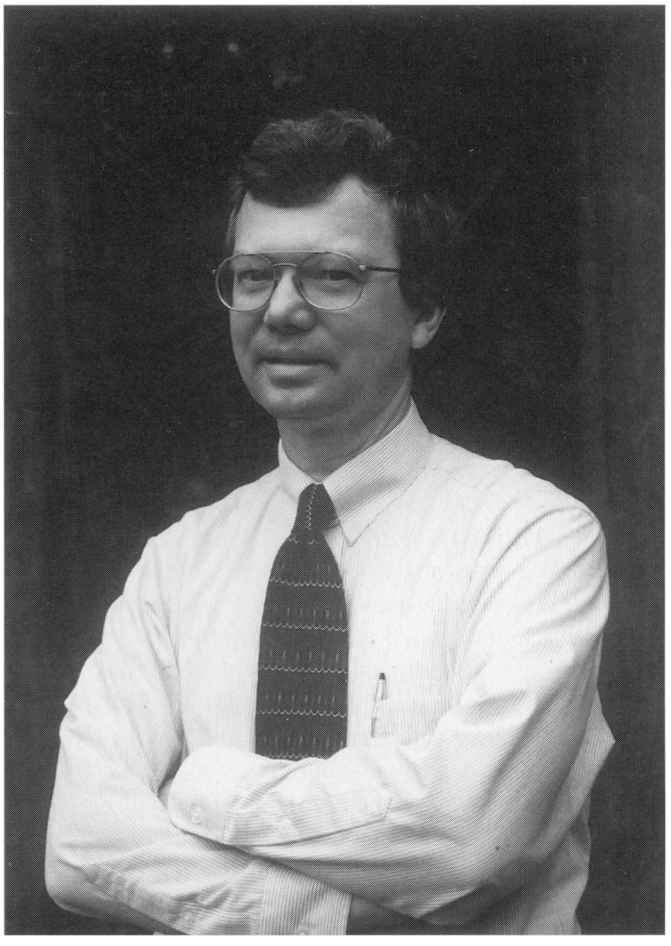

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