Managing Grasslands, Shrublands and Young Forests for Wildlife

A Guide for the Northeast

The Northeast Upland Habitat Technical Committee

2006

Managing Grasslands, Shrublands, and Young Forest Habitats for Wildlife
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Preface

On the weekend of May 4 - 5, 2002, over 200 ecologists, forest managers, and private landowners from across the Northeast descended onto the campus of the University of New Hampshire to attend a conference that focused on the importance, status, and management of shrublands and young forest habitats in the region. My participation in this conference both as a presenter and audience member led to the realization that to effectively remediate the negative impacts of the decline of these habitats on wildlife more needed to be done to educate land managers and private landowners about their importance and how to manage them. Relatively little has been done in this regard. It is my hope that this guide will help to fill this void to some extent. Given that more than 73% of forestland in the region is privately owned, it is imperative that landowners and the professionals that provide resource management guidance help to address the decline of these habitats. The active participation of landowners and land managers in addressing this issue is the only way to ensure enough of these habitats will be available for the multitude of species dependent on them well into the future.

— James D. Oehler (June 30, 2004)

Acknowledgements

This guide is a publication of the Northeast Upland Habitat Technical Committee, sanctioned by the Northeast Association of Fish and Wildlife Directors. The Northeast Upland Habitat Technical Committee is comprised primarily of state wildlife agency biologists who specialize in upland habitat management. The committee was formed in 1998 by the Northeast (State) Wildlife Administrators Association to address the decline of grassland, shrubland, and young forest habitats in the region, and to develop recommendations and guidance to the administrators on the 2002 Farm Bill. Members of the committee as of June 2004 are:

Paul Rothbart (Chairman), Connecticut Department of Environmental Protection
Charles Bridges, New Hampshire Fish & Game Department
Andrew Burnett, New Jersey Division of Fish, Game & Wildlife
Steve Capel, Virginia Department of Game & Inland Fisheries
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Committee members acted as authors, reviewers, and/or supporters of the guide. I thank all members, past and present, for their efforts in helping to make this guide a reality. I would also like to thank all of the other authors that contributed to this guide who are not committee members. They graciously offered their expertise to help make this guide more complete. Thanks also go out to the talented individuals in the

Information and Education Section of the Massachusetts Division of Fisheries & Wildlife for providing their expertise in completing the formatting and layout of the guide. Robin Blum of the Connecticut Department of Environmental Protection offered her time and skill for copy editing.

The quality of this publication was substantially enhanced by the time and expertise provided by a talented pool of peer reviewers. In addition to committee members, peer reviewers included Robert Askins, Mark Banker, Joel Carlson, Alan Carter, Steve Clubine, Tim Cooper, Richard DeGraaf, Joseph Dowhan, Catherine Hibbard, Andrea Jones, Ron Joseph, Paul Karczmarczyk, Gary Kemp, David Kittredge, Hal Laskowski, John Litvaitis, Chris Mattrick, Chris Miller, Laura Mitchell, William Murphy, Holly Obrecht, William Patterson, John Randall, Charles Rewa, Ellen Snyder, Janath Taylor, and Mariko Yamasaki. Thanks to all of them for their considerable help.

Foreword

The wave of forest clearing that swept across the Northeast and Midwest beginning about 1750 is well known. Land that was cleared for agriculture was soon abandoned with the opening of the Erie Canal, the California Gold Rush, the Civil War, and the rise of industrial cities. Such clearing put a cultural premium on forests; they were rare compared to the open countryside, even though it was already reverting to forest with the decline of agriculture in the first half of the 19th century. Less well known is the extent and variety of early successional habitats that existed in much of the Northeast upon European settlement. Disturbances due to fire, hurricanes, floods, Native American burning and agriculture, and beaver, as well as native prairies, barrens, and oak openings imparted an open character to much of southern New England and the Mid-Atlantic region, and created patches of early successional and young forest habitats elsewhere. Such areas were tilled or grazed from earliest settlement; the loss of natural open habitats, once considerable, actually began centuries ago, and is now the most important wildlife habitat issue in the Northeast.

Today, once open habitats have either reverted to forest or are developed, fire is controlled, and periodic flooding prevented to the fullest extent possible. Except for wind, creation of early successional habitats by natural disturbance has been greatly curtailed for the past century or more, and wildlife populations dependent upon them have been quietly declining as well. Many of these species are habitat specialists, using only specific-stages of old fields, or brushlands, or regenerating forests. Now in critically short supply such habitats need to be maintained by periodic treatment or created in places where they did not exist historically.

This volume is a much-needed presentation of the specific management practices that are necessary to create or maintain early successional and young forest habitats on the northeastern landscape. In some cases they replicate the processes that historically created them, fire, or past agriculture practices such as mowing or grazing. Newer methods such as use of herbicides and new problems such as invasive exotic plants further challenge efforts to provide habitat for disturbance-dependent species.

With most of the landscape in forest cover, great opportunities exist to provide young forest habitat through timber management. Even-aged silviculture is well suited both ecologically and economically to most of the major forest types of the Northeast. Convincing the public and more landowners to use even-aged practices or larger group/patch selection practices, however, will not be easy. Most suburban residents and even some biologists view forestry activities not as periodic management of renewable resources, but rather as precursors to development. Today's wildlife agencies face the challenge of not only creating and maintaining diverse wildlife habitats in forest landscapes across myriad landownership classes in the Northeast, but of also educating the public in the overall values of such management for a wide variety of species. People need to understand that early-successional forest habitats are ephemeral by nature, and not permanent features on the landscape. Active forest management can create the vegetative conditions many early-successional species as well as humans use, and can influence the proportion and distribution of early-successional habitats over time. When practiced across essentially forested landscapes, a broad array of wildlife habitat values can be enhanced as well as conserved without sacrificing mature forest values. Taken in total, this guide gives managers and interested publics some excellent insights into the nature of this management challenge and the

numerous opportunities to positively influence the presence and maintenance of early-successional habitats in the Northeast now and in the future.

— Richard M. DeGraaf and Mariko Yamasaki

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Chapter 1. Introduction

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When we consider the tremendous diversity of habitats found in the northeastern United States (for the purposes of this publication, the "Northeast" refers to the geographic region that includes the following states: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia), we must ask ourselves, "Why narrowly focus the attention of an entire guide on grassland, shrubland, and young forest habitats?". The answer lies in the problems of species and habitat declines, which biologists have noted over the last few centuries, especially in recent decades. For instance, 22 of 40 shrubland birds have significant declining population trends in the Northeast; 7 grassland birds are listed as endangered or threatened in at least one state in the region; American woodcock populations have declined by 40% over the past 30 years; New England cottontails occur in only 20% of the area historically occupied; 5 species of butterflies are thought to be extirpated from New England and numerous others associated with shrubland habitats are dramatically declining throughout the region. But are these declines simply natural events or ones that have been influenced by human impact? Just how has our use of the land been a factor in these declines? Let's explore these questions.

Which habitats are we talking about?

"*Grasslands*" is a broad term that applies to many open land habitats. Typically we think of grassy areas with no shrubs or trees and no agriculture. However, even pastures and hayfields can provide adequate habitat for some grassland species (e.g., upland sandpipers and bobolinks, respectively). Their use by wildlife will depend on the vegetation height, density, and composition.

Old fields differ from grasslands in that they contain a mix of grasses and herbaceous plants along with shrubs and some tree seedlings and saplings. Old fields vary from upland meadows dominated by herbaceous plants such as goldenrod and meadowsweet to successional openings containing a large component of shrubs such as dogwoods, viburnums, and blueberries. The later stages of old fields are commonly referred to as *shrublands*. Shrublands also include those habitats typically found on sandy soils in coastal areas and ridge tops that contain a heavy component of scrub oak. Old fields and shrublands vary greatly in structure and composition of herbaceous and woody vegetation, depending on the soils, moisture, and time since last disturbance.

In contrast to both grasslands and old fields, *young forests* are dominated by woody seedlings and saplings. The tree species found on these sites is largely dependent on what was there before the area was disturbed either through a timber harvest or natural event. However, they are typically dominated by relatively shade tolerant late-successional species such as oak, beech, and maple. The young forest stage can last up to 40 or 50 years post-disturbance, depending on soil fertility, tree species, and other conditions.

Absent grazing, mowing, burning, or other type of disturbance, grasslands will turn into upland meadows and upland meadows will revert to old fields. In turn, these will eventually grow into young forest and eventually to climax forest. This process is referred to as *succession*. As such, grasslands, old fields, and young forests are often referred to as *early-successional habitats* (Figure 1).

Figure 1. The grasslands, shrublands and young forest habitats may be referred to as "early-successional habitats." In this graphic showing the time sequence of plant succession, early-successional habitat would continue through 20+ years, fading out sometime during the 25- to 100-year phase. (Graphic provided by Paul Fusco, Connecticut Department of Environmental Protection.)

Wildlife in need of habitat

Grassland wildlife species are declining. Of the ten grassland birds that are well sampled by Breeding Bird Survey routes in the Northeast, seven show significant declines since 1966 and none exhibit significant increases (Figure 2). Additionally, reptiles like black racers and wood turtles, which are grassland dependent, have shown declines in the Northeast.

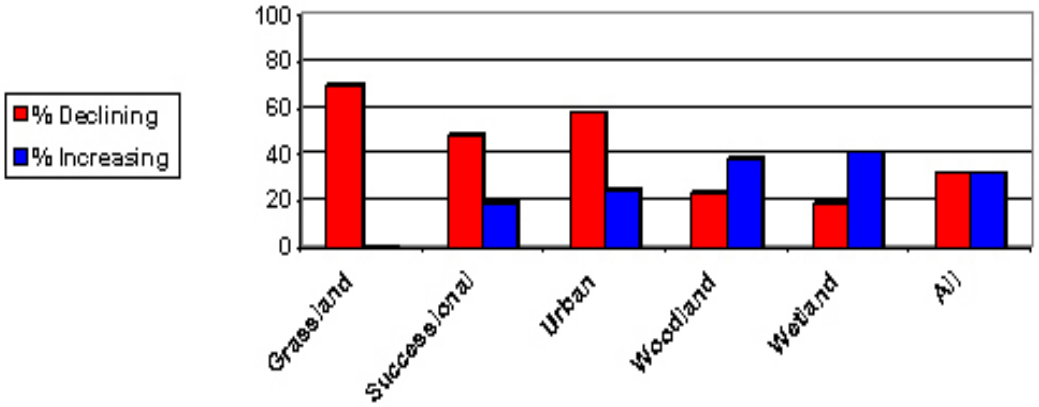

Figure 2. Northeastern United States bird population trends from Breeding Bird Surveys, 1966-2000, with birds grouped by primary breeding season habitat (Sauer et al. 2001). Data are provided for species encountered on more than 14 routes within U.S. Fish and Wildlife Service Region 5 (northeastern U.S.). Percent declining or increasing includes only those species with statistically significant ($P < 0.1$) trend estimates.

Many shrubland and young forest birds are also declining (Figure 2). Nearly half (48%) of the 27 shrubland birds covered by Breeding Bird Survey routes have significantly declining population trends in the last 35 years; whereas, only 19% have demonstrated population increases. Other animals like New England cottontails and many butterfly species (e.g., Karner blue and Persius duskywing) are declining and/or rare in the northeastern U.S.

How much habitat then and now?

Among early-successional habitats, grasslands in the northeastern United States have declined the most significantly in the past one hundred years. One study found that of those ecosystems in eastern North America that have been nearly wiped out (e.g., experienced greater than 98% decline), 55% are grassland, savannah, and barren communities. Few wildlife-friendly grasslands exist today. They have been mostly replaced by forest, intensive agriculture, or commercial or residential development. The grasslands that do remain are typically fragmented, isolated, and too small to be of significant use by many wildlife species.

As you might expect, the amount of shrubland and young forest habitat in the Northeast has fluctuated widely through history. Because of their dynamic nature, it is difficult to pinpoint a number for what percent of the northeastern landscape these habitats represented prior to European colonization. Instead, biologists look at the historic "range of variability," to try to estimate what the landscape looked like over time.

Prior to European colonization, early-successional habitat was not well represented (3 to 5% of the landscape) in the northern spruce-hardwood forests (Table 1). As one moved further south, the northern hardwood forest saw 4 to 28% of the landscape in an early-successional state (this includes small gaps of just over an acre in size caused by moderate disturbances). Moving further south and toward the coast, interior oak woodlands, away from most hurricane influence, had the lowest percentage of young forest (1 to 3%). Coastal oak woodlands, on the other hand, showed tremendous variability of regenerating habitat, from less than 3% if it was more than 15 years after a hurricane, to as much as 40 to 50% in the years following a hurricane. Finally, pine-oak barrens show a historic range of 10 to 31% early-successional habitat.

So, how does our current state of shrubland and young forest compare to those historic figures? It varies considerably from lows of 4 to 6% of timberland in early-successional habitat in Massachusetts, Connecticut and Rhode Island, to highs of 24% in Ohio and 25% in Maine (Table 2). States with a great deal of Atlantic coastal influence, such as Massachusetts, Connecticut, and Rhode Island likely historically had a much higher percentage of young forest habitat than they do today; perhaps averaging closer to the 15 to 20% range, depending on forest type and proximity to the coast. On the other hand, states away from the coast, like Ohio and Vermont, may have averaged in the 5 to 15% range.

Two things are important to note here. One, the average percent for a state doesn't tell you much about how you should manage your specific property. You really have to think about the range of variability within the forest type(s) in your area. Two, just because your region has young forest habitat equal to historic levels doesn't mean that the same complement of wildlife species can survive there. Why? Because of the dominance of people and our built infrastructure (e.g., roads and buildings). The remaining successional habitat in an area is likely fragmented, making it difficult for animals such as New England cottontails and black racers to sustain a population. Finding ways to connect existing grassland, shrubland, and young forest habitat by creating new patches of similar habitat should improve the likelihood that populations of dependent wildlife will survive through time.

Changes over time

Certainly there have been changes in the land over the eons, both due to natural causes and humans. Just 12,000 years ago there were thick sheets of ice over much of northern New England. Imagine the open areas (grasslands, wet meadows, and young forest habitats) that flourished as these glaciers receded. We would expect that wildlife associated with these habitats thrived at this time, perhaps reaching their peak population numbers.

Another major influence on the land was Native Americans. Burning to maintain open areas was widespread among native people up to and during the colonial period. Historians have noted, however, that these maintained open areas were more widespread as you went nearer the coast. The spruce-fir and northern hardwood forests of the great north were not typically subjected to burning by Native Americans.

Increasing numbers of colonists expanded agriculture more intensively in coastal regions, as well as further inland from the 1700s through most of the 1800s. Many grassland wildlife populations increased their numbers at this time, and even extended their ranges further inland. However, due to land clearing, shrubland and young forest habitat actually declined in the Northeast during this time period, and the wildlife associated with those habitats declined along with them (Figure 3).

Figure 3. Farm abandonment, 1850, as depicted in the Harvard Forest dioramas, showing New England land use history. Used with permission of Harvard University Press. Photo by John Green.

But something happened after the Civil War. The westward expansion began as fertile, rock-free prairies showed greater promise than the rocky soils of the Northeast. Farms were abandoned, fields lay fallow and then reverted to forest. Grassland birds and other grassland-associated wildlife declined over this time; whereas shrubland and young forest animals abounded. But young forests are fleeting, and after the early to mid-1900s, the maturing forests lost their appeal to the corresponding suite of wildlife found therein. Since that time, most wildlife species in all the habitats covered in this guide have declined significantly.

The intensification of agriculture, with haying two or three times each season, pesticide use, and the fragmentation of remaining fields has exacerbated problems for grassland birds. For shrubland and young forest species, the suppression of fires due to property and human safety concerns has led to the loss of one major natural factor that formerly supported those species. So, instead of Native Americans starting fires and actively managing open lands for agricultural use, berry production, and game species, modern Americans are taught to prevent fires and suppress them at first sight. Prescribed fire for management purposes is but one tool that is described in the following pages.

Addressing the issues

The following chapters will provide the details needed to help landowners and managers address the many issues of managing grasslands, shrublands, and young forest habitats. Whether you own a 5-acre grassland, a 20-acre old field, or a woodlot of 100 acres or larger, there is something you can take away from this publication. The authors of these chapters have thought long and hard about the management issues that must be dealt with if the target habitats and associated wildlife are going to improve.

Each chapter contains detailed information about managing these habitats. You will also find case studies that perhaps will serve as models for you to follow. Finally, since you may not have the financial ability to undertake the management prescriptions outlined in this guide, there is a chapter devoted to funding opportunities. So, please read on and find out what you can do to better manage our region's grasslands, shrublands, and young forests.

Suggested reading

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Biography

Darrel F. Covell is Assistant Extension Professor and Specialist of Wildlife at the University of New Hampshire Cooperative Extension. He earned a B.S. degree in Wildlife Management from the University of New Hampshire in 1989 and a M.S. degree in Wildlife Ecology from the University of Wisconsin in 1992. Darrel worked as a wildlife outreach specialist for seven years for the University of Wisconsin's Department of Wildlife Ecology. He served as executive director of the New Hampshire Wildlife Federation for two years prior to assuming his current position in 2001.

Table 1. Historic range of the percent of early-successional habitat among forest types in the northeastern United States (Lorimer and White 2003).

	Historic percent of early-successional habitat	
	Range	Mid-point
Interior oak woodlands	1-3%	2%
Spruce-hardwoods	3-5%	4%
Northern hardwoods (including small gaps just over an acre in size)	4-28%	16%
Pine-oak barrens	10-31%	20%
Coastal oak woodlands	1-50%	25%
All forest types above	1-50%	13% (avg)

Table 2. Current percentage of timberland in seedling-sapling for each of the Northeastern states. Data collected from 1986-1998 as per Trani et al. (2001).

State and subregion	Percent seedling-sapling
Massachusetts	4
Connecticut	5
Rhode Island	6
New Hampshire	9
Vermont	10
Maine	25
New England subregion	17
Maryland	10
West Virginia	10
New Jersey	13
Pennsylvania	15
New York	16
Delaware	18
Ohio	24
Middle Atlantic subregion	15
Northeast region	16

Chapter 2. Looking Beyond Property Boundaries – Landscape and Regional Considerations for Managing Early-Successional Habitats

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Wildlife biologists realize that any management activity should start with a substantial amount of "front-end time". That is, developing an understanding of what needs to be done before taking any action. Among the first steps are completing a comprehensive inventory of the property and developing an understanding of the landowner's desires and goals for the property. But it's also important to look beyond the immediate management area. Because most landowners don't control thousands of acres, it is essential to determine what habitats surround the parcel and give some consideration to a "landscape approach" when managing wildlife habitats. But what is actually meant by a *landscape*? And what is a *landscape approach*?

A landscape usually refers to a tract of land that has a recognizable pattern (e.g., forest-field or forest-field-riparian zone), and supports at least several individuals of a species under consideration. Like the term habitat, landscape is used to describe the environment of a particular animal. It is different from the term *home range,* which refers to the area an individual animal occupies while it feeds and reproduces. For the sake of our discussion, a landscape will refer to an area of at least several square miles that contains several home ranges of most animals we manage habitat for.

Taking a landscape approach to habitat management means having a good understanding of the food and cover resources that are available for wildlife (or in short supply) on your own land and the land of your neighbors. As a result, a landscape approach should provide an opportunity for neighboring landowners to consider joint efforts where their cooperation yields greater habitat rewards than would be possible by working individually. This can be especially important in areas where individual ownerships are relatively small and where the objective is to enhance the habitat for wide-ranging species, such as turkeys and black bears. Like most birds and mammals in the Northeast, turkeys and bears utilize a variety of habitats and forest age classes. Both of these species utilize early-successional habitat during specific seasons. For example, turkey hens and their poults feed on insects in hayfields during summer. After hibernation ends, black bears often feed on grasses and forbs in clearings because these are the first foods available. Several months later, they feed on raspberries in young clearcuts. As a result, the landscape occupied by these two species should contain an early-successional component if all their habitats needs are to be meet.

In this chapter, I'll provide some background information and explain why placing habitat management activities in a context beyond the boundaries of a landowner is so important. As many of the authors of this manual indicate, it's important to know how present-day habitats differ from historic conditions and how these differences should be considered as we manage early-successional habitats. So let's start there.

Historic versus present-day landscapes

In chapter 1, Darrel Covell reviewed the available information on the abundance of early-successional habitats in the Northeast prior to the arrival of European settlers. As he indicated, simple comparisons between historic and current abundance of early-successional habitats don't provide a good assessment of how well these habitats function in present-day circumstances. Historically, the abundance of early-successional habitats was probably less than 10% of land area in much of the Northeast. Among inland forests, small openings were created by frequent windstorms or beaver impoundments. On the other hand, coastal areas were much more susceptible to large disturbances, like wild fires and hurricanes. As a result, patches of early-successional

forests, barrens, and grasslands represented at least 20% of coastal New England, Long Island, New Jersey, Maryland, and Delaware. Now, let's look at these same regions 400 years later.

According to the most recent census in 2000, the 11 states that represent the Northeast are occupied by almost 60 million people. As we know, the consequences of that many people includes dense road networks and a variety of land uses that range from sparsely settled agricultural areas to densely populated urban centers. On a state-by-state basis, the average population density in New Jersey is 1,100 people per square mile whereas in Maine it is only 40 people per square mile. Regardless of the state, much of our human population is clustered within 50 miles of the Atlantic coast. Because of these differences in human distributions, opportunities to manage wildlife habitats will likely differ among states and even within states depending on the degree of development.

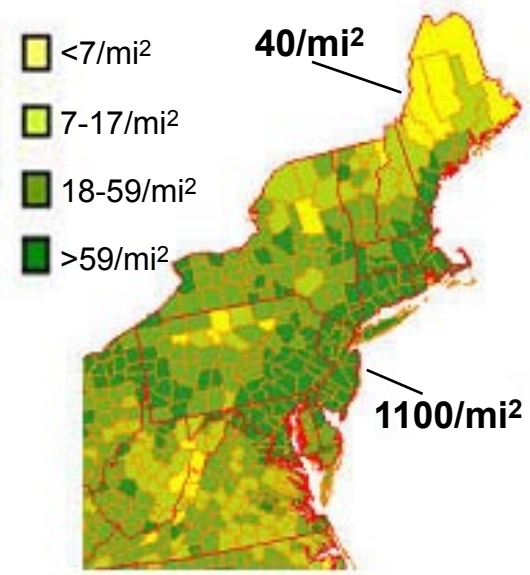

Figure 1. Human population density varies substantially in the northeastern United States, ranging from 40 residents per square mile in Maine to approximately 1100 per square mile in New Jersey. Managing wildlife habitats will likely vary in response to population density and associated land uses.

Historically, the Northeast was dominated by continuous forests. Our relatively recent changes to these forests either through clearing for farms or shopping malls have had profound effects on wildlife populations. In many landscapes, the most obvious influence is that wide-ranging animals can no longer move without encountering a road or other man-made obstacle. Remaining patches of habitat, including early-successional forests and native shrublands, are broken up or fragmented into disjunct patches. Animals that have relatively large home ranges, like bobcats that hunt these habitats for rabbits and hares, may find the remaining patches of habitat too small to fulfill their needs. In more developed landscapes, this results in frequent road crossings that make bobcats vulnerable to vehicle collisions. Other species with small home ranges (such as gray catbirds, towhees, or New England cottontails) may be able to occupy the scattered fragments. However, even these animals may be hampered by the consequences of human land uses that surround small patches of habitat. For instance, populations of generalist predators including foxes, raccoons, skunks, and crows often thrive in developed landscapes because of their ability to take advantage of resources associated with humans. Large populations of these predators result in predation rates that can reduce or even eliminate small populations of prey species like New England cottontails and some songbirds. Over time, these small patches may contain fewer species than similarly-sized patches that are surrounded by extensive forests.

Although the ramifications of contemporary forest fragmentation are real, it is important to remember that they too are affected by landscape properties. There is increasing evidence that many of the current concerns of fragmentation are dependent on habitat features that are described at large spatial scales. The general trend is that the effects of fragmentation are minor or even absent in rural areas where forests are essentially continuous. As you move into more developed landscapes, where agriculture or suburban developments replace forests, populations of generalist predators and nest parasites (especially brown-headed cowbirds) become more abundant and exert a greater influence on the local wildlife community. A couple of examples will illustrate this.

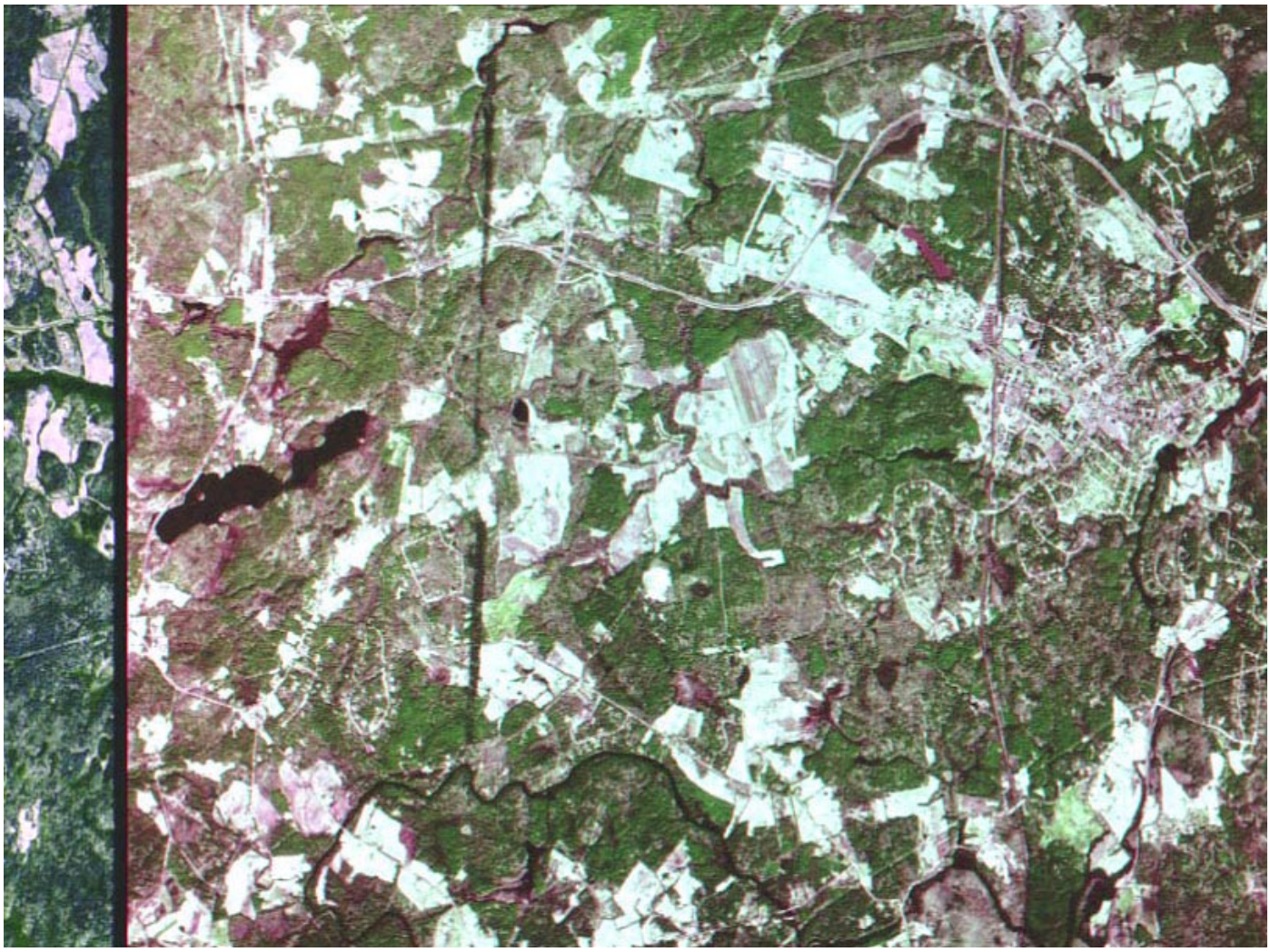

Figure 2. Much of the Northeast can be characterized by a mix of agricultural fields, forests, and suburban develops like this aerial view of southeastern New Hampshire. In these diverse landscapes, populations of such generalist predators as raccoons, coyotes, and red foxes reach higher densities than in less developed. As a result, larger patches of early-successional habitat may be more effective in sustaining species associated with these habitats that are vulnerable to predation (e.g., New England cottontails).

Researchers in New Hampshire examined the abundance of raccoons, foxes, and coyotes in three study areas (each was approximately 20 square miles). Forest coverage, agricultural land, suburban development, and human density were measured in each study area and compared to the relative abundance of generalist predators (based on systematic track counts). Looking at the most different study areas, the rural area was dominated by continuous forest (81% coverage, 3% in agricultural fields, and 3% in development) and a sparse human population (4 people per square mile). In comparison, the most developed landscape had less continuous forest (58% forest, 8% agricultural fields, and 17% in residential or commercial developments) and a human density of over 100 people per square mile. In the developed area, the abundance of generalist predators was twice that encountered in the rural area. As a result, generalist predators probably had a greater influence on local wildlife populations than in the rural area.

In addition to predation, avian brood parasites are another consequence of habitat fragmentation. Brood parasites reduce the ability of other birds to successfully rear young by laying their eggs in the nest of a host species. Brood parasitism is now acknowledged as a major factor causing the regional decline of several forest birds. Because cowbirds are the only brood parasite that regularly occurs in forests of the Northeast, understanding how land use may affect their abundance is important. Among the preferred breeding habitats of cowbirds are clearcuts. So efforts to increase the abundance of early-successional habitat with timber harvests

may potentially attract cowbirds. Research in the Green Mountains of Vermont has provided some insight into a more complex relation than that observed for generalist predators. In that study, extensive forests (over 90% of the study area) would suggest that cowbirds would not be a concern. However, cowbirds are known to "commute" more than four miles between their preferred feeding habitats (agricultural fields and livestock pens) and breeding habitats (riparian zones, clearcuts, and forest edges). The presence of cowbirds in recently logged areas in the Green Mountains was dependent on several landscape features, including the distance to a permanent opening (such as mowed pasture or residential lawns) and the number of farms that supported livestock within four miles. Even in extensive forests, cowbirds were detected if livestock operations were nearby with rather small amounts of residential or recreational development. On the other hand, cowbirds were rarely found in areas that were isolated from livestock operations or permanent openings.

Responding to shortfalls in early-successional habitats in contemporary landscapes

It is now apparent that early-successional habitats in some portions of the Northeast have become scarce and that active management of these habitats is essential. In the past decade or so, wildlife biologists have been developing a framework for managing early-successional habitats. From these deliberations, there seems to be increasing interest toward using natural disturbance regimes as a guide for management of early-successional habitats. By adopting such an approach, habitat managers would attempt to create patches of early-successional habitat in a pattern similar to wind throw, beaver flowages, wildfires, and other events that historically opened up patches of forest. Using natural disturbance as a guide usually means generating patch cuts or mowing small clearings that are a few acres or less in size. In many respects, creating scattered patches of young forest would result in a landscape that is similar to the conditions most animals in the Northeast are adapted to. In landscapes where forests are still mostly intact, the effects of fragmentation may not be an issue. So landowners can consider a range of management activities. It may be appropriate to mimic small-scale natural disturbances if early-successional habitats are well represented in the area; larger cuts may be appropriate if early-successional habitats are scarce in the area. Regardless of the size of the timber harvest, it is still important to avoid conflicts with important habitat components. Early-successional habitats should not be increased at the expense of mature stands that may contain groups of large mast-producing oaks, hickories, or beeches. Additionally, mature stands may contain large roost or den trees that are essential to many species.

In more developed regions of the Northeast, forests are quite different from the forests that existed before settlement. In the previous section, I summarized some of the effects of habitat fragmentation. It's important to consider the extent of these effects when managing distinct patches of habitat. Creating small patches of early-successional habitats in diverse landscapes may not be an effective approach toward addressing the habitat needs of animals that occupy these habitats. Recall that predation pressure is often quite intense on these small patches of habitat. As a result, small patches of habitat will not be able to offset the effects of predation. Also, surrounding land uses may effectively isolate small patches making it difficult for animals to reach them. Therefore, the notion of using natural disturbance as a guide to management may not be appropriate in many portions of the Northeast. In areas that contain a diversity of land uses (e.g., some combination of forest, agriculture fields, development, etc.), landowners may want to consider an approach that differs from natural disturbance patterns. Here, efforts may include positioning managed habitats in close proximity to existing patches of shrubland, wetland, or a beaver flowage. Such an approach would create patches of habitat that would likely be much larger than natural openings. The establishment and maintenance of some moderate (>10 acres) to large-size (>25 acres) patches of early-successional habitat can serve as core habitats within these modified landscapes. As a core habitat, species that are dependent on these habitats will likely produce sufficient offspring to offset local losses to predation and surplus young that can disperse to other patches of habitat within the landscape. An added advantage of this approach is that it may help alleviate some of the concerns of fragmentation and edge habitats that are associated with scattered patches of early-successional habitat.

Combining management efforts with existing land uses may offer some additional opportunities. Powerline corridors, for example, are often kept in an early-successional state. Recent research in southern New York has shown that powerline corridors can be very productive habitat for a number of songbirds that nest in thicket habitats. However, these linear habitats may not be suitable for other species affiliated with early-successional habitats. New England cottontails, for example, are not found along corridors, possibly because raptors perched on utility poles are very efficient predators. Therefore, positioning several acres of managed early-successional habitat immediately adjacent to a powerline corridor could substantially improve the suitability of corridors for cottontails and other species that may be vulnerable to predation. Placing managed habitats near utility corridors may also increase the ability of animals to move across a landscape by using the utility corridor as a dispersal route.

From these examples, it should be clear that approaches to managing wildlife habitats are often dependent on the surrounding landscape. But some of the factors that influence management are best described at a spatial scale even larger than a landscape.

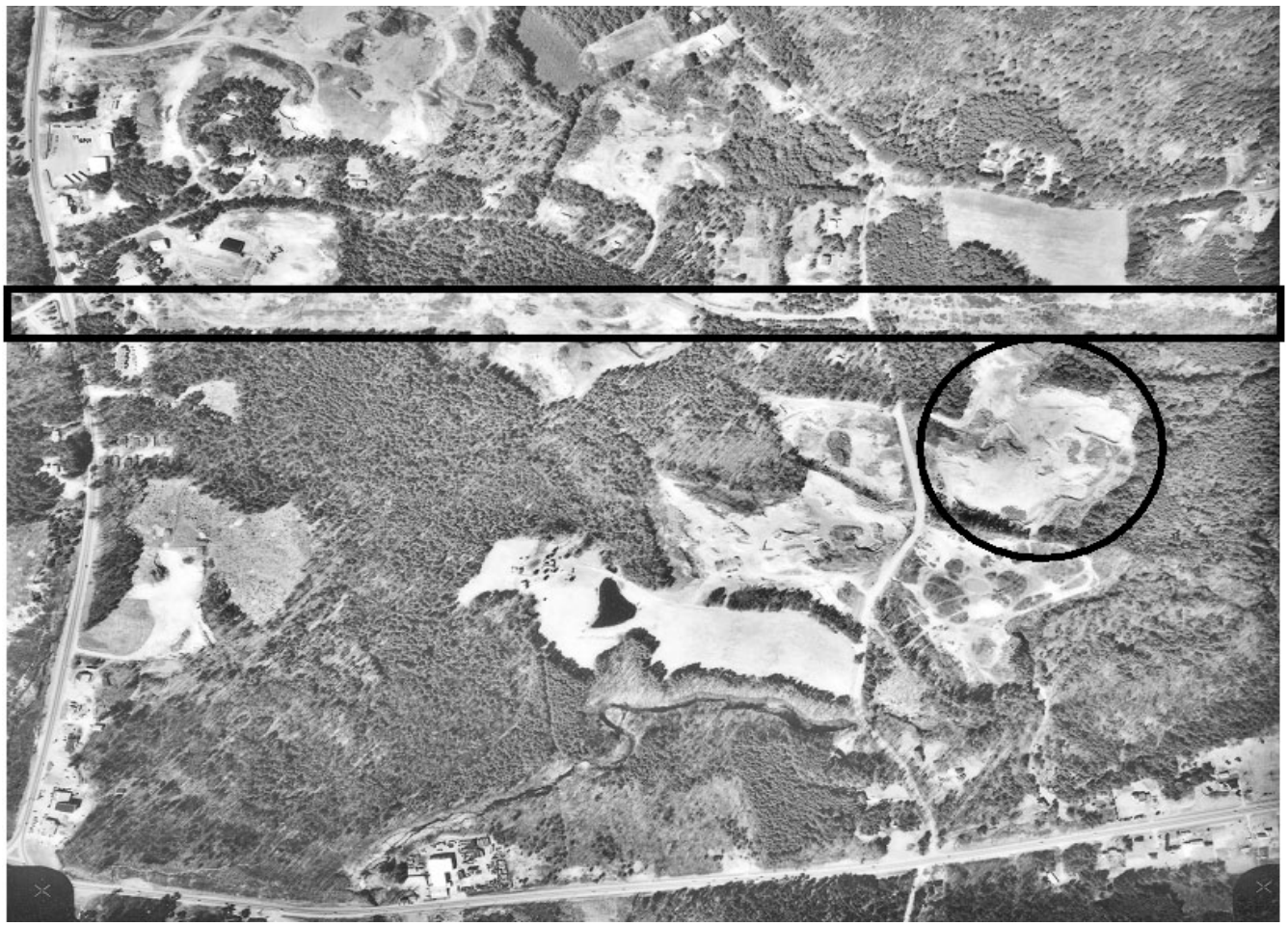

Figure 3. Positioning managed parcels of early-successional habitats in close proximity to existing land uses like powerline-rights-of-way can maximize the benefits of contemporary land uses. In this aerial photograph, an aerial successional habitat (outlined by the circle) is next to a powerline that may serve as additional habitat and a dispersal corridor.

Early-successional habitats in a regional context

I'll now introduce the concept of *regional* concerns in habitat management. For our discussion, a *region* is much larger than a landscape, probably measured in hundreds of square miles. Regional divisions may be based on natural properties, such as forest type. For example, the oak-pine forests of central New England and the yellow pine forests of southern New Jersey and portions of Delaware have a number of plants and animals that differ. As a result, management prescriptions for the two regions also differ. Regions also may be described by major land use patterns, such as rural, agricultural, or suburban. Recall from our previous descriptions of historic habitats that the distribution of early-successional habitats was greater along the Atlantic coast than among interior forests. However, human populations also are most abundant near the coast, limiting our ability to manage habitats. As we move inland and away from major river drainages, human populations become less dense and the intensity of development is lessened. Our ability to manage wildlife habitats often increases in these regions than in more densely settled regions.

Recognize that we are building on the concept of spatial scale. We now have three terms that represent a continuum. At one end is the land controlled by a single landowner. This may be represented by a single woodlot or a portion of a larger forest. At the landscape level, we are considering what surrounds a single ownership. Finally, at the regional level, we are acknowledging the importance of major natural properties like forest type but also how humans have affected wildlife habitats with road networks and developments.

A new challenge - ownership fragmentation

From the discussion above, it should be clear that habitat fragmentation can have a substantial influence on the ability of wildlife populations to persist. In addition to habitat fragmentation, ownership fragmentation or *parcelization* can have a substantial influence on our ability to maintain wildlife habitats in the Northeast. For a variety of reasons, the size of a tract of land owned by someone has an influence on ownership tenure and the likelihood that the owner will develop a habitat management plan. In general, as parcel size decreases, ownership turns over more frequently, and landowner involvement is less likely. Even if the landowner is motivated, management of small parcels can often be too expensive for a single owner to justify. Let's consider how parcelization is affecting wildlife habitats and what can be done to counter this influence.

In the Northeast, the overwhelming majority of forestland is privately owned; public lands represent only 11% of the timberland of this region. Although the amount of forestland in private, non-industrial ownership has remained relatively constant since the 1950s, the number of individual owners has changed substantially, increasing to almost 2 million by the mid 1990s. Ownerships have become most fragmented in southern New England (e.g., Massachusetts, Connecticut, and Rhode Island) and among coastal middle Atlantic states (e.g., New Jersey, Maryland, and Delaware). Individually, 60% of non-industrial owners own less than ten acres but their total ownership represents only 5% of all non-industrial timberland.

Even in rural states such as New Hampshire, parcelization is becoming a significant factor influencing land management. In rapidly developing southeastern New Hampshire (e.g., township of Exeter), almost 60% of the land area is in parcels less than 50 acres; whereas in Tamworth (a township that borders the White Mountain National Forest in central New Hampshire), approximately 65% of the parcels are at least 50 acres, and over 10% are in parcels more than 500 acres.

Although there is no distinct woodlot size where management is not considered, 50 acres is the approximate threshold where ownership tenure, landowner motivation, and cost efficiency seem to coalesce into a reduction in sustained management activity. In areas where suburban development is expanding rapidly, owners of the remaining large parcels may have a real influence on wildlife populations if they become the only land available for management. Yet in many areas, the reliance on large landowners may not be a practical option for achieving a diversity of wildlife habitats. In such regions it also may be useful to form a *management cooperative*. Management cooperatives have been established in states like Massachusetts where development pressures are great. In chapter 11, Paul Catanzaro summarizes how the Massachusetts Woodlands Cooperative

is developing a comprehensive structure within which landowners in western Massachusetts can more effectively address the management of private lands and marketing of forest products. Although cooperatives aren't a complete solution to offsetting the effects of expanding human populations, they have the potential of having a very important influence in some areas.

Conclusions

If our efforts to enhance early-successional habitats are to be successful, we now know that we need to consider the consequences of human land uses. Regardless of the specific management technique that is applied, it should now be clear that taking landscape and regional characteristics into consideration can greatly increase the intended benefits that landowners are hoping to provide wildlife. Think beyond your property line! Many species occupy areas much larger than most private landowners control. Considering how your land is affected by surrounding lands and how your management efforts will complement surrounding lands will likely yield the greatest returns for wildlife.

Suggested reading

See a special issue of Forest Ecology and Management (2003, Volume 185) that includes a series of papers on early-successional habitats in the Northeast. These are available in pdf format at: http://www.unh.edu/natural-resources/livaitis-papers.html or contact John Litvaitis. Also, a developing web site (www.unh.edu/ncssf) will provide substantial information on managing forest in the Northeast.

Chapter 3. Maintaining and Restoring Grasslands

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Northeastern grasslands have provided habitat for grassland birds and other wildlife for many hundreds of years. Historically, most of northern New England was forested with grasslands generally restricted to scattered small openings along river floodplains, wetlands, and beaver meadows. Southern New England, on the other hand, was described by many early settlers as having some extensive openings and many smaller grasslands, usually in the form of coastal sandplain grasslands and heathlands, and openings maintained through Native Americans' use of fire. Further south, in areas such as Long Island and Virginia, large grasslands and savannahs were quite common. These openings were among the first areas settled and farmed by Europeans.

By the 1800s, grasslands were widespread throughout the region and grassland birds including grasshopper sparrows, savannah sparrows, vesper sparrows, upland sandpipers, eastern meadowlarks, and bobolinks benefited. During the late 1800s and the early 1900s, grassland quality and quantity declined due to changes in agricultural technology, a reduction in the use of fire, the loss of farm acreage in New England, and an increase in the human population. Wildlife species adapted to grassland landscapes are now diminishing as farmlands are left idle and revert to forests or are replaced by housing and commercial development.

