

INFLUENCE OF FIRE AND OTHER ANTHROPOGENIC PRACTICES ON GRASSLAND AND SHRUBLAND BIRDS IN NEW ENGLAND

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Abstract. The extent of grassland and shrubland habitat in New England has changed dramatically over the past 400 yr as a result of changing land uses. Presently, grasslands and shrublands in New England have been created and maintained primarily as a result of four types of habitat management: mowing, livestock grazing, clearcutting, and prescribed burning. Hayfields and pastures comprise the largest proportion of open land, approximately 718,500 ha. Clearcutting has created extensive shrubland patches in northern Maine, where 3.5% (243,000 ha) of the commercial forestland has been harvested in the past 20 yr, creating ephemeral, early successional shrublands used by a wide variety of warblers, sparrows, and other birds. The most widespread use of prescribed fire is agricultural and takes place on commercial lowbush blueberry (*Vaccinium angustifolium*) barrens in Maine, where approximately 3,000 ha are burned annually. These barrens are especially important habitats for Upland Sandpipers (*Bartramia longicauda*) and Vesper Sparrows (*Poocetes gramineus*). The scale of ecological prescribed burns in New England for habitat management of endangered ecosystems has been small; in recent years fewer than 300 ha have been burned annually. The effects of burning differ in grasslands versus shrublands. In native grasslands, burning has a strong effect on vegetation structure, which, in turn, has clear effects on most grassland specialist birds. Shrubland fires have less impact on shrubland birds because most of the woody structure remains intact.

Key Words: blueberry barrens, farmland, grassland birds, New England, prescribed fire, shrubland birds.

INFLUENCIA DEL FUEGO Y OTRAS PRÁCTICAS ANTROPOGÉNICAS EN AVES DE PASTIZALES Y ARBUSTOS EN NUEVA INGLATERRA

Resumen. La extensión de hábitats de pastizales y matorrales ha cambiado drásticamente en los últimos 400 años en Nueva Inglaterra, debido a los cambios en el uso del suelo. Actualmente, los pastizales y matorrales en Nueva Inglaterra han sido creados y mantenidos principalmente por el resultado de cuatro tipos de manejo del hábitat: segar, pastoreo, tala-rasa, y quemadas prescritas. Campos de heno y pastizales comprenden la proporción más grande de tierras abiertas, aproximadamente 718,500 ha. Los aprovechamientos forestales han creado extensos parches de matorral en la parte norte de Maine, donde 3.5% ((243,000 ha) del bosque comercial ha sido aprovechado en los últimos 20 años, creando matorrales efímeros de sucesión temprana, utilizados por gran cantidad de aves (*Dendroica* spp.) y (*Ammodramus* spp.), entre otras. El uso más recurrido en quemadas prescritas, es el de la agricultura, y tiene lugar en arbustos bajos de (*Vaccinium angustifolium*) in Maine, donde aproximadamente 3,000 ha son quemadas anualmente. Estas campo de arbustos bajos, son especialmente hábitats importantes para aves tales como (*Bartramia longicauda*) y (*Poocetes gramineus*). La escala de las quemadas ecológicas prescritas para manejo del hábitat de ecosistemas en peligro en Nueva Inglaterra ha sido baja; en años recientes menos de 300 ha han sido quemadas anualmente. Los efectos del fuego difieren en los pastizales contra los matorrales. En pastizales nativos, los incendios tienen un fuerte efecto en la estructura de la vegetación, lo cual, por el otro lado, tiene efectos claros en la mayoría de las aves especializadas de pastizales. Los incendios en matorrales tienen menor impacto en las aves de matorral, debido a que la mayor parte de la estructura de madera permanece intacta.

Native grasslands and shrublands in New England were historically the result of natural disturbances (e.g., wind, fire, disease, beaver [*Castor canadensis*] meadows, insect damage, or a combination of these forces). Although fires were not usually a frequent form of disturbance in New England forests, they had profound effects on vegetation, and therefore birds, and sometimes burned thousands of hectares (Whitney 1994). Fire and other disturbances created habitat for a distinctive suite of grassland and shrubland birds, including the now

extinct Heath Hen (*Tympanuchus cupido cupido*), the eastern form of the Greater Prairie-Chicken, which once ranged from southern Maine to Virginia and Maryland but disappeared in the 1930s (Gross 1932). The steep population declines of many species of grassland and shrubland birds in the past 35 yr (Peterjohn et al. 1999), and the extinction of grassland taxa such as the Heath Hen, has created an awareness that these species and their habitats should be a high conservation priority (Vickery 1992, Askins 2000).