Remnant stands of native warm-season grasses still remain throughout the Northeast along railroad grades, rivers, roadsides, cemeteries, pastures, old fields, and reverting farmlands. Although cooler temperatures in parts of the Northeast do not allow warm-season grasses to produce as much biomass as they do in the warmer climates, a variety of species have proven useful for reclamation projects, wildlife habitat improvements, and forage production throughout the region.

Comparative values of cool-season vs. warm-season grasses

Grasses are generally categorized into two groups: cool-season grasses and warm-season grasses. Most of the grasses found in the Northeast are non-native, cool-season grasses. They grow best during the spring and fall when soil and air temperatures are cool. This group of plants begins active growth when minimum air temperatures reach 40 to 42o F. Grasses in this group include smooth brome grass, timothy, Kentucky bluegrass, tall fescue, and orchardgrass. Alfalfa and clover, though legumes, are often incorrectly referred to as cool-season grasses.

As agricultural activity spread through the region after European colonization, various cool-season grasses were introduced because they are easily established, they green up earlier than native grasses and thus provide excellent early season forage, they can be closely grazed, and they can be easily managed as monocultures. However, there are some disadvantages to using cool-season grasses. These include high cost to maintain stand vigor (fertilizer, lime, herbicides, and re-seeding), and low quality forage during the summer. Some species such as tall fescue grow so dense that it hinders travel of songbirds, rabbits, and quail in their search for food or bare ground for dusting sites. Tall fescue also produces a toxin that inhibits other plant species including many native species that are becoming increasingly rare. A reduction in plant diversity has a direct impact on the array of butterflies, moths, bees, small mammals, and birds within a particular patch of grassland habitat. Cool-season grasses also mat down easily from winter storms resulting in poor cover for wintering wildlife and for nesting the next spring.

Native warm-season grasses, those species present in the region prior to European settlement, are typically referred to as "prairie or bunch grasses." These grasses grow best in the summer heat, from June through mid-September, and do not begin green-up until the minimum air temperature reaches 60 to 65o F and soil temperatures reach 50° F. Native grasses including switchgrass, indiangrass, big bluestem, and little bluestem once dominated the Great Plains and accented the forested regions of the east as savannahs. Broomsedge is perhaps the most common native species found in many old fields. Today native grasses are typically mixed with wildflowers along roadsides and railroad rights-of-ways, in remnant fields, and in fields planted by conservation agencies and organizations.

Figure 1. (From left) Switchgrass, little bluestem and big bluestem are a few of the native warm-season grass species that are increasingly being planted in the Northeast because of their value to wildlife. Photos by Paul Rothbart.

Warm-season grasses provide a multitude of ecological benefits and management opportunities:

- They are well adapted to a variety of site conditions.
- Maintenance costs are low once stands are established. Native grasses do not typically require ongoing insecticide and herbicide applications. Fertilizer is not needed unless a stand is intensively managed for forage.
- Root systems are extensive, growing 5 to 15 feet deep. Root systems completely regenerate every three to four years resulting in increased soil fertility, organic matter, and carbon sequestration. Deep root systems provide excellent drought resistance and soil holding capabilities. Native warm-season grasses provide excellent wildlife habitat. Most native warm-season grasses are "bunch grasses" that grow in clumps. The clumping nature of these plants typically results in more bare ground under and between individual plants, which provides dusting areas and travel corridors for birds and their feeding broods. The bunchy structure also allows a diversity of forbs, legumes, wildflowers, and insects to colonize the area, creating better foraging conditions. Warm-season grasses do not mat down easily under winter snows. Therefore, they provide excellent winter escape cover and nesting cover the following spring.
- Warm-season grasses are harvested or grazed at a greater height (eight to ten inches) than cool-season grasses, thus offering reliable nesting cover while also providing forage.
- Warm-season grasses provide dependable forage production. They are less influenced by severe weather fluctuations, more disease and insect resistant, they provide quality summer forage when cool-season species have slowed growth, and are long lasting.
- Native grasses are tolerant of and even stimulated by fire. They are readily managed with prescribed burning and can yield excellent nesting and brood-rearing habitat.

Habitat values of small and large grasslands

Grasslands provide habitat for a variety of wildlife, including meadow voles, meadow jumping mice, white-tailed deer, red fox, cottontail rabbits, several species of sparrow, meadowlarks, turkeys, bobwhite quail, bats, butterflies (e.g., swallowtails, monarchs, fritillaries, among others), and a wide array of amphibians and reptiles including green snakes and box turtles.

Although grasslands provide habitat for a wide array of wildlife species, recent concerns over grassland habitat have focused on declines in grassland bird populations. Breeding Bird Surveys throughout the United States have shown alarming declines in the number of grassland birds nationwide. These declines are reflected throughout our region (Table 1).

Table 1. Status of grassland birds in the Northeast [taken from Mitchell et al. 2000)].

Species	CT	DE	MA	MD	ME	NH	NJ	NY	PA	RI	VA	VT	WV
Upland sandpiper	E		E	E	T	E	E	T	T	E	T	T	T
Horned lark	T												
Vesper sparrow	E		T				E						
Savannah sparrow							T						
Grasshopper sparrow	E		T		E		T			E			
Henslow's sparrow			E	T			E	T			T	E	T
Bobolink							T						

E = state endangered; T = state threatened.

Maintaining grasslands provides critical habitat for this group of birds. Following the guidelines prepared by Jones and Vickery (1997) for the Massachusetts Audubon Society, grasslands in the remainder of this chapter will be categorized as small, large, and agricultural. Small grasslands are 10 to 75 acres in size and are not in agricultural use. These types of grasslands include conservation areas, recreation fields, small landfills, corporate parks, and airports. Large grasslands are more than 75 contiguous acres and include conservation lands, airports, and landfills. Agricultural lands are grasslands on active farms including hayfields, crop fields, and pastures.

Small, isolated grasslands

Small, isolated grasslands are not suitable for grassland birds such as upland sandpipers and grasshopper sparrows that require large contiguous tracts for breeding (Table 2). However, these sites do provide summer breeding habitat for bobolinks, eastern meadowlarks, northern bobwhite, and savannah sparrows. In the fall, these fields provide food for migrating sparrows, larks, and warblers.

Figure 2. Bobolinks (a) and savannah sparrows (b) utilize small grasslands. Photos by Paul Fusco.

Large grasslands

Upland sandpipers, grasshopper sparrows, and northern harriers (all listed as threatened or endangered in most northeastern states) nest in large contiguous fields that contain a mosaic of mowed areas, tall grass meadows, and wildflowers. In the fall, large grasslands provide feeding and loafing areas for migrating sparrows and warblers, while waterfowl and shorebirds sometimes feed in flooded portions of these fields. These fields are also important to birds of prey such as American kestrels and short-eared owls that forage for small mammals throughout the year. Large fields are also beneficial to rare snowy owls in the winter. They regularly visit large airports and wet meadows in the region from more northerly climes.

Figure 3. Upland sandpipers (a) and Northern harriers (b) require extensive grasslands of 75 acres or more. Photos by Paul Fusco.

Agricultural fields

Agricultural hayfields, meadows, and pastures have provided homes to grassland birds for hundreds of years in the Northeast. Grassland specialists utilize these sites for nesting, brood rearing, and foraging. Songbirds including bobolinks and eastern meadowlarks build ground nests, raise young, and forage in hayfields, meadows, and pastures during the summer. In the fall, agricultural fields provide feeding sites for migrating larks, sparrows, and warblers. Many hawks and owls including American kestrels, northern harriers, and short-eared owls forage in these fields for small mammals. Waterfowl and shorebirds frequently feed in flooded portions of crop fields during migration.

Managing and maintaining grassland fields

Prescriptions for grasslands

Cool-season grasses and agricultural lands certainly can be beneficial to wildlife. The vast majority of grasslands throughout the Northeast are dominated by introduced cool-season species, which provide valuable habitat to grassland specialists such as savannah sparrows, bobolinks, and eastern meadowlarks. It is essential that we conserve, maintain, enhance, restore, and establish both cool- and warm-season grasslands throughout the region. Due to a heightened interest in establishing native warm-season grasses, increased availability of seed sources, wildlife and ecological values inherent with these native species, and the availability of funding to conduct private land habitat enhancement practices, the management guidelines presented in this chapter will concentrate on these native grasses. Many of the management recommendations such as mowing dates, use of prescribed burning, grazing, and the use of herbicides would also apply to cool-season grass management.

Before rushing into any management project, a thorough evaluation of the project site should be conducted, so no harm is done to any thriving or potentially valuable warm-season grasses. An evaluation may reveal conditions where warm-season species remain but in a suppressed condition. In such situations, a combination of management prescriptions (i.e. prescribed burning, brush and tree removal, mowing, and/or herbicide applications) may restore warm-season grasses without the need to re-plant.

Although established stands of native warm-season grasses require minimum maintenance, periodic management is important. Stand deterioration is usually caused by a combination of competition from woody plants and cool-season grasses, overgrazing, or an accumulation of plant litter. In the Northeast, management may be necessary every three to four years. Activities should be scheduled outside of the primary bird-nesting season (April 15 to August 15) and some untreated sections should remain to ensure that food and cover is always available. Species-specific management must consider individual habitat needs (Table 2).

Table 2. Habitat characteristics for grassland birds in the Northeast [taken from Mitchell et al. (2000)].

Species	Minimum habitat patch size (acres)	Vegetation type[a]	Vegetation height (inches)
Upland sandpiper	64-113 (NY)	Sandplain grasslands (ME), Old hayfields with short patchy grass (NY), Peatlands with ericaceous shrubs (Quebec)	4-6 (WI)
Horned lark	< 2.5 (NY) 2.5-25 (MO)	Sparsely vegetated agricultural fields (NY), Stony acid soils with sparse grasses (WV)	Very short to bare soils (NY)
Vesper sparrow	12-25 (ME)	Sandplain grasslands with patchy vegetation (ME), Acid soils with coarse grasses and 44% open ground (WV)	
Savannah sparrow	12-25 (ME)	CSG pasture (MD, NY), Marshes (Quebec), Sandplain grasslands (ME), Sparse grasslands (WV)	12 (MD) 33 (PA) 8-24 (Quebec) 17 (WV)
Grasshopper sparrow	64-113 (NY)	Sandplain grasslands (ME), Old hayfields with short, patchy grass (NY), Lightly grazed CSG pastures with 9% forbs (NY), Bunchgrasses with 30% bare ground (WV)	22 (NY) 8-14 (WV)
Henslow's sparrow	74-89 (NY)	Old fields with scattered shrubs and dense litter (MD), Ungrazed CSG pastures with 13% forbs (NY), Grass-dominated old hayfields with thick litter (NY) Tall, dense hayfields (PA)	40-46 (PA)
Eastern meadowlark	60 (NY)	Diverse old fields (MA), Sandplain grasslands with high % forb and grass cover (ME), CSG pasture and forb dominated fields (NY)	16 (WI)
Bobolink	4 (MA) 40 (NY)	Grass-dominated old fields (MA), Sandplain grasslands with high % forbs (ME), CSG pasture and forb dominated fields (NY)	13-16 (Ontario)

[a] CSG = cool-season grasses

Prescribed burning

- Prescribed burning is the most effective management tool to maintain and rejuvenate native grasslands. Burns should be conducted between March 1 and April 15. Burns can be conducted later in the summer (after August 15) and early fall to reduce woody plants that invade grassland fields. Check with the state fire authorities to determine if there are any restrictions on proposed burning. Burning increases

forb diversity, promotes vigorous warm-season grass growth, releases nutrients back to the soil, and suppresses invasive competition. Burning, unlike other routine management practices, removes accumulation of vegetative litter from the ground's surface. Removal of this thatch can be critical to ground-nesting birds that travel through the fields to forage for food and escape from predators.

- Although a limited number of nests may be destroyed in a prescribed burn, grasslands burned every three to four years have higher avian nesting densities than unburned sites.
- Burning produces more succulent vegetation, which is more palatable to rabbits and deer and supports a larger number of insects that are readily available to young birds.

Refer to the prescribed burning section of chapter 10 for information on planning and conducting prescribed burns.

Mowing

Mowing has long been used to manage grasslands as a means to suppressing invading hardwoods.

- Timing is critical. Mowing should generally be scheduled outside of the primary bird-nesting season (April 15 to August 15).
- Mow every two to three years in fields not used for high quality hay production.
- In intensively managed agricultural fields where mowing occurs during the bird-nesting season, strips and edges should be left unmowed to provide areas of food and cover.
- In agricultural fields over ten acres, delay the cutting of the outer 75 feet of the field and mow the interior portion early. This practice will provide some nesting cover while minimizing the impact on high quality hay.
- Utilize standard wildlife conservation mowing practices such as raising the mower blades to at least ten inches or more, which permits the grass to recover quickly.

Herbicides

Herbicides can be utilized to control weeds in grasslands. Each herbicide controls or suppresses a range of weeds and differs in its effects on warm-season grasses. Selective spraying of isolated patches of woody plants or exotic invasive plants such as autumn olive and multiflora rose can be accomplished with Roundup® or a combination of Garlon® 3A and Escort®. Applying a selective herbicide such as Plateau® throughout an entire field will enhance existing native grasslands where tall fescue may be a problem, but may stunt switchgrass. Refer to the herbiciding section of chapter 10 for a more detailed discussion on applying herbicides.

Figure 4. Prescribed burning (a) is the preferred method of maintaining grassland habitats. However, in situations where burning is not feasible, periodic mowing (b) is a suitable alternative. Photos by Paul Rothbart.

Grazing

- Moderate grazing can benefit grassland wildlife. Grazing produces a diversity of grass heights and reduces ground litter, which at certain densities can be detrimental to foraging birds and wildlife escaping from predators. Grazing on fields with high densities of ground nesters during the critical nesting period (April 15 to August 15) should be closely monitored.
- Develop a rotational system that creates a mosaic of plant species and structure, while providing a longer period of time for animals to graze. On fields utilized by grassland nesters, 40% of the vegetation should be maintained at a minimum height of 8 to 12 inches.
- Do not overgraze. This will reduce plant vigor and lead to erosion, reduced invertebrate diversity, increased weed invasions, and decreased wildlife usage.
  Refer to the grazing section of chapter 10 for other wildlife considerations associated with grazing.

Native warm-season grass planting considerations

A native warm-season grass establishment plan should be considered when high quality grasslands do not exist and management treatments to enhance existing grasslands have failed. Several factors should be considered during the planning process to improve chances of success.

Objectives

Objectives for native grassland restoration may include the following:

- Beauty
- Historical value
- Erosion control due to their extensive root systems
- Enhancing grazing systems by providing quality summer forage to augment cool-season species
- Landscaping that conserves water and reduces chemical applications
- Providing habitat for a diversity of wildlife species.

Specific objectives will play a significant role in determining the desired seed mix and seeding rates.

Site selection

Site selection criteria should include climate, location, existing vegetation, soils, cropping history, potential future site use, and potential use of fire as a management tool. Warm-season grasses can be successfully established on an array of sites ranging from forestland to agricultural fields. All sites must be reclaimed to a plantable condition, which may require herbicides, land clearing, or agricultural equipment. Geographic factors play a significant role in grassland establishment. Regional characteristics will have a major influence on seeding regimes, variety selection, seeding rates, planting dates, and soil nutrient requirements. Few site conditions exist in the Northeast that challenge cool-season grass establishment. In contrast, there are several factors that may create problems for warm-season grass establishment.

- The length of the growing season and the heat received during that time period are key factors that affect seed germination, seedling growth, and ultimately the number of years to achieve good stand density.
- The Northeast region has shorter, cooler growing seasons than the Prairie and Plains states because of the high incidence of cloudy days and the cooling effects of forest cover. Successful plantings require a growing season of 100 to 140 days.
- Frost heaving during the fall, winter, and spring after planting can ruin a promising grass stand. On poorly drained sites where air and soil temperatures are cooler, moisture alternately freezes and thaws causing plants to be uprooted. Such areas should be avoided or planted during late spring or early summer to ensure that the seedlings are well developed prior to the first freeze. Do not burn a stand of young, frost-heaved grass. The fire will kill the roots.

- Soil characteristics must be thoroughly evaluated to determine the type of vegetation needed to meet specific habitat objectives. Native warm-season grasses tolerate a broad range of soil types and conditions. However, there are a few site conditions that are simply not suitable for warm-season grasses. These sites contain soils that remain wet due to poor internal drainage, continuous flooding, and heavily compacted soils comprised of more than 30% clay.
- Elevation and aspect play roles in microclimatic variations that must be considered during seed selection. On warm and better-drained sites big bluestem, little bluestem, indiangrass and switchgrass would be good choices for planting. On cool, poorly drained sites eastern gamagrass, switchgrass and wild rye would be better suited.
- Cropping history provides valuable insight regarding herbicide carryover and potential weed problems that may impact seedling survival and vigor. Pastures and hay fields may have infestations of persistent weeds such as thistle, quackgrass, reed canarygrass and smooth bromegrass, which can reappear immediately or soon after seeding. Warm-season plantings do well following an annual crop rotation in which the preceding crop was corn treated with Atrazine®. Planting a crop such as Roundup®-ready soybeans can also alleviate some weed problems.

Seed Selection

Seed Selection is a key component to a successful planting. Always purchase native grass seed in terms of pounds of pure live seed (PLS) - a combination of germination and purity. This is the best way to ensure that you do not pay for the unavoidable inclusion of leaves and stems in the fluffy seeds of bluestem and indiangrass. PLS % = (% purity x % viable seed) divided by 100. Tags placed on bags of seed by manufacturers list the percentage of pure live seed, germination rates, percentage of inert materials and percentage of dormant seed and weed seeds in each bag. The tags should also indicate a lack of noxious weeds. Do not to use seed originating more than 100 miles north or 200 miles south of the project site to minimize problems with hardiness and disease. Within the Northeast, east-west variation is not critical because precipitation is not a limiting factor. Elevation, however, can be significant. An elevation change of 1,000 feet is equivalent to a move of 175 miles to the north. The number of native grass "cultivars" (species or varieties that have undergone replicated testing for two or more generations to document the heritability of traits, performance, and adaptability) that are commercially available for the Northeast are much more limited than for the Plains states. Still, a number of cultivars are available that are suitable for the growing conditions found in the Northeast (Table 3).

After determining specific objectives and evaluating site characteristics, other factors must be considered.

- Purchase seed from a reliable source, allowing several months lead time to ensure availability.
- Purchase seed of individual species and prepare your own mix. Do not mix small, hard seeds with light, fluffy seeds.
- Purchase warm-season grass seed as pure live seed (PLS). This process ensures that you are paying only for viable seed of the species or cultivar desired, not for dead seed, sticks, stems, and weed seeds.
- Seeding rates of warm-season grasses range from 5 to 12 lbs of PLS/acre, which equates to approximately 30 to 60 seeds/ft^2. This rate is much lower than that needed for cool-season plantings because warm-season grasses are bunch-type plants which occupy more space per plant.
- Eastern gamagrass used for grazing should be planted as a single species because it can be difficult to manage in a mixed stand. Another excellent option for grazing and haying is a mixture of big bluestem, indiangrass, and switchgrass planted at seven to nine lbs PLS/acre.
- Plant diversity is the key for wildlife. A good mix of warm-season grasses is a combination of big bluestem, little bluestem, indiangrass, and switchgrass seeded at a rate of 5 to 12 lbs PLS/acre. Southern and midwestern states plant at a rate of five to seven lbs PLS/acre while in the Northeast a higher

rate of 10 to 12 lbs PLS/acre is used because of greater site and climatic variation. On high quality agricultural soils a lower seeding rate (particularly switchgrass) should be utilized to avoid developing stands that are too dense for optimum wildlife benefits. The switchgrass component on high quality sites should not exceed one lb PLS/acre. Legumes and wildflowers can be added to a seed mix at approximately one lb PLS/acre. Plant variety adds structural diversity and therefore a greater diversity of nesting and perching sites for wildlife. Plant diversity also ensures more stable seed production and increases insect populations.

Table 3. Suggested cultivars for the Northeast.

Species	Cultivar	Geographic Use Area
Big bluestem	Kaw	Southern VT/NH & south
	Niagra	All
Little bluestem	Aldous	NY & south
	Camper	NY & south
Salt meadow cordgrass	Avalon	VA to NH, coastal wetlands
Smooth cordgrass	Bayshore	VA to NH
Deertongue	Tioga	All
Eastern gamagrass	Pete	All
Sideoats gramma	El Reno	NY & south
	Trailway	Southern New England & north
Indiangrass	Cheyenne	VA & south
	Lometa	VA & south
	NE-54	NY & north
	Osage	Central PA & south
	Rumsey	VA & north
Sand lovegrass	Bend	Central VT, NH & south
	NE-27	NY & south
Coastal panicgrass	Atlantic	All
Switchgrass	Blackwell	NY & south
	Cave-In-Rock	NY & south
	Kanlow	Long Island & south
	NJ-50	PA & south
	Shelter	WV to southern NH
	Trailblazer	Central VT & north

Pre-planting preparation

Pre-planting preparation actually begins the year prior to seeding. Once a site has been selected and the proper seed mix has been determined, an evaluation of existing vegetation, mulch, nutrient deficiencies, and weed problems must be conducted. A heavy mulch layer hinders proper seed placement, maintains cooler soil temperatures that slow down germination, and serves as a source of high slug populations (within the northern portions of the region) that can destroy warm-season grass seedlings as they emerge the following spring. Tilling the soil or burning the site the year prior to planting can address these concerns.

On sites being converted from agricultural use, re-growth of grasses such as tall fescue, foxtails, crabgrass, and reed canary grass can crowd out emerging seedlings. Fields dominated by these grasses should be herbicided with Roundup® or another suitable product the fall prior to planting. If the vegetation is over two feet tall the field should be mowed prior to herbicide application.

Figure 5. On sites being converted from agricultural use, perennial grasses, which can crowd out emerging seedlings, can be treated with herbicide prior to planting. Photo by Paul Rothbart.

Planting preparation

Planting preparation considerations prior to seeding include planting date, seedbed conditions, weed control, seeding rate, and equipment. Dormant seedings are not recommended for warm-season grasses in the Northeast because of the probability of frost heaving, seed loss to feeding wildlife, and early spring competition from weeds.

- Optimum seeding dates throughout the Northeast are between mid-spring and early summer, typically May and June. Warm-season grasses require minimum air temperatures of 60 to 65 ° F and soil temperatures of 50 ° F. Later plantings may reduce weed and cool-season grass competition, while earlier plantings allow more time for stand establishment.
- Warm-season grass stands do not usually require fertilizer applications during establishment and if managed for wildlife may never require fertilization. If fertility levels are low due to cropping history or poor soil quality, potassium and phosphorus may be applied at the rate recommended according to soil test results. Nitrogen should not be applied during the establishment year because it will stimulate weed competition.
- Weed control prior to planting is essential for successful establishment of warm-season grasses. If weeds persist after pre-planting year treatments, a selective herbicide such as Plateau® can be applied during the spring. Other herbicide options include Banvel® or 2-4D, but these cannot be used if forbs or legumes are part of the seed mix. Note that Plateau® will suppress or retard switchgrass.
- Tilling is a non-chemical option for controlling weeds. Deep plowing and/or multiple diskings can be used to remove each new crop of emerging weeds up to the time of planting. Tilling should be

followed by soil compaction prior to seeding. A drawback of tilling is that the soil disturbance results in the germination of weed seeds that had laid dormant in the soil.

- A combination of herbicides and tilling is probably the most effective means of controlling weeds. This involves tilling the soil, allowing weed seeds to germinate over a period of 7 to 14 days, applying Roundup® to the newly germinated weeds, and planting a few days later.
- Seedbeds must be firm for successful seeding. This helps to conserve moisture and ensures good seed-to-soil contact, which is critical for adequate germination. Recently tilled soil should be compacted with a roller packer or soil finisher prior to planting. A seedbed is properly prepared when a human footprint penetrates no more than 1/4 inch deep. If the soil is not properly compacted, seeds will be planted too deeply and adequate germination will not occur. Soil packing is not necessary in stubble fields because compaction is already adequate.

Planting equipment and practices

The equipment used to plant warm-season grasses should provide a uniform distribution of seeds planted at the proper depth and provide for good seed-to-soil contact. Seeds should be planted at a depth of 1/4 to 1/2 inch. Up to 25% of the seed should be visible in the drill rows on the soil surface to ensure that the seed is not planted too deeply. Seed of switchgrass, coastal panicgrass, and deertongue are small and hard and can be planted with a regular grain drill that has a legume box attached or a traditional broadcast seeder. Eastern gamagrass seed resembles corn seed and is best planted with a corn planter at a depth of one inch. Most of the seed mixes used for wildlife contain big bluestem, little bluestem and indiangrass, which are all light and fluffy. Poor seed distribution will occur if using traditional seeding equipment to plant seeds of these species because seeder tubes become plugged quickly. This can be overcome by adding a light rate of oats or an inert carrier such as cracked corn or pelletized lime to the warm-season seed mix. These carriers will help the fluffy seeds flow through seeder tubes properly.

A no-till drill, such as a Truax® or Great Plains® seeder, is the most effective means to plant fluffy warm-season grass seed. These drills are designed with multiple seed boxes to plant warm- and cool-season grasses, legumes, wildflowers and small grains. The warm-season box is divided into compartments each with an auger/agitator, picker wheels for feeding the seed into the seed cup and oversized drop holes to ensure proper seed disbursement. Optimum seed placement is achieved with double disc furrow openers, depth bands and independent press wheels. This equipment works well on prepared seedbeds, agricultural fields with residual cover and herbicide-treated sod. Heavy-duty versions of no-till seeders are needed for the latter two scenarios. Specialized broadcast seeders are also available for planting fluffy native seeds on prepared seedbeds and have the advantage of eliminating the artificial row effect that results from using no-till seeders. If broadcasting seed, be sure to roll or pack the soil after seeding to ensure good seed-to-soil contact.

Regardless of seeding equipment used, it must be calibrated prior to seeding. When seeding with a no-till drill, it is critical to routinely observe and clean the seeding tubes and furrow discs to assure proper seed distribution.

Figure 6. A no-till drill, such as a Truax® (pictured) or Great Plains® seeder, is the most effective means to plant fluffy warm-season grass seed. Photo by Paul Rothbart.

Post planting evaluation and management

Patience, patience, patience

A variety of methods can be used to successfully establish warm-season grasses. Success is never guaranteed. However, if the guidelines presented in this chapter are followed, failures should be rare. Evaluating stand development is very important and patience can be the key factor to a successful planting. Native grass seedlings spend most of their first year developing extensive root systems for the long haul. It is often difficult to find the thread-like leaves during the first growing season. Give the stand two full growing seasons before making a final determination as to its success or failure. If a field has one strong plant per square foot by the second growing season the stand is successful. A successful stand may take 2 to 3 years to become fully functional.

During the first two years and in particular the first growing season, weeds are the biggest concern because they may out-compete the warm-season grasses. A variety of techniques may be applied during this critical establishment period and thereafter, for long-term grassland maintenance.

- Mowing should be used to control weeds during the first summer. Every time weeds reach 18 inches in height they should be mowed back to six to eight inches. This mowing regime will reduce competition for sunlight and moisture and prevent unwanted species from producing seed. Mowing before the weeds are too tall will prevent thick mulch layers from developing that might smother the warm-season seedlings. Discontinue mowing or cut higher after mid-August to avoid cutting the warm-season grasses that are developing their root systems. If prescribed burning is not an option, then mowing or haying should be continued every three to five years for maintenance. Generally, clippings should be removed whenever possible since dense thatch can be detrimental to nesting grassland birds. However, some species including upland sandpiper, vesper sparrow, and Henslow's sparrow prefer thicker levels of thatch.
- Prescribed burning can help control many woody plants and cool-season grasses. Burning should not be conducted the first year after planting because damage to young plants may occur. Commence burning during years three or four and every two to five years thereafter. Burns should be conducted during late February through early April when native species are dormant, or new growth is less than two inches tall.
- Herbicides can be utilized to control weeds during and after the establishment period. Each herbicide controls or suppresses a range of weeds and differs in its effects on warm-season grasses. Selective spraying of weedy patches is one approach. Another is to use a selective herbicide such as Plateau® throughout an entire field. Plateau® will provide control of an array of annual and perennial grasses and broadleaf plants. Plateau® can be helpful in establishing big bluestem, little bluestem, and indiangrass but may inhibit or injure eastern gamagrass and switchgrass.
- Warm-season grasses are quite palatable and nutritious for livestock, but are subject to damage by excessive grazing pressure. Grazing for short time periods and/or on a rotational basis can be beneficial to the long-term productivity of a native grass stand. When grass has been taken down to a height of 10 to 12 inches, livestock should be removed to allow the grass to regrow. When the grasses have reached 24 inches grazing can be resumed. The final seasonal rotation should leave a minimum height of 12 inches so the plants have an adequate energy reserve to initiate strong re-growth the following spring.
- Warm-season grasses established for wildlife can be long lived with little or no soil enhancements required. Periodic soil samples will indicate soil amendment needs. Warm-season grasses and forbs that are cut for hay will need occasional phosphorus and potash fertilizer.
- Monitoring should be a component of all habitat projects. Unfortunately, these activities are traditionally under-funded and therefore rarely completed. Typical monitoring efforts should include annual bird and vegetation surveys that are reproducible at designated plots. At a minimum, data collected in vegetation surveys should include species present, percent cover, structural diversity, woody plant and cool-season grass encroachment and ground litter density. Photographs taken from the same location

and looking in the same direction, before and periodically after seeding is a quick and easy means of monitoring progress. Corrective measures should be taken as monitoring results dictate.

Figure 7. Patience is required when trying to establish a stand of warm-season grasses. Stands may require two years to become established. Photo by Paul Rothbart.

Warm-season grasses have unique characteristics that make them especially beneficial to grassland birds and a wide variety of other wildlife. These habitat benefits along with the ecological, aesthetic, and historical values have led to a renewed interest in the restoration of native grasslands. Fortunately, there are funding opportunities available through many government programs (i.e. Wildlife Habitat Incentives Program, Landowner Incentives Program, Conservation Reserve Program, Wetlands Reserve Program, Environmental Quality Incentives Program, and the U.S. Fish & Wildlife Partners Program) that will allow natural resource agencies, organizations, and private landowners to establish and/or enhance these critical but vanishing habitats. Technical assistance may be available through state wildlife agencies, Natural Resources Conservation Service, and U.S. Fish & Wildlife Service staff to work with landowners in evaluating, planning and conducting these valuable grassland projects (refer to chapter 12 for more information on potential funding opportunities and obtaining technical assistance).

When establishing a stand, remember to plant shallow, mow weed competition, and have patience. Stands may require two years to become established.

A multi-faceted approach is essential in dealing with grassland habitat loss (cool- and warm-season) and the associated breeding bird declines on a regional basis. This includes maintenance of existing grassland habitat, restoration of degraded grasslands, creation of new grasslands where feasible, outreach regarding grassland values and development of mutually beneficial agricultural-grassland wildlife operations, and development and continuation of monitoring and evaluating programs.

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Biographies

Paul Rothbart is the District Operations/Habitat Program Supervisor for the Connecticut Department of Environmental Protection's Wildlife Division. Paul received his B.S. in Natural Resources Conservation from the University of Connecticut and his M.S. in Wildlife Science from Louisiana State University. Paul has been involved with habitat management activities including sage grouse habitat restoration, early-successional field enhancements, and wetlands management throughout his 25-year career. Paul enjoys developing cooperative partnerships essential to delivering habitat management practices both on state and private lands. Paul currently serves as the Northeast Upland Habitat Committee Chair.

Steve Capel grew up in Indiana and Illinois, and headed west for his undergraduate education at Utah State University. He then spent a couple of years working on waterfowl in North Dakota, while pursuing a Master's degree from the University of Missouri. After seven years as a Big Game Biologist in Kansas, he began 17 years as a Regional Wildlife Manager with Kansas Wildlife and Parks, dealing extensively with quail, pheasant and rabbit management, and managing early-successional habitats. He has spent the last 15 years in Virginia, supervising early-successional wildlife efforts, including a major bobwhite restoration initiative.

Chapter 4. Managing Shrublands and Old Fields

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Shrublands and old fields are critical wildlife habitats that are essential for the survival of many wildlife species. The loss of these habitats through conversion to other land uses, residential development or through succession, is resulting in the decline and disappearance of some wildlife dependent on early-successional habitats. In eastern North America over the last 60 years, open habitats (grasslands, savannah, barrens, and shrublands) have declined by 98%, with shrubland communities comprising 24% of this decline. These habitat changes provide significant challenges for wildlife biologists who strive to maintain a biologically diverse mix of species and habitats on the landscape. If we are to address these declines, management practices must be employed to create and maintain sufficient early-successional habitats that provide the proper structure and size to meet the needs of associated species.

Importance of shrublands and old fields to wildlife

Old-field and shrubland communities provide vegetative structure and diversity that provide vital nesting, brood rearing, feeding, and escape habitats for early-successional wildlife. Shrubland communities are habitat patches with woody plants typically less than ten feet tall with scattered open patches of grasses and forbs that provide floristic diversity. Wildlife that occupy and make use of shrublands and old fields also inhabit power line rights-of-way, abandoned farmland, restored strip mines, and regenerating clearcuts.

Figure 1. Old-field and shrubland habitats attract a wide variety of early-successional dependent birds and mammals, including many ground and shrub nesting songbirds, American woodcock, and New England cottontails. Photo by Paul Fusco.

The vegetative make up of a shrubland or an old field is variable and dynamic depending on the length of time since abandonment, management history, and other factors that can affect the long-term stability and composition of plants that occupy the site. A habitat patch dominated by shrub species such as blueberry, arrowwood, and alder is quite different from that created by a clearcut dominated by regenerating late-successional tree species such as maples or oaks. Patches dominated by shrub clones (e.g., witchhazel, alder, and dogwood) are relatively stable and can last up to 40 years with little management. In contrast, patches dominated by late-successional tree species are short lived (10 to 15 years) and typically much more densely stocked. The greater longevity of a shrubland community is due in part to the ability that many shrub species have to suppress forest regeneration and tree development. Shrubs and shrub-like species having this characteristic include mountain laurel, great laurel, and scrub oak. The greater the longevity of the habitat patch, the greater the length of time that early-successional wildlife species will occupy the habitat patch.

Figure 2. Old-field habitats dominated by coppice growth, saplings, and small trees provide excellent stem density and vertical cover to protect wildlife from avian predation. Photo by Brian Tefft.

Old-field and shrubland habitats consisting of woody shrubs and herbaceous plants have structural diversity that provides nesting sites, escape cover, and food for wildlife. Cottontails and other small mammals benefit from shrub cover, which they use to escape detection from hawks and owls. American woodcock benefit from the protective nesting sites afforded by thick stands of alder and other small trees and shrubs. Turkeys, quail, kingbirds, and others benefit from the abundance of insects found in herbaceous openings.

Apple trees are also an important food source often found in abandoned fields and should be preserved. Apples provide a valuable food supply for many species of wildlife and can be released (opened up) and preserved when managing, mowing, or selectively removing unwanted species to maintain shrubland habitat cover. Refer to chapter 7 for more information on how to release and maintain apple trees. Other important fruiting trees and shrubs to preserve include highbush blueberry, winterberry, black cherry, and wild raisin.

Figure 3. Native, fruiting shrubs, such as winterberry provide important high-energy foods for many birds. Photo by Brian Tefft.

Of 40 bird species associated with shrubland habitats, 22 are undergoing significant population declines in eastern North America (Table 1). Additionally, 139 species of reptiles, amphibians, birds, and mammals either prefer (17 species) or utilize (122 species) shrub and old-field habitats. Shrubland habitats in the Northeast also contain higher proportions of state-listed butterflies and moths than other natural community types. Of 3,500 species of butterflies and moths in the Northeast, 58 are dependent upon shrublands, which provide sunny open areas in combination with desired host plants such as scrub oak and blueberry. Fifty-six of these are considered rare.

Management of shrublands and old field habitats

Patch size

Patch size and distribution on the landscape are important considerations in planning and managing habitats. Some species will use a range of patch sizes while others may require a certain minimum amount of habitat. For instance, small isolated patches less than two acres are not large enough for species such as New England cottontails, yellow-breasted chats, and field sparrows to survive. However, they are large enough for species that have small home ranges including various butterflies, dragonflies, and some songbirds such as chestnut-sided warblers. Small patches will also provide foraging opportunities for more mobile and wide-ranging species such as white-tailed deer and turkeys.

However, if managing shrublands to enhance the long-term survival of a variety of wildlife, generally speaking larger is better. Habitat patches in a range of sizes, from 5 to 25 acres and larger, will enhance reproduction and survival, may contribute surplus animals to the population, and will facilitate movements between larger habitat patches. Patches of at least 25 acres in size are required for yellow-breasted chats, golden-winged warblers, and New England cottontails.

Although most habitat management will be conducted at the parcel level, managers should be aware of what is going on at the landscape level and provide a sufficient mix of shrubland patches. In general, maintaining 10 to 20% of a landscape in an open condition (grassland, old field/shrubland, regenerating forest, and even scrub-shrub wetlands) should be sufficient to meet wildlife diversity needs.

For old-field and shrubland habitats, managers should evaluate the opportunities available at the parcel scale and use available techniques to maintain the habitats that are present while keeping patch size considerations in mind. Old-field and shrubland habitats can be maintained for decades with minimal management. However, development and restoration of shrublands requires considerable effort. New shrublands can be created by clearcutting and then reentering the stand at short intervals (one to three years) to aid in conversion from regenerating late-successional trees to relatively stable shrubland. Powerline rights-of-way are shrublands that have been created in such a manner and require only periodic maintenance.

Management plan

A management plan for any wildlife habitat project requires careful consideration of goals and objectives for the proposed project. A manager should consider patch size and distribution and the proportion of forests and other habitats contributing to wildlife diversity. A variety of management options, including mechanical mowing, herbicides, selective removal of trees, prescribed burning, and grazing may be considered to manage old-field and shrubland habitats. Frequency and timing of such techniques must also be considered. Invasive exotic plants (see chapter 8) should be addressed, since some of these species are aggressive and will displace desirable native species if not controlled. These and other factors must be addressed in the management plan.

Frequency and timing of management

Most early-successional habitats are temporary and dynamic in nature; constantly changing as more shade-tolerant trees replace sun-loving shrub species. Since old-field and shrubland habitats are relatively short lived, 20 to 25 years in most cases, periodic management must be conducted to maintain the desired habitat structure.

The frequency of vegetation management activities necessary to maintain old-field and shrubland habitat conditions will depend on several factors. Old fields and shrublands that are relatively stable still require monitoring and occasional selective cutting, mowing, or herbiciding of small trees that invade the area (e.g., every five years). Patches dominated by regenerating trees will require aggressive management for several years to aid in conversion to a more stable shrubland. This may include stumping and mowing every one to three years, perhaps coupled with an herbicide application to control trees attempting to resprout. Reclamation

of old fields and pastures that have begun to succeed to forest will initially require aggressive management using land clearing equipment such as a hydroaxe, Brown Brontosaurus, or even a tree shear (see chapter 10 for equipment descriptions) to remove larger unwanted trees followed by less frequent action (e.g., every three to five years) to maintain the habitats. Once shrublands become well established they may require only periodic management (every five to ten years or longer). In areas with patches of shrubs interspersed with openings of grasses and forbs, management may only be required every two to four years to prevent these openings from reverting to forest. Monitoring of your habitat patch will be required to determine when management is necessary to maintain the desired habitat condition.

Timing is another important management consideration. Generally, if possible, mowing should not be done during the nesting and brood rearing portion of the year (April 15 to August 15) to minimize impacts to wildlife. However, if trying to control invading tree species, mowing should take place as soon after August 1 as possible since mowing during the growing season helps to minimize resprouting. Mowing can also take place without serious impacts to wildlife during late fall and winter, but it is not as effective at controlling resprouting.

The control of invasive species (see chapter 8) requires annual inspection and employment of control measures to keep old fields and shrublands free of these aggressive plants. In parts of southern New England, invasive species such as autumn olive and multiflora rose are so aggressive that they can become well established and dominant in two to three years. Without diligence, invasive species can rapidly get out of hand at the expense of native shrubs. Managing to prevent invasive exotic plants from becoming dominant must become a routine part of the land manager's job to maintain good old-field wildlife habitat. By combining techniques, particularly mowing and herbicide application, managers can obtain good control. Refer to chapter 8 and the herbiciding section of chapter 10 for more information on controlling invasive exotic plants.

Techniques

Selective clearing and herbicides

Power utilities have pioneered the use of selective clearing and herbicide application to maintain stable shrub communities that will not interfere with power lines. Relatively stable shrub communities can be created and maintained by eliminating trees with selective cutting, followed by selective herbicide application. Dense shrub clones can actually discourage invasion by trees for 15 years or more and result in stable shrub communities once they have become established. Herbicides (see herbicide section of chapter 10) can be successfully employed in the management of old fields.

Figure 4. Power line rights-of-way are often maintained using selective tree removal and herbicides to maintain stable shrub communities that attract a wide variety of birds. Photo by Brian Tefft.

Mechanical methods

Mechanical methods include clearcutting or selective mowing of unwanted trees and shrubs to maintain desired conditions. There is a wide range of capabilities in mowing equipment, from hand-held brush cutters to tractor-mounted mowing decks often referred to as brush hogs, to tree shears and commercial grade mowers such as skid steer mowers, hydro-ax, and the Brontosaurus mower. The Brontosaurus is a mower mounted on the boom of a tracked excavator. In this format, the Brontosaurus has few terrain limitations and has the

power to mow small- to medium-sized trees up to 12 inches in diameter. This equipment is costly to rent or acquire but is widely available through private contractors and does an admirable job because of its ability to be selective. Refer to the mechanical tools section of chapter 10 to obtain information on the Brontosaurus and other mowing/land clearing machines.

Small projects involving maintenance of old fields containing shrubs and trees less than three inches in diameter can be handled with a farm tractor and brush hog. Skid steers combine low ground pressure and high maneuverability and have wide applicability. These machines minimize ground disturbance and permit access to soft or moist areas that would mire rubber-tired vehicles. They can provide a highly selective means for removing undesirable species to create openings or reclaim old-field habitats.

Prescribed burning

Periodic controlled burning (see prescribed burning section of chapter 10) is a valuable method for manipulation of the herbaceous component of the old-field community and will assist in the control of woody encroachment. Short burning rotations (every two to four years) will help restore or reclaim shrublands with a heavy tree component. Once restoration is complete, longer rotations of five years or longer will favor and maintain upland shrub communities, yet stimulate grass and forb production.

Prescribed grazing

Grazing (see grazing section of chapter 10) can be used to control some species of woody vegetation, reduce litter build-up and reduce vegetation height and density. Grazing results in a more diverse vegetation structure in shrub habitats than either mowing or burning because of the uneven pattern of grazing cattle, due to distribution of preferred plants.

Shrubland birds, which have a high percentage of their North American breeding population occurring in the region, have been experiencing significant population declines. Additionally, the vast majority of moths and butterflies that require shrubland habitats are considered rare in the region. Lastly, the New England cottontail, the only cottontail native to New England, has declined to such a point that it is being considered for federal listing under the Endangered Species Act. Active management by private and public landowners is required to help reverse these trends. By using the management techniques and principles outlined in this chapter and this habitat guide as a whole, we may be able to provide enough shrubland and old-field habitat to keep these species around long into the future.