Early successional habitats have declined sharply and become more fragmented and isolated as a result of the decline in agriculture since the late nineteenth century, increased development, and active fire suppression (Litvaitis et al. 1999). Indeed, wildfires are now vigorously suppressed, which means other forms of disturbance, or habitat maintenance, have become more important for providing habitat for grassland and shrubland birds. These habitats are now more commonly a product of human disturbances, including farming, silviculture, and active grassland and shrubland habitat management (Askins 1999, 2000).

NEW ENGLAND FIRE HISTORY

FIRE BEFORE EUROPEAN SETTLEMENT

Fire has been an important, if infrequent, part of the New England landscape since at least the last ice age, some 12,000 yr before present (Patterson and Sassaman 1988). Fire has had important ecological and evolutionary effects for the biota in the Northeast. For example, all native plants found in eastern sandplain grasslands are adapted to fire (Vickery and Dunwiddie 1997), and flowering and reproductive phenology for some northeastern grassland plant species have clearly evolved with fire (Vickery 2002).

Some New England forest types burn more regularly than others (Parshall and Foster 2002), and fire has been more frequent on dry sandy outwash plain and glaciomarine delta soils than richer, more mesic soils (Winne 1997, Fig. 1). For example, the sandy pine barrens (10,600 ha) in Plymouth, Massachusetts, have burned three times in the past 40 yr, with major fires in 1964, 1974, and 1991 (T. Maloney, pers. comm.).

It is generally thought that American Indians (numerous tribes collectively known as Eastern Algonquians; Patterson and Sassaman 1988) probably ignited most fires and that only a small proportion of wildfires were the result of lightning strikes (Pyne 1984). However, an alternate view holds that fires in pitch pine (*Pinus rigida*) and oak (*Quercus* spp.) forests in south coastal New England were more likely natural in origin (Parshall and Foster 2002). It seems clear that fires were more common in southern New England, from the Saco River region in southern Maine to coastal Massachusetts and the Middle Atlantic states (Patterson and Sassaman 1988). But fire was also an important part of the landscape in parts of eastern Maine; Winne (1997) analyzed pollen from pond sediments in Washington

County, Maine, and determined that the xeric blueberry barrens (glaciomarine deltas) in this area had been in some form of open grassland–pine/shrub barrens for at least the past 1,700 yr.

The spatial scale of fires started by American Indians was shaped by their needs (Cronon 1983). Prescribed fires near permanent settlements along the coast were likely for agriculture and game management; such fires would have been smaller and less intense than fires in more remote areas, which were probably less frequent but more intense and probably larger (Patterson and Sassaman 1988). At this point it remains unclear whether New England grasslands were shaped primarily by pre-European human influences or by climate, soil, and vegetation (Parshall and Foster 2002).

FIRE AFTER EUROPEAN SETTLEMENT

European settlement brought profound changes to the New England landscape that potentially benefited grassland birds by reducing forest cover and increasing coastal heathlands (Askins 2000). By the 18th and 19th centuries, more than 60% of the forests in Massachusetts, Rhode Island, and Connecticut were cleared and converted to pasture and agriculture (Cronon 1983, Whitney 1994). The reduction in forest cover over this period is thought to have provided novel habitats for grassland birds, which responded by extending ranges and increasing populations into the once-forested New England landscape (Askins 1999). In addition to vastly increasing the amount of open grassland, Europeans introduced many species of exotic grasses, forbs, and shrubs. Cool-season grasses such as timothy (*Phleum pratense*) were usually rhizomatous, creating a substantially thicker vegetation structure and density, which benefited grassland habitat generalists such as Savannah Sparrow (*Passerculus sandwichensis*) and Bobolink (*Dolichonyx oryzivorus*).