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Biography

Brian C. Tefft received a B.S. degree in Natural Resources Management from the University of Rhode Island in 1978 and an M.S. in Wildlife Management from Frostburg State University in 1981. He is a Principal Wildlife Biologist with the Rhode Island Division of Fish and Wildlife. He supervises habitat planning and restoration, as well as the upland game species projects on wild turkey, ruffed grouse, and woodcock for the Division. Other significant duties include wildlife habitat management planning and restoration on all state and private lands.

Table 1. Selected list of wildlife that use shrubland and old-field habitats, including seasonal use and population trends in New England. Reprinted from DeGraaf and Yamasaki (2001).

Common Name	Habitat Preference[a]	Seasonal Use[b]	Population Trend[c]
Spotted turtle	Preferred	B/NB	Locally common
Black rat snake	Preferred	B/NB	Locally common
Northern harrier	Utilized	W	Decreasing
American kestrel	Utilized	W	Decreasing
Ring-necked pheasant	Preferred	B/W	----------
Northern bobwhite	Utilized	B/W	Decreasing
American woodcock	Utilized	B	Decreasing
Mourning dove	Utilized	B/W	Decreasing
Black-billed cuckoo	Utilized	B	Decreasing
Yellow-billed cuckoo	Utilized	B	Decreasing
Common nighthawk	Utilized	B	Decreasing
Whip-poor-will	Utilized	B	Decreasing
Willow flycatcher	Preferred	B	Trend uncertain
Eastern kingbird	Utilized	B	Decreasing
Loggerhead shrike	Utilized	B	Decreasing
Northern mockingbird	Preferred	B/W	----------
Blue-winged warbler	Preferred	B	Stable
Golden-winged warbler	Preferred	B	Decreasing
Chestnut-sided warbler	Utilized	B	Decreasing
Prairie warbler	Preferred	B	Decreasing
Mourning warbler	Utilized	B	Decreasing
Common yellowthroat	Utilized	B	Decreasing
Yellow-breasted chat	Utilized	B	Decreasing
American tree sparrow	Utilized	W	Decreasing
Field sparrow	Utilized	B/W	Decreasing
Vesper sparrow	Utilized	B	Decreasing
Fox sparrow	Preferred	W	Stable
Song sparrow	Preferred	B/W	--------
White-throated sparrow	Preferred	B/W	Decreasing
American goldfinch	Utilized	B/W	Decreasing
Eastern cottontail	Preferred	B/W	Common
New England cottontail	Preferred	B/W	Rare
Snowshoe hare	Preferred	B/W	Common
White-footed mouse	Preferred	B/W	Common
Ermine	Preferred	B/W	Common

[a] Habitat preference as described by DeGraaf and Yamasaki (2001).

[b] Seasonal use of habitats: B = Breeding, NB = Non-breeding W = Wintering, as described by DeGraaf and Yamasaki (2001)

[c] Continental population trend taken from Breeding Bird Survey data for avian species (Hunter et al. 2001); New England status after DeGraaf and Yamasaki (2001) all others.

Chapter 5. Managing Regenerating and Young Forest Habitat

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If you are a landowner and are reading this chapter for the first time, there are a few things you ought to know about regenerating and young forest habitats. First, regenerating and young forest habitats in any of the forested communities, with the exception of hemlock, contain a greater diversity of wildlife species than any other forest age class. Regenerating and young forest habitat availability is declining throughout the Northeast as the remaining forests mature or change to non-forest uses such as parking lots. Therefore, well-planned efforts to create or maintain these habitats will result in a big payoff for wildlife. If you are interested in wildlife you definitely should be interested in these types of habitat.

Second, the regeneration stage, in terms of age, starts right after a timber harvest or other type of disturbance and lasts from 10 to 15 years depending on which forest type, or forest community, is involved. Young forest habitat starts at age 10 to 15 years and continues to 40 or 50 years, again depending on the community involved.

Figure 1. Regenerating stands of forest in the seedling/sapling (foreground) and pole stages (middle of photo) provide excellent habitat for many species dependent on early-successional habitats. Photo by John Lanier.

Third, regenerating or young forest habitat can be established in two general ways. The first option is to wait for some natural event to flatten your present stand to the point that it will start over by itself. This usually takes a hurricane, fire, ice storm, or insect outbreak in catastrophic proportions. If this is how you want to establish young forest habitat on your property then you need read no further, just sit back and wait. Perhaps, during your lifetime, one of the above events will come to pass and naturally regenerate your forest. For those who would like to control when and how your forest is regenerated, this chapter will focus on important considerations and options for managing your forest.

Each forested community has different dynamics when it comes to how it regenerates. The forested communities discussed here are those listed in *New England Wildlife: Management of Forested Habitats* (DeGraaf et al. 1992). The management applications/silvicultural techniques used for your forests will vary from complete overstory removal (i.e. clearcutting) to small group selection harvests of less than 1/4 acre to 1/2 acre in size. Some communities regenerate better in full sunlight and others are adapted to more shaded

conditions. For example, regeneration in forests comprised of aspen or paper birch and, in some cases northern hardwoods, respond better to full sunlight; whereas coniferous, sugar maple, and oak stands regenerate better in partial shade. Specific silvicultural options for each community can be found in *New England Wildlife: Management of Forested Habitats*. There are also specific silvicultural guides available for nearly every tree species that has any commercial value.

By using these references and, if needed, consulting a professional forester or wildlife biologist, you can be confident that you can successfully grow any type of forest that your land will allow. The difficulty lies in deciding which of the communities are appropriate for your property, how much of those communities should be in a regeneration or young stage at any given time, and how the communities relate to each other across the landscape so that they provide optimum habitat for the wildlife species that you expect to be present. The answers to these questions define the real ball game for habitat managers. The ball game can be rather complex. The remainder of this chapter is aimed at helping you understand the rules of the game.

Management considerations

Prior to developing an early-successional forest management plan for your land, you must consider several important factors:

- What kinds of wildlife are you interested in?
- What are the current and past conditions of your property that will influence your management goals?
- Does the land have the potential or inherent ability to produce the kinds of habitats needed for the wildlife of interest?
- How large is your property?
- How does your property fit in the overall landscape perspective?
- What management actions need to be implemented to create or maintain the conditions you have chosen?

Wildlife goals

Making choices about the kinds of wildlife you want on your property will depend on property size and ability to produce the kind of habitat required for those animals. If you own one acre you will not be able to provide all the life requirements for a bear, and if you are interested in parrots you will not be very successful in growing tropical rain forest in the Northeast. This may sound elementary but it is the place we must start when deciding what to do.

There are a number of publications that describe the habitat requirements and home-range sizes of wildlife species found in the Northeast. These publications, some of which are listed at the end of this chapter, cover all northeastern species and can be helpful in identifying potential species that will use your property. You will find that nearly every forest-dwelling species in the Northeast utilizes at least some regenerating or young forest habitat during part or all of its life. The size of your property is going to make a big difference in your management decisions.

Most landowners in the Northeast own ten acres or less. Relatively few own hundreds of acres or more. However, there are many wildlife species with home ranges of less than ten acres including dragonflies, butterflies, and small mammals (e.g., meadow voles, white-footed mice, etc.), that act as an important prey base for larger species. A well-managed small property can provide all of their life requirements. Even if you are a small landowner, you should also consider providing some of the habitat elements for wildlife species that have larger home ranges and may only use your property some of the time.


Figure 2. Mid- and large-sized land holdings are appropriate for managing species with moderately-sized home ranges like ruffed grouse (a). However, even properties of ten acres or less can be effectively managed for many wildlife species including dragonflies (b), which act as an important prey base for many species. Photos by John Lanier (a) and Jim Oehler (b).

Current and past land conditions

Some wildlife species prefer specific communities such as northern hardwoods, spruce/fir, or oak/pine while others prefer more general community combinations. Soil characteristics on your property will dictate which forest communities will grow on your land. To further add to the confusion, past disturbances to your land, such as wildfires, timber harvests, heavy grazing, or other agricultural activities may have altered the soil and vegetative characteristics of your land. These considerations are important in determining what your land is capable of producing as it relates to the wildlife species you want to attract. Fortunately, there is help. Your county Extension Forester or your county agent from the USDA Natural Resources Conservation Service will have information on soil types that influence forested communities. They can tell you what soils you have and provide information on the effects of past land use on your property. Biologists from state wildlife agencies also can help you sort through the various options regarding creating potential habitat conditions and recommend specific management prescriptions.

Landscape perspective

How your property lies in relation to other landscape features will influence the wildlife that may use it and therefore is important to assess. If you only own a small amount of land, you should discuss wildlife goals with your neighbors and find out what types of habitat they are providing. If regenerating or young forest habitat is lacking in the surrounding landscape, then you may have a perfect opportunity to provide some. Even if you own an acre or less you likely can do something that will complement an adjacent habitat type. For example, you may be able to increase the size of an opening or enlarge an area of regenerating or young forest. By collaborating with adjacent landowners, you can increase the chances that wildlife species of interest will show up in your area.

Even if habitat is ideal on your property, but you live in a sea of lawns, buildings, or hayfields, wildlife may not use your land. You should try to persuade neighbors to plant trees to connect your habitat to others, increasing the probability that wildlife will find your "island" of habitat. Conversely, if trees dominate the surrounding landscape, some openings on your property would likely increase the diversity of species in the area.

If your land lies along a stream, river, or lake, you should expect occasional visits from wildlife species that follow river corridors such as otters, mink, or ospreys. You should consider creating or maintaining high-quality habitats to provide cover for the wildlife in these riparian areas. You should also provide a consistent supply of regenerating or young early-successional forest for beaver and other early-successional species, without completely eliminating the forest cover. Refer to chapter 9 for more information on management options in riparian areas.

There are many other landscape level factors to consider depending on the individual situation. By assessing the landscape, you can be sure your management activities do not become a barrier in some way to the natural movements of wildlife.

Management options

Regenerating and young forest habitat can be established using a variety of management techniques. Once you have determined your wildlife habitat goals and the associated forest communities required, you will need to select a management strategy to put the habitat "on the ground". Your management should supply desired habitat components on a continuous basis to ensure high wildlife use of your land.

Typically, commercial timber harvest operations can be used to reach your habitat goals if your property is larger than 50 acres. We highly recommended that you consult a professional in the planning, preparation, and operation of commercial timber harvest operations. Many logging operations throughout the Northeast and elsewhere are "logger's choice," meaning the logger picks what he or she wants to cut (typically the commercially valuable wood) and leaves the rest. This leaves you with little or no recognizable regenerating or young forest habitat and no opportunity for future timber profits. A professionally trained forester or wildlife consultant can help you identify your goals and set up a program to reach those goals systematically over time. Many states require these individuals to be licensed or registered and you can get a list of names from your State Forester's office.

Properties too small for commercial timber harvest operations can still be managed. Several states in the Northeast have assistance programs through the University Cooperative Extension, state wildlife agencies, or USDA Natural Resources Conservation Service that will help you establish desired regeneration or young forest using a variety of mechanical or hand tools. You may be able to do some yourself, and bring home some firewood if desired. A plan should be formulated to cut a certain amount of your property on an annual basis. A rule of thumb is to keep about 10% of the forested communities on your property in regeneration in any given ten-year period. This translates into cutting an average of 1% per year. If you currently have no regeneration on your property, you can start by cutting more than 1% to establish a significant amount of regeneration early, and then cut less during the last part of the ten-year cycle. The key is to decide what proportion of your property you want in regeneration and set an annual schedule to accomplish it.

If you are a larger landowner you should carefully plan your timber cuts throughout your property. You are likely to have several communities on your land and you should consider establishing a regeneration component in each of them. Your cutting patterns should not disrupt major travel corridors or other areas of concentrated use. An ideal cutting area size for regeneration in northern hardwood or aspen forests ranges between 10 and 50 acres. Softwood, or conifer, regeneration cuts should occur in patches of 1/4 to 2 acres. Larger units tend to encourage hardwood regeneration except in the far northern regions. Oak and sugar maple should also be regenerated in small patches. The percentage of the community that should ideally be in regeneration at any one time varies depending on the tree species, ranging from about 8% in northern hardwoods, Appalachian hardwoods, oak, pine, spruce, and hemlock communities to about 12% in aspen and fir stands. The cutting pattern should be thought out in advance so that the spacing between cuts allows the resident wildlife species to move between them and to continue to use them over time.

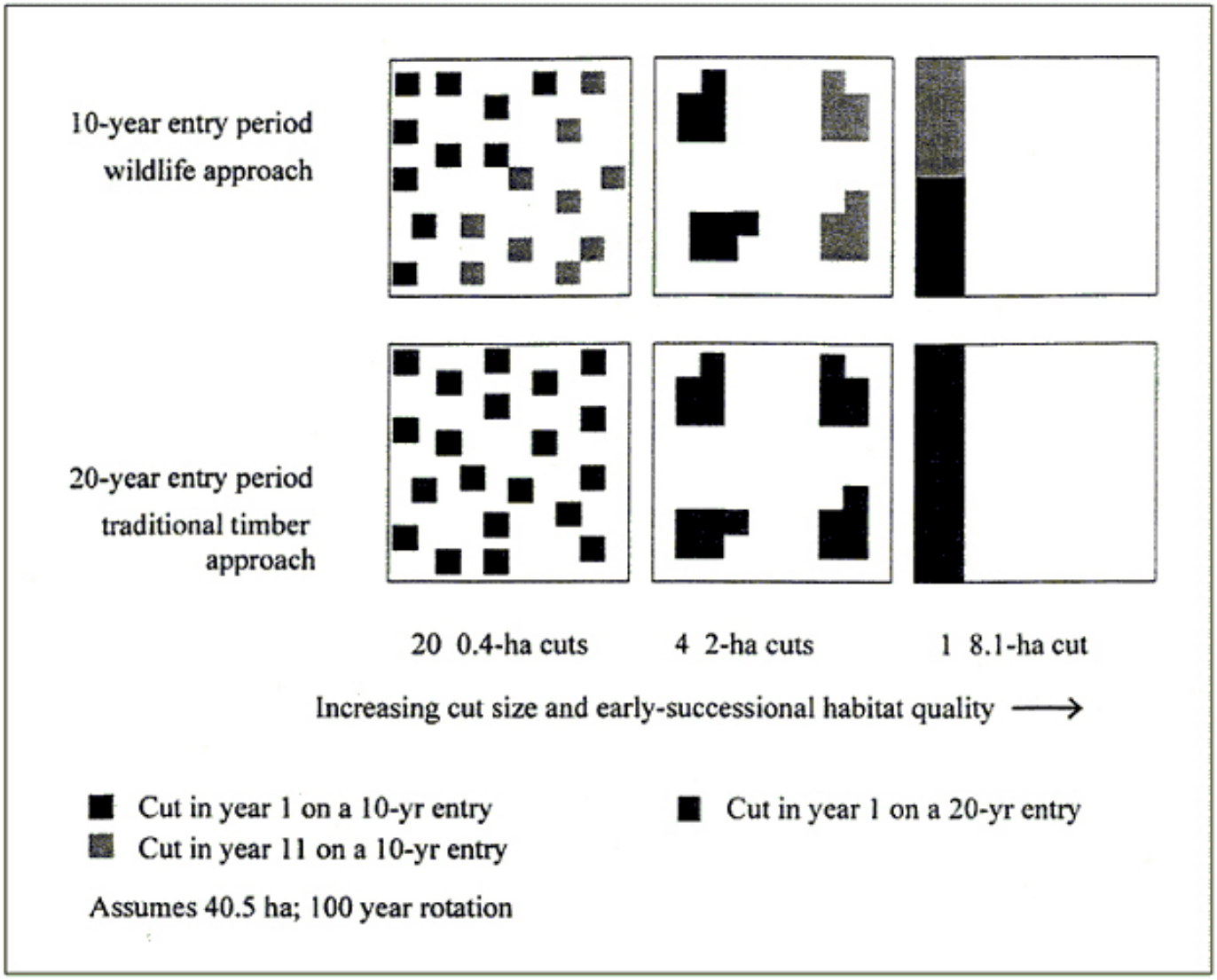

Figure 3. Comparison of stand entry periods under sustainable, regulated even-aged management for providing continuous early-successional wildlife habitat versus traditional silviculture in the northeastern U.S. Reprinted from DeGraaf and Yamasaki (2004) with permission.

The same principles apply on a smaller scale for smaller scale landowners. Set up a plan to work within the capability of your land, choose the community or communities you desire and establish the amounts of regeneration and young habitat you want to sustain over time. You may not have enough land to rotate your cutting schedule, but you can easily select a single area to maintain in permanent regeneration or young habitat through more frequent mowing or cutting.

Aspen forests, a common and important forest type in the Northeast, require special regeneration considerations. If you are interested in promoting aspen, look for individual aspen trees or small groups and focus your initial cutting on them. Clearcut at least 1/2 acre around each individual tree and at least one acre around groups. Be sure to include the aspen trees in the cut. Aspen regenerates both by seed and by root suckers. With adequate sunlight, root suckers will emerge up to 1/2 acre from the cut root system on one tree. Cutting should be done in the late fall or winter after the tree has stored most of its energy in its root system.

Pine regeneration is best accomplished in two stages. Wait for a good seed year and then cut about 60% of the mature trees, preferably in late summer of the following year. The cutting operation will disturb the ground, expose bare soil, and allow the pine seed to mix with the soil. Late summer cutting will reduce the chances of damage to the pine you are going to leave behind because the bark will have begun to harden up after the early growing season. The remaining 40% of the trees should allow enough sunlight to reach the

forest floor so that the pine seeds will germinate and grow, while creating enough shade to discourage white pine weevil. White pine weevil is an insect pest that invades young pine stands in full sunlight, resulting in deformed trees that exhibit forked branching at the top. Wait about 20 years after the initial harvest (this allows the establishment of a new pine stand), and then remove the remaining mature trees.

If forked tops and loss of value from a saw log standpoint is not a concern, then you have the option to harvest most of the mature trees during the first cutting, leaving a few scattered trees throughout the stand for perches and future cavity trees. The thick bushy pines with multiple tops that will eventually become established are excellent habitat and escape cover for many wildlife species.

There are a number of other techniques that can be employed by capable consultants depending on your objectives and the capability of the land in question. Prescribed fire can be successfully applied in oak forests. After a regeneration cut, typically a shelterwood type cut, and after oak seedlings have been established for two to three years, a spring prescribed fire will promote the growth and development of the oak seedlings. Be sure to consult a professional for prescribed burning assistance. Appropriate permits are required and conditions need to be suitable to ensure a safe burn. Refer to the prescribed burning section of chapter 10 for additional considerations.

You can evaluate wildlife responses and vegetative responses to your management over time. *New England Wildlife: Management of Forested Habitats* contains a table that describes responses by some selected bird species to clearcutting in northern hardwood forest. It is included in this chapter to give you an idea of the time frame in which some species respond to habitat changes. Keep in mind that regeneration habitat lasts for 10 to 15 years after a disturbance after which young forest habitat occurs up to 40 or 50 years or so. Some birds come in early and phase out early and others phase in and out at other times.

Regeneration and young forests in the Northeast are important habitat types for a large number of woodland wildlife as well as some wetland and grassland species. The supply of these habitats is in steady decline. This kind of habitat is created either through catastrophic wind, fire, or other storm events at periodic unpredictable intervals or through a number of management activities that can be planned and implemented on an annual basis. If you, as a landowner, decide to implement appropriate habitat management to supply regeneration and young forests for wildlife, you need to consider many factors. Determine what the overall habitat conditions are on a landscape level and what role your property can play. You need to know what your land is capable of producing, what you have out there now, and what you need to do to encourage the appropriate communities on your land. Many agencies and individuals can help you with this part of the process. There are management guidelines for every major tree species that will provide you with information regarding the best methods for stand establishment and regeneration. Commercial timber harvest is the most economical way to achieve regeneration goals on large properties. Harvest schedules should consider appropriate spacing and distribution so that wildlife travel corridors or other concentrated use areas are not disrupted. If you are a smaller landowner, young forests can be established and maintained using your own equipment or by hiring the work out. Many states in the Northeast have assistance programs for small-scale habitat work through cost sharing or professional advice.

If you decide to try your luck at early-successional forest management, you should record the changes observed on your land over time. A journal, log, or photographic record can provide you with an interesting look back at your property. You may be amazed how fast some of the changes take place and you will be able to take pleasure in demonstrating to others that the wildlife community responded favorably to the habitat you have provided.

Suggested reading

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Biography

John W. Lanier received his B.S. Degree in wildlife management from the University of Massachusetts in 1967. He was the wildlife program leader on the White Mountain National Forest (WMNF) for 24 years. During that period he was extensively involved in the application of habitat management principles on numerous projects throughout the WMNF and New England. He worked closely with wildlife habitat researchers to determine the effects of management activities on wildlife species associations and habitats. He also worked for the New Hampshire Fish and Game Department for ten years managing habitat on state-owned properties until his retirement in 2004.

Table 1. Number of years after clearcutting an eastern deciduous forest that breeding early-successional birds first appear, become common, and then decline. Retention of some residual stems (snags and live trees) is assumed. Reprinted from DeGraaf and Yamasaki (2004) with permission.

Bird species	First appear	Become common	Decline
Ruffed grouse	10	15	20
Northern flicker	1	1	7-10
Olive-sided flycatcher	1	1	3-4
Willow flycatcher	1	2	5-7
Tree swallow	1	1	7-10
Winter wren	1	4	7-10
Eastern bluebird	1	1	2
Veery	3	10	20
Swainson's thrush	2	4	15
Cedar waxwing	2	4	7-10
Chestnut-sided warbler	2	4	10
Black-and-white warbler	3	10	[a]
Mourning warbler	2	5	10
Common yellowthroat	2	6	10
Canada warbler	5	15	[a]
White-throated sparrow	1	2	[a]
Rose-breasted grosbeak	3	15	[a]

[a] Present until next cutting cycle

Chapter 6. Managing Small Forest Openings for Wildlife

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Small forest openings are generally dominated by plants that thrive in full sunlight, including herbaceous plants, shrubs and vines, and depending on how advanced succession is, seedlings, saplings, and even small trees. Small forest openings discussed in this chapter include small old fields, old homestead sites, logging roads, and log landings of several acres or less, embedded within primarily forested areas. These openings can help to diversify largely forested areas by providing early-successional habitat needed by many species of wildlife.

In contrast to the regenerating forest habitats discussed in chapter 5, small forest openings begin with a disturbance great enough to create full sunlight conditions on the ground and at least some bare soil for herbaceous plants to take hold. People create these openings through a variety of activities including land clearing and gravel mining. After abandonment, the disturbed soil and full sunlight allow pioneer species to grow.

Even though both regenerating forests and small forest openings provide low, woody growth, they differ in vegetative structure. The forest regeneration stage typically lasts 10 to 15 years and is dominated by vertical woody seedlings and saplings. The tree species found in regenerating forests will largely depend on what was there before the canopy was removed. However, shade-tolerant, late-successional species such as beech and maple typically dominate. Some shrubs and vines may be present, but the trees grow and eventually spread their crowns to create a closed canopy that shades out the sun-dependent plants in the herb and shrub layer.

Small forest openings, on the other hand, have much greater vertical and horizontal diversity due to mix of shrubs and small trees of varying heights and tangles of vines, all interspersed in patches of herbaceous vegetation. This type of habitat provides cover, nesting sites, and a variety of food sources for birds. For instance, ruffed grouse and turkeys use openings for nesting, brood rearing, and feeding. Additionally, white-eyed vireos are commonly found in the dense early-successional habitat found on powerlines, but not in clearcuts dominated by seedlings and saplings.

Most wildlife species use a variety of habitats and are not solely dependent on any one particular habitat type, making small openings in forested areas valuable for a wide variety of species. Black bears feed on forbs and berries in forest openings, but depend on acorns and other nuts found in mature forests during the fall. Some species of forest-dependent songbirds feed in openings in late summer following the breeding season.

Shrubland-dependent songbirds such as chestnut-sided warblers, prairie warblers, and blue-winged warblers often can successfully nest in small isolated patches of shrubs within forested openings. However, recent research has shown that some species, such as yellow-breasted chats, field sparrows, and orchard orioles, prefer larger areas of shrubland and young forest habitat, typically exceeding 12 acres. Early-successional habitat patches would need to be clustered together and of greater size than the openings discussed here in order to be of greatest benefit to these species.

Species like indigo buntings, American goldfinches, bobwhite quail, and monarch butterflies are associated with the types of habitats typically found in small forest openings. For example, bobwhite quail relish ragweed seeds and poison ivy berries, American goldfinches favor bull thistle seeds, monarch butterflies rely on milkweeds, and black-capped chickadees peck out insect larvae from the swollen stems of goldenrods. All of these plants are commonly found in small forest openings. Turkeys, quail, and grouse use openings and nearby edges for nesting, brood rearing and feeding, while white-tailed deer use them for browsing and cover.

Figure 1. Examples of species that benefit from small forest openings include blue-winged warblers (a) and monarch butterflies (b). Photos by Paul Fusco.

Obviously, which wildlife species will use a particular opening depends on a variety of factors, including the type of habitat provided by the opening, proximity to and arrangement with other habitat types (including other early-successional habitats), the types of wildlife locally and regionally present, topography, hydrology, etc. Highly mobile species like deer, turkeys, and woodcock exploit small openings interspersed in a large area of forestland, but less mobile species like cottontail rabbits benefit by providing larger areas of early-successional habitat and young forests in close proximity.

Edge habitat

Edge is the interface between two habitat types, plant communities or successional stages, and is created when forest openings are made. Edge also occurs where two different patches of habitat meet or where forest stand conditions are markedly different, such as where mature forest meets seedling/sapling forest. Edges are unique; they usually contain a high diversity of vegetative species because plants characteristic of both habitat types are present. High plant diversity results in higher structural diversity, which can create very desirable conditions for some species of wildlife, especially those that have small home ranges and thrive in early-successional and young forest habitat.

Edges may be very abrupt or they may be feathered. Feathered edges gradually blend into each other. The value of feathered edges depends on how gradual the transition is (e.g., how gradually the forest becomes a field). The greater the variety of native plants and the more vertical and horizontal diversity found in an edge, the more valuable it is for wildlife in general. Feathered edges can be created through a variety of techniques but typically must be maintained through active management. Many species including ruffed grouse, bobwhite quail, turkeys, white-tailed deer, rabbits, raccoons, foxes, coyotes, song sparrows, brown thrashers, gray catbirds, indigo buntings, and red-tailed hawks benefit from the presence of feathered edges.

Pros and cons of creating openings

Management of early-successional habitats is a priority for many land managers because of the marked decline of many of the species dependent on them. However, many species of wildlife do not benefit from the creation of openings in forestland and an increase in edge. Depending on what the surrounding landscape looks like, species that require large unbroken expanses of forestland to produce viable populations may not benefit from the creation of forest openings.

The effects of forest fragmentation on birds has been the subject of many studies. Most conclude that small forest stands surrounded by agriculture or development result in dire consequences for the birds attempting to use them. Creating a small forest opening in an already small forest block will just contribute to the birds' demise. On the other hand, small forest openings in large, unfragmented blocks of forested habitat will actually benefit a number of species and may even benefit some songbirds that require large expanses of forest.

For example, if you owned 100 acres of wooded habitat surrounded by primarily agricultural land, placing permanent openings in the woodland would be of minimal value. On the other hand, if you owned 100 acres of mature forested habitat and much of the surrounding land was forested, creating some small permanent openings would greatly benefit a variety of species. The conservation of large areas of forestland, while vitally important and necessary, must be balanced with the need to manage early-successional habitats and the host of species, both common and uncommon, that are dependent on them.

Before implementing management actions, the landowner or manager should establish clear objectives based on an assessment of the quality and quantity of existing habitats, natural features, juxtaposition of those habitats and features on the property, wildlife species currently using the property and those with the potential to use the property based on the habitat present. This assessment must be made with consideration to neighboring habitats and in view of the larger landscape. State wildlife agency biologists or Cooperative Extension wildlife specialists may be able to provide technical assistance to help with the planning and implementation of openings for wildlife based on local, state, and regional objectives.

Types of small forest openings

There are three main types of small forest openings: herbaceous, successional, and planted food plots.

Herbaceous

Herbaceous openings are permanently maintained and contain grasses, herbaceous plants, wildflowers, legumes, or some combination of these. Permanent herbaceous openings provide good food sources, nesting sites, and escape cover for ruby-throated hummingbirds, broad-winged hawks, deer, black bears, red foxes, chipmunks, and other wildlife. Insects thrive in open, sunny herbaceous conditions that also provide important high-protein food for growing grouse chicks, turkey poults, and songbirds.

Successional

Successional openings are those that are permanently maintained to encourage an early-successional mix of grasses and herbaceous plants, shrubs, and some seedlings and saplings. In these openings you may find shrubs such as pokeberry, raspberry and blackberry, and seedlings and saplings that provide nesting habitat for indigo buntings, feeding areas for woodcock, black bears, white-tailed deer, coyotes, and ruffed grouse, and cover for snakes and small mammals. Openings containing both herbaceous vegetation and shrubs are generally the most valuable for wildlife, because of the vegetative diversity and amount of food that they provide.

Food plots

Food plots are openings that are periodically planted with an agricultural crop desired by wildlife (sorghum, oats, soybeans, sugar beets). These areas must be prepared for planting much like an agricultural field. The site must be free enough of rocks and stumps so that it can be plowed and/or harrowed and possibly raked after seeding. Single, small isolated food plots that contain an annual crop like sorghum or sugar beets have little impact on the overall supply of food and typically benefit only a small number of individual animals. If wildlife populations become concentrated around food plots, predation can increase in and around that area. In order to significantly improve the level of nutrition for any particular wildlife species, about 10% of the land base needs to be cultivated and dedicated solely to that species. In some localities with high deer concentrations, deer may eat the foot plot before it even develops or matures. Nonetheless, if wildlife viewing and hunting opportunities are your objectives, small wildlife food plots can help supplement naturally available foods and attract wildlife to your property.

Creation and site preparation

New permanent openings can be created through management of log landings created during forestry operations, and expansion of existing openings such as former homestead sites and small overgrown old fields. To create an opening, all overstory trees must be removed and the site cleared of tree stumps, rocks and other debris. The most efficient way to accomplish this is with a bulldozer. Clearing and bulldozing the site exposes mineral soil for natural regeneration or seeding and smoothes the site enough to allow for future maintenance mowing. However, doing so will also create a perfect seedbed for the invasion of exotic plants that can eventually take over the opening. As such, it is advisable to address any invasive exotic plant issues prior to clearing. Refer to chapter 8 for more on invasive exotic plants and the herbiciding section of chapter 10 for invasive exotic plant control options.

In the Northeast, cleared areas do not necessarily need to be seeded because they typically resprout to a mix of herbaceous plants, briars, and eventually saplings and trees depending on the region and seed source. Some research has shown that areas allowed to regrow to native herbaceous plants and shrubs are more valuable than those that are planted with a conservation mix (commercially available mixes containing rye, various cool-season grasses and a legume like clover). However, in areas prone to erosion, seeding with at least an annual cover crop such as winter rye is advisable. Ultimately, the decision of whether to seed the prepared site should be based on management objectives and site conditions.

If creating a food plot, the site needs to be prepared by disking, liming, fertilizing, disking again, and seeding. Commonly used seeds include ladino or white clover, bird's-foot trefoil, Canada rye, smooth bromegrass, switchgrass, and various types of conservation mixes. Warm-season grasses or cool-season grasses can be used, depending on site conditions and management objectives. Wildflowers can be planted to increase the attractiveness of an opening for insects, especially butterflies. A mix of seeds is always preferred, because it provides a greater variety of food and cover.

Recommended seed types and planting specifics will vary depending on locality, soil type, hydrology, and the habitat management goals of the landowner or land manager. The Natural Resources Conservation Service (NRCS), state wildlife agency, and/or Cooperative Extension office may be able to provide technical assistance on site preparation, planting, and the best seeding mixture to use for meeting your habitat management goals. If necessary, soils can be tested for lime and fertilizer requirements through the local NRCS or Cooperative Extension office.

Log landings

One of the most efficient ways to create a permanent opening is through a planned forestry operation. Log landings can be created and/or managed to provide permanent openings. Landowners or managers can specify that loggers remove rocks and other debris from the log landing, exposing mineral soil. Loggers

can prepare the site adequately by back-blading with the skidder before leaving the job site. The cost of this process can be absorbed in the sale of the logs. Log landings can purposely be made larger to provide greater benefits to wildlife. Once the site has been prepared, it can be planted with a seed mixture chosen based on the management goals for the property or left fallow to resprout to herbaceous growth, briars, and seedling- or sapling-sized trees.

If there are few shrubs in the area to naturally seed in or you just want to ensure that highly desirable shrubs become established, native shrubs can be planted on the site. Fruit-producing shrubs such as dogwoods, viburnums, serviceberry, and blueberry are excellent choices for planting. Small clumps of evergreens can also be planted in openings to provide cover. However, once an evergreen has reached 10 to 12 feet, it should be cut back to about four feet (topped) to keep cover close to the ground, otherwise it will grow up to dominate and shade the herbaceous growth in the opening. A relatively inexpensive source for tree and shrub seedlings may be your state nursery. Check with your state's forestry department to see if a nursery exists in your state.

Placement of openings

Placement of temporary openings will depend to a large extent on the amount of land being managed, existing habitat conditions, and the species being managed for. Generally, for species with small home ranges (e.g. rabbits, woodchucks, small mammals), creating both permanent and temporary openings in close proximity to one another and close to other early-successional habitat is preferred. A larger area of successional and young forest habitat allows for more individual species to breed and produce offspring, because it provides more space for individual territories. More habitat resources are present in a concentrated location, making it easier for species to meet their food and cover needs. Additionally, species with small home ranges will have an easier time finding and colonizing the newly created temporary opening if they do not have to travel long distances. Concentrating early-successional habitat in one area also leaves mature blocks of forestland unfragmented, which benefits area-sensitive species.

On the other hand, highly mobile animals such as deer, turkeys, ruffed grouse, bears, and some species of birds will readily use widely scattered openings. Assess your current habitat conditions in conjunction with your management objectives to help decide where and how to create, reclaim, or manage openings. In general, large forested areas of at least 1,000 acres should maintain at least 5% of the total acreage in permanent openings. Of this, at least 2% of the total acreage should be managed for permanent herbaceous cover.

When creating new permanent openings, look for areas that are relatively flat (less than 6% slope) and cut the opening so that it has an east-west orientation to allow maximum sunlight exposure. South-facing slopes are preferred, as they tend to receive more hours of direct sunlight per day and remain free from snow for longer periods of time in early spring and fall. Sites with good soil make the best permanent openings. Flat to gently sloping areas will be less prone to erosion if they are plowed or disked before planting, and will be easier to maintain once they are established.

The size of openings should be dictated primarily by the species or suite of species being managed. In general, openings should be no less than 1/4 acre in size but can range up to several acres in size. Smaller openings of 1/4 to 2 acres are usually feasible for a landowner to create and maintain on their own and are very beneficial to a variety of species.

Maintaining openings

Once established or reclaimed, openings will need to be maintained through one or more of the following: periodically mowing, prescribed burning, hand cutting and/or herbiciding. Maintenance is critical to prevent succession into mature forestland.

Mowing

Many permanent openings can be maintained through periodic mowing. A tractor and brush hog are the most efficient tools for mowing openings. Brush hogs are readily available that can cut woody stems up to three inches in diameter and cut herbaceous vegetation at the same time. If managing for an herbaceous opening, mow every two to three years to prevent woody growth from invading. If the goal is to maintain a successional opening, mow every three to six years depending on the growth rate of woody plants at the site.

If the objective is to allow for the completion of breeding, nesting, and rearing activities of wildlife, maintenance mowing should be done after August 15 but before April 15 of the following year. This is when many species start breeding again. If the objective is to have some growth return to provide food and cover during the fall and winter, mow during August but prior to September so that some vegetation can grow back. If the objective is to maximize seed production for game birds, herbaceous openings should be mowed after July 1 but before August 15. This allows game birds to complete their nesting cycle, but provides for succulent new growth and a flush of insects in late summer.

Prescribed burning

Depending on location, site conditions, and regulations, prescribed burning may be an excellent option to maintain an opening. Burning done in the springtime will help maintain the current vegetative state. Summer burns are more efficient at killing woody material and setting back succession, but may not be feasible due to the smoke and potential of exceeding federal and state air quality standards.

Burning can enhance habitat quality by improving the nutrient levels and palatability of wildlife foods. It removes litter, making foods easier to find for some species such as bobwhite quail and allowing new vegetation to sprout, attracting and producing an abundant insect population. Ash and various minerals are released, stimulating valuable nitrogen build-up in the soil. Refer to the prescribed burning section of chapter 10 for more information.

Herbiciding

Herbicides can be used to manage successional habitat and to control invasions of certain exotic plant species that can easily colonize openings during and after their creation. Generally, herbicides are applied to the foliage or to the cut stem of a shrub or tree. The type of herbicide and method of application should be decided on a case-by-case basis. Refer to chapters 8 and 10 for thorough discussions on invasive exotic plants and the use of herbicides, respectively.

Food plots

Food plots require a considerable amount of effort to establish and maintain. These openings will need to be disked, seeded, and possibly fertilized every year. Annual or periodic disking leaves some soil exposed beneath the new growth, creating highly desirable conditions for many species including bobwhite quail. The local NRCS office is an important resource to obtain the planting requirements of various agricultural crops.

Reclaiming existing sites

Old existing openings that have grown beyond the stage of providing high-quality early-successional habitat can be reclaimed if desired. These areas generally still have some herbaceous growth in the understory and may even still contain some shrub growth, but may have become dominated by large saplings, or pole-sized trees. Removing the larger trees will increase the amount of sunlight that reaches the ground, stimulating herbaceous growth and providing the necessary light to allow shrubs to thrive. When managing for early-successional habitat, concentrate on removing trees three to four inches in diameter and larger. Old homestead

sites, old fields, and overgrown orchards can be cleared of unwanted trees and mowed to remove overgrown herbaceous growth.

The scale of the project, the size of the trees to be cut, and available resources will dictate how the opening will be reclaimed. Individual trees can be cleared with a chainsaw. Trees three inches or less in diameter can be cleared with most commercially available brush hogs. Sites to be mowed with a tractor and brush hog should be relatively clear of rocks. Previous openings were likely cleared of debris when they were created, so mowing should be an option. All trees larger than 3 inches in diameter should be removed, unless they have overriding wildlife value (den trees, apple or other fruit trees, or trees containing vines). The goal should be to re-open the area to sunlight so that herbaceous growth is stimulated and not shaded out by large trees.

In some instances, machinery larger than a tractor and brush hog may be needed to remove trees, tangles of multiflora rose, or other vegetation that is difficult to remove. A heavy duty Brontosaurus or other suitable equipment may be required (see the mechanical tools section of chapter 10 for additional options). Once the site has been cut, it can be brush-hogged on a periodic basis, depending on what stage of growth is desired.

Management of edges

Edges can be improved by making them more feathered. The forest edge should grade from mature trees into smaller diameter trees, then into shrubs, brush, and finally herbaceous growth. If you have an abrupt edge between mature forest and a field, feathering can be achieved over time by cutting back into the forest edge via selective hand cutting, girdling, or mowing with a Brontosaurus, and then allowing young trees to sprout or grow if already present. Approximately 30 feet of the field edge can be left to grow up into herbaceous plants and mowed every two to four years. If few shrubs invade the edge, valuable food-producing shrubs can be planted to help with the creation of a high-quality feathered edge.

Edges need to be maintained by periodic cutting, as trees become too large and shade out desirable growth. Without maintenance, edges will continue to creep into the permanent opening, eventually eliminating it. Periodic cutting of edges should be done in stages so that there is always some of this habitat available, some growing back and some ready to be cut.

Although typically less than a few acres in size, small forest openings can provide extremely valuable early-successional habitat if managed correctly and placed in the right location. Creating a small forest opening in an already small forest block may not be wise because doing so may lead to higher predation rates of the birds and small mammals attempting to use it. However, a small forest opening in a large, unfragmented block of forest will benefit a number of species, even those songbirds thought to require large expanses of forest such as scarlet tanagers and wood thrushes. In such a setting, a small forest opening can be a supermarket of food compared to that typically found in a closed canopy forest. Raspberries and pokeweed berries provide food for bears and songbirds, while abundant insect populations provide food for grouse, turkey, and flycatchers. By using the techniques outlined in this chapter, you can ensure an important and stable food source for these and other species.

Suggested reading

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Biography

Judy Wilson is the Private Lands Program Coordinator for the Connecticut DEP Wildlife Division. She earned her B.S. degree in Wildlife Management from the University of New Hampshire in 1982 and an M.S. in Natural Resource Management, specializing in wildlife, from the University of Connecticut in 2004. Judy began her career as the Eastern District Biologist in 1985 and in 1987 went to work as the Western District Biologist before assuming her current position in 2003.

Chapter 7. Managing Abandoned Orchards and Apple Trees for Wildlife

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Apple trees provide a valuable source of food, cover, and nesting sites for wildlife and old, abandoned apple orchards with thick herbaceous growth, shrubs, and small trees provide extremely important habitat to a myriad of species that require early-successional habitat (Table 1). With this in mind, it comes as a surprise to most landowners that the apple tree is not native to the United States. The tree originated in Asia, where it has grown since the late Stone Age. John Endicott, one of the early governors of the Massachusetts Bay Colony, is said to have brought the first trees to America from England in 1629. From the early plantings by colonists of seedlings and grafted trees in the eastern United States, apple trees rapidly spread to the western U.S. Native Americans, traders and missionaries carried seeds beyond established European settlements. The most famous of apple tree distributors was a missionary named John Chapman, who became known as Johnny Appleseed.

Value of apple trees and orchards to wildlife

Apples are the most widely grown and valuable fruit to people, and they are also highly valuable to wildlife, especially in the Northeast. The bark, buds, twigs, leaves, and fruit are used by a variety of wildlife. For example, porcupines, beavers, mice, cottontail rabbits and deer consume the bark; grouse and deer consume the buds; and beaver, deer, snowshoe hares and cottontail rabbits eat the twigs and leaves. Deer, turkeys, fox, fishers, porcupines, bobcats, coyotes, red squirrels, and black bears have all been known to eat the fruit.

Figure 1. Species such as Baltimore orioles benefit from apple orchards. Photo by Paul Fusco.

Apple trees provide a year-round food source in one form or another, but they are particularly important in the winter when many uneaten apples remain hanging on trees. These apples are readily eaten after other fruits have dropped off and rotted or have disappeared under the snow. Wildlife become familiar with apple tree locations and seek them out for food.

Apple trees provide perching and nesting sites for songbirds like orchard orioles, eastern kingbirds, eastern wood peewees, and least flycatchers. Old apple trees often have cavities that are used by eastern bluebirds,

black-capped chickadees, and white-breasted nuthatches for nesting. Unmaintained apple trees will have many dead branches and stubs, providing insects for woodpeckers, chickadees, and flickers.

While a lone apple tree here or there can provide an attractive source of food for wildlife, old, abandoned apple orchards are a great source of early-successional habitat. "Old, abandoned orchards" are those that are no longer being commercially grown or maintained for human consumption. These abandoned orchards may range from open in character with herbaceous ground cover under mature apple trees, to clumps of shrubs and small stands of seedling/sapling trees interspersed with herbaceous ground cover and apple trees. More successionally advanced abandoned orchards will have mature hardwoods (less typically softwoods) overtopping the apple trees. Which successional stage the abandoned orchard is in depends mainly on when the orchard was last maintained. Only periodic mowing and/or cutting of invading trees will prevent these areas from succeeding to mature forest.