Along south coastal New England, especially in Massachusetts, maritime heathlands increased to become a major component of the landscape as settlers cleared oak and pine forests from the sandy, easily eroded outwash soils (Dunwiddie 1989). European grasses generally did not thrive in these acidic, low-nutrient soils, and native plants expanded. Livestock grazing and prescribed fire maintained these heathland plants (Dunwiddie 1989), providing important nesting habitat for grassland birds.

Since the beginning of the twentieth century, wildfires have been suppressed in New England to reduce property damage and to minimize loss

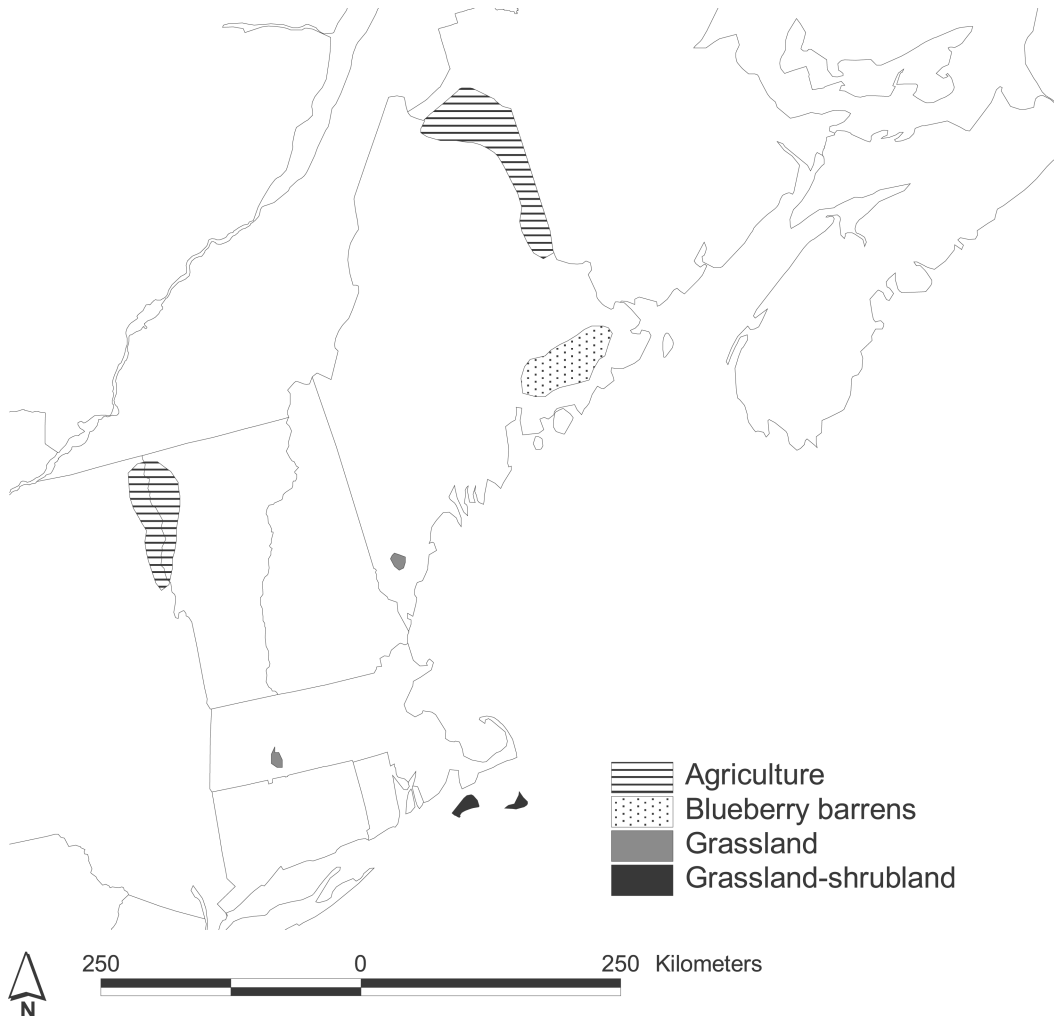


FIGURE 1. Ecological regions of New England and New York, as defined by The Nature Conservancy. Large contiguous patches of agricultural habitat occur in northern Maine and northeastern Vermont. Major grassland habitats, including blueberry barrens, occur in eastern and southern Maine and in western Massachusetts. Substantial grassland and shrubland habitats also occur on the islands south of Cape Cod. There are also many smaller farms, grasslands, and shrub patches interspersed throughout this region. Historically, fires were more frequent along the coastal plain, defined here as the North Atlantic coast. Fires also occurred regularly on the sandy glacio-marine deltas inland from the coast of eastern Maine.

of merchantable timber (Whitney 1994). For example, in Maine, 0.4% of forest area burned annually between 1903 and 1910, but this number was reduced to 0.02% by 1961–1970 (Fahey and Reiners 1981). Active fire suppression continues to the present and even has a strong effect on prescribed burns on conservation land. On Nantucket Island, Massachusetts, prescribed fires can only be conducted during the dormant season between October and April (E. Steinauer, pers. comm.) despite the fact that growing-season burns appear to be more effec-

tive in controlling shrubs and maintaining grasslands (Rudnicki et al. 1999).

CONTEMPORARY USE OF FIRE

Contemporary prescribed fires are primarily used for two reasons in New England: habitat management of rare plant and animal assemblages, and pruning of commercial lowbush blueberry fields. In the first case, prescribed fires are used to conserve rare, pyrogenically mediated habitats such as sandplain grasslands,

coastal heathlands, and pitch pine-scrub oak (*Quercus ilicifolia*) barrens. Prescribed fires are used to maintain vegetation structure and composition, reduce fuel loads, and provide an important mechanism to protect and enhance globally rare plants and animals (Dunwiddie and Caljouw 1990).

Importantly, the scale of prescribed burns in New England for management of threatened ecosystems tends to be small. In the past 10 yr, fewer than 400 ha of grassland and shrubland have been burned annually and burns were rarely larger than 15 ha. For example, in 2002, 301 ha of native grassland and heathland were burned in New England; average burn size was 10 ha (T. Maloney, pers. comm.), although somewhat larger burns (60–65 ha) have taken place on Nantucket Island (E. Steinauer, pers. comm.). Since 1996, an average of 12.0 ± 2.3 ha (SE) have been burned annually on the Kennebunk Plains, Maine; the largest burn unit was 31.8 ha (P. Schuerman, pers. comm.). The size of fires on blueberry lands is not accurately recorded but these ignitions are undoubtedly much larger than the prescribed burns on conservation lands, probably on the order of 20–100+ ha (P. Vickery, pers. obs.).

FIRE EFFECTS ON GRASSLANDS

On a landscape level, fire is relatively unimportant for maintaining large tracts of grassland habitat in New England. Agricultural land clearly represents the largest proportion of graminoid-dominated open land. In 1997, 1,760,000 ha of open farmland existed in New England. Approximately 718,500 ha were hayfields, pastures, and idle cropland (National Agricultural Statistics Service 2002), habitats that are most likely to provide suitable nesting sites for grassland birds. The 354,500 ha of hayfields in New England are rarely burned but are mowed or cut one or more times annually.

In eastern Maine, commercial lowbush blueberry production covers approximately 26,000 ha (D. Yarborough, pers. comm.), creating a low-stature vegetation type (<15 cm), commonly called blueberry barrens, that are better described as grassland barrens (Vickery et al. 1994). Grassland birds use this mosaic of short shrubs and grasslands. Prescribed fire on these barrens represents the greatest extent of fire management in New England. These grassland barrens are managed for commercial production on a 2-yr rotation: berries are harvested one year and the plants are then mowed or burned (sometimes both) in the second year. In the past 10 yr, approximately 20–30% of the non-harvest-year fields, or ca. 3,000 ha, have been burned annually. The remain-

ing non-harvest fields are generally flail mowed (D. Yarborough, pers. comm.).

Blueberry barrens provide especially important nesting habitat for Upland Sandpipers (*Bartramia longicauda*) and Vesper Sparrows (*Pooecetes gramineus*; Weik 1998, Shriver et al. In press). A regional survey of New England and New York from 1997–2000 revealed that both species had similar ranges and that they often occurred together; 85% of these sites were located on the commercial blueberry barrens of eastern Maine (Fig. 2; Shriver et al. In press). At least 140 territorial male Upland Sandpipers and 350 Vesper Sparrows were found on these barrens, representing a substantial proportion of the entire population for these two species throughout New England and New York, 45% and >70%, respectively (Weik 1998, Shriver et al. In press).