With so many species in the Northeast wholly or partially dependent on early-successional habitat, abandoned orchards can play an extremely important role in providing needed habitat (Table 1). Depending on the successional stage, abandoned orchards can provide appropriate habitat for a variety of wildlife species, with many species overlapping use from one successional stage to the next. "Open" orchards dominated by grass, herbaceous ground cover and widely spaced apple trees create productive conditions for insects that are sought after by turkey and grouse poults. Eastern bluebirds utilize these open conditions for feeding and nest in cavities often found in apple trees. Not surprisingly, orchard orioles prefer orchard areas, but Baltimore orioles also make use of them. These open conditions also provide excellent habitat for eastern peewees, eastern kingbirds, least flycatchers, American robins, garter snakes, eastern hognose snakes, woodchucks, meadow voles, white-footed mice, and many other species.

Abundant small mammal populations found in abandoned orchards attract raptors and owls, which may perch in either apple trees or taller adjacent trees. The prey base also attracts red and gray foxes, eastern coyotes, and weasels. Many bat species found in the Northeast, including little brown myotis, northern long-eared bat, Indiana myotis, silver-haired bat, eastern pipistrelle, big brown bat, red bat, and hoary bat will use orchard areas for feeding or roosting.

Late- or mid-successional stage abandoned orchards that contain apple trees, areas of open herbaceous growth interspersed with clumps of shrubs, and some small trees provide extremely valuable successional habitat for many species due to their structural diversity and diversity of species available for food, cover and nesting. These areas are used by species such as ruffed grouse, American woodcock, indigo bunting, eastern cottontail, New England cottontail, and garter snake. Shrub-dependent wildlife species, including chestnut-sided warblers, blue-winged warblers, prairie warblers, and golden-winged warblers also exploit these overgrown abandoned orchards.

Figure 2. Species such as garter snakes (a) and chestnut-sided warblers (b) make use of late- or mid-successional stage abandoned orchards. Photos by Paul Fusco.

Species wholly or partially dependent on early-successional habitat often use apple orchards through a range of successional conditions. However, once the abandoned orchard is dominated by overtopping trees, use by early-successional species drops off markedly and is replaced by mature forest dependent species (Table 1 in chapter 5).

You may have only a few abandoned apple trees on your property or maybe you are lucky enough to have an old orchard of 1/2 acre or larger. The apple trees on your property may have seeded in naturally, particularly if you have only a scattered few. Larger orchards were likely planted from the early 1920s through the 1950s, when they were popular for home use and as a source of extra income. Apple trees can grow from seed or can be grafted (where a branch or scion is inserted into another stem and continues to grow).

Abandoned apple orchards are disappearing due to forest succession, human development, and a decline in agricultural activity. Few new orchards are being planted today and those that are provide little value to wildlife due to intensive management.

While single apple trees can provide food for a few individuals, an entire abandoned orchard can provide habitat for a variety of species. Abandoned orchards of 1/2 to several acres in size that are managed for wildlife can provide highly desirable early-successional habitat. Larger orchards (greater than 5 acres) are even more valuable for wildlife. Even though many species using abandoned orchards have small home ranges, a greater diversity of species will be supported if the abandoned orchard is larger. A larger area of habitat is also likely to produce more individuals of a species than a smaller area and thus may act as a "source" of individuals to disperse to other habitats.

Reclaiming abandoned apple orchards

Apple trees were originally planted in clearings because they need full sunlight to thrive and produce fruit. As people moved off the land and into cities and suburbs, many orchards were abandoned and were quickly grown over with taller hardwood trees. The remaining apple trees are sometimes called "wild," in various wildlife management publications, because they are no longer being grown for human consumption as part of a maintained orchard.

As the forest grows back around an apple tree, it crowds and shades the tree, causing a decline in vigor and lower fruit productivity. Eventually the tree will die; diminishing its value to wildlife (a dead or dying apple tree still supports insects, provides perching sites and may contain one or more useable cavities). Releasing apple trees is a common technique used to improve their vigor and fruiting capacity. This technique involves cutting the vegetation around the apple tree and allowing full sunlight to reach it, resulting in increased growth and fruit production.

Before the landowner or manager begins work, it should be decided if the orchard will be managed for more open habitat as described previously, or one offering a mosaic of apple trees, shrubs, grass and herbaceous growth. This decision should be based on the landowner's goals and objectives, the species being managed for, how much abandoned orchard habitat is present, its condition, and its placement on the landscape. For example, abandoned orchards being managed for eastern bluebirds, orchard orioles, and woodchucks should contain larger amounts of open grass or herbaceous vegetation and few small trees and shrubs. Abandoned orchards that contain valuable, native food-producing shrubs along with apple trees and herbaceous ground cover should be managed to maintain this shrub component, because shrubs provide valuable food, cover and nesting sites to a variety of species including ruffed grouse, indigo bunting, brown thrasher, blue-winged warbler, golden-winged warbler, New England cottontail, and various insects.

Any overtopping trees that could eventually shade out apple trees must be removed. In cases where there are a few overtopping trees that have outstanding wildlife value, such as a large tree with a well developed cavity, or one draped in grapevines (a good food and cover combination for wildlife) the decision can be made to leave one or two of these trees. Any trees larger than three inches in diameter should also be removed, since it's usually not long before they will compete with and overtop the apple trees. Abandoned orchards with trees and shrubs less than three inches in diameter can be re-cleared using a tractor with a brush hog, ASV® (all season vehicle) or Bobcat® machine with a heavy duty mowing head (or machine with similar

capabilities). Trees between three and nine inches in diameter can be efficiently and effectively cleared using a Brown Brontosaurus (specialized cutting head) mounted on a tracked excavator or rubber-tired machine. Refer to chapter 10 for a more detailed list of mechanical tools used for reclaiming and maintaining early-successional habitats. A qualified chainsaw operator can cut trees of any size, but it is usually most efficient to hand-cut trees too large to be handled by machinery. Of course very small orchard restoration jobs could be accomplished using a chainsaw and brush cutter if necessary. Portions of the orchard dominated by herbaceous plants should also be periodically mowed (using a tractor and brush hog or flail mower) to prevent tree and shrub invasion.

Maintaining the abandoned orchard

If the landowner or land manager desires open orchard habitat, all woody growth and most shrubs should first be removed. To maintain this condition, the entire area should be mowed every two to four years, depending on site conditions. If a slightly more advanced successional habitat is desired, the abandoned orchard area can be mowed every three to seven years, again, depending on site conditions. In some areas, soils, hydrology and existing vegetative conditions allow forests to regenerate more quickly. Abandoned orchards containing a combination of native shrubs, herbaceous growth, and apple trees are desirable to the greatest variety of species.

Herbiciding, while not popular, can be a very safe and effective tool for maintaining abandoned orchards. Spot herbicide applications will help to control undesirable trees and shrubs or invasive exotic plants that can quickly take over an orchard (refer to chapter 10 for more information on using herbicides). If the abandoned orchard area is large enough (more than ten acres) it can be managed to provide both an open condition (dominated by grasses and herbaceous growth) and a mix of shrubs, apple trees, grasses, and herbaceous growth. This is the ideal situation, as it meets the habitat needs of a wide range of wildlife species.

Pruning apple trees

Once the abandoned orchard has been cleared and reclaimed, the apple trees may be pruned. Pruning accomplishes two objectives: it improves tree vigor, and increases fruit production. Allowing more sunlight to reach all parts of the tree and removing dead and dying branches will improve tree health, resulting in increased fruit production. Additionally, removing excess live branches allows the tree to put more of its energy into growing fruit.

Pruning should be accomplished in stages, over a period of three or four years. Try to avoid the tendency to over-prune wild apple trees, which leads to stress and can harm the trees; it is better to under-prune than to over-prune. Following are a few basic steps for properly pruning apple trees:

- Remove dead, diseased and dying wood and low hanging branches, starting from the top of the tree. In the winter, dead wood can be differentiated from live branches by the lack of buds. Make the pruning cut just outside of the thickened live wood formed when the branch died.
- Cut branches that cross or rub on one another, drooping branches and branches with narrow "V" crotches (they are weak and split easily).
- Lower the height of the tree if needed so that it maintains a spherical shape, but do not remove more than five or six feet in any given year.
- Reduce overcrowding of live wood by removing roughly 1/3 of the live growth to open up thick clusters of branches. Thin out branches in all parts of the tree to allow more sunlight to get to the interior of the tree.
- Remove strong upright growing shoots and water sprouts (fast growing unbranching upright shoots) as well as other weak growth. Upright branches do not produce fruit.
- Leave the short spur branches that grow on the sides of larger branches because these are the fruit bearing branches.

- Encourage horizontal branches because they capture more sunlight and tend to bear more fruit. (Branches at a 45-degree or 90-degree angle are the most desirable.)

For more information on pruning apple trees and recommendations on what tools to use, refer to the publications listed at the end of this chapter.

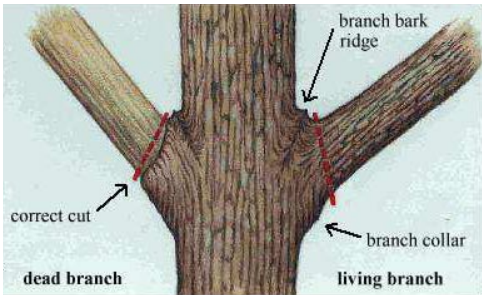

Figure 3. Targeting the cut. Picture courtesy of United States Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry. NA-FR-01-95

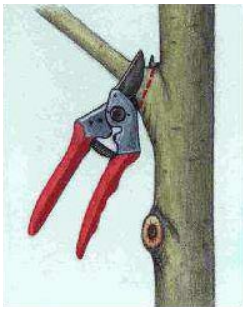

Figure 4. Cutting a small branch. Picture courtesy of United States Department of Agriculture, Forest Service.

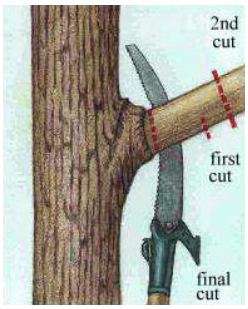

Figure 5. Cutting a large branch. Picture courtesy of United States Department of Agriculture, Forest Service.

When to prune

Pruning should be done in late winter or early spring before the leaves appear. Pruning at this time makes it easier to see the structure of the tree and what cuts are needed. By late winter, the tree is less susceptible to injury because it is fully dormant and able to form a protective barrier behind the cuts prior to spring disease and insect activity.

Brush piling

Branches cut from apple trees along with any other trees cut during the reclamation process can be used to make brush piles. Brush piles provide valuable cover to species such as weasels, rabbits, raccoons, chickadees, winter wrens, and ruffed grouse. Placing the brush over rocks, stumps, or logs produces a better brush pile with more hiding spaces.

Planting apple trees

Landowners and managers can also plant additional apple trees to supplement those already in the orchard, to improve pollination or to increase the amount of available food. Trees that are good apple producers and resistant to disease and insects should be chosen, since you don't want to have to use pesticides on apples

grown for wildlife. When buying trees from state or private nurseries explain that the trees are for use by wildlife so they can suggest the best varieties along with directions regarding planting and maintenance. Crab apples may be a good option; they are a close relative of the apple tree and produce large amounts of small fruit that persist throughout the winter.

All young apple trees must be protected from mice, rabbits and deer in order to become established. The stems should be protected by either a commercially-available plastic tree shelter or 1/4-inch by 1/4-inch mesh hardware cloth encircling the tree. Both will prevent animals from damaging the bark. Without protection, animals will gnaw through the cambium layer (nutrient transporting tissue) causing injury and possibly killing the tree. Plastic shelters have an added benefit of conserving heat and moisture, acting as "mini-greenhouses" and ensuring rapid seedling growth.

Abandoned orchards and apple trees provide food and cover for a plethora of wildlife. However, they must be maintained to keep their wildlife value. By applying the techniques outlined in this chapter, this can be accomplished. It is well worth the effort, as the landowner or land manager will be met with the rewards of numerous hunting and wildlife viewing opportunities, and the knowledge that he/she is contributing to the long-term conservation of numerous wildlife species.

Suggested reading

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Biography

Judy Wilson is the Private Lands Program Coordinator for the Connecticut DEP Wildlife Division. She earned her a B.S. degree in Wildlife Management from the University of New Hampshire in 1982 and an M.S. in Natural Resource Management specializing in wildlife, from the University of Connecticut in 2004. Judy began her career as the Eastern District Biologist in 1985 and in 1987 went to work as the Western District Biologist before assuming her current position in 2003.

Table 1. Summary of New England wildlife species that may use orchards as preferred or utilized habitat, based on DeGraaf and Yamasaki, 2000 (in conjunction with other habitats and features not listed).

Species	B	BF	W	WF	Species	B	BF	W	WF	Species	B	BF	W	WF
Sharp-shinned hawk		X		X	Black-capped chickadee	X	X		X	Northern long-eared bat		X		
Cooper's hawk		X		X	Tufted titmouse		X		X	Indiana myotis		X		
Northern goshawk		X		X	Red-breasted nuthatch				X	Silver-haired bat		X		
Broad-winged hawk		X			White-breasted nuthatch	X	X	X*	X*	Eastern pipistrelle		X		
American kestrel		X	X	X	Brown creeper				X	Big brown bat		X		
Peregrine falcon		X		X	House wren	X	X			Red bat		X		
Ring-necked pheasant	X	X	X	X	Blue-gray gnatcatcher	X	X			Hoary bat		X		
Ruffed grouse		X		X	Eastern bluebird	X*	X*	X	X	Eastern cottontail	X*	X*		
Wild turkey		X		X	American robin	X	X	X	X	New england cottontail	X	X		
Northern bobwhite	X	X	X	X	Gray catbird	X	X			European hare	X	X	X	X
Mourning dove	X	X		X	Northern mockingbird	X	X	X	X	Woodchuck	X*	X*	X*	
Black-billed cuckoo	X	X			European starling		X		X	Southern flying squirrel	X	X	X	X
Yellow-billed cuckoo	X	X			Bohemian waxwing			X	X	White-footed mouse	X	X	X	X
Barn owl		X		X	Cedar waxwing	X	X	X	X	Meadow vole	X*	X*	X*	X*
Eastern screech owl	X	X	X	X	Yellow warbler	X	X			Woodland vole	X*	X*	X*	X*
Great horned owl		X		X	Black-and-white warbler	X	X			Southern bog lemming	X	X	X	X
Barred owl		X		X	American redstart	X	X			Norway rat	X	X	X	X
Long-eared owl		X		X	American tree sparrow				X	House mouse	X	X	X	X
Northern saw-whet owl			X		Chipping sparrow	X	X			Meadow jumping mouse	X	X	X	
Common nighthawk		X			Field sparrow				X	Porcupine		X	X	X
Whip-poor-will		X			Vesper sparrow	X	X			Coyote		X		X
Chimney swift		X			Song sparrow	X	X	X	X	Red fox		X		X
Ruby-throated hummingbird	X	X			White-throated sparrow				X	Black bear		X*		
Red-headed woodpecker	X	X	X	X	Dark-eyed junco				X	Raccoon		X		
Red-bellied woodpecker			X	X	Northern cardinal		X		X	Long-tailed weasel		X		X
Yellow-bellied sapsucker			X*	X*	Rose-breasted grosbeak	X	X			Striped skunk	X	X		
Downy woodpecker			X	X	Indigo bunting	X	X			Bobcat		X		X
Hairy woodpecker			X	X	Eastern meadowlark			X	X	White-tailed deer		X		X
Northern flicker		X		X	Common grackle		X		X					
Eastern wood-peewee	X	X			Brown-headed cowbird	X	X		X					
Least flycatcher	X	X			Orchard oriole	X*	X*			Species	B	NB		
Eastern phoebe		X			Baltimore oriole	X	X			Eastern american toad		X		
Great crested flycatcher	X	X			Pine grosbeak			X	X	Fowler's toad		X		
Eastern kingbird	X*	X*			Purple finch				X	Wood frog	X	X		
Loggerhead shrike	X	X	X	X	House finch				X	Common snapping turtle	X			
Northern shrike			X	X	Common redpoll			X	X	Spotted turtle	X			
Warbling vireo	X	X			Hoary redpoll			X	X	Wood turtle	X	X		
Red-eyed vireo	X	X			American goldfinch	X	X	X	X	Eastern box turtle	X	X		
Blue jay	X	X	X	X	Evening grosbeak				X	Blanding's turtle		X		
American crow		X		X	Virginia opossum		X			Common musk turtle	X			
Purple martin		X			Masked shrew	X	X	X	X	Northern brown snake	X	X		
Tree swallow		X			Pygmy shrew	X	X	X	X	Common garter snake	X	X		
Northern rough-winged swallow		X			Northern short-tailed shrew	X	X	X	X	Eastern hognose snake	X	X		
Bank swallow		X			Least shrew	X	X	X	X	Northern black racer	X	X		
Cliff swallow		X			Eastern mole	X	X	X	X	Black rat snake	X	X		
Barn swallow		X			Little brown myotis		X			Eastern milk snake	X	X		

Birds and mammals: B=breeding shelter, BF=breeding feeding, W=winter shelter, WF=winter feeding.

Reptiles and amphibians: B=breeding activity, NB=non-breeding activity.

X=utilized habitat, X*=preferred habitat.

Chapter 8. Invasive Exotic Plants

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The title "Invasive Exotic Plants" may sound like the beginnings of a title for a cheap 1950s science fiction B-movie, but the ecological and economic harm that these plants cause is no work of fiction. About 1/3 of the thousands of plant species known to occur in the Northeast were introduced from some other country or region of the U.S. Most are benign and are enjoyed by many as landscape and garden plants. However, free from the diseases and organisms that keep a plant species in check in their land of origin, a select few have aggressively spread since their introduction and have become difficult to control. As a result, these invasive exotic plants have degraded our natural communities by out-competing native species for resources and have cost millions of dollars to control. Let's take a closer look at some of the invasive exotic plant species that are commonly found in early-successional habitats (both upland and wetland) and see why they tend to be invasive, what problems they cause, and how we might be able to control them.

The Invaders

Asiatic bittersweet

Also known as oriental bittersweet or round-leaved bittersweet, this species is a deciduous, woody, perennial vine with small, greenish flowers occurring in clusters along the stem. The showy yellow fruits with red seeds have made Asiatic bittersweet a popular plant for fall and winter floral arrangements. The plant is originally native to Japan, Korea, and China, but is now established in the U.S. from Maine, south to Louisiana, and west to the Great Plains.

A native bittersweet, American bittersweet, is also present in the Northeast. It is similar in appearance but its fruiting and flowering clusters occur at the ends of stems, while those of Asiatic bittersweet occur along the stem. Asiatic bittersweet can hybridize with native bittersweet and it has been suggested that the hybrids may outcompete the native species and may thus be helping to displace it.

Figure 1. Asiatic bittersweet vine in late summer (a) and late fall (b). Photos by John M. Randall, The Nature Conservancy (a) and John Lynch, The New England Wildflower Society (b).

Olive: Autumn and Russian

These nitrogen-fixing shrubs or small trees have oval- (autumn) or lance-shaped (Russian) leaves. The leaves of autumn olive are dark green above and silver below, while those of Russian olive are silvery green on both sides. Both species produce small, fragrant, light yellow flowers that produce numerous reddish to pink (autumn) and yellow (Russian) fruits that are typically smaller than a wild blueberry. The fruits will

persist into winter. The twigs of autumn olive are typically bronze colored, while those of Russian olive are typically silver. Both species are thorny. Autumn olive was introduced from China, Japan, and Korea, and is now well established from Maine, south to Florida, and west to the Great Plains. Russian olive was introduced from western Asia and Europe and now causes localized problems in many states of the eastern U.S., western plains, and the Rocky Mountains.

Figure 2. Leaves and flowers of autumn (a) and Russian (b) olive. Photos by Bill Byrne (a) and Paul Wray, Iowa State University, www.invasive.org (b).

Buckthorn: Common and glossy

These shrubs or small trees can attain 20 to 25 feet in height and ten inches in diameter. Their bark is grey to brown and is rough when mature. Common buckthorn often exhibits a spine at the tip of its branches. Leaves of both species resemble that of a dogwood, but leaf veins aren't as parallel in formation. Common buckthorn leaves are toothed, while glossy buckthorn leaves have a smooth edge. Fruits are numerous, small, black, and up to 1/4 inch in diameter. When mature, common buckthorn may resemble an abandoned apple, plum, or other domestic fruiting tree from a distance. Native to Eurasia, the buckthorns are now common throughout the northeastern and north central third of the country. A native species, alder-leaved buckthorn, does occur in the Northeast. However, it is a low shrub generally less than three feet tall.

Figure 3. Branch of common (a) and glossy (b) buckthorn. Photos by Paul Wray, Iowa State University, www.invasive.org (a) and Chris Mattrick, The New England Wildflower Society.

Bush honeysuckle: Amur, Morrow's, and Tartarian

Bush honeysuckles are deciduous shrubs with one- to two and one half-inch untoothed leaves, and flowers that range from off-white to pink or crimson and produce numerous red to orange berries. Careful identification is needed because exotic bush honeysuckles can easily be confused with the native bush honeysuckles (swamp

fly honeysuckle and American fly honeysuckle), although the native species are typically much smaller and occur exclusively in wooded areas. Exotic bush honeysuckles are native to Japan, China, Korea, Manchuria, Turkey, and southern Russia, but now occur in the U.S. from southern New England, south to Georgia, and west to the Great Plains.

Figure 4. Flowers of Tartarian honeysuckle. Photo by John M. Randall, The Nature Conservancy.

Figure 5. Japanese barberry. Photo by Leslie J. Mehrhoff, University of Connecticut.

Barberry: Japanese and European

Barberry shrubs are generally two to three feet high but can grow as high as six feet. Japanese barberry has smooth-edged, oval leaves typically with a single spine behind each cluster. European barberry is similar but has leaves with toothed edges and multi-parted spines. The bright red berries of both species are small, oblong and found singly or in clusters. Native to Europe and Japan, these species are now found in this country from Maine, south to North Carolina, and west to Montana.

Figure 6. Multiflora rose bush (a) and closeup of flowers (b). Photos by James D. Oehler (a) and James H. Miller, USDA Forest Service, www.invasive.org.

Multiflora rose

Multiflora rose is a perennial shrub with a fountain-shaped drooping appearance and leaves with seven to nine toothed leaflets. Like all roses, the stems of multiflora rose bushes are adorned with stiff thorns. In late spring, small white to pinkish fragrant flowers will form in clusters. In late summer and early fall, flowers will form small, bright red, oval, and fleshy rose hips. Multiflora rose was introduced to the east coast from Japan and Korea as a rootstock for cultivated roses. It was also widely promoted by the U.S. Department of Agriculture to farmers in many parts of the country for "wildlife cover plantings". It is now present throughout the U.S. with the exception of the Rocky Mountains, the Southeastern Coastal Plains, and the Nevada and California deserts.

Tree-of-heaven

Also known as Ailanthus, tree-of-heaven is a deciduous tree with smooth gray bark that can attain heights of 27 to 54 feet. Leaves have 11 to 25 leaflets that are coarsely toothed only at the base. Leaves can be easily confused with those of black walnut and sumac. However, unlike those species, tree-of-heaven leaves will produce an offensive odor when crushed. The leaves also form a heart-shaped scar on the branch. Yellow-green flowers occur in clusters near the tips of branches in late spring, with maple-tree-like winged seeds forming thereafter. However, unlike maple, the seeds of tree-of-heaven have a single wing. This tree is native to China, but was introduced into this country as a hardy ornamental and is now found throughout the U.S.

Figure 7. Tree-of-heaven (a) and closeup of leaves with centrally located flower (b). Photos by Chuck Bargeron, The University of Georgia, www.invasive.org (a) and John M. Randall, The Nature Conservancy (b).

Sericea lespedeza

Sericea lespedeza, also known as Chinese bush clover, silky bushclover, Himalayan bushclover and hairy bushclover, is a bushy, warm-season perennial legume with a deep taproot that is native to Asia. Flowers of sericea lespedeza are creamy-white with purple throats, and when mature, plants have numerous tall, coarse stems that grow in bunches. Each leaflet of this lespedeza contains dense hairs that give the plant a grayish-green or silvery appearance. It is the only species of lespedeza that has wedge-shaped leaf bases. Sericea lespedeza was introduced in the 1940s for its value as an agriculture crop and for erosion control projects. Today, it is commonly found in grasslands and rangelands in the Midwest and eastern U.S. where it commonly dominates and displaces native vegetation.

Purple loosestrife

Purple loosestrife is a stout perennial herb with a well-developed taproot that occurs in marshes, wet meadows, and shrub swamps with little or no overhead cover. Plants range from one and one half to six feet in height. Stems are angular and can be fuzzy or hairy. Purple, white, or light pink flowers form in a spike at the top of the plant and produce small seeds in light brown capsules. Purple loosestrife will commonly take over entire wetland systems. Native to Europe and Asia, it is now found throughout the U.S., but is most problematic in the Northeast.

Figure 8. Purple loosestrife plants (a) and closeup of flowers (b). Photos by Bernd Blossey, Cornell University, www.invasive.org (a) and Norman E. Rees, USDA ARS, www.invasive.org (b).

Common reed

Commonly known as Phragmites, common reed is a 6- to 12-foot high perennial grass that occurs in marshes, fens, shrub swamps and other types of vegetated fresh and brackish water wetland systems with little or no overhead cover. Its purplish flowers form feathery plumes of whitish or brownish seeds at the top of each stem. It reproduces by seed or more commonly via spreading root systems known as rhizomes. Common reed occurs on every continent except Antarctica. A recent study indicates that both native and invasive exotic strains occur in the U.S. The invasive strain was introduced from Europe and Asia and is now widespread.

Figure 9. A stand of common reed. Photo by John M. Randall, The Nature Conservancy.

What's the big deal?

Why are all of these species considered invasive? For one, they all produce prolific amounts of seed or fruit. For instance, a single 12-inch diameter tree-of-heaven can produce 1 million seeds in one year. An autumn olive tree can produce two to eight pounds of seed per year with 20,000-54,000 seeds per pound. Lastly, a purple loosestrife plant can produce up to 900 capsules per year with an average of 120 seeds per capsule.

Once seeds and fruits are formed, they are widely dispersed by a variety of means. Small mammals and birds carry some types of seeds in their fur or feathers to new locations, or defecate a viable seed after consuming a piece of fruit. The next time you go for a walk in an old field, pay attention to where invasive exotic plants are growing. You will commonly find them growing along fence lines and field edges or at the base of trees in the middle of fields because these are the places where birds like to perch. Wind also effectively disperses seeds of common reed, tree-of-heaven, and purple loosestrife because the seeds are either very lightweight or are contained in a winged sheath that is easily carried by the wind. Humans are great dispersers of invasive exotic plant seed as well. Most of the species listed above are still widely available from nurseries and are desired for their use as ornamentals, in erosion control projects, in floral arrangements, or planted as a source of food and cover for wildlife.

Many of these species are also effective at reproducing vegetatively. Asiatic bittersweet, tree-of-heaven, and common reed have massive root systems that will aggressively spread out and push up new plant shoots, which aids these plants in creating dense monocultures. Additionally, the branch tips of multiflora rose and the two species of barberry will take root when branches droop to the ground.

All of these species can outcompete native species for resources even in areas that seemingly have few resources to offer. Many can survive and even proliferate in soils ranging from nutrient rich to nutrient poor, from acid to alkaline, and can tolerate a wide variety of light conditions. Most of the invasive exotic shrubs and trees will be among the first plants to leaf-out and the last to lose their leaves in the fall. Some can even alter soil chemistry, making the area uninhabitable by other species. Japanese barberry appears to be such a species. Areas that I know to be dominated by Japanese barberry have few if any plants growing underneath. Research has shown that even when Japanese barberry is controlled, herbs and woody seedlings are slow to recolonize. Additionally, because of their nitrogen-fixing capabilities, autumn and Russian olive have the capacity to sharply increase soil nitrogen levels, putting many native species at a disadvantage favoring invaders.

Once these species become well established, they can have a tremendous impact on the native plants and animals in the invaded area. Dense stands of common reed and purple loosestrife will result in fewer numbers of small mammals and birds, especially waterfowl as common reed displaces more desired foraging plants. Common reed was threatening to take over a rare fen community in Massachusetts, home to more than 20 state threatened and endangered species, before The Nature Conservancy and Massachusetts Division of Fisheries & Wildlife teamed up to control the species at that site.

Other species cause problems as well. During fall migration, songbirds require a great deal of energy to complete their long treks south. Many native shrubs (especially dogwoods) produce high-quality fruits with plenty of fat to maintain songbird energy levels. In contrast, many invasive exotic plants including common buckthorn, Japanese barberry, multiflora rose, and Asiatic bittersweet, are nutrient poor and alone probably would not be able to support the energy needs of migrating songbirds.

Additionally, Asiatic bittersweet will twine and climb on top of trees and shrubs, effectively shading them out. Bush honeysuckle and both buckthorn species will inhibit forest regeneration and reduce the variety and cover of herb communities. It is not uncommon for annual herbs to be entirely suppressed by these plants. Multiflora rose will also displace native vegetation and cattle are often reluctant to enter fields dominated by this plant.

What to do

Now that you have learned a little about these plants and the damage that they can cause, it's time to take a walk around your property to see if you have any of them growing on your land. If you do, determine the extent of the invasion on your property and on adjacent properties (remember invasive exotic plants can easily spread across boundaries). Then, consider the following questions:

- Is the species currently having or likely to have a negative impact on the resources that you want to promote?
- Is it feasible to control the species?
- If it appears feasible to control the species, how should it be done?

Regardless of any other actions that are taken, landowners/managers should be diligent in identifying and preventing new invasions. A few new seedlings may be easily pulled by hand, but if allowed to proliferate they may form a dense stand that is difficult and costly to control. When managing a property with invasive exotics on or near it, use techniques that won't worsen the invasion. Many invasive exotic plant species will thrive in areas where other vegetation has been damaged or destroyed and soils have been disturbed or exposed. For instance, reclaiming an old field with a bulldozer can create a perfect bed for seeds of invasive exotic plants that are picked up and inadvertently spread by the machine. The numerous root segments that are left behind in the soil also will likely resprout, producing many more shrubs than were present at the start. When planning a timber harvest it is better to address an invasive exotic plant problem in a stand prior to harvest. Many invasive exotics will respond favorably to the added sunlight that a timber harvest provides, taking advantage of it more quickly than more desirable native species can. Like the bulldozer scenario, harvesting equipment can also expose soil and effectively disperse seed. It is often necessary to delay management plans for an area until invasive exotic plant control efforts are well underway. Otherwise you may be contending with them for years, to the detriment of other management goals and objectives.

If you determine that the invasive exotic plant is not and will not adversely affect the resources that you want to promote, continue to monitor the plant annually (it could take a number of years for impacts to be realized). If the plant is having or going to have a negative impact, then determine if it is feasible to control the plant given the extent of the invasion, available control techniques, and associated costs.

There are a number of techniques to control invasive exotic plants, which can be grouped into two general categories: manual and chemical. Manual techniques include pulling, cutting/mowing, and other techniques that physically damage plants. Manual techniques can minimize damage to desirable plants and animals in many situations, but they are generally labor and time intensive compared to chemical techniques, and therefore can be much more costly. Manual techniques can also cause a great deal of site and soil disturbance, creating seedbeds for further invasions. As such, manual techniques are generally limited to use against small infestations, which can be easily monitored and controlled. When using manual methods, it is especially important to thoroughly clean and inspect all equipment when finished. This will lessen the probability of spreading the invasive plant elsewhere. Let's take a closer look at some of the more commonly used manual control methods for the types of invasive exotic plants addressed in this chapter.

Manual control techniques

Weed pulling

Pulling by hand or using a pulling tool such as the Root Talon® or Weed Wrench® is an effective means of controlling shrub/tree seedlings and saplings (Table 1). Pulling is not as effective on plants with taproots (e.g., sericea lespedeza) or mature root systems, since root segments that are left in the ground will often resprout. When using this technique, try to minimize soil disturbance by pulling out weeds slowly and carefully, and replace soil in disturbed areas where possible. Trampled and disturbed areas can provide optimal germination sites for many weeds. For more information on the Root Talon® and Weed Wrench® contact:

- Root Talon®: Lampe Design, LLC, 262 South Griggs Street, St. Paul, MN 55105, (612) 699-4963.
- Weed Wrench®: New Tribe, P.O. Box 638, Grants Pass, OR 97528, (541) 476-9492, www.canonbal.org/weed.html.

Figure 10. A Weed wrench can be an effective means of controlling shrub/tree seedlings and saplings. Illustration reproduced with permission from Brooklyn Botanic Garden.

Mowing, cutting, and weed-eating

Mowing and cutting can reduce seed production and restrict growth for many species, but won't totally control an invading plant (Table 1). To be most effective, mowing should be done two to six times per season over numerous years. For some species, like Asiatic bittersweet, vigorous resprouting will occur after cutting, and may ultimately result in increasing the abundance of the invader. Mowing and cutting are often used in conjunction with herbicide applications. For example, vegetation that is too tall to safely treat with herbicides is cut or mowed, after which herbicides are applied to resprouts.

Girdling

Girdling can be an effective means of controlling individual trees (Table 1). This technique involves cutting away a strip of bark at least two inches wide around the circumference of the trunk (some fast growing species can actually "heal" over a girdle that is narrower) with an axe, knife, or saw. The cut must be deep enough to remove the cambium, or inner bark, which is the lifeline of the tree. Girdling typically requires less labor than cutting and removing the tree, is inexpensive, kills only the targeted plant, and provides valuable wildlife habitat in the form of snags. Because it will resprout vigorously, girdling should not be used to control tree-of-heaven unless accompanied by a spray application of 100% triclopyr herbicide to the cut (see herbiciding section of chapter 10).

Tilling

Tilling is often used to control weeds in agricultural situations, but may also have a place in old-field habitats where the soils have already been disturbed. Tilling is effective against annuals and shallow-rooted perennials, but root fragments of species with dense root systems (e.g., Asiatic bittersweet, tree-of-heaven) can often resprout following tillage. If attempted, tilling should be at a depth of 6 to 24 inches, and completed before seeds develop and shed onto the soil. It is best to use this technique during dry periods or in well-drained soils so root segments won't survive and grow. This technique has not been used widely, so any successes or failures should be widely shared with other land managers.

Flooding

If the water level of a wetland or riverine system can be manipulated, flooding can be used to control some of the plant species listed above (Table 1). Common buckthorn seedlings in particular have been successfully killed with flooding. Additionally, common reed patches are often reduced when tidal flows are restored in salt marsh areas. Check with local and state wetland authorities before implementing this technique to see if any wetland regulations apply.

Biocontrol techniques

Biocontrol agents have also been successful at controlling the spread and reducing the deleterious effects of many unwanted plants. Biocontrol pertains to the use of organisms to feed upon, parasitize, or otherwise interfere with a targeted pest species. Although often viewed as an environmentally friendly approach to controlling invasive exotic plants and other unwanted pests, some biocontrol agents have been documented as causing irreparable harm to non-target organisms. For instance, a weevil introduced in the 1960s to control non-native thistles has been documented attacking and significantly reducing the reproduction of native thistles. On the other hand, the benefits of using biocontrol include the potential for attacking specific plants (if adequately researched and documented prior to introduction) and the ability to act over huge areas with little or no cost.

With regards to the invasive exotic plants addressed in this chapter, biocontrol agents have been tested and proven successful at reducing above ground biomass of purple loosestrife. Since the early 1990s, four species of *Galerucella* beetles have been introduced to attack purple loosestrife in the U.S. and Canada. Introductions of these beetles in Ontario led to a 200-fold reduction in above ground biomass of purple loosestrife. However, it is not yet clear whether or not the beetles also reduce the root biomass of established loosestrife stands. As with any management technique, the pros and cons of using biocontrol methods to control invasive exotic plants must be carefully researched and weighed prior to implementation.

Figure 11. Golden loosestrife beetles (Galerucella pusilla) and other Galerucella species can reduce above ground biomass of purple loosestrife. However, it is not yet clear whether or not the beetles also reduce the root biomass of established loosestrife stands. Photo by Agriculture and Agri-Food Canada Archives, Agriculture and Agri-Food Canada, www.invasive.org.

Chemical control techniques

All of these tools and techniques have their place in the invasive exotic plant control tool belt. However, when dealing with large invasions, manual techniques become less practical and except for purple loosestrife, biocontrol techniques currently are not an option. In these cases chemical techniques typically are used. Chemical techniques involve the use of herbicides either alone or in combination with manual techniques (e.g., cutting a stem and then dabbing herbicide on the cut surface). Even though the use of herbicides can be efficient and cost effective (if hiring someone to do the work), a land owner/manager should be confident that herbiciding will do more good than harm and not endanger the health of the applicators or others in the area. For more information on using herbicides to control invasive exotics and other plants, refer to the herbiciding section of chapter 10 in this management guide. There you will find guidance on what you should consider prior to using herbicides, which herbicides may be the best to use given your situation, the techniques used to apply them, and associated costs.

After reading all of the manual and chemical control information provided here, you may determine that it is not feasible to control the species at present. The reasons for this are probably one or a combination of the following:

- Controlling the plant is cost-prohibitive. If this is the case, you may still have some options. One option is to look into cost-share programs such as the Wildlife Habitat Incentives Program or the

Forest Land Enhancement Program (see chapter 12). In some states, these programs will provide financial assistance to landowners to control invasive exotic plants. A second option may be to enroll your neighbors into the project. They are likely having the same problems with invasive exotic plants, but may not know it. The cost per acre may decrease substantially if additional acres are added to the scope of the project. At the very least, keep abreast of new developments on the invasive exotic plant control front. New techniques may be developed that are more cost effective.

- There is concern about using herbicides. The decision whether to use herbicides should not be taken lightly by any land owner/manager. The use of the wrong chemical in the wrong situation can indeed have negative impacts. Unfortunately, invasive exotic plants can and do have tremendous negative impacts on our natural resources as well. The key is deciding whether the benefits of controlling the invasive plants outweigh the potential negative impacts of herbicide or other treatment methods (or combination of methods) under consideration. The only way to determine this is to become educated on all aspects of the issue. Hopefully this chapter and the herbiciding section of chapter 10 will help in this regard.

Many invasive, exotic plant species not discussed in this chapter can be found in our fields, forests, and wetlands. Those described here are some of the more commonly observed species in the early-successional habitats of our region. Many states maintain invasive exotic plant lists. To find out what other plants are considered invasive in your area, contact your state's Natural Heritage Program (http://www.natureserve.org/visitLocal/usa.jsp).

Suggested reading

Invasive and Exotic Species of North America (images and links to other publications) http://www.invasive.org/

Invasive Plant Atlas of New England (information on invasive exotic plant distributions in New England, life history information, and images) http://invasives.eeb.uconn.edu/ipane/

Native Plant Conservation Initiative, Exotic Plant Working Group (invasive exotic plant fact sheets) http://www.nps.gov/plants/alien

The Nature Conservancy, Weed Control Methods Handbook (detailed information on controlling invasive exotic plants) http://tncweeds.ucdavis.edu/handbook.html

Wisconsin Manual of Control Recommendations for Ecologically Invasive Plants http://www.dnr.state.wi.us/org/land/er/invasive/manual_toc.htm

Biography

Jim Oehler has a B.S. in Wildlife Management from the University of Wisconsin – Stevens Point, and an M.S. in Wildlife Ecology from the University of New Hampshire. Prior to joining the New Hampshire Fish & Game Department in January 2003, Jim spent five years with the Massachusetts Division of Fisheries & Wildlife reclaiming and maintaining early-successional habitats and controlling the invasive exotic plants commonly found in those habitats.

Table 1. Invasive exotic plants commonly found in early-successional habitats and the manual techniques known to be effective against them.

Plant Name	Pulling[a]	Cutting/Mowing	Girdling	Flooding[b]
Asiatic bittersweet	Yes	--	--	Yes
Barberry	Yes	Mow 3-6x/yr for 3-5 yrs	--	Yes
Buckthorn	Yes	Mow 3-6x/yr for 3-5 yrs	Yes	Yes
Bush honeysuckle	Yes	Mow 3-6x/yr for 3-5 yrs	--	--
Common reed	Yes	--	--	Restore tidal flow or flood in 3 feet of water for a prolonged period.
Multiflora rose	Yes	Mow 3-6x/yr for 3-5 yrs	--	Yes
Olive	Yes	--	--	Yes
Serecia lespedeza	No	Mow 1-2x/yr for at least 3 yrs	--	--
Purple loosestrife	Yes	--	--	--
Tree-of-heaven	Yes	--	--	Yes

[a] Mostly those plants with undeveloped root systems (e.g., seedlings and saplings). Pulling is either by hand or with a Weed Wrench or similar tool. Care must be taken to remove all of the roots as fragments commonly resprout.
[b] Check with local and state authorities to determine if any wetland regulations apply prior to implementing this technique.

Chapter 9. Riparian Zones: Managing Early-Successional Habitats Near the Water's Edge

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As a landowner, you may at some time during your tenure decide to manage the habitat on your property. It may be for economic gain, such as a timber harvest, or converting an old field back into hay production, or pasture, or maybe for simply enhancing wildlife habitat. In any case, the choices that you make should be influenced by how surrounding lands are managed and by the effects that your management will have on adjacent natural communities, whether you own them or your neighbor does. This relationship is never more critical than when considering the effects of upland management on adjacent streams, lakes, and wetlands. Most landowners interested in managing for wildlife habitat on their property are also concerned with protecting or enhancing water quality, protecting aquatic habitat for fish and other aquatic species, and for providing habitat for species that use the margins of wetlands and other aquatic communities. In this chapter, I hope to expand your view of the interface between uplands and wetlands, demonstrate how wildlife is influenced by this transition zone, explain how actions on surrounding lands can affect aquatic communities, and review what steps can be taken to minimize negative effects.

Defining the issue

The riparian zone is the area where terrestrial and aquatic ecosystems converge. It has been defined as the area between the stream channel or near shore portion of a lake or pond and the furthest upland extent of the aquatic system's influence. A riparian zone occupies space above ground, but extends below ground too, where biological processes take place that help protect adjacent aquatic systems. Many riparian zones lack discrete boundaries. Instead, they gradually transition from plants (and soil conditions) tolerant to periodic inundation to those that are less tolerant.

Structurally, riparian habitat is often similar to, and for many wildlife species may be considered, early-successional habitat. Periodic flooding and ice scouring can easily set back succession along larger streams especially in the northern portion of our region. Examples of easily recognized riparian zones include floodplain forests along rivers and streams, the shrubby fringes of lakes, ponds, and streams, sedge- and grass-dominated meadows, as well as damp, braided channels of headwater streams.

Figure 1. Slow moving rivers are often flanked by extensive hardwood floodplain forest. Photos by Tom Hodgman.

Figure 2. Headwater streams are the roots of aquatic systems, yet are vulnerable to disturbance because of their small size and often intermittent flow.

Figure 3. Most lakes, ponds, and rivers are flanked by riparian zones with well-defined shrub communities where woody plants dominate the transition from aquatic to upland habitat. Photo by Merry Gallagher.

Riparian zones are among the most structurally diverse and naturally dynamic ecosystems in the Northeast. Part upland, part wetland, they frequently hold the greatest diversity of species of any habitat in our region and are considered by some scientists to be more sensitive to environmental change than any other ecosystem. The benefits of riparian zones to wildlife are far reaching. For example, riparian zones serve as travel corridors, help protect and enhance aquatic habitat, and provide structurally complex habitats themselves. A recent report indicated that 90% of wildlife species in the Northeast use riparian habitats. Benefits extend beyond wildlife as well. Riparian zones slow floodwaters and help to protect water quality by reducing erosion and modifying runoff before it enters streams, ponds, and wetlands.