Livestock grazing is an important form of habitat management that affects grassland birds. In New York, Smith (1997) found that moderate grazing with stocking rates of 0.12–0.24 head of cattle per hectare provided adequate habitat for Henslow's Sparrows (*Ammodramus henslowii*) and Grasshopper Sparrows (*Ammodramus savannarum*) in the Fingers Lake National Forest. The same stocking rates are likely to be applicable for New England as well.

FIRE EFFECTS ON GRASSLAND BIRDS

Despite their small size, conservation burns can have important benefits for grassland birds, at least locally (Table 1). In Maine, the 210-ha Kennebunk Plains supports a rich assemblage of grassland birds that clearly benefit from fire management (Vickery et al. 1999a). In an 8-yr study at this site, prescribed fire affected all eight species that breed there (Vickery et al. 1999a). Savannah Sparrow, Grasshopper Sparrow, Bobolink, and Eastern Meadowlark (*Sturnella magna*) densities declined for 1 yr following fire but remained high for 5–7 yr following prescribed burns (Fig. 2). Horned Larks (*Eremophila alpestris*) and Vesper Sparrows preferred recently burned sites; abundances of both these species and Upland Sandpipers declined with time since fire. Field Sparrows (*Spizella pusilla*) preferred sites that had not been burned or mowed in 5 yr (Fig. 3; Vickery et al. 1999a). A study of the effects of fire on Grasshopper Sparrows at Katama Plains, Martha's Vineyard, Massachusetts, was consistent with the Maine findings; sparrows generally preferred recently burned sites and avoided sites that had not been burned for ≥ 5 yr (Harris 1998).

Prescribed fires in coastal grasslands in Massachusetts primarily benefit Savannah Sparrows,

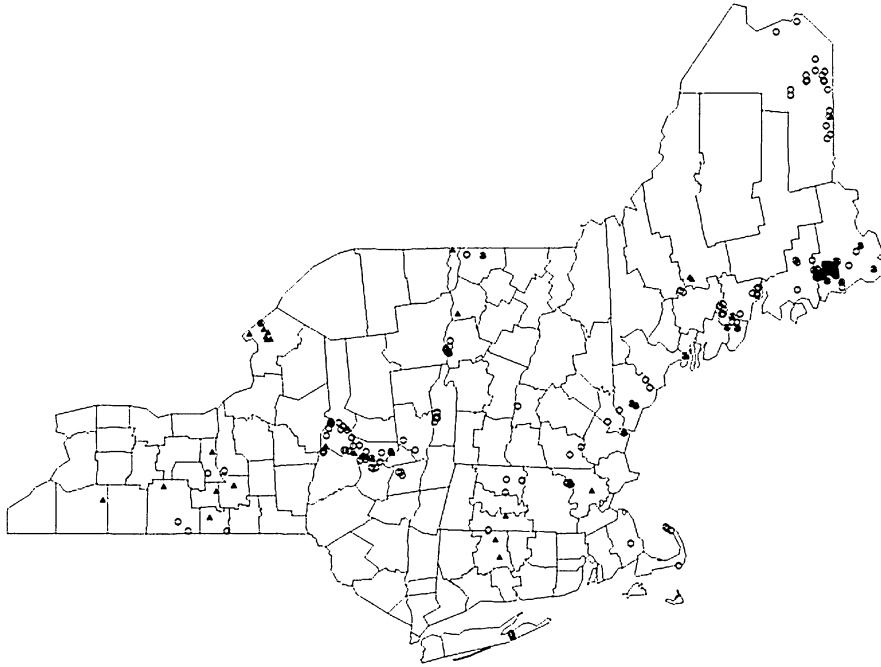


FIGURE 2. A grassland bird inventory of New England and New York, 1997–2000, revealed that Upland Sandpipers (filled triangle) and Vespers Sparrows (open circle) were most common on the large commercial blueberry barrens in eastern Maine. These two species frequently occurred together on these sites (adapted from Shriver et al. 2003).

Eastern Meadowlarks, Bobolinks, and foraging Northern Harriers (*Circus cyaneus*) (Zuckerberg 2002). On Nantucket Island, Massachusetts, Savannah Sparrow territory densities did not differ in grasslands that had been burned, mowed, or left unmanaged (Zuckerberg 2002).

EFFECTS OF FIRE AND OTHER DISTURBANCES IN SHRUBLANDS

Because wild fires are assiduously suppressed in New England, fire has not been a major factor affecting shrubland birds. Clearcutting, a silvicultural practice that removes all standing wood, was a common practice in the 1980s and early 1990s, especially in northern Maine. This practice has created a continuum of early successional shrubland habitats used by a wide variety of shrubland warblers and sparrows, especially Chestnut-sided Warbler (*Dendroica pensylvanica*), Palm Warbler (*Dendroica palmarum*), Mourning Warbler (*Oporornis philadelphia*), Common Yellowthroat (*Geothlypis trichas*), Wilson's Warbler (*Wilsonia pusilla*), Lincoln's Sparrow (*Melospiza lincolnii*), and White-throated Sparrow (*Zonotrichia albicollis*; King et al. 2001).

Although the extent of this silvicultural practice has declined in the past 10 yr, approximately 3.5% (243,000 ha) of the commercial forest land has been clearcut within the past 20 yr (Maine Forest Service 2001). Maine GAP analysis, using 1993 satellite imagery, revealed that an estimated 2% (127,000 ha) of Maine's forests consisted of clearcuts with an additional 4% (267,000 ha) in selective cuts (Krohn et al. 1998). In general, clearcuts are ephemeral, providing suitable shrubland habitat for an average of 10 years in northern hardwood forests (Thompson and DeGraaf 2001).

Fire has played a more important role in pitch pine–scrub oak habitats. These areas are priorities for conservation in New England because they support several rare plant and animal species (Schweitzer and Rawinski 1988; Barbour et al. 1999). On the Montague Plain in central Massachusetts, fire has been an important historical factor for promoting the stability of scrub-oak stands by removing hardwood canopy trees and initiating vigorous sprouting of shrubs (Motzkin et al. 1996), benefiting Whip-poor-wills (*Caprimulgus vociferus*), Prairie Warblers (*Dendroica discolor*), and Field Sparrows. Within the past 10 yr prescribed fire has also been used to

TABLE 1. SUMMARY OF AVAILABLE LITERATURE ON THE RESPONSE (CHANGE IN ABUNDANCE) OF BREEDING GRASSLAND BIRDS TO PRESCRIBED FIRE IN GRASSLAND HABITATS IN NEW ENGLAND (FIG. 3).

Species	State	Years after fire	Size of fire (ha)	No. of sites	Response	Reference ^a
Upland Sandpiper (<i>Bartramia longicauda</i>)	ME	4–8	6–24	1–4	–	1
Horned Lark (<i>Eremophila alpestris</i>)	ME	1–8	6–24	1–12	–	1
Field Sparrow (<i>Spizella pusilla</i>)	ME	3–8	6–24	1–4	+	1
Vesper Sparrow (<i>Pooecetes gramineus</i>)	ME	2–8	6–24	1–4	–	1
Savannah Sparrow (<i>Passerculus sandwichensis</i>)	ME	1–6	6–24	1–12	+	1
	MA	1–2	4–31	1–7	0	2
Grasshopper Sparrow (<i>Ammodramus saviarum</i>)	ME	1–4	6–24	1–12	very +	1
	ME	5–7	6–24	1–4	slightly +	1
	MA	1–4	4–18	1–4	+	3
Bobolink (<i>Dolichonyx oryzivorus</i>)	ME	1–2	6–24	4–12	very +	1
	ME	3–6	6–24	1–4	moderately +	1
Eastern Meadowlark (<i>Sturnella magna</i>)	ME	1–7	6–24	1–12	very +	1

^aReferences: 1 = Vickery et al. 1999a; 2 = Zuckerberg 2002; 3 = Harris 1998.

manage pine barrens in Plymouth, Massachusetts; the reasons for these burns have been primarily to reduce fuel loads and avoid uncontrolled fires that could damage houses and other structures (T. Maloney, pers. comm.).