Value as wildlife habitat

When considering land management to benefit a selected group of species, you will find that some species have dual needs. That is, a species may use one habitat type for one aspect of its life cycle and a different habitat type for another. This raises some obvious limitations for small landowners. Just as someone with a ten-acre parcel has less control over wildlife with large spatial needs, owners of small parcels may have less influence on species with complex habitat needs. Some obvious examples of these crossover species include American bitterns, beavers, and wood turtles. All three species are wetland obligates. However, bitterns will forage and sometimes nest in wet meadows and hayfields especially if they are close to marshes. Beavers require woody vegetation for both food and building materials. Young and regenerating aspen stands near a wetland can be the center of beaver activity for years as they construct a dam, lodge, and winter food cache. Wood turtles are aquatic, but lay their eggs in soils adjacent to rivers and streams where adequate sunlight is a prerequisite for a timely hatch. During summer, they venture throughout the riparian zone and into surrounding uplands to forage on such things as wild strawberries, mushrooms, and earthworms. Numerous other species share a desire for upland and wetland habitat. White-tailed deer, moose, some amphibians, and many invertebrates such as dragonflies, and of course, many songbirds fit this description.

Figure 4. Beavers are the ultimate riparian species relying on (and modifying) resources found in both the aquatic and terrestrial ecosystems. Photo by Tom Hodgman.

Figure 5. Wood turtles are closely associated with riparian habitats and often venture into neighboring uplands. Photo by Maine Dept. of Inland Fisheries and Wildlife.

Riparian zones may serve as travel corridors, funneling wildlife as they move from place to place in search of food or shelter. White-tailed deer and predators, such as foxes and coyotes are good examples. Otters and mink are two species that are closely tied to aquatic habitats, but spend much of their time in the riparian zone. Both, however, occasionally make brief forays into surrounding uplands. Species such as water shrews and meadow jumping mice have spatial requirements that are small enough to occupy riparian zones for their entire life cycle. Riparian zones that are especially wide can offer sufficient habitat for some songbirds like Louisiana waterthrush, common yellowthroats, prothonotary, and yellow warblers.

Be aware, however, that as habitat conditions in the uplands adjacent to riparian zones are altered, the habitat conditions in the riparian zone also may be altered. This may enhance riparian habitat for some species, yet reduce its suitability for others. Consider too that the habitat needs of some species are not well known and that many species will not be detected or easily identified without careful, trained observation. To ensure that no species of conservation concern will be detrimentally affected, an inventory of wildlife on the property should be conducted. Results of such an inventory will allow you to make more informed decisions and actually may change your opinion as to how you should proceed with management.

Enhancing aquatic ecosystems

It is widely understood that water temperature affects which species live in a particular waterway. This is especially true with fish, but also has been demonstrated for other aquatic life. Streams may no longer support trout populations, for example, if temperatures exceed certain thresholds. Land management activities adjacent to streams, such as logging, can have an important influence on water temperature. In an extreme case, harvesting all trees along a small stream would greatly increase its maximum summer temperature. Following removal of streamside vegetation, it may take from several years (in the case of shrubs) to decades (in the case of a tree canopy) before vegetation develops enough to once again have a shading and thus cooling effect. Removing streamside cover in a small area, especially in the headwaters, can affect much larger portions of the watershed as warm water is transported downstream. In contrast, cool, spring-fed streams, can help to mitigate effects of lost streamside shading further downstream.

Figure 6. Brook trout, a popular sportfish, can benefit when riparian zones are carefully managed.

Figure 7. Extensive timber harvest along headwater streams can have negative effects on aquatic organisms far downstream. Photo by Maine Dept. of Inland Fisheries and Wildlife.

Some ecologists have suggested that slight warming of cold spring-fed streams by removal of some shading vegetation may increase their suitability to aquatic organisms, thus increasing their productivity. Technically, this may be true. However, there is a fine balance between providing enough warmth to enhance productivity and possibly providing too much heat resulting in mortality of valued aquatic organisms. Most states have restrictions on the volume of timber that can be removed adjacent to streams and what sort of activities can be undertaken adjacent to water bodies. Check with your state's forestry and wetland conservation departments regarding such restrictions. Consultation with biologists from your state's fish and wildlife agency is also a must if considering such a management strategy to ensure more good than harm will result from your project. The effects of stream shading are important and alterations, even if allowed by law, can be far-reaching. Care must be taken to strike the right balance.

Surrounding vegetation has other physical influences on aquatic habitat. Direct inputs of leaves and small twigs from surrounding vegetation serve as an important food source for many species of aquatic insects. Input of organic matter in this form is widely considered a critical component of aquatic food webs. Structural inputs too, are important. Large branches and even whole trees falling into streams redirect currents, slow moving water, and create structurally diverse microhabitats in the form of small pools and riffles as water flows over and around such large woody debris. Trees, whether leaning over and shading the surface or partially submerged along lake and pond shores, create important habitat for many fish. Any angler knows that a few casts around a partially submerged log often will result in a strike. Such structural complexity probably provides security from avian predators for large fish, escape cover for small fish, as well as habitat for aquatic insects.

Protecting water quality

Turbidity

Some degree of topsoil erosion is inevitable with many land management activities. As a result, fine sediments are the most widely occurring pollutant in streams. How far that sediment is transported and where it is deposited can be a problem for some species. When water contains a large amount of fine sediments in suspension it becomes more opaque, a condition known as turbidity.

Results of turbid runoff entering streams and rivers can be significant. Aquatic organisms, mayflies for example, have different tolerances for turbidity just as they do for other environmental conditions. Streams that become too turbid often have lower species abundance and diversity. Highly turbid water also blocks sunlight penetration, which in turn limits the depth to which photosynthesis can take place. Bottom dwelling plants as well as phytoplankton can be negatively affected.

Sedimentation

Another primary concern is sedimentation, which typically refers to deposition of fine materials in streams. This results from the slowing of water by small restrictions in flow, causing sediments to settle out. Sedimentation can have negative effects on aquatic life as well. Fish that spawn on a sand or gravel bottom can lose spawning habitat if fine sediment blankets spawning areas. Habitat for aquatic insects that live on submerged rocks and logs can be smothered by sediment as well. In extreme cases, availability of different microhabitats within a stream can be reduced as pools are gradually filled in with sediment. Sedimentation in headwater streams is especially serious, as these waterways have limited flushing capacity. Careless management that puts even small amounts of sediment in headwater streams is likely to have a long-lasting effect.

Streams with high turbidity often occur in agricultural landscapes where riparian zones have been removed or significantly reduced in extent. Intact riparian zones slow runoff from fields, allowing sediment to fall out before entering waterways. Maintaining riparian zones is an excellent step toward minimizing the negative effects of runoff from adjacent uplands. A number of federal programs exist that provide technical and financial assistance to landowners to restore and maintain riparian buffers. Refer to the Conservation Reserve Enhancement Program (CREP) case study in chapter 11 for more information.

Fortunately, soils in the Northeast, especially forest soils, tend to be coarse-textured and well drained, often with a thick organic layer (leaves and debris) at the surface and are not as easily put into suspension. Consequently, extreme storm events and snowmelt during spring are the times of highest concern. However, consulting with a conservationist from the USDA Natural Resources Conservation Service is recommended as a way to learn more about the soils on your property and their capabilities and limitations.

Eutrophication

Eutrophication is a condition in lakes or ponds (sometimes in moving waters as well) indicating a relatively high level of productivity. A pond with a diverse and robust plant community, abundant planktonic organisms as well as other larger invertebrates, and a healthy and diverse fish population would be considered more eutrophic than a high mountain pond with few plants, few insects, and few or no fish. Generally speaking, streams in forested landscapes tend to be less eutrophic than streams flowing through agricultural areas. With increasing eutrophication, aquatic species composition may change. With changes in abundance and diversity of aquatic insects, fish populations also may change.

Hypereutrophication is a condition where certain nutrients are in great abundance and can lead to some damaging ecological consequences. Typically, nitrogen and phosphorus are the culprits. The sources of these nutrients are often man-made, resulting from chemical fertilizers, sewage, and other untreated wastewater. However, livestock waste also can be a contributing factor. This is especially problematic when livestock are allowed to graze within the riparian zone or allowed access to a stream or pond for water.

Figure 8. Livestock should not be allowed extensive access to streams where they increase nutrient inputs, consume riparian vegetation, and destabilize stream banks. Photo by Tom Hodgman.

During the heat of summer, cattle and other livestock may spend a disproportionate amount of time in the riparian portion of the pasture and consequently consume or trample vegetation there while depositing much manure in or near the water. Over time, especially in adjacent or downstream ponds, nutrients in the water become so high that algae become superabundant. Algae may cover the surface of the water, such that in extreme cases, it strips the water of available nutrients, starves aquatic plants of needed sunlight, and may ultimately affect the amount and distribution of dissolved oxygen available for fish and aquatic insects. Large "sheets" of green slime washing up on the shore or suspended on the surface, often visible as a floating bubbly mat, is an indication that a site has become hypereutrophic. Once conditions have reached this extreme, it can be difficult to reverse. A better strategy may be to do nothing in the upland that would pose an undue threat to neighboring aquatic systems or at least take steps in the riparian zone that will ensure maintenance of high water quality.

Riparian buffer strips

If you could meet multiple objectives with one management technique, would you try it? If that same technique allowed for flexibility in landowner objectives, desired habitat conditions, and overall appearance, would you be interested? If this idea sounds interesting, then perhaps riparian buffer strips are something you should consider.

Setbacks from shorelines that are intended to protect lakes, ponds, streams, and rivers from activities in adjacent uplands are often referred to as riparian buffer strips. Buffer strips will help remove sediment from overland flow, lock up nutrients and pollutants from runoff, improve habitat value for aquatic organisms by shading surface waters and adding coarse and fine organic matter (twigs and leaves), and provide travel corridors and habitat for wildlife.

Riparian buffers, whether managed or unmanaged, provide a multitude of benefits. Long narrow strips of forest along waterways, however, provide little more than a beauty strip. Such narrow strips may be vulnerable to windthrow, thus jeopardizing stream bank stability, serve as ecological traps where nesting birds suffer high rates of nest loss to predators, and generally are an inadequate means to protect aquatic systems. Buffer design and use have become quite complex, but generally fit two categories: grassy filter strips and multi-layered designs.

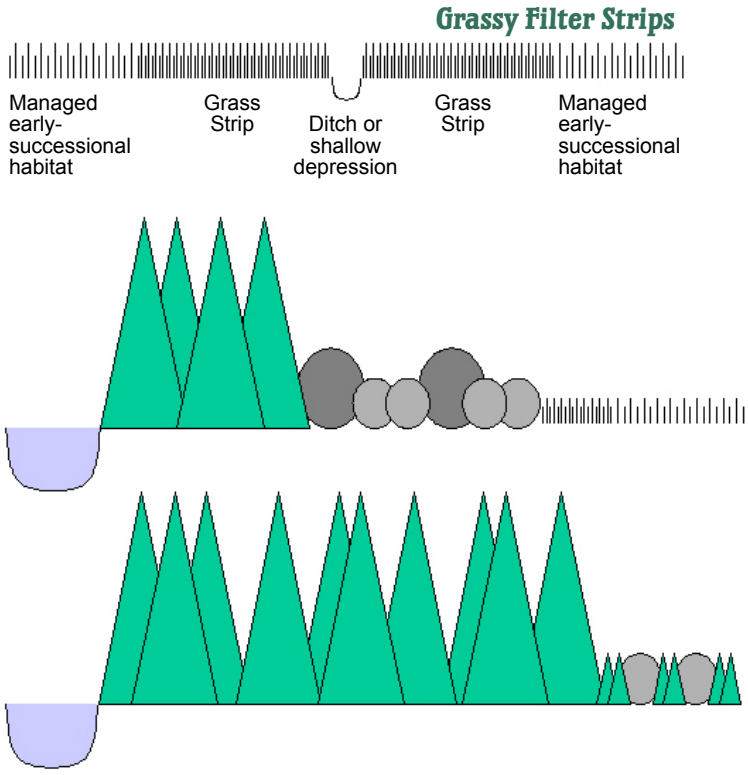

Figure 9. Three examples of riparian buffers compatible with early-successional habitat management in both agricultural and forested settings.

Grassy filter strips

Grassy filter strips are used in agricultural settings, often along drainage ditches and between tilled fields, to limit the transport of sediment to nearby streams or other water bodies. Management that entails plowing, disking, or tilling should always assume some loss of topsoil and owners should take precautions to guard against negative effects of sedimentation downslope. Buffers along drainage ditches and along the edges of waterways also may reduce movement of agricultural chemicals, chiefly pesticides and fertilizers.

Figure 10. In a shallow depression between two fields, a grassy filter strip and narrow shrub zone buffer downstream areas from runoff from this hayfield. Photo by Tom Hodgman.

Grassy strip buffers should be considered an absolute minimum for protecting water quality, but should not be used to replace an established natural shrub or forested buffer. Grassy strips obviously should not be grazed or they will likely lose much of their value for slowing overland flow of water and ultimately removing contaminants. Strips as narrow as 20 feet have been used, but are not as effective as wider ones. Wide grassy strips actually may provide habitat for some species, and strips as wide as 150 feet should be considered when increasing wildlife habitat is an important landowner objective.

Multi-layered buffer strips

Multi-layered buffer strips employ a series of vegetation of different heights (i.e., layers) that provide a more natural transition from managed upland to an aquatic system and may be applied in both agricultural and forested settings. If wide enough, multiple layers of vegetation are often desirable to many bird species, therefore, this technique provides not only buffering of aquatic ecosystems, but wildlife habitat as well.

A typical design when buffering upland activities that involve significant soil disturbance, such as disking, could include a strip of herbaceous vegetation (i.e., grassy strip) next to a strip of shrubs, and finally a forested strip along the shoreline or stream bank. The herbaceous strips would function similar to the method described above, while the shrub strip would slow waters during flooding and generally add structural and therefore habitat diversity to the buffer. The forested portion would stabilize banks of streams and shores of lakes and ponds and contribute to removal of nutrients from ground water.

Figure 11. Around this marsh, a mix of grass and shrubs have been allowed to develop buffering this wetland from activities in the neighboring upland. If left undisturbed, shrubs will likely increase in this riparian buffer over time. Photo by Tom Hodgman.

A formal design known as the multi-species riparian buffer system uses plantings to create the buffer. In this system, the minimum widths are 20 to 24 feet for warm-season grasses, followed by a 12-foot strip of shrubs, and finally a 30-foot wide strip of trees closest to the water. This system was designed in the Midwest where riparian zones have been heavily degraded. However, there is little reason not to employ a similar system in the Northeast, though plantings may not be necessary unless a riparian zone needs to be restored.

Selective removal of some large shrubs and trees over time would extend the effective life of this design. A three-layer design would seem to fit well adjacent to pasture, hayland, or old fields, especially if the managed area already is ringed with shrubs and other early-successional vegetation. This system could be easily modified to include just shrub and tree strips when landowner objectives are focused on maintaining a high proportion of shrub cover in the upland. Or, if abundant shrub cover already exists at the water's edge, then perhaps there would be no need (opportunity) for a forested strip.

Another design, more applicable in forested settings, where early-successional forest is the target, involves forest strips of varying widths and timber harvest intensity. The first strip, located at the water's edge is permanent forest cover and should remain undisturbed (i.e., no harvest). The second strip is the managed forest zone and allows for periodic selective harvesting. Single tree removal or removal of small groups of trees (e.g., group selection) would be acceptable in this zone. Widths of these strips vary, but in general, should be 100 to 150 feet wide.

One ecologically based approach to define buffer width in this setting compares the similarity of the vegetation within the riparian buffer to that of the abutting managed area. When the riparian buffer and managed area are quite dissimilar (e.g., forested riparian zone adjacent to large clearcut) consider retaining a no-cut and/or limited-cut buffer totaling several hundred feet. In contrast, if the riparian zone and adjacent managed site are similar (e.g., forested riparian zone adjacent to forest cover with only single tree or large group selection harvests) then a riparian buffer equal in width to one or two tree heights may be adequate.

An even more prescriptive approach to buffering aquatic systems from timber harvest is used in the northern part of our region. This approach includes varying buffer widths and harvest intensities within buffers depending on size of water body or stream order (i.e., a classification system for moving waters where first order streams are unbranched headwater streams, second order streams are formed by the confluence of two first order streams, and third order streams are formed by the confluence of two second order streams, etc.). This approach allows the harvest of 30% or less of the stand volume of trees six inches or less in diameter over a ten year period within the riparian buffer. Residual basal area per acre following harvest must not be less than 100 square feet for softwood stands, 80 square feet for mixed stands, and 60 square feet in hardwood stands. These criteria are applied to a buffer width (on each side of a stream) of 660 feet for fourth order streams and larger, 330 feet for third order streams, 250 feet for nonforested wetlands and ponds less than ten acres, 100 feet for vernal pools, nonforested wetlands less than ten acres, and first and second order streams, and 75 feet for unmapped, intermittent streams. In addition, no-harvest zones of 25 feet are included within the widths described above for third and fourth order streams, nonforested wetlands less than ten acres, lakes, and large ponds (greater than ten acres).

Additional considerations

Using riparian zones as buffers seems to be a relatively simple strategy for protecting aquatic environments. Buffers may take many shapes, but what is suitable for owners of agricultural lands may not be directly applicable to forest landowners. Some degree of creativity and flexibility on a site-by-site basis often will be necessary as long as integrity of the aquatic ecosystem is maintained. There may be cases where the presence of, or potential for, high priority species of conservation concern, such as woodcock or golden-winged warbler, justify management activities in the riparian zone. For example, if carefully planned to minimize soil disturbance, a small timber harvest in an aspen-dominated stand adjacent to a stream could result in a long-term food resource for beaver. The young, regenerating forest also could provide habitat for grouse and woodcock. Furthermore, regenerating (or reclaiming) a stand of alders within the riparian zone

that is being overtopped by trees would provide foraging habitat for woodcock and other shrub-nesting birds. Additionally, research has demonstrated that berry-producing shrubs in riparian corridors are important for fall migrating birds. The amount of fruit such shrubs produce can be enhanced by removing overtopping vegetation. As each situation is unique, your state wildlife agency would be a good place to seek advice on how to approach individual situations.

There are numerous variations suggested for buffer designs and widths, and recommendations vary from state to state. As previously indicated, state regulations should be consulted whenever managing lands near waterways. Some interesting modifications to buffer width include varying the width of a buffer depending on the slope of the adjacent managed upland. For example, sites managed for early-successional habitat that occur on steep slopes should consider a wider riparian buffer than sites that rise very little from the riparian zone. So then, is wider always better? The law of diminishing returns certainly applies to the concept of riparian buffers. That is, beyond a certain point there is no additional gain (i.e., protection) afforded to the water body with a wider buffer. One aspect to consider is to imagine where the riparian edge may have been before the area was first disturbed. This may be easy in some areas with much natural vegetation in place, but not so in areas that have been cleared up to the stream bank.

Are buffers and their widths the only concern? No, when streams run at peak flow, often referred to as bank full, they exert great influence on the characteristics of the channel. Over time, stream channels tend to become straighter while increasing in width, but not necessarily depth. In general, both of these conditions result in streams with lower structural diversity and can lead to lower biological diversity as well. Drainage basins that receive much timber harvesting (i.e., 1/2 to 2/3 of basin area converted from mature to young forest) can greatly increase peak flows. In predominantly forested landscapes, keeping young forest and other open areas (early-successional habitats) to less than 2/3 of the area of the drainage basin will help to prolong stream channels in their natural condition. In the end, as long as you are in compliance with state regulations, the decision of how you manage adjacent uplands, how you lay out a buffer, and the intensity with which you manage (e.g., timber harvest) within the riparian zone is yours. Whenever possible, let nature, the experiences of others, and your good judgment guide your decision making.

Riparian zones stand at the transition between terrestrial and aquatic ecosystems. As an area of transition, they are strongly influenced by activities on adjacent lands. Riparian zones host more species of wildlife and more rare plants than nearly any other habitat and are among the most dynamic ecosystems in our region. Despite their resilience, many riparian zones have been degraded either by grazing, overharvesting of timber, or have been converted to other land uses, often agricultural. The use of riparian zones as buffers between management in the uplands and sensitive aquatic systems has been recognized for years. This concept has been put into place along countless miles of stream banks and shorelines through the use of riparian buffer strips. Use of buffer strips can be designed to meet habitat management objectives as well as safeguard aquatic habitat from potentially damaging runoff. Many riparian zones, in effect, may provide early-successional habitat if managed appropriately and if large enough to accommodate the spatial needs of wildlife. It is much easier to protect water quality in small streams than major streams and rivers. Small landowners, therefore, can play an especially important role as seemingly small changes along headwater streams can have far reaching effects downstream. Management of early-successional habitat to benefit wildlife is important as many of these species suffer from an ever-shrinking habitat base and subsequent population declines. However, management for these habitats must be done with consideration for surrounding habitats as well.

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Biography

Tom Hodgman has 17 years experience as a biologist in northern New England. He earned a B.S. in Environmental Science from Unity College and an M.S. in Forest and Range Management from Washington State University. Tom has both teaching and research experience in the subject of wetlands ecology. He currently serves as a Wildlife Biologist for the Maine Department of Inland Fisheries and Wildlife where he works primarily in the conservation of nongame birds especially those associated with wetland habitats.

Chapter 10 A. Habitat Management Tools: Using Prescribed Fire to Manage Habitats in the Northeast

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Fire is a natural phenomenon that is complex, dangerous, and absolutely critical to the conservation of biological diversity in our region. However, for the vast majority of private landowners, prescribed fire as a habitat management tool is not currently an option. Prescribed burning programs are simply not yet advanced in most states because there has been a long hiatus in burning since the federal Clean Air Act was passed in 1962. In this chapter, I present some basic information required to evaluate the need for fire as a management tool. Included are sections on reconstructing fire histories, the rationale for using fire, and the essential ingredients of planning and conducting fire in a safe and productive manner.

Fire history in the Northeast

Other sections of this book discuss fire as a historical influence on northeastern habitats, so this discussion focuses on obtaining fire history specific to the land you manage. The first step in thinking about applying fire is to research the historical role fire has had on the ecology of your area. There are numerous methods used to reconstruct fire histories. No single tool can tell the fire story of a landscape by itself, so one should always apply as many sources of information as possible. The goal is to reconstruct the frequency of historical fires and their influences on the landscape and help understand the potential role of fire in structuring ecosystems. Knowledge of prehistoric fire occurrence may be useful, as well as the ecological affinities that many species evolved over a long period of time in response to fires that were occasionally a component of their habitat.

Further discussion can be found in scientific journals and textbooks, but methods frequently employed include charcoal and pollen analyses, researching town, county and state histories, newspaper accounts, interviews with fire departments, and other sources as practical. Town, county, and state histories with descriptions of historical land use practices and vegetation or habitat types are good sources of information. Often you must read hundreds of pages to glean two that are relevant to fire history or fire ecology. In many parts of the Northeast, the use of fire was historically so common that only catastrophic conflagrations that damaged structures or took human lives were reported, while most wildfires were unreported in local newspapers or historical accounts.

An excellent source of local fire history is the local fire department. Many fire departments possess written logs of fires, their locations and dates, sizes of the fires and the time and equipment that were necessary to contain and suppress them. Similarly, interviews with members of the local fire departments can yield valuable information. Old photographs can be used in reconstructing fire histories. Sometimes placing an ad in the local paper asking residents to look for old photographs of an area can yield abundant evidence not only of fire history but also of other events that helped shape current habitat conditions.

Ice storms, tornados, and hurricanes that snap large numbers of trees are often precursors to large, intense fires due to the abundant dry fuels left in their wake. Photographs taken of post-storm damage can provide clues to vegetation conditions prior to some severe fire events. Aerial photographs available from federal, state, and other planning agencies can be sources of pertinent information if the images were taken at times coinciding with fire or storm events. Local history is avidly pursued by many who may have little interest or knowledge of fire ecology, but who enjoy applying their interests to practical conservation issues, so check with the nearest historical society for sources of information. Some projects have had great success having fire history research done by volunteers or interns.

The biology and ecology of species dependent on fire-influenced habitats can provide hints about a region's fire history. Museums and herbaria are invaluable as records of historical flora and fauna. Fire scars on tree trunks and the stems of resprouting trees are good determinants of recent fires and some trees bear the evidence of previous fires for decades and even centuries.

Figure 1. The village of Lake Pleasant in Montague, Massachusetts is embedded in a pitch pine scrub oak barrens and has lost homes to wildfires on several occasions. A program using fuel reduction techniques including prescribe fire is benefiting wildlife habitat and improving public safety.

Some of these methods are significant at a regional scale, some apply only at a very local scale, and all are subject to the interpretation of the land manager. Contrary to popular belief, fire has had very significant impacts on the Northeast region's ecology, but one rule that emerges from all the investigations is that few generalizations apply. The nature and influence of fire varies from place to place and from time period to time period. Interpretations by fire ecologists of a state's fire history will change as information accumulates.

Pre European settlement (prior to 1600)

Evidence from all the sources listed above strongly supports the conclusion that fire was an important tool used liberally in some parts of the Northeast. Unlike the western U.S., lightning fires are much rarer, though by no means absent, in the Northeast. The Algonquian peoples of the region used fire as the tool of choice in modifying their environment. Fire was used to clear trees, to open up the shrubby understory of forests, to promote fruit bearing shrubs such as blueberries, to make travel easier, and to attract game. Large grasslands and savannahs were described throughout much of Virginia by early explorers. The pine barrens of New Jersey would not exist without the consistent periodic influence of fire. Early settlers on Long Island, New York encountered large grasslands. Southern New England was described by many early explorers as supporting large open areas, smaller grasslands, and extensive areas of burned forests. Immigrants built the early settlements in the Northeast directly upon the areas that had been opened by native peoples, thus saving the new arrivals the labor of clearing new land for cultivation and habitation.

But fire was not of equal importance everywhere in the region. Although portions of the Northeast were described by early explorers as having open grasslands, park-like woodlands, and low shrubby areas that could only result from frequent fires, other parts appear to have experienced less frequent fire. Most states within the region have a rich history of supporting fire-dependent habitats prior to European settlement. Yet, some areas, especially in northern New England, have much less evidence of fire. This is not surprising as forest vegetation types differ in northern and interior areas from those found from southern New England to the Virginias. The effects of fires are not as obvious in spruce forests and northern hardwoods as in oak-dominated landscapes, although large fires did occasionally burn in these types, especially after insect outbreaks.

Post settlement

Depending on their region of origin, immigrants brought different attitudes about fire to this continent. They sometimes used fire for different reasons than had the Algonquians, but they continued to use fire to manage land. Local histories of the17th, 18th, and 19th centuries include frequent references to fire in the Northeast. Large catastrophic fires followed clear-cutting of forests and agricultural activities continued to require fire as a means of rejuvenating forage lands for stock. In some areas, a regime of frequent fire was imposed on ecosystems that had evolved with infrequent fire. In other areas, a historical regime of frequent fires was, by the 20th century, replaced by the near absence of fire.

Current conditions

Attitudes about fire have undergone drastic changes since the early 20th century. Increased technological advances and a highly successful fire prevention campaign embodied by Smokey the Bear have resulted in nearly total exclusion of fire from northeastern ecosystems. This has led to the degradation or elimination of some habitats critical to the survival of the region's biodiversity. Many of these habitats are discussed in other chapters in this book and include burned forests, savannahs, scrubby plains, meadows, and grassy shrub habitats.

Figure 2. Smokey the Bear fire prevention campaign symbol

Air quality

Since the 1960s, recognition that excessive smoke represents a public health hazard has resulted in federal, state, and local laws curtailing or eliminating the use of fire by citizens. While prescribed fire was curtailed nationwide following the passage of the Clean Air Act in 1962, it continued to be applied in the Southeast, Southwest, and the West, but in the Northeast only wildfires continued to burn and these, with a few major exceptions, were usually small.

The exceptions include the 200,000 acres that burned in Maine in 1947. Towns were devastated and several never recovered. In 1957, 15,000 acres burned with extraordinary intensity and speed in Plymouth, Massachusetts. Observers recorded that the fire burned at a rate of 18 acres per minute! Nineteen sixty-three was a remarkable fire year throughout the region and in New Jersey in particular, where 200,000 acres burned and 450 houses were destroyed. Similar fires could burn again in all of these areas, and with increased residential and industrial development, the results could be catastrophic. Property losses could easily exceed $1 billion dollars if large fires burned in portions of southeastern Massachusetts, on Long Island, or in the New Jersey pine lands.

In these and other areas, current conditions are untenable from both a public safety and a habitat conservation perspective. Highly flammable vegetation has accumulated in areas subject to periodic high intensity fires, while dozens of plants and animal species are imperiled in the region due to the loss of habitats that vanish in the absence of fire.

In contrast to prescribed fires, where the timing and conditions of management actions are carefully selected, wildfires often occur at times when adjacent human resources are at greatest risk and adverse impacts on air quality are greatest. It is far wiser to choose the conditions under which prescribed fires will occur and, by doing so, air quality concerns will be enormously reduced.

Rationale

The following is a rule of thumb when contemplating fire's ecological benefits: fire can simultaneously have immediate benefits for some species and negative consequences for other species. For example, using fire to restore grassland bird habitats can have negative consequences for certain reptiles and butterflies if proper precautions are not taken. However, short-term effects should not be used to gauge long-term benefits. In most habitats, the timing, frequency, and size of fires can be adjusted so that minimal damage is inflicted on populations of rare and endangered plants and animals and their habitats. It is imperative that fire managers be able to clearly articulate and defend the reasons they use fire.

Every state in the region harbors plants and animals that benefit from the conditions created and maintained by fire. Similarly, every state in the region contains communities of high conservation priority that will vanish without the conditions created or maintained by fire.

Seasonal fire effects

Many of the early descriptions of fire-influenced habitats describe fires in the spring and fall seasons. Currently, most prescribed burns are conducted in the spring and fall but under conditions that minimize smoke impacts and the possibility of a burn escaping the burn unit boundaries. This means that most burns are set in relatively moist conditions. Historical fires had no such constraints and fire effects were likely more severe than prescribed burn effects are now.

These spring and fall burns occur primarily in the dormant season for most plants. Under prescription conditions burns are low in severity and intensity. Generally, fire severity refers to the amount of available fuels consumed and a severe fire leaves bare soil, having consumed all available dead wood, leaf litter, and duff. Fire intensity refers to the amount of heat released by combustion. Generally, fire managers cannot safely conduct a severe and intense fire.

Many imperiled plant and animal species depend on the effects of severe and intense burns. One way to achieve better ecological results is to apply growing season fires. In fuels that support intense fire behavior such as pitch pine and scrub oak, growing season fires achieve fuel reduction and habitat restoration more quickly and, under appropriate conditions, are more easily managed than are dormant season fires. One reason is that plant nutrients are above ground in the growing season and below ground in the dormant season. Fire may be more efficient if performed during the growing season and managers must balance growing season burns with habitat needs of breeding animals.

Is fire necessary?

When contemplating using prescribed fire as a management tool, you must first ask yourself, "Is fire necessary to achieve desired habitat management goals?". To begin to answer this question you must consult professionals at universities, as well as public and private conservation agencies. Mechanical treatments such as logging, brush hogging, mowing, and disking all perform as disturbance agents capable of creating suitable conditions for many species and communities addressed in this volume. Herbicide applications are also quite effective at modifying and managing vegetation. However, fire performs some functions that these other tools cannot. Fire removes some dead vegetation and turns it into ash, smoke, and steam, and provides nutrients that are immediately available to plants. Dead grass, thatch, and leaf litter are often completely consumed and serve to carry fire throughout the habitat patch. The removal of thatch and litter allows sunlight to penetrate to the ground surface and prepares a seed bed for colonizing grasses and wildflowers. Some seeds require scarification by fire for germination to occur.

Planning

Prescribed fire requires significant consideration for safety issues, and the goals must be worth the risks. The key to success in prescribed burning is careful and systematic planning. There are several definitions of prescribed fire, but all include reference to a plan with measurable and achievable objectives, preferably one that is reviewed and approved by other fire planning professionals. Of course, economies of scale do apply. A manager needs a less complex plan to conduct a prescribed fire in a rural pasture with no nearby structures than in a large forest tract composed of highly flammable vegetation near roads and residential areas. Both situations require an assessment of several critical features discussed below. But first, some definitions are required.

Wildland fire - any fire burning in vegetation, planned or unplanned.

Prescribed fire - a fire conducted for specific, clearly stated purposes that is confined to a predetermined area under specific weather conditions and conducted by personnel with the required training and experience. The term "controlled fire" has been used as a synonym. However, this term is better applied to brush pile fires and the controlled burning of unwanted structures.

Burn prescription - the conditions under which a fire will be conducted, usually dominated by weather parameters. Fire behavior is influenced primarily by wind speed and direction, relative humidity, and fuel moisture levels. Each of these weather conditions have a range under which a prescribed fire is acceptable and ranges under which prescribed burning cannot be attempted because they represent an unacceptable, unsafe hazard.

Burn plan - describes the conditions under which a prescribed fire can be conducted and includes necessary features such as site descriptions and maps, descriptions of the steps that will be taken by assigned personnel to conduct the burn, and methods for evaluating the burn during and after the burn.

Components of a burn plan

At a minimum, burn plans should include the following:

- Site name.
- Location - state, county, town, USGS topographic quadrangle, and street address if applicable.
- Site ownership and abutting tract ownership.
- Unit description(s) – description of the current vegetative state of the site, which would include unit size (acreage).
- Required regulatory agency notifications - depending on the state in which the burn is planned, air quality agencies, wildlife agencies, forestry departments, conservation commissions, and/or other entities may need to be informed, and perhaps written approval obtained, prior to a prescribed fire.
- Fuel model and proportions - fuel models, developed by the U.S. Forest Service, categorize vegetation types according to fuel properties (e.g., fuel size and depth among others), and help fire managers realistically estimate fire behavior or fire danger.
- Safety hazards - a description of items/objects that may pose a hazard to individuals participating in the prescribed burn (e.g., fences, holes, foundations, snags located near firebreaks, etc.).
- Safety zones - a description of areas that someone attending or participating in the burn can go to should the fire threaten the crew's personal safety in the event of an unplanned weather change or other event.

- Site management goals - a description of what the manager is trying to accomplish with the use of fire.
- Burn objectives - a description of how the burn will help meet site management goals.
- Smoke management hazards - an evaluation of potential impacts to downwind areas especially those particularly sensitive to smoke (e.g., schools, health care facilities, churches, highways, etc.).
- Crew size and qualifications - description of the crew size and crew qualifications necessary to conduct the burn safely.
- List of equipment - hand tools, power tools, fire trucks, radios for communications, and anything else necessary for the completion of a burn that meets management goals and objectives safely.

Federal agencies have adopted National Wildfire Coordinating Group training standards for crews, burn bosses, and other fire crew positions, and some state and private agencies have adopted similar standards. Crew qualification requirements are determined by evaluating the complexity and difficulty of the planned burn. In many states, assembling a qualified crew requires participation of multiple agencies. Building public/private multi-agency partnerships strengthens fire management programs and solidifies interagency cooperation that is uniquely necessary for conducting prescribed fire in the Northeast. Cooperation and commitment are important because the ecological effects of fire are rarely achieved in short time periods or with individual fires.

Burn plan review

All burn plans should be reviewed by at least one person with the experience necessary to determine if a plan adequately and thoroughly addresses all the information appropriate for the site. This could include prescribed fire managers and/or wildfire control officers for federal or state natural resources departments, or conservation organizations.

Liability

Perhaps the greatest constraints on successfully managing habitats with prescribed fire are the questions of legal responsibility and accountability. Few private entities carry the insurance policies that would cover the many potential liabilities associated with prescribed fire. While escaped fires burning off-site are easily identified as potential liabilities, there are many other potential problems. Individual injuries while en route to or during a fire, smoke damage to adjacent property, and decreased visibility on highways due to smoke are just a few examples of liability issues that should be addressed prior to embarking on a fire management program.

Safety

The foundation of fire crew training is personal and crew safety in all aspects of fire operations. Protecting public safety is an equally important ingredient in all burn plans. However, residents of fire-prone landscapes need to learn to protect themselves from inevitable wild fires. As a general rule, if an area has experienced fires in the past, it is highly likely that it will experience fires in the future. Due to years of inattention, large accumulations of fuels create the conditions for catastrophic wildfires. The boom in rural residential housing places many homes in direct contact with highly flammable vegetation. Most of the newly arrived homeowners have never experienced a conflagration in which thousands of acres burned in day or two. Fortunately, there is a nationwide program, Firewise, that advises homeowners on managing vegetation on their land to reduce the likelihood that their structures will be destroyed the next time a wildfire burns the area. *It is in the best interest of all fire managers to encourage an active Firewise program in any town where prescribed fire is planned or conducted*. Reducing the likelihood that private property will be damaged in wildfires reduces opposition to

the use of prescribed fire. Land managers should consider assigning high priority to fire and fuel management to areas that, after treatment, will provide the greatest protection to public health and safety. Often ecological goals and public health and safety goals can be achieved simultaneously.

Monitoring

No burn is complete until monitoring has been completed. Describing site conditions prior to a burn, measuring fire behaviors during a burn, and measuring fire effects after a burn are all part of finishing the job you started when you began to think about using fire to meet your management objectives. While no one can monitor every aspect of every fire, everyone can monitor at least those aspects of burns that relate specifically to their objectives. The most efficient way to determine exactly what data you will need to collect depends on the specific goals and objectives set for the site. As an example, if an objective is to reduce fuel loads and in so doing reduce the hazard for wildfires, the amount of fuel in an area should be measured before and after a prescribed burn to quantify the extent to which fuel loads have been reduced. If the primary objective of a burn or series of burns is to provide habitat for grassland birds, the observations and data collected should reflect this and focus on grassland birds occupying or failing to occupy the habitat. Once appropriate variables have been sampled, the fire manager should then determine if objectives were met. Fire management is far too time-consuming and expensive to waste resources on tools and methods that do not achieve established goals and objectives.

How to get started?

Many state chapters of The Nature Conservancy have programs that can provide more information on fire ecology and management. Every state has at least one agency responsible for administering prescribed fire or open burning permits. Air quality agencies often have authority to issue permits. Many states have forestry departments and/or forest fire control bureaus responsible for controlling and preventing wildfires. These departments should be able to steer you in the right direction when initiating inquiries about using prescribed fire and training opportunities.

Is fire for you?

Establishing a prescribed fire program presents a formidable challenge. Planning, coordinating, and conducting a burn requires a significant time commitment, as does acquiring the necessary training and experience. But if you start small, in low complexity fuels such as old fields and grasslands and show authorities that fire can be a useful and safe tool, the ordeal is a challenge worth accepting. Indeed, failing to accept the challenge throughout the Northeast will result in a continuing downward spiral for too many plants and animals.

Fires alone, especially in the increasingly suburbanized Northeast, will never satisfy habitat restoration needs. Throughout the region, we are seeing successful experiments that involve pre-treating dangerous fuels by thinning and mowing followed by prescribed fire. The short-term expense of developing these programs is well worth the long-term benefits gained in habitat restoration and increased public safety.

Suggested reading

Pyne, Stephen J. 1982. Fire in America: a cultural history of wildland and rural fire. Princeton Univ. Press. This comprehensive treatment of fire throughout the U.S. is a must read for anyone beginning to explore fire as a historical feature of the landscape.

Pyne, Stephen J., P.L. Andrews and R.D. Laven. 1996. Introduction to wildland fire. 2nd Edition. John Wiley & Sons, Inc. NY. This book discusses all aspects of fire behavior, fire management, fire research and administration presented with case studies and abundant references.

Lewis, Henry and M. Kat Anderson (Editors) 2002. Forgotten fires: Native Americans and the transient wilderness. University of Oklahoma Press. This book serves as a comprehensive review of the use of fire by Native Americans.

Whelan, Robert J. 1995. The ecology of fire. Cambridge University Press. Cambridge, Great Britain. This book presents a balanced, international review of the effects of fire on plants, animals, and vegetation.

www.Firewise.org: The website for information on protecting homes and communities from wildfire disasters. It also presents information on funding sources.

Good sources for prescribed fire programs include the web sites for the National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service, and The Nature Conservancy.

Biography

Tim Simmons is a restoration ecologist with the Massachusetts Natural Heritage & Endangered Species Program within the Department of fish and Game. Previously he was Director of Science and Stewardship for the Massachusetts Chapter of the Nature Conservancy and their fire manager for the New England region.

Chapter 10 B. Habitat Management Tools: Herbiciding

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For many people the decision of whether or not to use herbicides to control vegetation is a difficult one. Herbicides are effectively used to control invasive exotic plants that threaten natural communities and rare species, to control vegetation under power lines that provide electricity to our homes and businesses, and for a variety of other situations. However, to many, their use is somewhat controversial. Many people are concerned that herbicides contaminate groundwater, harm desirable as well as undesirable organisms, pose a threat to human health, and cause other negative impacts to people and the environment. However, if used correctly, herbicides can be a safe and effective means of helping to conserve our natural resources and our native species.

Whether or not negative impacts are realized is largely dependent on the herbicide applicator. Did the applicator have sufficient knowledge of the site where herbicides were applied? Did he select the right herbicide, the right concentration, and the right application technique for the job? Did he follow all of the safety precautions recommended by the herbicide manufacturer, the federal Environmental Protection Agency, and/or state pesticide regulatory agency? This section is dedicated to helping you, the potential herbicide applicator, answer "yes" to all of these questions.

Before deciding to use herbicides consider the following:

- Are unwanted plants threatening conservation targets or management goals on the site?
- Given the scope of the project and available labor pool, are there manual (mechanical) techniques that could effectively control the unwanted vegetation? Refer to chapter 8 for information on mechanical tools to control invasive exotic plants.

If you don't believe that manual control techniques will work or if they haven't worked in the past, then herbicides may be the only means left to conserve the resource under consideration. As such, arm yourself with as much information as possible before deciding which herbicide or application technique to use.

Applicator's license

Find out if your state requires an applicator's license. Some states require all applicators to have a license. Others allow private landowners to apply herbicides on their own land without a license. Contact the pesticide regulatory agency in your state to find out what is required. Visit http://npic.orst.edu/state1.htm to obtain contact information for your state agency.

Know your site

Get to know the project site. Are there any wetlands, rare species, or other sensitive natural resources within or near the project site? If wetlands are present, find out if your town or state regulates them and if a permit is needed to apply herbicides in or near them. You can only use an herbicide that the EPA has approved for aquatic uses when applying near or over wetlands or open water. Some herbicides with the active ingredient glyphosate are approved for use in wetlands (e.g., Accord® Concentrate and Rodeo®). Glyphosate is also the active ingredient in Roundup® herbicide, but Roundup® is not approved for use over water because the surfactant (the soapy substance that helps the herbicide stay on the leaf surface longer) in the Roundup® formulation is toxic to aquatic organisms. If using Accord® Concentrate or Rodeo®, a surfactant that is not toxic to aquatic organisms (such as Kinetic®) can be mixed in.

Figures 1a & 1b. The presence of wetlands such as this vernal pool (a), rare species such as this marlbed salamander (b), and other sensitive natural resources will play a major role in deciding whether the use of an herbicide is appropriate and which herbicide and application technique to use. Photos by James D. Oehler (a) and Paul Fusco (b).