Large power lines also provide persistent shrubland habitat used by many species, including Gray Catbird (*Dumetella carolinensis*), Blue-winged Warbler (*Vermivora pinus*), Prairie Warbler, Common Yellowthroat, and Indigo Bunting (*Passerina cyanea*; King and Byers 2002).

FIRE EFFECTS ON SHRUBLAND BIRDS

The effects of fire on shrubland birds have received little attention in New England (Table 1). Most shrubland studies have examined the effects of various silvicultural practices on shrubland birds (e.g., King et al. 2001). For example, a study of clearcuts in southeastern Connecticut found that vegetation structure (e.g., canopy height), as well as surrounding landscape features, influenced shrubland bird occupancy (R. A. Askins, B. Zuckerberg, pers. comm.). These clearcuts provided important breeding habitat for Blue-winged Warbler, Chestnut-sided Warbler, Prairie Warbler, Common Yellowthroat, and Eastern Towhee.

A recent study on Nantucket Island shrublands in Massachusetts found that Eastern Towhees (*Pipilo erythrophthalmus*) were more abundant in areas that

had been burned or were left unmanaged compared to areas that had been mowed (Zuckerberg 2002). Conversely, Song Sparrow (*Melospiza melodia*) territory densities in shrublands were similar in burned, mowed, and unmanaged units (Zuckerberg 2002).

In general, these results indicate that burning has a stronger effect on grassland birds than on shrubland birds, although the response of shrubland birds to fire has not been adequately studied in New England. Not surprisingly, mowing has a more substantial effect on bird occupancy in shrubland habitats because this form of habitat manipulation has a much more pronounced effect on vegetation structure (Zuckerberg 2002).

CRITICAL MANAGEMENT AND RESEARCH ISSUES

Large-scale prescribed burning in most of New England will continue to be a difficult management issue because of the density and spatial distribution of houses and other structures. Consequently, prescribed fires will generally continue to be small and isolated, usually occurring in the dormant season (October–April). It is unlikely that dormant-season fires mimic the effects of natural wildfires and summer fires are most effective in killing woody shrubs (Rudnick et al. 1999), a high priority in most grassland burn programs. Additionally, small-scale prescribed fires alone are unlikely to increase habitat