If rare species are present, contact your state's natural heritage bureau and/or fish and wildlife agency to determine if there are any laws or regulations that pertain to your project. The presence of rare species may also influence what type of herbicide or application technique is used. For instance, if a rare plant was growing next to a plant targeted for control, a foliar spray application would not be appropriate. A more targeted technique, such as a cut-stem application, might be better suited (but note that in some cases herbicides applied to cut stumps or as a basal bark treatment have moved from the roots of the target plant into the roots of adjacent plants, perhaps through natural root grafts). You will find out more about application techniques later in this section.

Selecting the right herbicide

Find out which herbicides are effective against the targeted plant(s) (Table 1). Contact federal (U.S. Fish & Wildlife Service, U.S. Forest Service, and U.S. Department of Agriculture), state (state wildlife, forestry, and agriculture offices, and university cooperative extension programs), non-profit, or other conservation land managers in your area to find out what they have found to be effective. The Internet also provides a great deal of information on chemical plant control, especially on invasive exotic plants. Refer to the list of suggested readings at the end of this article for recommended websites.

Behavioral properties

Once a list of potential herbicides is chosen, review the behavioral properties of each product (Table 2). How long do they last in the environment? How toxic are they to animals? How mobile are they in the ground? Choose the least persistent, least toxic, and least mobile herbicide(s) that will do the job safely and effectively. Another consideration is the herbicide's selectivity. That is, does the herbicide kill a wide range of plants, or a select group of plants? If trying to control glossy buckthorn in a grassland community using a foliar spray application, an herbicide that doesn't kill grasses, such as triclopyr (active ingredient in Garlon® and Brush-be-Gone®), would be preferred, all other things being equal.

Figure 2. Buckthorn that has been mowed annually for numerous years can degrade a grassland community. When choosing an herbicide to help restore such a community, choose one that will not have an impact on the underlying grasses. Photos by James D. Oehler.

Read herbicide labels and Material Safety Data Sheets [MSDS sheets (the list of suggested readings provides a website where you can obtain these materials)]. Herbicide labels and MSDS sheets have information on the properties of the specific formulation in question. They also provide safety precautions, directions for handling, mixing, and applying the herbicide, information on required personal protection equipment, storage, cleanup, posting of the project site, and much more. When reading an herbicide label, the word "must" is used for actions that are required by law, while the word "should" is used for actions that are recommended but not required. After reading the label, consider whether or not you have the resources or can readily obtain the resources to handle the herbicide(s) safely. ALWAYS FOLLOW LABEL DIRECTIONS. IT IS AGAINST FEDERAL LAW TO DO OTHERWISE.


Roundup PRO

The complete broad spectrum postemergence professional herbicide for industrial, turf and ornamental weed control.

Complete Directions for Use

AVOID CONTACT OF HERBICIDE WITH FOLIAGE, GREEN STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, BECAUSE SEVERE INJURY OR DESTRUCTION IS LIKELY TO RESULT.

1.0 INGREDIENTS

3.0 PRECAUTIONARY STATEMENTS

3.1 Hazards to Humans and Domestic Animals

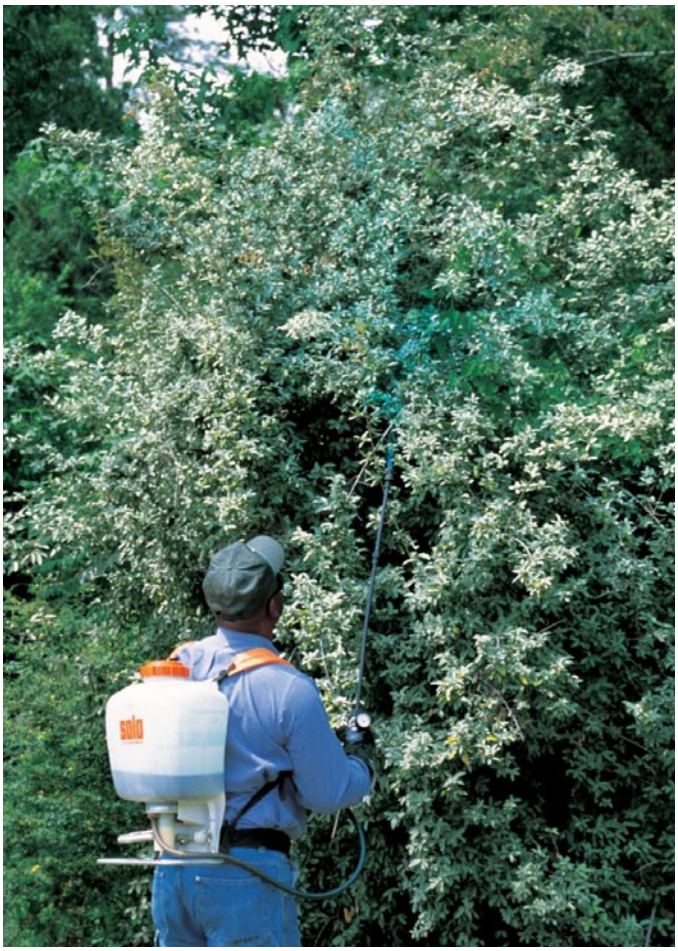
CAUTION!

3.2 Environmental Hazards

Figure 3. Herbicide labels and MSDS sheets provide a plethora of information regarding the safe application and handling of herbicides.

Selecting the right application technique

The next step is to learn about the various application techniques. Some of the more popular techniques include:



Foliar spray application

Herbicide is sprayed onto the leaves of targeted plants. Care must be taken to avoid over spraying onto nearby non-target plants. Avoid using boom spray applications where possible because it can result in a relatively high amount of herbicide contacting non-target species and bare ground.

Figure 4. Foliar spray applications are a common technique for controlling large invasions of problem plants. Photo by James H. Miller, USDA Forest Service, www.invasive.org.

Cut-stem

A tree or shrub is cut near the base and herbicide is immediately sprayed, squirted, or painted on the exposed cambium (living inner bark) of the stump. Care must be taken to avoid applying too much herbicide and allowing it to run-off. Because it is so targeted, this technique has a low probability of affecting non-target species or contaminating the environment. A homemade PVC applicator is a cheap, effective, and pain-saving tool for applying water-soluble herbicides to cut-stem surfaces. For more information on how to construct an applicator, visit the following websites:

- The Maryland Department of Agriculture: www.mda.state.mn.us/ipm/thicket/volume3no1/wickapplicator.htm
- The Nature Conservancy Weeds on the Web: tncweeds.ucdavis.edu/products/handbook/22.PVCapplicator.pdf

Figure 5. Cut-stem applications are more targeted than foliar applications and therefore produce fewer non-target impacts. Photo by James H. Miller, USDA Forest Service, www.invasive.org.

Basal bark

A 6 to 12 inch band of herbicide is sprayed or painted around the circumference of the trunk of the plant, approximately one foot above ground. This technique works best on young trees with smooth bark. It is usually not effective against older plants or those with thick, corky bark. Girdling a tree first may substantially increase the success of this technique.

Figure 6. Basal bark treatments can be effective at controlling certain tree species including autumn and Russian olive and tree-of-heaven. Photo by James H. Miller, USDA Forest Service, www.invasive.org.

Wick application

This technique utilizes a three to four inch pipe usually made of PVC with wicking rope that winds from inside to outside of the pipe along its entire length. The pipe is capped at both ends, with one end threaded so it can be filled with herbicide. The rope winds through tight-fitting grommets that prevent herbicide drip. The applicator is mounted on a tractor

so it can be raised and lowered as necessary to treat undesirable plants as the tractor drives along. This technique is commonly used in Mid-Atlantic states to treat tall weeds (e.g., Johnsongrass) growing among lower growing crops (e.g., soybeans). In wildlife habitat management applications, a wick applicator can be used to treat tall-growing weeds in a newly planted native warm-season grass field. If built ruggedly enough, a wick applicator may also be useful in treating seedling-sapling trees growing above other plants in an old-field setting. Kits to build wick applicators are commonly available through farm service supply companies. For more information on wick applicators, visit the following website:

- Kansas Forest Service: www.oznet.ksu.edu/library/forst2/mf2342.pdf

or contact:

- Speidel Applicator, Inc., 7800 South 40th St, Lincoln, NE 68516, (402) 423-4003

Injection

A specialized tool called the EZ-ject® lance injects .22 caliber-sized capsules filled with herbicide into the trunk of a tree. The lance is a 5-foot long metal tube that is manually operated. It provides a convenient, easy, and safe way of applying herbicides with minimal cleanup and exposure to other organisms. However, the lance and capsules are not inexpensive ($425/lance and $500/4,800 capsules) and can be difficult to use in densely vegetated areas. For more information on the EZ-ject lance visit:

- The Nature Conservancy Invasives on the Web website: tncweeds.ucdavis.edu/tools/ezject.html
- Odum Engineering, the manufacturers of the EZ-ject lance: www.ezject.com.

Figure 7. The EZ-ject® lance is can be an efficient means of controlling larger shrubs and trees without non-target impacts. Photos ©2003 Forestry Suppliers, Inc. All rights reserved. Used by permission. 540010.

Targeted application techniques, such as cut-stem and basal bark, usually require a much more concentrated solution of herbicide (25-100% active ingredient), as compared to foliar spray applications (typically 2-5% active ingredient). As such, be especially diligent when applying herbicides using these techniques so no other organisms will be affected. Regardless of the herbicide(s) used, be prepared to repeat treatments one or more times, as no treatment is 100% effective.

The use of herbicides to control unwanted vegetation is not a management technique that should be taken lightly. However, if knowledgeable about all of the issues pertaining to herbicides, a land manager can use this tool safely and effectively and can rest assured that he has accomplished more conservation good than harm.

Suggested reading

Wisconsin Manual of Control Recommendations for Ecologically Invasive Plants. www.dnr.state.wi.us/org/land/er/invasive/manual_toc.htm.

The National Pesticide Information Center website (herbicide properties, labels, MSDS sheets, more). npic.orst.edu/index.html.

The Nature Conservancy's Element Stewardship Abstracts (ESAs provide detailed information on many invasive exotic plants and how to control them). tncweeds.ucdavis.edu/esadocs.html.

The Nature Conservancy, Weed Control Methods Handbook (detailed information on controlling invasive exotic plants). tncweeds.ucdavis.edu/handbook.html.

Biography

Jim Oehler has a B.S. in Wildlife Management from the University of Wisconsin – Stevens Point and an M.S. in Wildlife Ecology from the University of New Hampshire. Prior to joining the New Hampshire Fish & Game Department in January 2003, Jim spent five years with the Massachusetts Division of Fisheries & Wildlife reclaiming and maintaining early-successional habitats and controlling the invasive exotic plants commonly found in those habitats.

Table 1. List of selected invasive exotic plants and commonly used herbicide(s) known to be effective at controlling them.[a]

Plant Name	Cut-stem[b]	Basal Bark	Foliar[c]	Notes
Asiatic bittersweet	100% glyphosate or 40% triclopyr	--	1-2% triclopyr	Cut stem: apply after last killing frost. Foliar: Cut stems early in spring, and spray resprouts.
Barberries	20% glyphosate or 25% triclopyr	--	5% glyphosate	Cut stem: apply anytime in August through October. Foliar: apply when in bloom.
Buckthorns	20% glyphosate or 25% triclopyr	--	5% glyphosate + 1/4 oz metsulfuron methyl per 100 gals.	Cut stem: apply in August or September.
Bush honeysuckles	20% glyphosate or 25% triclopyr	--	2-5% glyphosate or triclopyr	Cut stem: apply late in the growing season or throughout the dormant season. Foliar: apply when in bloom.
Common reed	30-50% glyphosate (Rodeo® or Accord® for wetlands)	--	3-5% glyphosate (Rodeo® or Accord® for wetlands)	Cut stem: inject herbicide into stem with eye dropper. Foliar: apply after plants have formed tassels.
Multiflora rose	20% glyphosate or 25% triclopyr	--	5% glyphosate + 1/4 oz metsulfuron methyl per 100 gals.	Cut stem: apply anytime in August through October. Foliar: apply when in bloom.
Olives	10-20% glyphosate	1% triclopyr (Garlon® 4) in diesel oil	5% glyphosate + 1/4 oz metsulfuron methyl per 100 gals.	Basal bark: a basal bark ready formulation is available and marketed under the brand name Pathfinder II®.
Sericea lespedeza	--	--	2% triclopyr	Apply in early to midsummer during the flower bud stage.
Purple loosestrife	30% glyphosate (Rodeo or Accord for wetlands)	--	3-5% glyphosate (Rodeo® or Accord® for wetlands)	Cut-stem: apply when flowering (Aug./Sept.)
Tree-of-heaven	100% triclopyr (Garlon® 3A formulation which is already somewhat diluted with water) or 100% glyphosate.	20% triclopyr (Garlon® 4) in diesel oil or 15% triclopyr (Garlon® 4) + 5% imazapyr in diesel oil or 100% glyphosate.	2% triclopyr or glyphosate	Basal bark: a basal bark ready formulation is available and marketed under the brand name Pathfinder II®. Cut stem: apply anytime in August through October.

[a] Listed herbicides and treatments are also effective against a number of other plants including many native plants. Care must be taken during application not to affect non-target plants.

[b] Remove and dispose of stems with seeds or root segments. Cut-stem applications are most effective when applied in late summer or fall when the plant is sending all resources down to the root system in preparation for the dormant season. Listed herbicide concentrations refer to solutions in water.

[c] Foliar applications are most effective when plants are in flower or forming fruits. Listed herbicide concentrations refer to solutions in water.

Table 2. Behavioral properties of selected herbicides (modified from a table presented in The Nature Conservancy's Weed Control Methods Handbook).

Herbicide	Brand Name Examples	Target Weeds	Average Half-life in Soil	Mobility in Soil	Average Half-life in Water	Mechanism of Degradation	Toxicity to Animals	Notes
Glyphosate	RoundUp®, Rodeo®, Accord®	Annual and perennial weeds	47 days	Low	12 days to 10 weeks	Primarily microbial	Low	Little to no soil activity. Some formulations are highly toxic to aquatic organisms (e.g., Roundup®).
Metsulfuron methyl	Escort®	Annual and perennial broadleaf weeds and some annual grasses	14-180 days	Low-moderate	29 days	Primarily microbial and chemical	Low	Useful in establishing native warm-season grass stands.
Imazapic	Plateau®, Plateau Eco-Pak®, Cadre®	Annual and perennial broadleaf weeds and some annual grasses	120-140 days	Low	< 8 hours	Primarily microbial	Low	Degree of control depends on selectivity of individual plants. Especially useful in establishing native warm-season grass stands.
Imazapyr	Arsenal®	Annual and perennial weeds	25-141 days	Low-moderate	2 days	Primarily microbial, but also solar	Low	Provides long-term total vegetation control.
Triclopyr	Garlon®, Remedy®	Annual and perennial broadleaf weeds	30 days	Moderate-high	4 days	Primarily microbial, but also solar	Low	Commonly used herbicide. The ester formulation is highly toxic to aquatic organisms.

Chapter 10 C. Habitat Management Tools: Grazing for Wildlife Habitat Enhancement

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Prescribed grazing

Prescribed grazing/browsing couples the use of foraging livestock that are selective in what they feed on with land management. It is a method of improving pasture forage production and livestock performance, and maintaining quality wildlife habitat by subdividing large areas of pastureland into smaller areas (paddocks) and grazing those areas in a flexible rotation when the plants are ready (mainly indicated by height). In this way, high quality forage is rationed out to meet livestock needs, while plants already grazed are protected from being eaten again until they have adequately recovered. It is the animals in these systems that are acting the same as equipment or fire to affect the vegetation in a plant community. When wildlife habitat enhancement is the planned objective, ruminants can be a very effective and rewarding management tool.

Considerations

When planning a grazing system for wildlife habitat enhancement it is important to first clearly identify the specific goals of the system. Identifying whether the land manager is looking to incorporate enhanced wildlife management practices into an existing managed agricultural production program, or rather is interested in using animals as a management tool for enhancement of an unmanaged tract of land will really help guide the planning approach. Ask yourself, how many animals, and what type of animal is going to be involved in the production plan? What are the daily food, water, and space requirements for these animals? What types of wildlife are present on the land under consideration and on adjacent parcels? What types of wildlife are commonly found within the region? What are the specific wildlife habitat enhancement goals of the land manager?

After identifying the specific production and wildlife habitat enhancement goals, determining the number and type of animals to be used, and outlining their daily requirements, it is time to inventory the resources required to manage them. After this assessment is complete a plan to manage the livestock to enhance or maintain wildlife habitat may be developed.

Production goals

Identifying production goals is an important step in planning a grazing program. Livestock producers who aim to incorporate enhanced wildlife habitat practices into their production models most likely will maintain primary focus on ensuring that dairy, food, or fiber yields continue to maintain economic viability and remain primarily unaffected by shifts in management for wildlife habitat. This can be difficult if working with a grass-based dairy producer who would like to maintain production and forage quality, while managing for grassland birds on a limited land base. However, if a landowner is managing a less nutritionally demanding type of livestock, such as non-lactating dairy heifers on grass, the likelihood of providing habitat for nesting birds without significantly impacting the weight gains for heifers is greater.

When considering the dairy objective, the planner may want to consider designing a grazing system with an increased stocking density (concentrated number of animals grazing an area at a given moment, expressed as Animal Unit/Acre/Time Period) prior to the start of the bird nesting season, and then decrease the density by increasing paddock size and decreasing the occupancy period during periods when birds are actively nesting

in pastures. This practice may significantly decrease the number of nests trampled by cattle. Additionally, the planner may want to consider a rotation system with a wildlife refuge set aside. In this system paddocks are alternately grazed while a centralized refuge area is retained. The refuge would be seeded with plants that would maintain forage quality until after the bird nesting season. Forage plants that would work well in this system include red and white clover, Kentucky bluegrass, and other leguminous plants. A similar system can be used for a heifer operation. However, feeding of some previously harvested forage (e.g., hay, alfalfa, or silage) within a few sacrifice paddocks stocked at high densities, will allow the producer to dramatically increase the size of the refuge area.

In both cases the production goals have been identified and planning recommendations are based on meeting those production objectives, while also introducing some management approaches that will enhance habitat for grassland birds and other wildlife species. This same approach can be taken for managing a variety of habitats using different types of livestock. Additional planning examples will be presented throughout this chapter.

Livestock considerations

Different types of livestock impact their environments to varying degrees and may exhibit foraging tendencies that are more or less suited for the desired habitat enhancement goals. Dairy cattle and many breeds of sheep tend to be grass foragers. Virtually all goat breeds, some sheep breeds, and a few cattle breeds, most noteworthy the Scottish Highland and the American Milking Devon, are browsers of both herbaceous and woody vegetation. While dairy cattle and sheep may effectively be used as a management tool for enhancing grassland bird habitat, they may not be an effective choice in managing for deer, turkeys, cottontails, and other wildlife dependent upon old field and shrubland type habitats. Additionally, animal size will certainly dictate the area necessary to meet daily food requirements, and may relate to the potential for erosion or compaction should management take place in wet areas, or fields with excessive slopes or sensitive stream bank resources.

An example of appropriate animal selection for wildlife habitat enhancement is the use of meat goats to control herbaceous vegetation to aid in the establishment of a planted forest riparian buffer. As long as the trees are protected, the goats can be allowed to graze small strips along the riparian corridor for short periods of time to control herbaceous vegetation that may out-compete planted tree seedlings. Overall, most goat breeds are not fond of getting their feet wet, and will stay off stream banks. Additionally, their size will help minimize compaction and erosion as long as the area is not overstocked.

Should a management plan call for a very low stocking density during a certain period of the grazing season for promotion of bird nesting habitat, the planner may want to consider employing a meat or wool producing sheep breed to move through these paddocks relatively quickly. Their harvest will promote a healthier stand for subsequent grazing after the nesting season. However, their small size and varied foraging habits will leave vegetation with varying heights and plenty of protection for the birds.

Livestock selection is an important part in planning for wildlife habitat enhancement. Should a manager and planner decide to utilize a type of livestock that is not already an integral part of their grazing system, the University Cooperative Extension livestock specialist and/or Natural Resources Conservation Service (NRCS) planner should be contacted for assistance in determining the animal's specific resource requirements. Other producers that have experience with the particular type of livestock under consideration are also good sources of information. For example, if considering adding goats to a grazing system, it is important to know that goats do not like to get wet. An experienced producer will know that without some sort of shelter a landowner may have a bunch of goats on his front porch or in the house after the first significant rain event.

Livestock requirements

Determining livestock daily resource requirements is essential to the success of a livestock-based wildlife habitat management program. Of course the two primary requirements for any type of animal are adequate feed and cool clean water. Generally, installing a water supply system is a cost effective and worthwhile investment, and will be discussed later in this chapter. Additional requirements may include salt, minerals, and supplemental feed, among other things. The Cooperative Extension livestock specialist or planner from NRCS should be able to identify these requirements in addition to estimating the area necessary to meet daily food needs.

Wildlife considerations

Wildlife considerations must start with identifying the types of wildlife prevalent in the area, and what types of wildlife the land manager would like to plan for. Generally, when using livestock to manage for wildlife in the Northeast, habitats of common consideration for livestock producers include grassland and old fields or shrubland. Lost and degraded habitat is probably one of the most detrimental impacts to wildlife in the Northeast. Both managed and unmanaged farmland hold immense potential to provide tremendously valuable habitat. Planners and land managers should contact local experts in federal, state, and local organizations for assistance in identifying what plant species and type of cover are most suited to the wildlife they would like to plan for. After identifying the requirements of targeted wildlife, one can begin to plan a livestock grazing system that helps to meet their needs.

Livestock management resource inventory and planning

After identifying livestock production and wildlife goals and contacting appropriate technical staff, it is time to start the planning process. Begin with a resource inventory and acquire materials and equipment required to contain livestock within desired areas.

Resource inventories must begin with the two most important facets in managing livestock: fencing and water. Livestock must be controlled in such a manner that the land manager can place animals where they want for as long as they want. Proper grazing management requires dependable fencing. With the development of low-impedance electric fence energizers and portable fences, controlling livestock has become easier and less expensive. Energizers are available to fit all needs and circumstances. There are models that run on 120 or 220 volts, 12 volt auto or marine batteries, solar energy or flashlight batteries. The various models have different power outputs suitable for different types of livestock and different kinds of fencing. Discuss your fencing and livestock situation with an experienced dealer to select the energizer that will meet your needs.

Water systems can also be designed from simple and cost effective materials. Three quarter inch black plastic pipe often costs less then 11 cents a foot. Coupled with a sensible layout with numerous spickets placed along the system that allow for flexible positioning of stock tanks, permanent water systems are very easy to install. Temporary systems can involve gravity feeding from a larger tank on a small trailer or hay wagon, or pumping water from ponds or surface water using small gas powered pumps. Contact the local NRCS field office or supply store for assistance in sourcing parts and designing a system that works for you.

Often times it is helpful, after thoroughly walking the land intended for grazing, to contact your local NRCS office for assistance in planning a grazing system using digital aerial photography to calculate acreages, and draw out a rough design of how and where livestock will be moved, and for how long they will be there. Additionally, there are several computer programs designed to assist producers in estimating daily feed requirements and, depending upon wildlife goals, these can be used to establish a rough rotation schedule. It is important to remember that a successful grazing plan is one that is flexible. Walk your grazed land! The best way to know how the animals and the land are responding to a particular grazing strategy is to walk it and see for yourself.

Managing land for wildlife habitat enhancement with livestock can be a very rewarding and effective experience. Walking the land and identifying the needs of the livestock and targeted wildlife will provide the land manager and planner with a significant amount of information to get started with planning a grazing system. After selecting the wildlife practices to be utilized and the livestock to be used in achieving that goal, thoroughly identify both the needs of the wildlife and the livestock. Consult regional experts, successful land managers, and applicable industry personnel. This is often the fastest way to obtain an immense amount of information about how to plan for your goals. When the fencing and water planning is complete, and a rough plan has been established, introduce the livestock and begin to observe. They and the land base will quickly tell you how things are going. If you remember that this is a flexible system that will adapt and respond to your management decisions, implementing a prescribed grazing plan can be an incredible method for creating additional habitat that will benefit many types of wildlife in the Northeast.

Suggested reading

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Wallisdevries, M. et al. 1998. Grazing and conservation management. Kluwer Academic Publishers, The Netherlands. 374 pp.

Biography

Tyler Webb is a Soil Conservationist with the USDA-NRCS in St. Albans, VT. His primary interests involve managing holistic landscapes using livestock as a tool for meeting resource goals and for harvesting solar dollars from Vermont grasslands. He is also the owner and operator of Stony Pond Farm, a grass-based organic diversified livestock farm in Fairfield, VT.

Chapter 10 D . Habitat Management Tools: Mechanical Tools

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A wide variety of mechanical tools in various configurations are available for use in maintaining early-successional habitats. The type of specialized equipment selected will depend upon many factors including the size class and stocking of existing vegetation, site terrain, and area of the treatment site. The information presented in this section is a sampling of the more commonly used equipment used in the Northeast. Local land clearing and agriculture equipment supply companies can offer a wealth of information for those individuals not familiar with a specific type of machine.

The information presented in this section was obtained from the US Forest Service Technical Report 0051-2826-MTDC, *Understory Biomass Reduction Methods and Equipment Catalog*. The use of trade, firm, or corporation names in this document is for the information and convenience of the reader, and does not constitute an endorsement of any product or service to the exclusion of others that may be suitable. For a more detailed and complete listing of equipment, readers are encouraged to refer to the technical report available by contacting the Missoula Technology and Development Center of the US Forest Service at (406) 329-3978, or download it off of the web at http://www.fs.fed.us/vegtools/techniques/mtdc.php.

Machine mounted vertical-shaft brush-cutters

Make/Model	Hydro-Ax 621E and 721E
Manufacturer	Blount, Inc. (919) 269-2438 www.blount-fied.com
Attachment Type/Model	Rotary ax attachment
Maximum Treatable Material Size	7 in
Cutting Mechanism	2 free-swinging blades
Cutting Width	8 ft

Make/Model	Gyro-Trac GT-18 XP Brushcutter
Manufacturer	GyroTrac, Inc. (888) 490-8722
Attachment Type/Model	Rotary ax attachment
Maximum Treatable Material Size	7 in
Cutting Mechanism	2 free-swinging blades
Cutting Width	8 ft

Make/Model	Klearway 800-1 and 1200
Manufacturer	Kershaw Manufacturing Co. (334) 215-1000
Attachment Type/Model	Kershaw Cutter Head
Maximum Treatable Material Size	Model 800-1: 6in Model 1200: 8in
Cutting Mechanism	Twin rotor discs
Cutting Width	Model 800-1: 7 ft 8 in Model 1200: 9 ft 9 in

Machine mounted horizontal-shaft brush-cutters

Make/Model	FS4000 Brown Bear Shredder Tractor
Manufacturer	Brown Bear Corp. (515) 322-4220 www.brownbearcorp.com
Attachment Type/Model	Flail shredder
Maximum Treatable Material Size	8 to 10 in
Cutting Mechanism	54 free-swinging knives
Cutting Width	8 ft 2 in

Make/Model	Delta DT-953CTrack-Mounted Mower/Brush Rake
Manufacturer	Fecon (800) 528-3113 www.fecon.com
Attachment Type/Model	BH 250 Delta 75
Maximum Treatable Material Size	240 hp: 6 in 450 hp: 15 in
Cutting Mechanism	Fixed
Cutting Width	7 ft 6 in

Make/Model	Klearway1200 with Bull Hog 100
Manufacturer	Kershaw Manufacturing Co. (334) 215-1000
Attachment Type/Model	Bull Hog 100 Wood Shredder
Maximum Treatable Material Size	10 in
Cutting Mechanism	42 fixed hammers on rotor
Cutting Width	6 ft 6 in

Skid-steer attachments

Make/Model	Davco BC 705 and BC 604 Brush-Cutters
Manufacturer	Davco Manufacturing, Ltd. (780) 532-0097
Attachment Type/Model	Vertical shaft brush-cutter
Preferred Prime Mover	ASV Posi-Track HD4500, HD4520 or 4810 (800) 346-5954 www.asvi.com
Maximum Treatable Material Size	4 in
Cutting Mechanism	4 replaceable, free-swinging knives
Cutting Width	BC 705: 70 in BC 604: 60 in

Make/Model	Brushcat Rotary Cutter
Manufacturer	Bobcat Co. 701-241-8700 www.bobcat.com
Attachment Type/Model	Vertical shaft brush-cutter
Preferred Prime Mover	700- and 800-series Bobcat loaders
Maximum Treatable Material Size	3 in
Cutting Mechanism	Two blades on rotating disc
Cutting Width	60 in

Whole-tree chippers

Make/Model	1900 Track Bandit Self-Propelled Chipper
Manufacturer	Bandit Industries, Inc. (800) 952-0178 www.banditchippers.com
Cutting Width	19-in diameter

Make/Model	Morbark 50/48 Mountain Goat
Manufacturer	Morbark, Inc. 800/233-6065 www.morbark.com
Cutting Width	24 in

Make/Model	Morbark 30/36 Whole Tree Chipper
Manufacturer	Morbark, Inc. 800/233-6065 www.morbark.com
Cutting Width	18 in

Brush-cutting, thinning, shredding, and crushing attachments

Make/Model	Seppi M Brush-Cutter Heads
Manufacturer	Carlson Tractor and Equipment Co. (763) 428-5099 www.brush-technology.com
Suitable Prime Mover	Any that can lift required weight and give required horsepower to cutting head: 60 to 300 hp
Maximum Treatable Material Size	up to 18 in trees depending upon model
Cutting Mechanism	Free-swinging or fixed-tooth

Make/Model	Timberwolf DF 90 Brush-Cutter
Manufacturer	New Forest Technology, Inc. (780) 962-8061
Preferred Prime Mover	Tracked Loader
Other Suitable Mover	Rubber tired loaders with 2 1 /2-yard capacity and larger
Maximum Treatable Material Size	16 in
Cutting Mechanism	free-swinging cutters
Cutting Width	55 to 90 in

Make/Model	Brontosaurus Brush Mower-Excavator Boom Mounted
Manufacturer	John Brown & Sons, Inc. 888-227-6686 www.brownbronto.com
Preferred Prime Mover	Designed for tracked or rubber-tired excavators
Maximum Treatable Material Size	6-10 in depending upon model
Cutting Mechanism	Horizontal drum shredder, free-swinging
Cutting Width	30 - 48 in depending upon model

Image Unavailable

Make/Model	Timberjack Feller Buncher
Manufacturer	Timberjack, Inc. (404) 629-9044 www.timberjack.com
Preferred Prime Mover	ASV Posi-Track skid steer with minimum 40-hp
Maximum Treatable Material Size	10 to 20 in depending on model

Make/Model	Dymax Tree Shears
Manufacturer	New Dymax, Inc. 800-530-5407 www.dymaxattachments.com
Preferred Prime Mover	ASV Posi-Track skid steer with minimum 40-hp
Maximum Treatable Material Size	10 to 20 in depending on model

Make/Model	Marden Brush-Cutter/Roller Chopper-Series SB10-GK
Manufacturer	Marden Industries, Inc. 800-881-0388 www.mardenind.com
Preferred Prime Mover	Cat D-6 or equivalent
Attachment Mount	Rear draw or winch cable
Maximum Treatable Material Size	4 in
Cutting Mechanism	12 fixed 1 in x 10 in knives
Cutting Width	10 ft

Make/Model	BushHog 285
Manufacturer	BushHog
Preferred Prime Mover	Tractor 30 hp or greater
Attachment Mount	3 pt Category I hitch
Maximum Treatable Material Size	2 in
Cutting Width	5 ft
Cutting Height	1.5 – 10.5 in

Seeding attachments

Make/Model	Flex II Grass Drills
Manufacturer	Truax 763-537-6639 www.truaxcomp.com
Preferred Prime Mover	Tractor 30-100 hp depending on model
Attachment Mount	3 pt hitch
Row Spacing	8 in
Seeding Width	4-15 ft depending on model

Make/Model	Trillion T-96 Broadcast Seeder with roller/cultipacker mechanism
Manufacturer	Truax 763-537-6639 www.truaxcomp.com
Attachment Mount	3 pt hitch
Seeding Width	5-10 ft depending on model

Chapter 11 A. Case Study: Creating Early-Successional Habitat on a Small Woodlot in Southeastern New Hampshire

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Even though many people would like to improve wildlife habitat conditions on their land, it can be difficult for many small forest landowners to do so. A woodlot may be too small to make a timber sale worthwhile for a logger, while equipment used in non-commercial projects is often so expensive as to be cost prohibitive for a small landowner. However, management options do exist even for small woodlot owners. Another case study in this chapter describes the benefits of neighboring landowners teaming up to cooperate and affect management on a large scale. Landowner cooperatives such as these can certainly help facilitate habitat management on small woodlots by enhancing economies of scale and/or spreading out the cost of management projects among many landowners. If forming a landowner cooperative is not a viable option, a landowner can still seek technical guidance from state natural resource agencies and apply for state and federal cost-share funds to offset management costs. Let's take a closer look at a real-world example in which this was done.

Situation

A 50-acre property located in southeastern New Hampshire was purchased in 1995 by a retiree just before the property was to be sold to a developer. After purchasing the property, the new owner became very interested in improving the forest and wildlife habitat on the land. Unsure of what she should do or how she should proceed, the owner sought assistance from a New Hampshire state wildlife biologist and her county Extension Forester. In New Hampshire, these professionals are available, free of charge, to assist landowners with the initial stages of land management. Specifically, the biologist and forester helped the owner develop achievable management objectives and identify important wildlife habitat types on her property and within the surrounding landscape. Additionally, they provided her with recommendations for accomplishing her objectives, and helped her secure federal and state cost-share money for her management projects.

Property description and landscape context

The property is about 95% forested. However, since the property had been scheduled for development, the previous landowner harvested all of the merchantable trees from the land prior to selling it. As a result, the forest on the property is in a two-aged condition. Most of the forested area is comprised of a mix of 20-year-old hardwoods and white pine averaging less than six inches in diameter at breast height (dbh). The largest trees on the property are red maples, hemlock, and white pine, averaging 14 to 16 inches dbh; these trees were not removed during the last timber harvest because they have low value as timber due to poor form and/or defects. The trees grow scattered throughout the property and in a five-acre stand near the Lamprey River.

Wetland habitats on the property include the river, a five-acre forested wetland, a 1/2-acre ephemeral wetland, and a 1/4-acre excavated farm pond. The river is the most prominent wetland habitat on the property and within the surrounding landscape. The property includes 2,500 feet of frontage on the river, which forms the eastern boundary. The five-acre wetland is associated with an intermittent stream that usually dries during the summer. The overstory in the wetland is dominated by red maple with a variety of wetland shrubs in the understory. Highbush blueberry shrubs dominate the 1/2-acre ephemeral wetland, which also functions as a vernal pool. The landowner uses the 1/4-acre farm pond for swimming and for training her retrievers.

Additional important habitats on the property include a two-acre grassy opening and a 1/2-acre abandoned apple orchard. The two-acre grassy opening contains a mixture of cool-season grasses such as timothy, as well as legumes such as bird's-foot trefoil and red clover. The apple orchard is overgrown with 30- to 40-foot white pines and red maples. Many of the apple trees are alive but in poor condition.

Wildlife habitat types located within the surrounding landscape are similar to those on the property. The area within a one-mile radius of the property is about 95% forested and is comprised of mixed hardwoods, white pine, and hemlock. The forest in this area averages about 60 years of age. Wetland habitats include the Lamprey River and forested wetlands dominated by red maple.

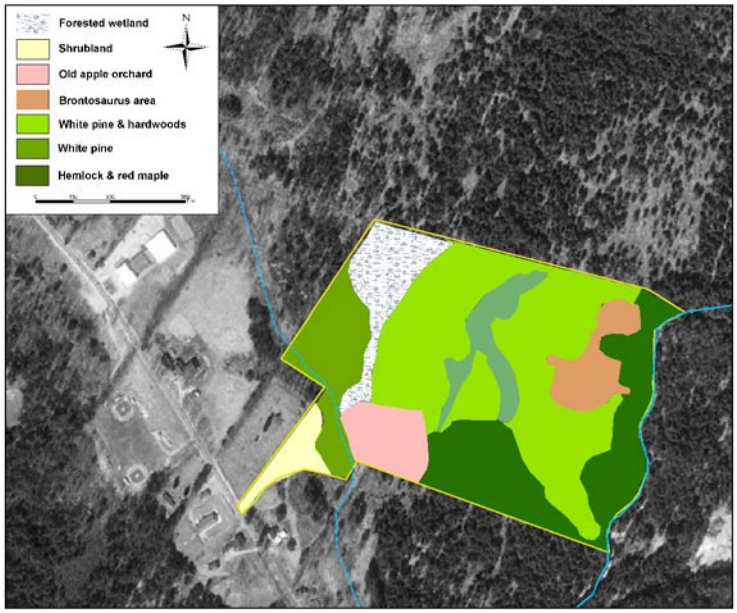

Figure 1. This cover type map clearly shows a lack of habitat diversity in and around the property. Adding a shrubland component will add to habitat diversity and the diversity of wildlife using the property.

Habitat management prescriptions

After considering wildlife habitat types on the property and those within the surrounding area, the forester and biologist determined that an early-successional habitat component was lacking. They immediately focused their attention on the five acres of low-quality timber near the Lamprey River, and recommended this be converted into a shrub-dominated opening. Several reasons made this area particularly suitable for conversion into a shrub-dominated habitat. First, the area contained an unfavorable mix of low-value timber species (no potential timber revenue would be lost by removing these trees) and the majority of trees were pole-sized and could be removed easily. Second, the mixture of upland and wetland soils had the potential to support a diversity of shrub and herbaceous plant species. Third, the shrub opening would create a valuable transitional habitat between the two-acre grassy opening and the Lamprey River. Last, the area would be suitable for many shrub-dependent wildlife species that often use habitats less than five acres in size. As a secondary benefit, this arrangement of habitats would provide the landowner with an ideal area for training her retrievers.

Management implementation

In early March 2002, the landowner hired a Brown Brontosaurus operator to convert the five-acre area into a shrub-dominated opening (refer to the mechanical tools section of chapter 10 for more information on the Brontosaurus). The landowner utilized New Hampshire Fish and Game Department's Small Grants Program to pay for one day of mowing with the Brontosaurus (cost = $1,400 for eight hours). The Small Grants Program provides up to $2,000 per year (maximum grant total of $6,000) to eligible properties to help implement a variety of habitat management practices (see chapter 12 for more information on this and other funding sources). In an effort to cover as much area as possible, only trees less than eight inches dbh were removed. Although a state regulation restricts timber cutting within the first 50 feet of a water body, the

Figure 2. A Brontosaurus grinding or "mowing" a tree. All that remains of mowed trees are small strips of wood fiber on the ground. Photos by Matt Tarr.

Brontosaurus operator was instructed to leave a wider 100-foot buffer of dense hemlocks along the edge of the Lamprey River as an undisturbed riparian corridor for wildlife. Additionally, all berry-producing shrubs were retained. By the end of the day, a five-acre opening, with only scattered remnant trees had been created.

Figure 3. The landowner and two of the 20 crabapple trees she planted as part of her wildlife habitat improvement project. Trees have been fenced to help reduce damage from antler rubbing and browsing by deer.

In May of the same year, the landowner planted 20 crabapple trees along the edge of the newly created five-acre opening. These trees were donated as part of a wildlife habitat improvement program sponsored by the New Hampshire Fish and Game Department.

Results and wildlife response

By the summer of 2002, the five-acre opening contained a mixture of upland and wetland vegetation. The drier areas of the opening were dominated by black raspberries, and the hardwood stumps had sprouted. Areas with wetter soils contained wetland rushes and sedges, as well as a mixture of ferns. Vegetation in the opening averaged three feet in height by early summer. Although no formal wildlife inventory was conducted, a variety of shrub-associated songbirds such as indigo buntings, chestnut-sided warblers, common yellowthroats, yellow warblers, and song sparrows were observed within the opening. As expected, the opening received very heavy browsing activity from both deer and moose.

Figure 4. A portion of the five-acre opening four months after being mowed by a Brontosaurus. A diversity of grasses, ferns, berry-producing shrubs and young trees are already establishing within the opening. The landowner did not seed or plant this area, but rather, allowed plants to regenerate naturally.

Photo by Matt Tarr.

Future management

The landowner has been approved to receive funding through the Natural Resources Conservation Service's (NRCS) Wildlife Habitat Incentives Program (WHIP), a cost-share program that pays up to 75% of a project's total cost. The landowner worked with a biologist from NRCS and developed a five-year plan to improve wildlife habitat on the property. Funding through WHIP and the NH Fish and Game Department's Small Grants Program will be used to cost-share the following projects:

Continued conversion to shrubland

A timber harvesting company with whole-tree chipping equipment will be hired to harvest the trees remaining within the five-acre opening. Any trees with timber value will be sold for lumber and the remaining trees will be chipped. The whole-tree chipping equipment will be used because it will allow all unwanted trees, including saplings, to be removed. Removing all trees in this manner will maximize the amount of sunlight in the opening and is expected to result in a positive growth response from shrub and herbaceous plant species. Once these trees are removed, the area will be allowed to regenerate for five to seven years. A Brontosaurus will then be used to maintain the opening every five to seven years by removing any trees or undesirable shrub species.

Small wildlife openings

While the whole-tree chipping equipment is on the property it also will be used to create two, one-acre wildlife openings in a section of the property dominated by low-quality hardwoods and white pine. Once created, these openings will be allowed to regenerate naturally, which will improve the diversity and distribution of forest age-classes on the property, as well as improve the overall habitat matrix within the immediate landscape.

Apple tree release

The whole-tree harvesting equipment will also be used to remove poor-quality white pines and red maples that are shading apple trees in the 1/2-acre orchard. The apple trees will be pruned gradually for three years after they are released.

Grassy opening maintenance

The two-acre grassy opening will be limed and fertilized according to a yearly soil test to ensure healthy, vigorous growth of the grasses and legumes. This area will be maintained by mowing it once each year in late August.

The landowner and the County Extension Forester will monitor wildlife response within each of the project areas over the next five years. Shrub-associated songbirds are expected to become more common on the property due to improved nesting and feeding opportunities within the five-acre opening. A similar response is expected from small mammals as herbaceous cover increases and berry production improves. The dense shrub cover combined with the adjacent forested stands and wetlands will provide suitable foraging habitat for raptors such as Cooper's hawks, sharp-shinned hawks, and northern saw-whet owls. Regeneration within the two forest openings will provide immediate browse opportunities for deer, moose and snowshoe hares, all of which have been observed on the property. These small forest openings will improve foraging conditions for barred owls and broad-winged hawks. High-quality forage within the two-acre grass opening will be grazed by deer and will provide turkeys and grouse with a habitat containing abundant insects. Improved apple production within the 1/2-acre orchard will provide a high-quality food option for small mammals, fox, turkeys, deer and bears.

Biography

Matt Tarr works for the University of New Hampshire Cooperative Extension Forestry and Wildlife program as an Extension Educator. He assists private landowners and municipalities in managing their land for timber, wildlife habitat, water resources, recreation, and aesthetics. Matt received an Associate's degree in Forest Technology, as well as a B.S. and M.S. in Wildlife Ecology from the University of New Hampshire.