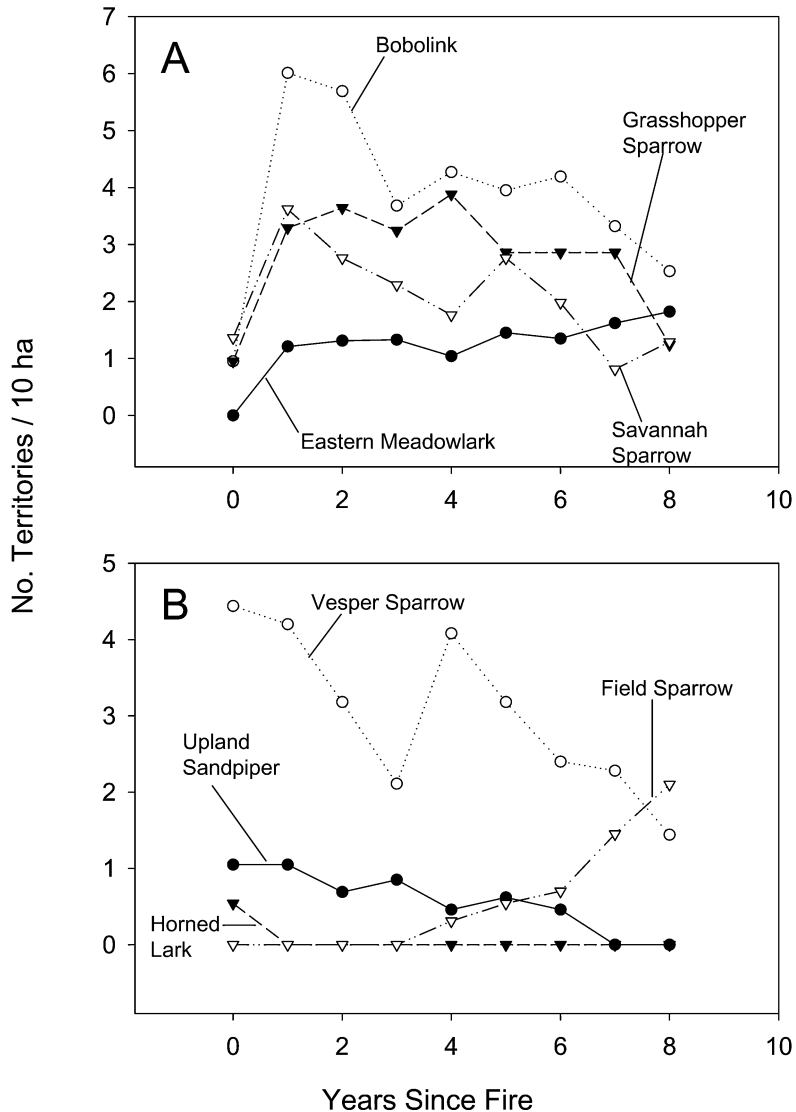


FIGURE 3. Eight species of grassland birds responded differently to prescribed fire at Kennebunk, Maine, 1984–1991. Four species (A) followed the same general pattern; breeding densities were very low during the burn-year but increased markedly in the year following the burn. Eastern Meadowlark densities remained high for 8 yr following fire. Bobolink and Savannah Sparrow densities were high in the year following fire but generally decreased thereafter. Grasshopper Sparrow densities remained high for 4 yr following fire but then decreased. Four other species responded differently to prescribed fires (B). Breeding densities of Upland Sandpipers and Vesper Sparrows were greatest in the burn-year but then generally declined with time since fire. Horned Larks only used burn-year sites whereas Field Sparrows only used sites that had not been burned for 4 yr. Standard errors, not shown, were <0.2 territories per 10 ha (adapted from Vickery *et al.* 1999a).

for declining grassland birds in New England. These fires improve the habitat quality of existing grasslands; they do not create additional habitat.

Grassland restoration may be a viable alternative for creating and, ultimately, managing large areas for grassland birds. Several sites in Rhode

Island (Ninigret National Wildlife Refuge) and Massachusetts (Allen's Pond, Dartmouth) have been restored since 1990. However, because these sites are relatively small (<50 ha), they are unlikely to support grassland birds that are strongly area-sensitive (e.g., Upland Sandpiper). It seems likely that these sites

will eventually be managed by a combination of burning, mowing, and grazing. It will be important to determine which types of grassland restoration and which combinations of management practices (burning, mowing, grazing) will be most beneficial to grassland birds.

There has been no research into the effects of commercial blueberry barrens management, including fire, on Upland Sandpipers and Vesper Sparrows in eastern Maine. Given the importance of these barrens for these two species (Weik 1998, Shriver et al. In press), this should be a high research priority.

Landscape-scale patterns in land use have been shown to affect the regional patterns of grassland bird distributions and reproductive success in the Midwest (e.g., Johnson and Igl 2001). It would be valuable to determine the extent to which similar landscape metrics influence grassland bird distributions and reproductive success in New England. Species distributions and relative abundances have been estimated recently (Shriver et al. In press) and could be coupled with land-use data to determine landscape-scale effects on species distribution patterns.

Since many of the natural disturbances that once created and sustained shrubland habitats throughout the northeastern United States are now gone or diminishing, it is increasingly important that shrubland management be considered at a regional scale (Askins 1998). Conservation planning should focus on the proportion and configuration of early seral habitats within a landscape (Litvaitis et al.

1999). Large-scale shrubland management has been a key issue for several agencies. In 1997, the Massachusetts Division of Fisheries and Wildlife initiated a program to increase the proportion of state-owned properties that are maintained as shrubland; currently the program has provided and maintained over 200 ha (Litvaitis et al. 1999). In the White Mountain National Forest in New Hampshire and Maine, the goal of the U.S. Forest Service is to manage 10% (30,000 ha) of the forest in a regeneration stage (USDA Forest Service 1986). Although both these programs are unique initiatives, public opposition to clearcutting remains a major obstacle in achieving these and other management goals (Litvaitis et al. 1999). To the greatest degree possible, management of early successional habitats within a landscape context should attempt to mimic the natural and historical processes that initially created them (Askins 1998). Conservation efforts should emphasize existing shrubland habitats (e.g., abandoned farmlands, silviculture, powerline corridors) in an attempt to consolidate and create larger shrubland patches.

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