Chapter 11 B. Case study: Grouse Management at the Monongahela National Forest, West Virginia

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History and management objectives

The Monongahela National Forest, located along the eastern highlands region of West Virginia, provides approximately 935,000 acres available to the public for wildlife-related recreation opportunities such as hunting, fishing, wildlife watching, and other forms of non-consumptive use. Since 1946, the United States Forest Service and the West Virginia Division of Natural Resources, Wildlife Resources Section have taken a cooperative approach in the management of the fish and wildlife resources on the National Forest lands within West Virginia. An example of this joint management philosophy is illustrated in the establishment of a Ruffed Grouse Management Area (GMA) within the boundaries of the Potomac Ranger District, Monongahela National Forest. A 30-year memorandum of understanding and a cooperative agreement were developed in 1983 between the public agencies to guide the management activities within the boundaries of the 1,739-acre GMA. The primary objective of the GMA is to enhance habitat quality for early-successional forest wildlife species such as ruffed grouse, woodcock, and other nongame species.

Figure 1a and 1b. Ruffed grouse and eastern towhee are just two of the species that stand to benefit from the habitat management occurring in the Grouse Management Area of the Monongahela National Forest.

Landscape context

Northern hardwood forests dominate the GMA and the surrounding landscape. More specifically, black cherry, red maple, and American beech comprise the majority of tree species within the GMA. Northern evergreen forest communities, dominated by red spruce, are found in close proximity at higher elevations. The majority of the surrounding landscape is federally owned with a few scattered private inholdings. Elevations on the GMA range from 3,500 to 4,120 feet above sea level. The following general cover classifications are found on the GMA: forestland, primarily black cherry-maple (1,630 acres), fern/forb openings (87 acres), and wildlife openings maintained in grasses/legumes (22 acres).

Early-successional habitat management prescriptions

Commercial timber sales administered by the U.S. Forest Service are used to achieve the objective of the GMA. Generally, a 100 to 120 year timber harvest rotation applies to most areas of the National Forest not designated as Wilderness Areas. A control plot, which lies in close proximity to the GMA (treatment area), encompasses 1,906 acres and is also managed on a 100- to 120-year timber harvest rotation. In contrast, the management strategy on the GMA has been modified and subsequently will be managed on a shorter 60- to 70-year harvest rotation. Positioning the GMA in close proximity to a control plot provides wildlife biologists the opportunity to monitor the wildlife benefits and impacts of an accelerated harvest strategy (GMA) in comparison to a longer-term harvest rotation (control plot), which favors older growth trees. Since 1986, a total of 409 acres have been harvested in the GMA utilizing clearcut treatments (Table 1).

Individual timber stands harvested to date have averaged eight to nine acres in size, but have ranged from 3 to 22 acres. Spacing and timing of timber sales and cuts is varied throughout the GMA to maximize the interspersion of habitat types and age classes. Future timber sales will be positioned adjacent to or in close proximity to previously conducted sales to maximize stand size class diversity. This management approach will ensure a diverse mosaic of sapling, pole-timber, and saw-timber size classes, which is so important to early-successional forest wildlife as well as other species that thrive on habitat diversity.

Figure 2. Clearcuts averaging 8 to 9 acres are generally used to enhance early-successional habitat conditions on the Monongahela National Forest.

Other habitat enhancement activities conducted in the GMA

Seeding of skid roads and log landings

Upon completion of logging activities, a portion of the haul roads and log landings are graded to contour and seeded with an appropriate wildlife seed mix. Herbaceous plantings, including grasses and legumes such as Ladino white clover, Dutch white clover, and bird's-foot trefoil provide excellent brood habitat and foraging areas for ruffed grouse, wild turkey, and other nongame species. In heavily forested landscapes such as the Monongahela National Forest, the lack of quality brood habitat limits the abundance of various wildlife populations such as wild turkey and ruffed grouse. Herbaceous seeding costs vary depending upon fertilizer and liming needs, but will typically range from $200 to $300 per acre. Log landings and roads are mowed annually or every other year during late July or August to maintain a herbaceous cover. Private landowners should consider including habitat enhancement practices such as the revegetation of log landings to an appropriate wildlife seed mix and construction of forest openings as a condition of the timber sale contract.

Figure 3. Log landings planted with grasses and herbs provide excellent brood habitat and foraging areas for ruffed grouse, wild turkey, and other nongame species.

Conifer seedling underplantings

The GMA is dominated by deciduous species with little evergreen cover. Conifers provide thermal cover especially during the cold winter months at high elevations. In addition, they provide excellent roosting/loafing areas and escape cover for a variety of wildlife species. Small patches of spruce have been planted randomly throughout the logged areas immediately following completion of harvest operations. Conifer plantings should encompass a minimum of 1/2 acre with trees planted on a six to eight foot spacing grid. Conifers are relatively inexpensive and can commonly be purchased for $15 to $25 per hundred seedlings.

Drumming log placement

During logging operations, unmerchantable logs with a minimum diameter of 12 inches that are 8 to 14 feet in length, are placed and/or left in clearcut areas (one to two per acre) to provide suitable grouse drumming sites.

Road closures

The majority of the access roads within the GMA are gated to prohibit public vehicular traffic. This action protects against human disturbance during the critical nesting season and brood rearing period, which can have a negative impact on population recruitment.

Releasing and planting of shrubs

Within the GMA, stands of hawthorn, American holly, mountain ash, and apple are released to increase sunlight availability, and as a result, increase long-term survival of these valuable soft mast-producing species. Release cuttings involve the selection of desirable tree and/or shrub species and the removal, by way of chemical or mechanical methods, of the non-desirable species that are competing for the same space. In addition,

native species such as hawthorn and crabapples are planted along timber haul roads and temporary openings upon completion of timber sale activities. Young tree seedlings (18 to 24 inches in height) can commonly be purchased for $70 to $100 per hundred seedlings from various nurseries throughout the country.

Other management activities

Wild grape arbors are identified and protected during logging activities. In addition, clumps of aspen are regenerated or expanded, when feasible. Clearcutting the aspen stand and an adjacent buffer around the stand can accomplish this, and is best done during the dormant season to maximize root suckering.

Management results and wildlife monitoring

Since 1989, ruffed grouse population trends in the GMA have been monitored. Observers walk pre-determined transects through the GMA and the control plot to evaluate the response of ruffed grouse to the accelerated timber harvest regime. Drumming surveys are conducted annually during the third week of April with observers recording the number of grouse heard drumming. Since 1989, drumming surveys have revealed that ruffed grouse numbers have been consistently higher in the treatment area than the control area. However, over the past three years, both the control plot and treatment area have exhibited positive population trends. This population growth is primarily related to the high mortality of American beech caused by the Beech Bark disease. The extensive loss of beech trees has opened the forest canopy and stimulated regeneration. In addition to having a positive impact on ruffed grouse populations, a management focus on early-successional habitat also provides food, cover, and nesting sites for a variety of resident and neo-tropical songbirds such as chestnut-sided warblers, Canada warblers, eastern towhees, and dark-eyed juncos.

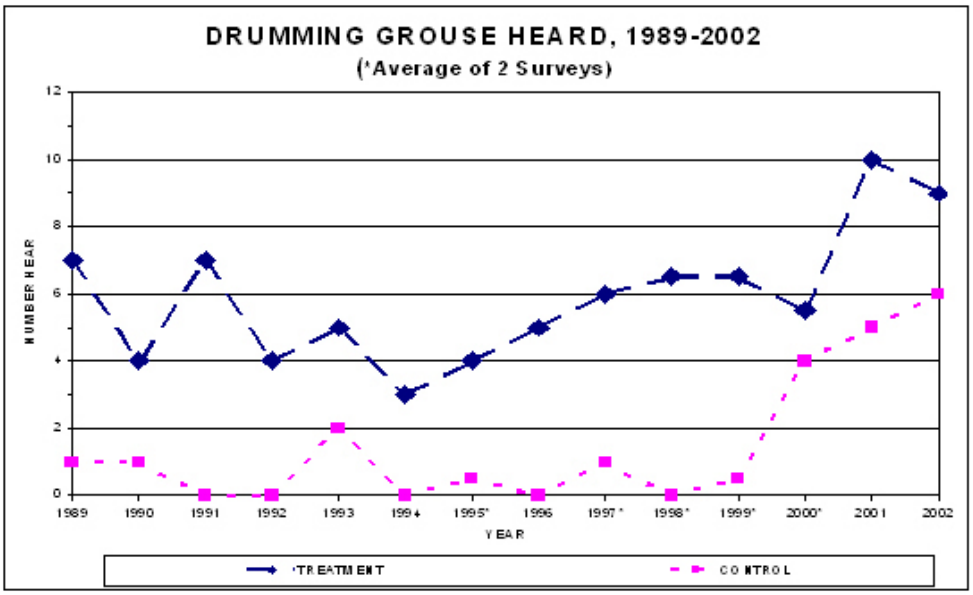

Figure 4. Comparison of the number of drumming grouse heard on the Grouse Management Area and the control plot, Monongahela National Forest, West Virginia.

The joint GMA effort will continue through 2013 at which time the project will be evaluated and a decision made to either extend the management regime for a future period or to terminate the project. Since the initiation of the GMA, similar management strategies have been incorporated in other Wildlife Management Areas throughout West Virginia, which have also exhibited positive results.

This traditional approach to early-successional forest management, as outlined above, may have applicability for industrial and private forest landowners throughout the Northeast, depending upon their

management goals and objectives. Property owners interested in managing their property for grouse or other species of wildlife should contact their state wildlife agency or a consultant wildlife biologist for additional technical advice.

Suggested reading

Brenneman, Ron., J.E. Kennamer and M. Kennamer. 1995. Managing openings for wild turkeys & other wildlife – a planting guide. National Wild Turkey Federation. Edgefield, S.C. 56 pp.

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Stoll, Jr., Robert J., W.L. Culbertson, M.W. McClain, R. W. Donohoe, and G. Honchul. 1999. Effects of clearcutting on ruffed grouse in Ohio's oak-hickory forests. Ohio Fish and Wildlife Report 14. Division of Wildlife, Ohio Department of Natural Resources. Waterloo Wildlife Research Station, New Marshfield, OH. 27 pp.

Thompson, Frank R., III and Daniel R. Dessecker. 1997. Management of early-successional communities in central hardwood forests: with emphasis on the ecology and management of oaks, ruffed grouse and forest songbirds. General Technical Report NC-195, USDA Forest Service, North Central Forest Experiment Station, St. Paul, MN. 33p.

Biography

Gary M. Foster currently serves as a District Wildlife Biologist for the West Virginia Department of Natural Resources (WVDNR), Wildlife Resources Section based out of Farmington, West Virginia. In addition, he serves on the Northeast Upland Habitat Technical Committee and as the WVDNR's Farm Bill Coordinator.

Table 1. Summary of timber harvests conducted on the Grouse Management Area, Monongahela National Forest, West Virginia (1985-1999).

Year Harvested	Total # of Acres	Total # of Stands	Harvest Method
1985-1989	57	11	Clearcut
1990-1994	148	17	Clearcut
1995-1999	204	20	Clearcut
Total	409[a]	48	Clearcut

[a]Represents 23.5% of the GMA cutover between 1985-1999.

Chapter 11 C. Case Study: Massachusetts Woodlands Cooperative: A New Tool for Landscape Planning and Management

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"The most important objective for my property is wildlife." Sound familiar? Wildlife is very often the objective given by landowners thinking about active forest management. Many people don't have a particular wildlife species in mind; they just want to see more wildlife and know that they are managing their property in a way that benefits wildlife. In Massachusetts, like most of the Northeast, properties are becoming smaller and smaller and changing hands more frequently. People don't own enough property to provide all of the habitat required for most species. It is becoming more important every day to look beyond our "stone walls" and develop tools that give landowners the ability to see their property as a part of a larger whole.

A group of like-minded landowners in Massachusetts got together in 1999 to share their forest management goals, as well as their common concerns. They decided to organize, since there is strength and opportunity in numbers. In the summer of 2001, they formally organized as the Massachusetts Woodlands Cooperative (MWC). This case study describes the MWC and how their cooperative efforts are turning into increased management opportunities and impacts, and particularly, how one MWC landowner is creating early-successional habitat to increase the habitat diversity of his landscape.

The landscape

The MWC concentrates its efforts in western Massachusetts, with most of its membership concentrated in the Westfield River watershed, located in the foothills of the Berkshires. Over 90% of the watershed is forested. Eighty percent of those forests are owned by what forestry professionals call

"non-industrial, private forest owners", or NIPFs which is, of course, a complicated way of saying the forests of western Massachusetts are owned by individuals and families. With the amount of attention paid to publicly owned land, such as state forests, you may think that successful forest management is in the hands of state foresters. It's not. Ultimately, the health of many of our forests, the quality of our water, and the diversity of our wildlife species is in the hands of what I call the 'other 80%'…. that's right - you!

Like much of the Northeast, our forests in the Westfield watershed are very similar in size, age, and species composition. This is due to the fact that our forests were established at relatively the same time in the early 1900s, after the clearing of the "old-field" white pine forest that established post-farm abandonment. The result is heavy forest cover that is very uniform. This is good news if you are a species that likes predominantly maturing forests, and we are seeing the return of many forest species such as bobcat, fisher, scarlet tanager, and thrushes. This is bad news if you are one of the many species that use early-successional habitat including farm fields, meadows, and young forests. These species include songbirds such as golden-winged warblers and eastern towhees as well as New England cottontails, ruffed grouse, American woodcock, and a variety of butterflies.

New tools

The MWC is a forest-landowner management, processing, and marketing cooperative organized by and on behalf of forest landowners in western Massachusetts. The MWC mission is to maintain the environment and character of western Massachusetts through the protection, enhancement, and careful economic development of one of the region's most plentiful resources, the forest. The cooperative gives

landowners access to information, technology, expertise, and management options that private landowners by themselves simply cannot obtain.

MWC is developing a computerized Geographic Information System (GIS) with a relational database. The GIS system allows for the mapping of property lines and significant property features, such as wetlands or fields, by downloading hand held Global Positioning System readings into the GIS and then transferring them onto a map. The map gives landowners a sense of their property's spatial relationship with other properties, both public and private. The database is being built to store information from the MWC members' forest management plans (i.e., what types, sizes, and amounts of trees are on the property as well as any other significant resource areas such as wetlands and streams). When all of this information is put together for all of the MWC properties, it will be possible to assess the location of forest types and their structure, and to consider management opportunities. For example, if a particular landscape was predominantly mature forest, then diversifying the habitat type would include creating more early-successional habitat. Determining that a seven-acre stand of sapling hardwoods abuts a six-acre hay field becomes a management opportunity because the sizes of the trees are small enough to be mechanically removed and, together, the two areas (the sapling stand and the hay field) create a significant area, 13 acres worth, of early-successional habitat. The more landowners that join, the more information the GIS database holds, the more informed the management decisions.

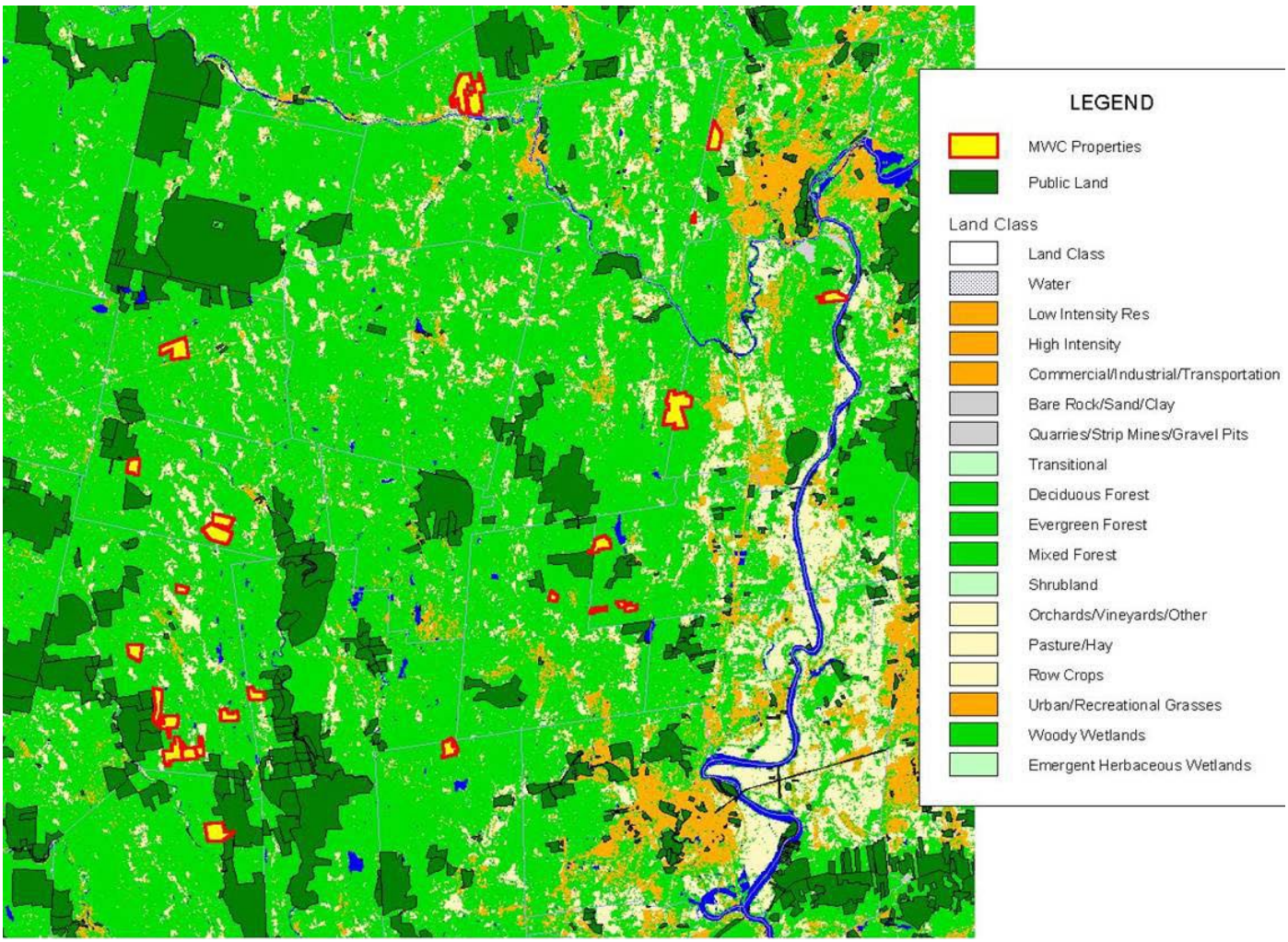

Figure 1. GIS map of western Massachusetts, highlighting the location of current MWC member property locations.

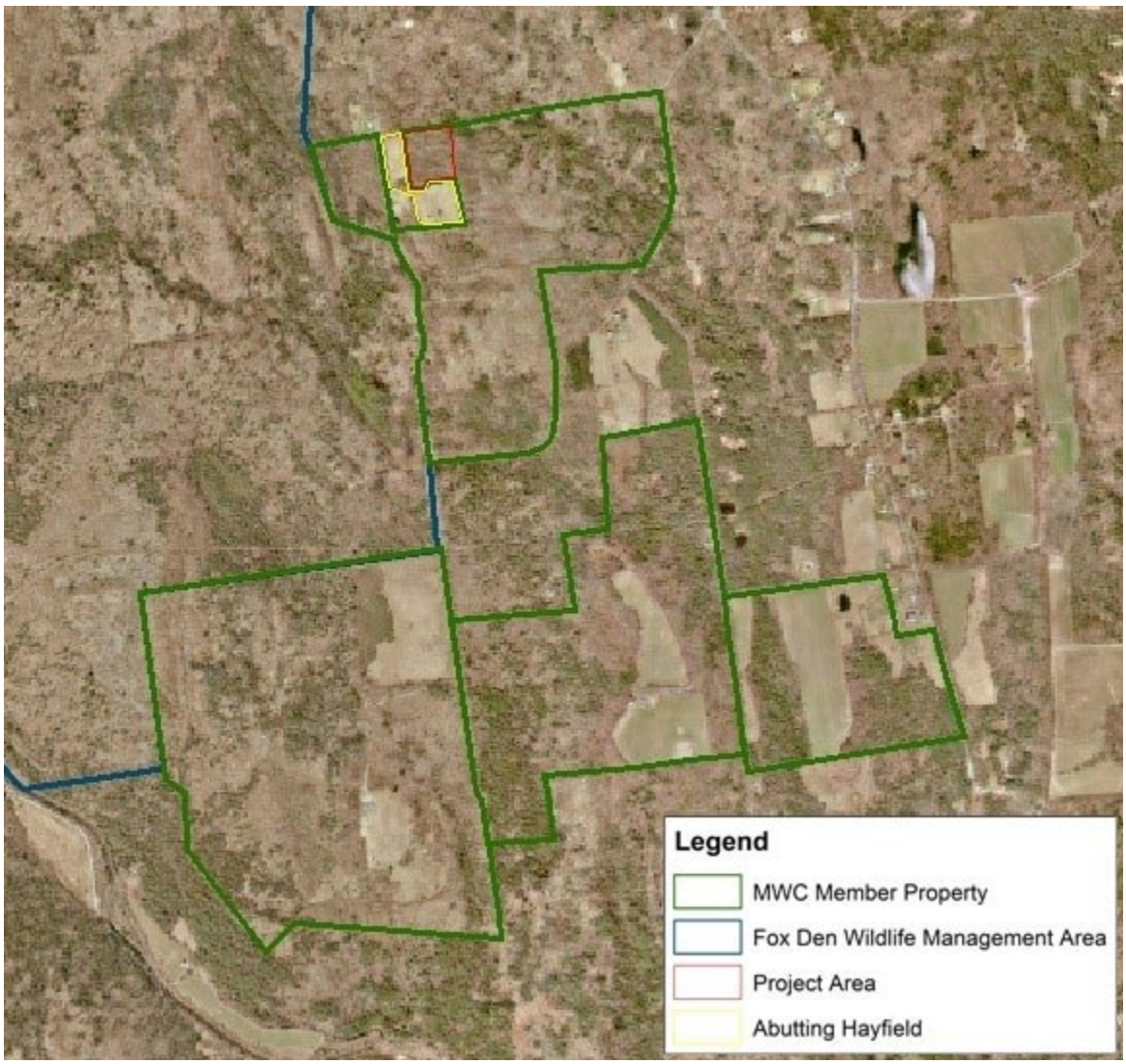

Figure 2. GIS map of the subject MWC landowner cluster, over a digital orthophoto layer. The map helps identify the opportunity for habitat management based on the relationship of the poor quality pole stand to the abutting hayfield.

The Westfield River watershed is dominated by forests with very similar species composition and structure, and therefore, very similar habitat types. For those landowners interested in wildlife management, helping to diversify this very homogenous landscape can have a significant beneficial impact. Diversifying habitat types often means creating very mature forests, creating early-successional habitats by reclaiming old fields that have recently grown in, or creating seedling/shrub habitat through forest management. To do these things effectively it is important to look at the landscape context in which the property lies. What types of trees or vegetation do you have on your property? How big are the trees? Are there invasive/exotics nearby (see chapter 8)? How can you make the work a financial reality? Are there other early-successional habitats on your property or nearby (e.g., say within 1/2 mile) such as hay fields, orchards, non-forested wetlands, or shrublands? Are there any very mature stands of trees nearby? Habitat patch value often can be increased if the patch is extended onto neighboring lands or if additional patches are created nearby. What are your neighbor's objectives? If your neighbor is a public entity, what are they planning to do?

Although certainly not the only way to make management decisions, the GIS database will provide MWC landowners and their resource professionals the opportunity to efficiently access vegetative and other types of information for their land and surrounding properties. Access to this information increases the effectiveness of the decision-making process by providing the information needed to evaluate where a management practice should be implemented to have the greatest value for wildlife.

Do you need a GIS database to make sound management decisions for your property? Not necessarily. The concept that MWC hopes to apply through the GIS database system can still be applied without the technology. The idea is the same. Take a look at your property, consider it in the context of the surrounding landscape, and talk to your neighbors to find out what resources and management objectives they have. Although the "old-fashioned" way may not be as efficient, it can be equally effective on the ground and it is on-the-ground management that ultimately matters. The old-fashioned way may also have the added benefit of connecting or reconnecting you with your neighbors. Reconnecting this patchwork of properties is what it is all about, ecologically and even socially. Below is a case study that shows how one member of the MWC reconnected his landscape, with the help of a professional forester, by looking at his property as a part of the whole.

On the ground

One MWC member owns 327 acres. The property is a mix of forest types typical for the Westfield watershed: northern hardwoods, hemlock, and white pine. There are a couple of perennial streams that flow through the property. The landowner has been involved with active forest management for ten years; ranging from timber stand improvement to selection system harvests that maintain the most vigorous trees in all age classes to wildlife clearings. Around the landowner's home are 20 acres of fields that are mowed annually for hay. In his management plan, the landowner described his objectives as follows:

- Maintain and/or improve aesthetics and recreational access to the property.
- Maintain or enhance the property's value as wildlife habitat.
- Increase forest productivity by improving stand quality and increasing growth rates.
- Generate revenue from occasional sales of forest products to fund some or all of the carrying costs of the property.
- Provide local employment by using/harvesting natural resources on the property in a small-scale, sustainable way.

The entire property is under the state's Current Use Forest Tax Program, which reduces local property taxes in exchange for long-term, sustainable forest management. Approximately half of the property is permanently protected from development through a conservation easement with a local land trust that encourages long-term forest management. This easement allows the landowner to own the land, but forbids him, according to the terms of the easement, to develop it. Easement terms vary and can be customized to meet the needs of the owner. Even if the land is sold, the terms of the easement stay with the land. While easements diminish the value of the land, this reduction can translate into lower annual property taxes and reduced federal taxes, as well as lower inheritance taxes. Conservation easements have become a very effective tool for land conservation and estate planning. The landowner intends to put the other half of the property under conservation easement as well. If you're interested in learning more about conservation easements, contact your local land trust or state environmental agency.

The 327-acre parcel is located in a rural, largely forested area. The property is abutted by private landowners, two of whom also have conservation easements, and by a portion of the 3,000-acre Hiram Fox Wildlife Management Area (WMA) (see Figure 2). The remainder of the WMA lies a short distance away, across a small dirt road. The WMA is managed by the Massachusetts Division of Fisheries and Wildlife. The most recent management activities on the WMA involved a 50-acre cut designed to mimic a natural disturbance. Only 10 to 12 wildlife trees per acre were retained.

The landowner hired a consulting forester and professional wildlife biologist to help him achieve his management objectives. The advantages of hiring professionals are many. They have the technical expertise to develop management plans, to represent the landowner when it is time to implement the plans to ensure that quality work is done at a fair price, and to help the landowner find reputable timber harvest operators and write strong contracts to protect a landowner and ensure goal achievement.

The forester developed a forest management plan that outlined a tree harvest strategy designed to meet landowner objectives while the professional wildlife biologist developed a wildlife management plan. The wildlife management plan and the forest management plan showed a lot of overlap in recommendations for wildlife habitat. Both agreed that creating more early-successional habitat in the form of young, seedling/sapling forest would help the landowner reach his goal of enhancing wildlife habitat.

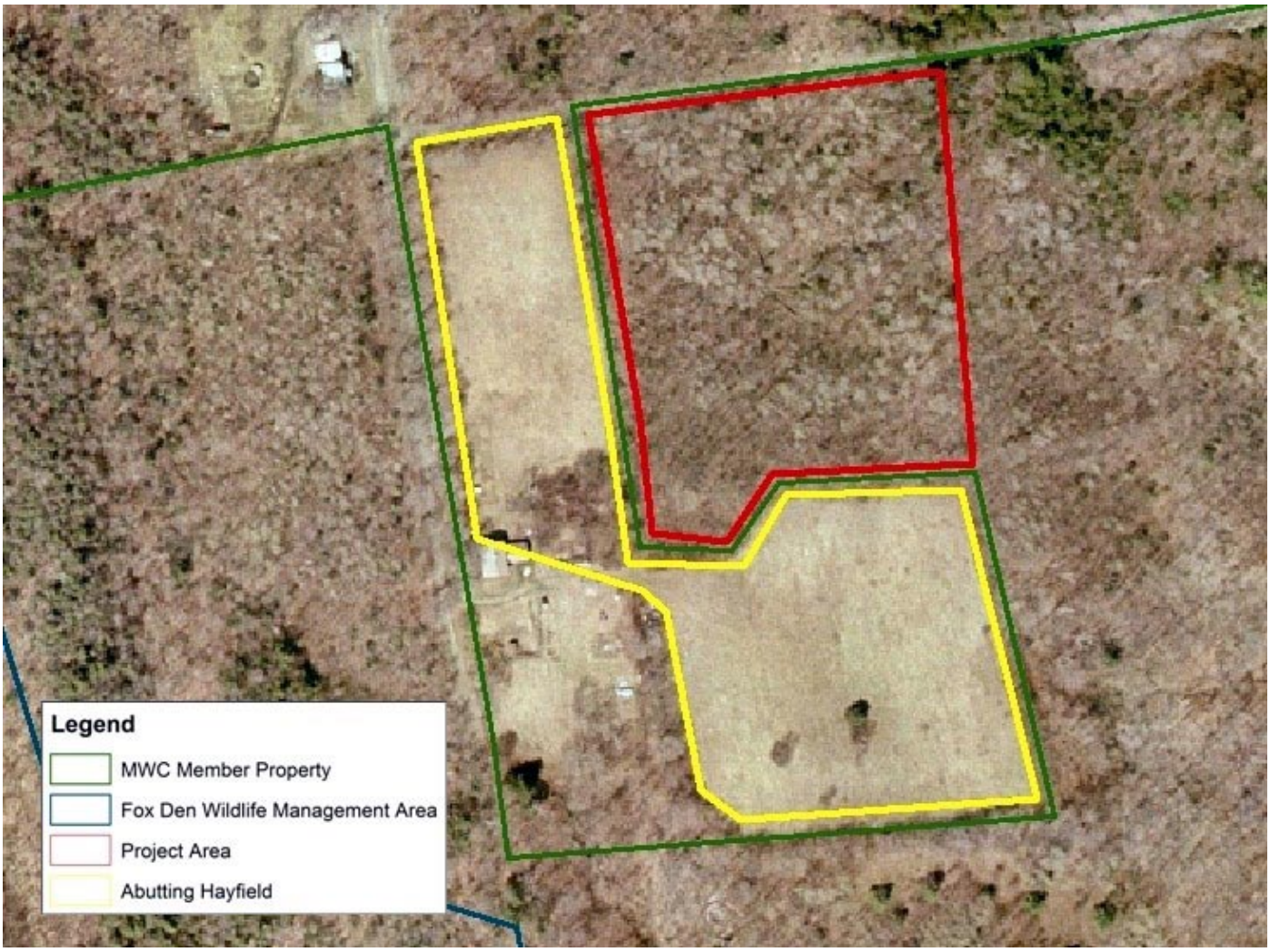

Figure 3. Close-up GIS map of the project area over a digital orthophoto layer, noting the case study area and abutting hay field.

Figure 4. Picture of the project area pre-treatment.

Figure 5. "Looking Beyond Our Stone Walls". Relationship of treatment area to field on abutting property.

The stand chosen for the project was an eight-acre area of low-value pioneer species, mostly aspen. Located in the very northwest corner of the property, the stand abuts a neighbor's hay field. The consulting forester's intent was not necessarily to attract a particular species of wildlife, but manage to reach an overall landscape target of 10 to 15% early-successional habitat to maximize wildlife diversity. The desire was to create early-successional seedling/sapling habitat by cutting almost everything. The stand boundaries were flagged, as were the shrubs and trees to be retained for food and structure, including highbush blueberry, old apple trees, shadbush, a few elm trees, and a large white-ash tree. The forester also assisted with applying for cost-sharing through the Natural Resource Conservation Service's (NRCS) Wildlife Habitat Improvement Program (WHIP) and the U.S. Forest Service Forest Stewardship Incentive Program (SIP; renamed to Forestland Enhancement Program: Table 1). Both WHIP and SIP offer cost-share opportunities for wildlife habitat work on private land. Refer to chapter 12 for more information on these and other cost-share programs.

Public money is used on private land since tremendous public benefit flows from private forests, such as wildlife and clean water. Management on private land is essential to maximizing the benefit from our forests. In addition, since it is cost-shared, the limited amount of both public and private money can be stretched to do more work.

Once the job was set up and cost-share secured, the forester then contracted with an experienced operator to implement the harvest. The machine that was used is called a feller buncher, a tool similar to an excavator, but with a head on the boom that holds the tree, cuts it from the stump, then lays it on the ground. The feller buncher operator was able to cut approximately 2 1/2 acres a day. Since there was no merchantable value in the trees being cut and since chipping or hauling the material off-site would have been very costly, a decision was made to pile the slash. The piles were large, 25 feet high in some cases. The piles of slash also serve to act as potential den sites for black bears.

Figure 6. Feller-Buncher used in the treatment.

The location of the area (e.g., close to hay fields and open fields with old apple trees), coupled with the heavy, 50-acre cut on the nearby WMA enhanced the habitat value of the treatment because additional early-successional habitat was created within a relatively homogenous landscape. The site's size (eight acres), poor species composition, poor quality (no loss in value from harvesting trees before maturity), and accessibility from the road (easier to get machinery to site) all made this a prime area to target for treatment. The goal of creating young, seedling/sapling forest was reached and the area is now valuable early-successional habitat in a mostly mature forested landscape. There are no formal plans to monitor the site, however the area is regularly monitored informally by the landowner and his neighbors while hiking a trail that runs through the opening.

Figure 7. Project area immediately following treatment.

Figure 8. Project area one growing season after treatment. Note the 4-foot aspen sprouts.

Figure 9. Project area three growing seasons after the treatment showing eight- to ten-foot aspen and the landowner's trail through the treated area.

A word of warning, however: this treatment was a drastic change. The roadside location of the harvest combined with the very large brush piles created quite a stir at the local coffee shop. A concerned neighbor also called the police. I was questioned about its value by a town official. The landowner and the forester posted an informational sign acknowledging both WHIP and SIP and discussing the importance of this type of work. They also offered a workshop on forest management and wildlife habitat as a way of educating other landowners and neighbors on the importance of private land management. The educational effort paid off. When people were told about the importance of this type of habitat, which is often scarce in our predominantly forested landscapes, they responded favorably to the landowner's efforts to create more.

Conclusion

Three hundred acres is a large ownership for Massachusetts, but relatively speaking, it is just a small fraction of the landscape in which it sits. To improve wildlife habitat, landowners should begin looking across their stonewalls or property boundaries. Considering the placement of a property within a landscape can give a management activity more impact. This case study property is "sandwiched" between two other members of the Massachusetts Woodlands Cooperative. To the northwest of the property is the WMA (see Figure 2). In total the four properties contain 3,728 acres. Taken together, these properties have enough acreage to affect wildlife at the landscape level.

Simply talking about management objectives with neighbors can often provide information to help make better management decisions. Will your neighbor (either public or private) be harvesting in the near future? If yes, can you coordinate to help one another, such as each landowner placing five-acre patches close to the property line to create ten acres of habitat? If no, you now know that their property will continue to fill a particular niche in the landscape, perhaps a mature, even-aged northern hardwood forest. Diversifying habitat would then mean creating something different, such as early-successional habitat. Communicating and working together with neighbors, whether they are public, private or both, can help increase the effectiveness of your management plan and impact the larger landscape in a greater, more efficient way.

Working with neighbors can be done as informally as talking over a cup of coffee at a kitchen table or as formally as joining a group like the Massachusetts Woodlands Cooperative. As technology evolves, planning management activities with a landscape perspective becomes easier. Making these technological wonders available to landowners and professional resource managers can be difficult because of the expense and the time required to learn it. An organization such as the Massachusetts Woodlands Cooperative can provide the mechanism for technology transfer. Through economies of scale, it is hoped that the cooperative will be able to provide its members and their resource managers more information to make better-informed decisions, which will ultimately have a greater effect on the landscape in a more efficient way. Exploring new ways, or re-exploring the old ways in which landowners talk and work together will only become more important as properties continue to break into smaller pieces, while the burden of providing the public benefit of wildlife increases.

Biography

Paul Catanzaro is the Extension Forestry Specialist for the University of Massachusetts at Amherst in the Department of Natural Resources Conservation. He was one of the innovators of the Massachusetts Woodlands Cooperative and has been instrumental in helping the MWC create a group certification model to achieve FSC Green Certification.

Table 1. Project and landowner costs for an 8-acre early-successional habitat opening, Westfield River watershed, Massachusetts.

Costs	
Clearing 8 acres:	$5,600
Consulting forester:	$1,120
Total project cost:	$6,720
Reimbursements	
WHIP cost-share (75%):	$5,040
SIP cost-share:	$1,222
Total reimbursements:	$6,262
Total landowner contribution:	$458

Chapter 11 D. Case Study: Quail and Cottontail Management on Buck Range Farm, Maryland

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Introduction

Most young hunters would love to see what it was like in the "good-old-days", to experience the days afield that they hear their fathers and grandfathers telling stories about. Likewise, the older generations, the ones that tell the stories, would love to re-live the experiences that live vividly in their memories. On the Eastern Shore of Maryland, most story-telling sessions turn to the 1950s and 60s, when wildlife was plentiful. It was a time when waterfowl hunting on the Chesapeake Bay was a way of life and every respectable hunter had a good bird-dog. Unfortunately, the good-old-days are just a memory for most. Waterfowl populations have suffered with increased pollution of the bay, and bobwhite quail have declined over 90% since the 1960s due to changing land uses.

Figure 1. A hunt at Buck Range Farm is like going back in time to the "good-old-days." Photo by Maryland Department of Natural Resources.

Spending a day on Buck Range Farm in Dorchester County, Maryland is like stepping back in time. On a recent hunt, the farm manager, Don Webster, invited me on a combination duck, goose, and bobwhite hunt. At dawn, the wings of mallards and pintails whistled over our heads, followed by numerous flurries of ducks and geese set to land in front of our blind. After our successful morning hunt, we followed Don's English setter as she halted to a point several times, resulting in five quail covey flushes in two hours. It was an amazing day afield, not only because of the fantastic hunting, but also because I realized that if landowners are willing, the "good-old-days" can be found in the present. The key is found in successful early-successional habitat management.

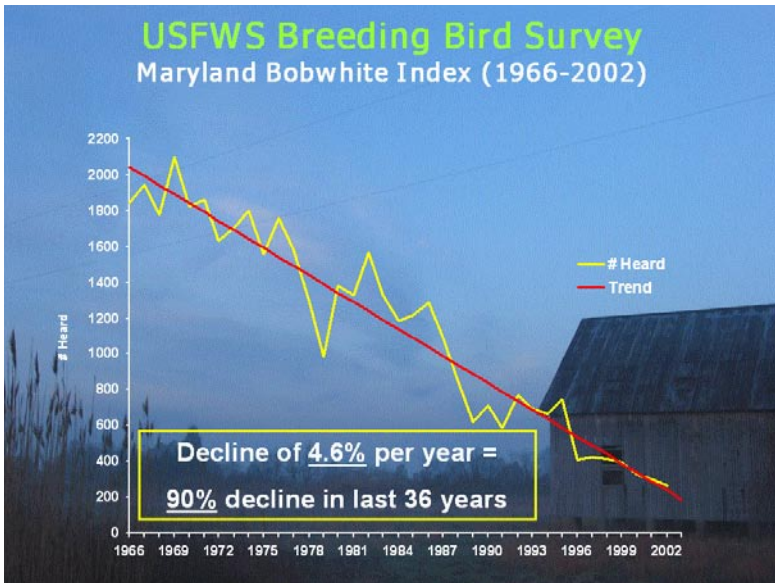

Figure 2. Northern bobwhite has declined over 90% since the 1960s due to changing land uses.

Landowner objectives

Not unlike many properties located throughout the Northeast, Buck Range Farm is managed with several landowner objectives in mind. Originally a dairy farm, most of the fields and pastures were converted to row crops before the current landowner purchased the property in 1978 for its waterfowl hunting potential. In 1987, intensive upland habitat modifications for bobwhite quail were incorporated into the management scheme. The landowner empowered the farm manager to perform any tasks necessary to accomplish the general goals of providing upland game and waterfowl habitat, creating diverse hunting opportunities, and offsetting costs through timber and cropland management when possible. These goals have been met to a large extent and habitat quality has been significantly improved for an array of early-successional wildlife species. Most habitat management practices were implemented with common farm tools and machinery, making the methods described here applicable to many similar farms in the Northeast.

Situation

The 350-acre Buck Range Farm is located in Dorchester County on Maryland's Eastern Shore. Situated on a peninsula of land adjacent to a Chesapeake Bay tributary, it is typical of many coastal plain farms in the Mid-Atlantic region. Currently, there are approximately 150 acres of agricultural land, 120 acres of loblolly pine forest with mixed hardwoods, 70 acres of tidal wetlands, and 20 acres of managed freshwater impoundments. A variety of soil types occur on the property, most are silty-clay in nature. Due to the low elevation and level topography, the soil in many areas of the farm is saturated during periods of heavy rainfall.

At the landscape level, the diversity of habitats creates ideal conditions to manage for a variety of upland and waterfowl species. Row cropland is abundant on most farms in the area, and forestland is primarily loblolly pine plantations. Hardwoods such as oak, hickory, and black cherry are present in some areas, particularly along riparian drainages. Brushy hedgerows, although abundant on Buck Range Farm, are not common on many of the surrounding farms.

Early-successional habitat management prescriptions

Initially, the farm manager identified a need to alter the management of woodlands and cropland to provide for the needs of bobwhite quail. This involved intensive land-use changes as well as an increase in frequency of maintenance practices that keep the habitat in early-successional stages. Below is a more detailed description of the common practices utilized on the farm in various situations to enhance wildlife habitat.

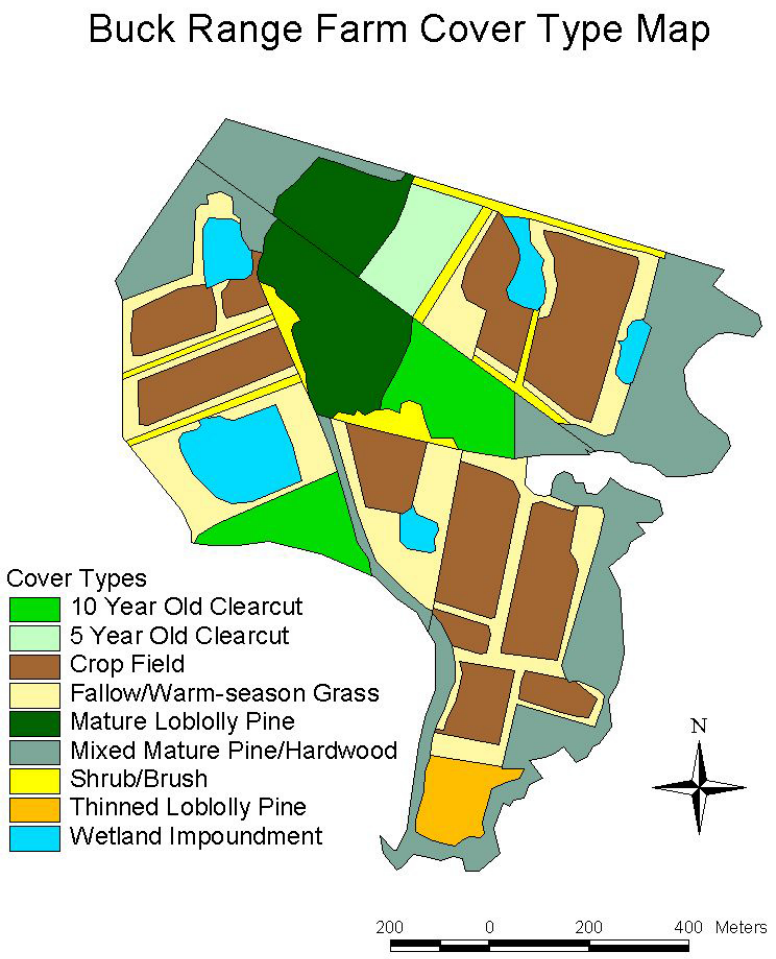

Figure 3. A cover type map provides a good view of the lay of the land at Buck Range Farm.

Forestland management

A large portion of the pine forests on Buck Range Farm have been either commercially harvested using clearcuts or non-commercially thinned. Both practices have been successful in increasing habitat quality for early-successional species. Two recent clearcuts totaling about 40 acres produced high-quality habitat for quail for five to eight years while providing additional income from timber sales (see cover type map). Perhaps more beneficial and visually attractive was the thinning of about ten acres of loblolly pines. Approximately 70% of the pines were cut and piled in windrows. The additional sunlight encouraged an understory of native grasses and forbs to revegetate, creating ideal food and cover for bobwhites while the windrows provided the benefit of additional escape cover for quail and cottontails. Korean lespedeza is often sown where tree thinnings have occurred to offer winter food and spring nesting areas for quail. Prescribed fires are used every three to five years in February or March to control common volunteer species such as sweetgum and oak, while the overstory pines are left alive. The burning rejuvenates the site, producing lush herbaceous growth at ground level. Refer to the prescribed burning section of chapter 10 for more details on the use of fire to enhance habitat.

Figure 4. This previously loblolly pine forest of Buck Range Farm was thinned heavily one year before the photo was taken. A lush understory of native plants has been established, providing ideal habitat for a variety of early-successional species. Photo by Bob Long.

Shrubs and hedgerows

Central to the management of Buck Range Farm is the development of permanent shrubby cover for quail and cottontails. It is the farm manager's belief, one that comes from 30 years of experience, that quail have vanished from most farms due to the lack of thick escape cover. As farming practices became more efficient, hedgerows were removed and "odd areas" around fields were cleared of brushy vegetation. Shrub establishment on Buck Range Farm was a simple process. Certain areas in and around the field borders and hedgerow corridors were simply left to grow up, producing a diversity of shrub species such as red cedar, wax-myrtle, and others. However, some of the best hedgerows were "grown" with the aid of a single strand of barbed wire and fence-posts. These fence lines offer perching sites for songbirds, whose droppings often include fruit-producing shrub seeds. The result is the creation of a high-quality hedgerow in five to ten years. Shrub areas and hedgerows are periodically disturbed with a disk or bulldozer when the shrub cover becomes too mature or hardwoods invade the site. The rule-of-thumb followed is "if it looks too big to run over with a tractor, knock it down anyway."

Field borders

Herbaceous field borders surround virtually all crop fields. Most of the borders are situated between forest and cropland and are approximately 50 to 75 feet in width. These borders are maintained through the use of strip disking. About 15 feet of the border is disked annually in the spring to control woody growth and maintain the border in an early-successional stage. On Buck Range Farm, spring disking has been found to encourage beneficial annual seed-producing grasses and forbs such as foxtail, fall panicum, partridge-pea, and native lespedezas. Disking also develops a favorable vegetation structure, allowing quail to move about freely under the overhead cover. In 1996, about 50 acres of the existing field borders adjacent to ditches and "wet woods" were enrolled in the Conservation Reserve Enhancement Program (CREP: refer to CREP case study in this chapter for more information). An attempt to plant native warm-season grasses was made in the CREP buffers. Although big bluestem, little bluestem, and indiangrass were planted, the wet conditions during the first growing season hindered growth. Fortunately, native broomsedge and switchgrass invaded the area within a year and the resulting diverse mixture of grasses, forbs, and legumes produced high-quality nesting and brood habitat for quail. Cottontails benefit greatly from the native grasses and forbs, which provide food and cover year-round. The proximity of field borders to shrub and cropland habitats provides important edge habitat used by a variety of species.

Cropland

Cropping is an important component of the Buck Range Farm management regime, both to provide food and cover for wildlife as well as farm income. Corn, soybeans, or sorghum is planted annually on the 85 acres of existing cropland, with minimal use of pesticides and herbicides. Cropland is only tilled one out of four years, with no-till planting methods used the remainder of the time. Although cropland is primarily managed as a wintering waterfowl food source, the proximity and arrangement of crop fields to other habitat types, such as field borders and hedgerows, create favorable conditions for bobwhite quail.

Figure 5. The proximity and arrangement of crop fields to other habitat types, such as field borders and hedgerows, creates favorable conditions for bobwhite quail. Photo by Bob Long.

Moist-soil managed impoundments

Two ten-acre impoundments were constructed in the 1990s to provide wintering waterfowl habitat. Interestingly, these areas have also been beneficial to bobwhite quail. The impoundments are drawn down in early spring to encourage annual seed-producing plants. Because the areas are essentially dry and fallow in the summer months, first year vegetation and bare ground are abundant, creating preferred bugging areas for bobwhite broods. In autumn, the impoundments are filled by natural rainfall during autumn, producing high-quality waterfowl and wading-bird habitat.

Figure 6. Waterfowl and upland habitat management can work together. Disking is used to improve habitat for thousands of ducks, geese, and wading birds, but the disk is an equally important tool for maintaining bobwhite quail habitat on Buck Range Farm. Photo by Donald Webster.

Results and wildlife response

The benefits of the intensive habitat work on Buck Range Farm are evident simply by walking around the property. In the spring, whistling bobwhites, gobbling turkeys, and an array of songbirds such as eastern meadowlarks and field sparrows can be heard everywhere. Autumn and winter are the times when the landowner's attention turns to hunting, a favorite pastime. Prior to the intensive upland habitat management, there were fewer than five bobwhite coveys on the entire farm. Covey numbers have increased over 300%; the farm now holds 15 to 20 coveys of wild bobwhites. Prolonged snow cover in the winter of 1996 temporarily reduced the number of breeding pairs, but with suitable habitat the population quickly rebounded within two years. Since that time, a typical afternoon hunt results in five to ten covey flushes. Habitat management of the wetlands also has produced desired results; harboring 500 to 1,000 puddle ducks annually, including mallards, widgeons, and pintails.

Figure 7. Bobwhite quail have disappeared from most farmed landscapes, but Buck Range Farm still harbors 15 to 20 coveys of wild quail each year. Photo by Maryland Department of Natural Resources.

Habitat management on Buck Range Farm can be considered an amazing success. Few properties in the eastern U.S. have the abundance and diversity of wildlife present on the farm. With the landowner's goals in mind, the farm manager has been instrumental in improving habitat conditions for upland game birds, grassland and forest songbirds, waterfowl, wading birds, wild turkeys and trophy white-tailed deer. Realizing the needs of the targeted species and then carefully planning the steps required to put that habitat on the ground has been vital to successful early-successional habitat management on the farm. According to the farm manager, those interested in early-successional wildlife must become "practitioners of disturbance", keeping the land in

an early stage of development that benefits many types of wildlife. Although it may be a unique situation to have the potential to manage for such a variety of species, any one of the habitat prescriptions discussed here can be successfully used on a property to improve the quality of the land for early-successional species.

Biography

Bob Long is the wild turkey and upland game bird project manager for the Maryland Department of Natural Resources. He received his B.S. in Wildlife Science at Virginia Tech in 1998. He is also working towards his M.S. in Wildlife Management from West Virginia University, conducting research with the Appalachian Cooperative Grouse Research Project.

Donald Webster is the waterfowl habitat manager for the Maryland Department of Natural Resources. He has over 30 years of experience managing upland and wetland habitats for wildlife. In his spare time, Donald manages several farms totaling about 800 acres near his home on the Eastern Shore of Maryland.

Chapter 11 E. Case Study: Pennsylvania's Conservation Reserve Enhancement Program

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Overview of Pennsylvania's CREP

Pennsylvania's Conservation Reserve Enhancement Program (CREP) is a partnership between the United States Department of Agriculture (USDA), the Pennsylvania Game Commission, the Pennsylvania Department of Environmental Protection, the Chesapeake Bay Foundation, Ducks Unlimited and many additional state agencies and non-governmental organizations. The Pennsylvania CREP partnership is working with agricultural producers and rural landowners to reduce erosion entering into the Chesapeake Bay by more than 14 million tons, reduce sediment loading by 193,000 tons, and nitrogen and phosphorus loading by more than 26 million pounds per year. The goal is to enroll 265,000 acres of highly erodible cropland and streamside cropland or pastureland into this 10- to 15-year program, plant the areas in native hardwood trees or perennial herbs and grasses, and restore riparian forest buffers that will filter sediment and nutrients from runoff water and provide wildlife habitat.

The CREP is a voluntary program available to landowners in 59 Pennsylvania counties located within the Chesapeake Bay and Ohio River watersheds. Among other things, the goals of CREP are to:

- Restore and enhance riparian habitat corridors next to streams and wetlands by enrolling at least 45,000 acres of buffers, grass filter strips and wetlands; and
- Restore and enhance grassland habitats for declining grassland-dependent wildlife and improve water quality by enrolling 220,000 acres of highly erodible cropland in conservation cover plantings.

To participate in CREP, landowners enter into 10 to 15 year contracts with the USDA, agreeing to establish and then maintain conservation practices for the life of the contract. Landowners receive technical assistance, a conservation plan for their land, financial assistance to pay for installation of the conservation practices, and annual rental payments. They also may receive a one-time incentive payment for choosing high-priority conservation practices such as forested riparian buffers, grass filter strips adjacent to streams, wetland restorations, and grassed waterways.

Eligible land includes highly erodible cropland that meets cropping history requirements (defined by USDA) and land within 180 feet of a stream. The type of land enrolled in CREP varies greatly from farm to farm. Active farmers often continue to farm their most productive land and enroll buffers along streams and marginal land, such as steep slopes and droughty soils. If needed, they may also choose to install grassed waterways or contour buffer strips in crop fields. Other farmers and rural landowners may enroll all of their eligible fields. Let's take a closer look at how CREP works, by visiting a couple of farms in central Pennsylvania that have enrolled in the program.

Case study – southeastern Northumberland County farm

This farm is located in a scenic, rural setting in southern Northumberland County. The farm consists of 400 acres in two parcels about one mile apart. Most of the acreage is in cropland and pasture. The balance is either forestland or in small woodlots and hedgerows scattered throughout the crop fields. The farm operation includes cash-grain crops (mainly corn and soybeans), beef, and produce. Seventy-nine acres of the farm were enrolled in CREP.

This family-owned farm was enrolled for a variety of reasons. First, the family was interested in good land stewardship. They enrolled their steepest, most erodible fields to reduce soil erosion and agricultural runoff and to minimize the use of farm equipment on the steep slopes. They enrolled the land adjacent to the stream that flows through their pasture to fence the livestock out of the stream thereby protecting the health of both the livestock and the stream. Crop fields adjacent to a forested ridge north of the farm were enrolled because crop damage from wildlife was consistently high. Other fields which produce inconsistent crop yields were enrolled as grass filter strips to buffer adjacent streams. In active crop fields where erosion problems occurred, critical areas were enrolled and grassed waterways were constructed.

Surrounding area

The majority of the land in the surrounding area is agricultural. Generally speaking, agriculture occurs in valleys that are divided by forested ridge tops and hillsides. The habitat types in the landscape surrounding this farm include crop fields, hay fields, livestock pastures, small scrub-shrub areas usually adjacent to low-lying wet meadows, seeps, and small streams. An oak-hickory forested ridge borders the farm to the north. A portion of the top of the ridge is owned and managed by the Pennsylvania Game Commission as a State Game Land. Small woodlots and hedgerows are interspersed within crop fields. Forested and brushy riparian zones are common.

Figure 1. The farm.

Figure 2. The surrounding countryside.

Implemented practices

The conservation practices implemented using CREP included planting a 3.5-acre forested riparian buffer in the pasture coupled with the installation of stream-bank fencing and two livestock crossings. Native hardwood trees and shrubs with wildlife benefits were planted in the buffer area. Other implemented practices included planting grassed waterways in crop fields, cool-season grass filter strips along streams, and cool-season grass fields on highly erodible cropland. All fields enrolled in CREP were planted to a perennial cool-season grass and legume mix containing timothy, orchard grass, red clover, and alsike clover. Tables 1 and 2 provide examples of the level of financial assistance provided for implementing these types of practices.

Figure 3. Planted riparian buffer.

Wildlife benefits

The CREP fields planted to grass and clover are fragmented and small. Field size is between 1.0 and 17.5 acres with an average of 4.1 acres. Although these grass fields may be too small to provide nest sites for most grassland bird species there will be increased opportunities for turkeys and quail to nest and forage for insects. Field and song sparrows, gray catbirds, eastern kingbirds, and cottontails will use the hedgerows between the fields. These same species plus common yellowthroats and willow flycatchers likely will use the newly planted riparian buffer once it becomes well established. Many of these species have experienced population declines in the region primarily because of a lack of habitat. The riparian buffer habitat, although narrow (70 feet wide), will also help to improve water quality, which will benefit the aquatic species found in the stream.

The farm acreage currently enrolled in CREP may or may not be returned to agricultural use after the contract expires (ten years). This depends largely on the owner's long-term plans and if programs such as CREP that provide technical and financial assistance to maintain land in conservation cover exist into the future.

Case study – southwestern Northumberland County farm

This farm is located in a scenic, rural setting on the border of Northumberland and Dauphin Counties. The farm is approximately 102 acres in size with most of the acreage in cropland. The owner used to farm the fields himself but started renting them to his neighbor a few years ago. The neighbor planted the fields mainly in corn and soybeans. The remainder of the farm is forestland and riparian areas dominated by a variety of grasses. Some of the riparian areas were once used for pasture and hay. The farm includes an approximately 1/2-mile stretch of a fifth order stream that drains into the Susquehanna River. Sixty-seven acres of the farm were enrolled in CREP.

The farmland was enrolled in CREP to improve the overall wildlife habitat. The owner is particularly interested in providing habitat for grassland birds such as ring-necked pheasants and eastern meadowlarks, which were present when he was a child growing up on the farm. He is also interested in providing habitat for cottontails and white-tailed deer. The owner is an avid sportsman who would also like to improve hunting and fishing opportunities on his land. He is committed to being a responsible steward of the land and wishes to reduce soil erosion and agricultural runoff to improve water quality in the streams that flow through his property. The owner had already begun establishing wildlife habitat on his land by planting warm-season grasses and evergreen trees. The opportunity to receive financial assistance, making it possible to establish larger areas of wildlife habitat at one time, was a big incentive.

Surrounding area

The area surrounding this farm is very similar to that surrounding the southeastern Northumberland County farm described earlier; farmed valleys divided by expanses of forested ridgetops and hillsides. An oak-hickory forested ridge borders this farm to the south. A unique feature in the landscape is an adjacent farming operation of over 1,000 acres that includes a cash-grain operation and a pheasant-hunting preserve. Numerous small (one to three acres), warm-season grass and sorghum fields are planted for hunting on the preserve.

Implemented practices

The CREP conservation practices implemented on the farm included planting 13 acres of forested riparian buffers in two locations. One of the buffers is 180 feet wide on both sides of a small (first order) stream. The second buffer is 180 feet wide and is located on one side of the fifth order stream (there is an existing forested riparian buffer on the other side). Both of the new riparian buffers were planted in native hardwood trees and shrubs such as white oak and silky dogwood, which are beneficial to wildlife. A few groups of four to five evergreen trees were planted as well.

Warm-season grasses with 15-foot wide cool-season grass and legume borders were planted in three fields totaling 54 acres (10, 16, and 28 acres each). Two, 1/2-acre food plots adjacent to the grass fields are planted in corn each year. The warm-season grass fields adjacent to neighboring properties and along the road that bisects the farm contain a mix of big bluestem, indiangrass, little bluestem, sideoats grama and 15 wildflower species (most native to the area) including partridge pea (a native legume), black-eyed susan, purple coneflower, and blanketflower. The rest of the warm-season grass fields were planted in switchgrass. The cool-season grass and legume field borders were planted in timothy and ladino clover. Tables 1 - 3 provide examples of the level of financial assistance provided for implementing these types of practices.

Wildlife benefits

Certainly implementation of the CREP practices will improve the overall value of the farm as early-successional habitat. The three fields planted with warm-season grasses are 10, 16, and 28 acres in size. The 16- and 28-acre fields are separated by one of the riparian buffers, while a road separates the 16- and 10-acre fields. Given that meadowlarks can occur in both native warm-season and cool-season grass fields

and generally require fields of 10 to 15 acres and larger, it is plausible that the landowner will get his wish of being able to watch meadowlarks in his farm fields like he did when he was growing up. Henslow's and vesper sparrows, as well as bobwhite quail, all of which have experienced population declines in the region, may also benefit.

The 15-foot wide strips of cool-season grasses and legumes and 1/2-acre food plots planted along the edges of the warm-season grass fields will provide turkey, quail, and pheasant nesting and foraging opportunities. The food plots will also provide foraging opportunities for white-tailed deer.

The wide riparian buffers may provide additional habitat for common yellowthroats, willow flycatchers, and yellow warblers, among other songbirds. The riparian buffers will also help reduce soil erosion and runoff from adjacent steep slopes, thereby improving water quality and habitat for aquatic organisms in the streams. Streams with good water quality adjacent to farmland also provide excellent habitat for wood turtles and a variety of dragonflies.

The forested riparian buffers will likely be maintained after the CREP contracts expire. The grass fields currently enrolled in CREP may or may not be returned to agricultural use after the CREP contracts are complete (ten years). As in the case of the Southeastern Northumberland County farm, this depends largely on the owner's long-term plans and if programs such as CREP exist into the future that provide technical and financial assistance to maintain land in conservation cover.

Eight of the 13 states covered by this manual (DE, MD, NJ, NY, PA, VA, VT, and WV), and the District of Columbia have CREP programs. To find out how to enroll your farmland, contact the USDA Farm Service Agency office in your state (Appendix A).

Biographies

Colleen DeLong is a biologist with the Natural Resources Conservation Service and the Pennsylvania Game Commission. She helps farmland owners and operators enroll land in USDA Farm Bill programs, especially Pennsylvania CREP. She has been helping private landowners manage their forest and farmland habitat since 1992. She received her M.S. in Ecology from The Pennsylvania State University.

Jeff Finn is a biologist with the Natural Resources Conservation Service and the Pennsylvania Game Commission. Jeff has been helping landowners in Ohio and Pennsylvania establish wildlife habitat and conservation practices through the CREP program since 2000. He received his B.A. in Environmental Studies from Ohio Wesleyan University and an A.A.S. in Fish and Wildlife Management from Hocking College.

Table 1. Example of financial assistance provided for ten acres of cool-season grass planting.

Seed	
Timothy (6 lbs/acres @ $1.25/lb.)	$75.00
Red clover (4 lbs/acre x $1.00/lb)	$40.00
CREP share (100%)	$115.00
Fertilizer	
150 lbs based on soil test @ $170.00/ton	$127.50
CREP share (50%)	$63.75
Fertilizer Application	
$3.50/acre	$35.00
CREP share (100%)	$35.00
Lime	
None required per soil test	
Site Prep and Seeding	
$15.00/acre	$150.00
CREP share (100%)	$150.00
Total Assistance	**$364.00**

Table 2. Example of financial assistance provided for ten acres of native warm-season grass planting.

Seed	
Big bluestem (4 lbs/acre @ $10.00/lb)	$400.00
Indiangrass (2 lbs/acre @ $14.00/lb)	$280.00
Switchgrass (2 lbs/acre @ $7.00/lb)	$140.00
Forb mix (1 lb/acre @ $26.00/lb)	$260.00
CREP share (100%)	$1,080.00
Site Prep and Seeding	
$15.00/acre	$150.00
CREP share (100%)	$150.00
Total Assistance	**$1,230.00**

Table 3. Example of financial assistance provided for a 1 acre, 50-foot wide riparian buffer planting

Fencing	
870 ft. x $1.50/foot	$1,305.00
CREP share (100%)	$1,305.00
Tree Seedlings and Accessories	
100 seedlings @ $3.00 each	$300.00
100 tubes/shelters @ $3.00 each	$300.00
100 stakes @ $1.00 each	$100.00
CREP share (100%)	$700.00
Labor	
$3.00/seedling	$300.00
CREP share (100%)	$300.00
Tree Seedling Maintenance	
Herbicide treatment @ $50/acre	$50.00
CREP share (100%)	$50.00
Total Assistance	**$2,355.00**

Chapter 12. Opportunities to Obtain Financial Assistance for Wildlife Habitat Management Projects

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While reading about many of the habitat management techniques described in this guide, you may have asked yourself once or twice, "how do they expect me to pay for this?" There are some options that can be used to reduce or entirely cover the cost of early-successional habitat management on your land:

- Use all or a portion of the proceeds obtained from a timber sale to conduct other habitat management practices. Some loggers will even trade timber for services.
- As Paul Catanzaro mentioned in his landowner cooperative case study in chapter 11, there are economies of scale. Coordinate with your neighbors on habitat management projects across parcel boundaries. Larger projects may reduce your cost/acre to implement a practice.
- Inquire about financial assistance from federal and state government agencies. A number of agencies administer conservation programs that provide technical and financial assistance to landowners to implement wildlife habitat management projects on their land. Following is a description of a number of these programs.

2002 Farm Bill

The U.S. Farm Bill is a collection of policies related to agriculture production and distribution that is enacted and renewed by law every four to six years. First enacted during the Depression in 1933, the Farm Bill was passed to protect farmers and stabilize rural economies by establishing minimum prices for commodities such as wheat, corn, milk, cotton, tobacco, etc. Through the years, additional policies were added to further assist in stabilizing and enhancing rural farming economies. These included credit programs to help farmers cover the cost of commodity production and programs to limit supply, thereby aiding to stabilize commodity prices.

Commodity production expansion in the 1970s and 1980s took an increasing toll on land, water, and wildlife habitat resources. As such, Congress installed a number of conservation programs in the 1985 Farm Bill. Many of these programs were renewed and expanded in the 2002 Farm Bill and may be an option for those landowners interested in restoring and maintaining wildlife habitat on their land. Farm Bill conservation programs are either administered by the Farm Service Agency (FSA), the Natural Resources Conservation Service (NRCS), or the U.S. Forest Service, all of which are housed within the U.S. Department of Agriculture (USDA). Following is an overview of Farm Bill conservation programs that are pertinent to wildlife habitat management.

Farm Service Agency Programs

Conservation Reserve Program: The Conservation Reserve Program (CRP) is a voluntary program that encourages cropland owners to take highly erodible farm fields out of production by providing annual rental payments based on the agriculture rental value of the land. The program also provides up to 50% cost-share assistance to establish approved conservation practices, such as warm-season grass and tree plantings, on retired fields. Participants enroll in CRP contracts for 10 to 15 years.

Conservation Reserve Enhancement Program: An offspring of CRP, the Conservation Reserve Enhancement Program (CREP) is a voluntary program for cropland owners. Like CRP, it is an agriculture

land retirement conservation program. Unlike CRP, CREP is a joint state-federal effort in which conservation goals and rental payments are set for a specific geographic area. The framework of a local CREP can be adapted to meet local conditions. For an example of what CREP may be able to do for you, read Colleen Delong and Jeffery Finn's case studies of two farms that enrolled in the Pennsylvania CREP in chapter 11.

For more information on these programs, contact your state FSA office (Appendix A) or visit the FSA Conservation programs website:http://www.fsa.usda.gov/dafp/cepd/default.htm.

Natural Resources Conservation Service Programs

Conservation of Private Grazing Land Program: The Conservation of Private Grazing Land Program (CPGL) is a voluntary program that provides technical assistance to owners and managers of private grazing land. Among other things, NRCS can provide advice on maintaining and improving private grazing land, implementing grazing technologies, protecting and improving water quality, and maintaining and improving habitat while enhancing the economic stability of the grazing land.

Grassland Reserve Program: The Grassland Reserve Program (GRP) is a voluntary program that helps landowners and operators restore and protect grassland, including rangeland, and pastureland, while maintaining the areas as active grazing lands. A landowner can opt for a permanent conservation easement where they will receive fair market value for their land minus the grazing value, a 30-year easement where the landowner will receive 30% of fair market value minus the grazing value, or a 10- to 30-year rental agreement where a landowner will receive up to 75% of the grazing value. Participants voluntarily limit future use of the land while retaining the right to conduct common grazing practices; hay production, mowing, or harvesting for seed production (subject to certain restrictions during the nesting season of bird species that are in significant decline or protected under federal or state law); conduct prescribed fires; and construct firebreaks and fences. If restoration is needed NRCS will provide up to 90% of the cost to implement restoration practices.

Environmental Quality Incentives Program: The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program that seeks to reduce non-point source pollution, reduce emissions of organic compounds that contribute to decreased air quality, reduce soil erosion, and improve habitat for at-risk wildlife species on active farmland. Farmland producers can be paid up to 75% of the cost to implement recommended conservation practices such as adding grassed waterways, filter strips, manure management facilities, and other practices. State Technical Committees establish eligible practices, criteria for project selection, and cost-share levels.

Wetlands Reserve Program: The Wetlands Reserve Program (WRP) is a voluntary program that provides technical and financial assistance to landowners to restore and protect wetlands that aid in providing wildlife habitat, improved water quality, and recreational opportunities. Eligible landowners can opt to sell a conservation easement to the USDA or enter into a ten-year contract to re-establish degraded or lost wetland habitat. In both cases the landowner still owns the land but use is restricted. With the easement option, the USDA pays 100% of the cost to restore wetlands, whereas the USDA pays up to 75% of the cost to restore wetlands with the ten-year contract option.

Wildlife Habitat Incentives Program: The Wildlife Habitat Incentives Program (WHIP) is a voluntary program that provides funding to landowners who enter into five-year, ten-year, or longer contracts to create and maintain high quality wildlife habitats that support wildlife populations of national, state, tribal, and local significance. State Technical Committees establish eligible practices, criteria for project selection, and cost-share levels. NRCS provides greater cost-share assistance to landowners who enter into 15- year and longer contracts.

For more information on these programs contact your state NRCS office (Appendix A), or visit the NRCS Conservation Programs website: www.nrcs.usda.gov/programs/farmbill/2002.

U.S. Forest Service Programs

Forestland Enhancement Program: The Forest Land Enhancement Program (FLEP) is a cost-share program that encourages the long-term sustainability of non-industrial private forestlands. It is administered by the U.S. Forest Service through the state foresters in coordination with State Forest Stewardship Coordinating Committees. The state foresters and Coordinating Committees establish program priorities, cost-share practices, and cost-share rates. Typically, a management plan is required for any property wishing to participate in FLEP, but cost-sharing is often provided for the development of a management plan. Depending on state priorities, FLEP funds may also be used to assist with the creation and maintenance of grasslands, shrublands, and young forest habitats among other things. States do not have to participate in FLEP. To find out if your state has a Forestland Enhancement Program and to find out how you can enroll, contact your state forest agency (Appendix A) or visit the FLEP website: www.fs.fed.us/spf/coop/programs/loa/flep.shtml.

Partners for Fish & Wildlife

The Partners for Fish and Wildlife Program provides up to 50% cost-share to landowners for on-the-ground projects to restore habitat for federal trust species (e.g., migratory birds, anadromous and catadromous (migratory) fish, and species federally-listed as threatened or endangered). Funding cannot be used for project planning. Types of early-successional habitat projects that have funded by this program include:

- Planting native trees and shrubs to restore riparian buffers.
- Planting native grasslands.
- Removal of exotic plants and animals that compete with native fish and wildlife and alter their natural habitats.
- Prescribed burning as a method of removing exotic species and to restore natural disturbance regimes necessary for some species survival.

For more information about this program contact your state coordinator. A listing of all Partners for Fish and Wildlife Program coordinators is available at http://partners.fws.gov/pdfs/pfwcoord-1-04.pdf.

Landowner Incentive Program

The Landowner Incentive Program (LIP) is a federal grant program administered by the U.S. Fish & Wildlife Service. State wildlife agencies compete for funds to be used to implement a program to provide technical and financial assistance for habitat projects on private lands that may support federally or state-listed species, or other species of concern. Currently, nine states in the Northeast have LIP programs, many of which allow for the management of early-successional habitats. To find out more about LIP in your state, contact your state wildlife agency (Appendix A).

Other state wildlife agency programs

Your state wildlife agency may administer other programs that provide technical or financial assistance to private landowners to enhance and restore wildlife habitat. For instance, the New Hampshire Fish & Game Department administers a Small Grants Program that provides up to $2,000 per year (not to exceed $6,000 in a ten-year period) to help cover the cost of releasing apple and other fruiting trees and shrubs, clearing brush and trees to maintain shrubland habitats, establishing cool- and warm-season grasses, and other habitat

management activities. Contact your state wildlife agency to see if a similar program exists in your state (Appendix A).

It is no secret that early-successional habitat management can be costly. Using the funding mechanisms described in this chapter, it is possible to at least greatly reduce or even entirely cover the costs of projects on your land.

Biography

Jim Oehler has a B.S. in Wildlife Management from the University of Wisconsin – Stevens Point, and an M.S. in Wildlife Ecology from the University of New Hampshire. Prior to joining the New Hampshire Fish & Game Department in January 2003, Jim spent five years with the Massachusetts Division of Fisheries & Wildlife reclaiming and maintaining early-successional habitats and both public and private land.

Appendix A. Contact information for selected federal and state agencies that can provide guidance on obtaining technical and funding assistance for early-successional habitat management projects.

State	Farm Service Agency	NRCS	State Wildlife Agency	State Forestry Agency
Connecticut	CT State Office 344 Merrow Rd Suite B Tolland, CT 06084 860-871-2944	CT State Office 344 Merrow Road Suite A Tolland, CT 06084 860-871-4011	CT Bureau of Natural Resources Wildlife Division 79 Elm Street Hartford, CT 06106 860-424-3011 dep.webmaster@po.state.ct.us	CT Division of Forestry 79 Elm Street Hartford, CT 06106 860-424-3630
Delaware	DE State Office 1201 College Park Drive Suite 101 Dover, DE 19904 302-678-4250	DE State Office 1203 College Park Dr Suite 101 Dover, DE 19904 302-678-4160	DE Division of Fish & Wildlife 89 Kings Hwy Dover, DE 19901 302-739-5297	DE Forest Service 2320 S. DuPont Highway Dover, DE 19901 302-698-4548
Maine	ME State Office 967 Illinois Ave. Bangor, ME 04401 207-990-9100	ME State Office 967 Illinois Ave Suite #3 Bangor, ME 04401 207-990-9100	ME Dept. of Inland Fisheries & Wildlife 284 State Street 41 State House Station Augusta, ME 04333 207-287-8000 ifw.webmaster@maine.gov	ME Forest Service 22 State House Station Harlow Building Augusta, ME 04333 207-287-2791
Maryland	MD State Office 8335 Guilford Rd. Suite E Columbia, MD 21046 410-381-4550	Hanson Business Center 339 Busch's Frontage Rd. Suite 301 Annapolis, MD 21401 410-757-0861	MD Dept. of Natural Resources Wildlife & Heritage Service 580 Taylor Avenue Tawes State Office Building Annapolis, MD 21401 877-620-8DNR customerservice@dnr.state.md.us	MD Dept. of Natural Resources Forest & Park Service 580 Taylor Avenue Tawes State Office Building Annapolis, MD 21401 877-620-8DNR customerservice@dnr.state.md.us

State	Farm Service Agency	NRCS	State Wildlife Agency	State Forestry Agency
Massachusetts	MA State Office 445 West Street Amherst, MA 01002 413-253-4500	MA State Office 451 West Street Amherst, MA 01002 413-253-4350	MassWildlife Field Headquarters 1 Rabbit Hill Road Westboro, MA 01581 508-792-7270 mass.wildlife@state.ma.us	MA Div. State Parks & Recreation 251 Causeway Street Boston, MA 02114 617-626-1250
New Hampshire	NH State Office 22 Bridge St., 4th Floor Concord, NH 03301 603-224-7941	NH State Office Federal Building 2 Madbury Road Durham, NH 03824 603-868-7581	NH Fish & Game Dept. 11 Hazen Dr. Concord, NH 03301 603-271-246 wildlife@wildlife.state.nh.us	NH Division of Forests & Lands Box 1856 - 172 Pembroke Rd. Concord, NH 03302 603-271-2214
New Jersey	NJ State Office Mastoris Professional Plaza, 163 Route 130 Bldg. 2, Suite E Bordentown, NJ 08505 609-298-3446	NJ State Office 220 Davidson Ave 4th Floor Somerset, NJ 08873 732-537-6040	NJ Division of Fish & Wildlife 501 E. State St. 3rd Floor P.O. Box 400 Trenton, NJ 08625 609-292-6685 NJFishandWildlife@dep.state.nj.us	NJ State Forestry Service P.O. Box 404 Trenton, NJ 08625-0404 609-292-2520
New York	NY State Office 441 S. Salina St. Suite 536 Syracuse, NY 13202 315-477-6300	NY State Office 441 S. Salina St. Suite 354 Syracuse, NY 13202 315-477-6504	NY Dept. of Environmental Conservation Bureau of Habitat 625 Broadway Albany, NY 12233 518-402-8996 fwhabtat@gw.dec.state.ny.us	NY Dept. of Environmental Cons. Division of Land and Forests 625 Broadway Albany, NY 12233 518-402-9405

State	Farm Service Agency	NRCS	State Wildlife Agency	State Forestry Agency
Pennsylvania	PA State Office Credit Union Place Suite 320 Harrisburg, PA 17110 717-237-2121	PA State Office Credit Union Place Suite 340 Harrisburg, PA 17110 717-237-2100	PA Game Commission 2001 Elmerton Ave. Harrisburg, PA 17110 717-787-5529 pgccomments@state.pa.us	PA Bureau of Forestry P.O. Box 8552 Harrisburg, PA 17105 717-787-2703
Rhode Island	RI State Office 60 Quaker Lane Suite 40 Warwick, RI 02886 401-828-8232	RI State Office 60 Quaker Lane Suite 46 Warwick, RI 02886 401-828-1300	RI Division of Fish & Wildlife 4808 Tower Hill Road Wakefield, RI 02879 401-789-3094	RI Div. of Forest Environment 1037 Hartford Pike North Scituate, RI 02857 401-647-3367
Vermont	VT State Office 356 Mountain View Drive, Suite 104 Colchester, VT 05446 802-658-2803	VT State Office 356 Mountain View Drive Suite 105 Colchester, VT 05446 802-951-6796	VT Fish & Wildlife Dept. 103 South Main Street Waterbury, VT 05671 802-241-3700 fwinformation@anr.state.vt.us	VT Dept. of Forests, Parks and Recreation 103 S. Main Street Waterbury, VT 05671 802-241-3678
Virginia	VA State Office 1606 Santa Rosa Road Suite 209 Richmond, VA 23229 804-287-1503	VA State Office 1606 Santa Rosa Road Suite 209 Richmond, VA 23229 804-287-1671	VA Dept. of Game & Inland Fisheries 4010 West Broad Street Richmond, VA 23230 804-367-1000 dgifweb@dgif.state.va.us	VA Dept. of Forestry 900 Natural Resources Drive Suite 800 Charlottesville, VA 22903 434-977-6555
West Virginia	WV State Office 75 High St., Room 239 Morgantown, WV 26505 304-284-4800	WV State Office 75 High St., Room 301 Morgantown, WV 26505 304-284-7540	WV Division of Natural Resources 1900 Kanawha Boulevard, E. Charleston,WV 25305 304-558-2771 wildlife@dnr.state.wv.us	WV Division of Forestry 1900 Kanawha Blvd., East Charleston, WV 25305 304-558-3446

Common Name	Scientific Name
Invertebrates	
Butterflies and moths	*Lepidoptera*
Fritillaries	*Papilionidae* family
Karner blue butterfly	*Lycaeides melissa samuelis*
Mayflies	*Ephemera spp.*
Monarch butterfly	*Danus plexippus*
Persius duskywing	*Ernnis persius*
Swallowtails	*Papilionidae family*
White pine weevil	*Pissodes strobi*
Fish	
Brook trout	*Salvelinus fontinalis*
Amphibians	
Eastern/American toad	*Bufo a. americanus*
Fowler's toad	*Bufo fowleri*
Wood frog	*Rana sylvatica*
Reptiles	
Black rat snake	*Elaphe o. obsoleta*
Blanding's turtle	*Emydoidea blandingii*
Common garter snake	*Thamnophis sirtalis*
Common musk turtle	*Sternotherus odoratus*
Common snapping turtle	*Chelydra s. serpentina*
Eastern box turtle	*Terrapene c. carolina*
Eastern hognose snake	*Heterodon platirhinos*
Eastern milk snake	*Lampropeltis t. triangulum*
Eastern smooth green snake	*Liochlorophis vernalis*
Norhtern black racer	*Coluber c. constrictor*
Northern brown snake	*Storeria d. dekayi*
Spotted turtle	*Clemmys guttata*
Wood turtle	*Clemmys insculpta*
Birds	
American bittern	*Botaurus lentiginosus*
American crow	*Corvus brachyrhynchos*
American goldfinch	*Carduelis tristis*
American kestrel	*Falco sparverius*
American redstart	*Setophaga ruticilla*
American robin	*Turdus migratorius*

American tree sparrow	*Spizella arborea*
American widgeon	*Anas americana*
American woodcock	*Scolopax minor*
Baltimore oriole	*Icterus spurius*
Bank swallow	*Riparia riparia*
Barn owl	*Tyto alba*
Barn swallow	*Hirundo rustica*
Barred owl	*Strix varia*
Black-and-white warbler	*Mniotilta varia*
Black-billed cuckoo	*Coccyzus erythropthalmus*
Black-capped chickadee	*Poecile atricapillus*
Blue jay	*Cyanocitta cristata*
Blue-gray gnatcatcher	*Polioptila caerulea*
Blue-winged warbler	*Vermivora pinus*
Bobolink	*Dolichonyx oryzivorus*
Bohemian waxwing	*Bombycilla garrulous*
Broad-winged hawk	*Buteo platypterus*
Brown creeper	*Certhia americana*
Brown thrasher	*Toxostoma rufum*
Brown-headed cowbird	*Molothrus ater*
Canada goose	*Branta canadensis*
Canada warbler	*Wilsonia canadensis*
Cedar waxwing	*Bombycila cedrorum*
Chestnut-sided warbler	*Dendroica pensylvanica*
Chimney swift	*Chaetura pelagica*
Chipping sparrow	*Spizella passerina*
Cliff swallow	*Petrochelidon pyrrhonota*
Common grackle	*Quiscalus quiscula*
Common nighthawk	*Chordeiles minor*
Common redpoll	*Carduelis flammea*
Common yellowthroat	*Geothlypis trichas*
Cooper's hawk	*Accipiter cooperii*
Crows	*Corvus spp.*
Dark-eyed junco	*Junco hyemalis*
Downy woodpecker	*Picoides pubescens*
Eastern bluebird	*Sialia sialis*
Eastern kingbird	*Tyrannus tyrannus*
Eastern meadowlark	*Sturnella magna*
Eastern phoebe	*Sayornis phoebe*

Eastern screech owl	*Otus asio*
Eastern towhee	*Pipilo erythrophthalmus*
Eastern wood pewee	*Contopus virens*
European starling	*Sturnus vulgaris*
Evening grosbeak	*Coccothraustes vespertinus*
Field sparrow	*Spizella pusilla*
Fox sparrow	*Passerella iliaca*
Golden-winged warbler	*Vermivora chrysoptera*
Grasshopper sparrow	*Ammodramus savannarum*
Gray catbird	*Dumetella carolinensis*
Great crested flycatcher	*Myiarchus crinitus*
Great horned owl	*Bubo virginianus*
Hairy woodpecker	*Picoides villosus*
Henslow's sparrow	*Ammodramus henslowii*
Hoary redpoll	*Carduelis hornemanni*
Horned lark	*Eremophila alpestris*
House finch	*Carpodacus mexicanus*
House wren	*Troglodytes aedon*
Indigo bunting	*Passerina cyanea*
Least flycatcher	*Empidonax minimus*
Loggerhead shrike	*Lanius ludovicianus*
Long-eared owl	*Asio otus*
Louisiana waterthrush	*Seiurus noveboracensis*
Mallard	*Anas platyrhynchos*
Mourning dove	*Zenaida macroura*
Mourning warbler	*Oporornis philadelphia*
Northern bobwhite (quail)	*Colinus virginianus*
Northern cardinal	*Cardinalis cardinalis*
Northern flicker	*Colaptes auratus*
Northern goshawk	*Accipiter gentalis*
Northern harrier	*Circus cyaneus*
Northern mockingbird	*Mimus polyglottos*
Northern pintail	*Anas acuta*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Northern saw-whet owl	*Aegolius acadicus*
Northern shrike	*Lanius excubitor*
Olive-sided flycatcher	*Contopus cooperi*
Orchard oriole	*Cteris spirois*
Osprey	*Pandion haliaetus*

Peregrine falcon	*Falco peregrinus*
Pine grosbeak	*Pinicola enucleator*
Prairie warbler	*Dendroica discolor*
Prothonotary warbler	*Protonotaria citrea*
Purple finch	*Carpodacus purpureus*
Purple martin	*Progne subis*
Red-bellied woodpecker	*Melanerpes carolinus*
Red-breasted nuthatch	*Sitta canadensis*
Red-eyed vireo	*Vireo olivaceus*
Red-headed woodpecker	*Melanerpes erythrocephalus*
Red-tailed hawk	*Buteo jamaicensis*
Ring-necked pheasant	*Phasianus colchicus*
Rose-breasted grosbreak	*Pheucticus ludovicianus*
Ruby-throated hummingbird	*Archilochus colubris*
Ruffed grouse	*Bonasa umbellus*
Savannah sparrow	*Passerculus sandwichensis*
Scarlet tanager	*Piranga olivacea*
Sharp-shinned hawk	*Accipiter striatus*
Short-eared owl	*Asio flammeus*
Snowy owl	*Nyctea scandiaca*
Song sparrow	*Melospize melodia*
Sparrows	*Emberizidae* family
Swainson's thrush	*Catharus ustulatus*
Thrushes	*Catharus spp.*
Tree swallow	*Tachycineta bicolor*
Tufted titmouse	*Baeolophus bicolor*
Upland sandpiper	*Bartramia longicauda*
Veery	*Catharus fuscescens*
Vesper sparrow	*Pooecetes gramineus*
Warblers	*Parulidae* family
Warbling vireo	*Vireo gilvus*
Whip-poor-will	*Caprimulgus vociferus*
White-breasted nuthatch	*Sitta carolinensis*
White-throated sparrow	*Zonotrichia albicollis*
Wild turkey	*Meleagris gallopavo*
Willow flycatcher	*Empidonax traillii*
Winter wren	*Troglodytes troglodytes*
Wood thrush	*Hylocichla mustelina*
Yellow warbler	*Dendroica petechia*

Yellow-bellied woodpecker	*Sphyrapicus varius*
Yellow-billed cuckoo	*Coccyzus americanus*
Yellow-breasted chat	*Icteria virens*

Mammals

Bats	*Vespertilionidae* family
Beaver	*Castor canadensis*
Big brown bat	*Eptesicus fuscus*
Black bear	*Ursus americanus*
Bobcat	*Lynx rufus*
Cottontails	*Sylvilagus spp.*
Coyote	*Canis latrans*
Eastern cottontail	*Sylvilagus floridanus*
Eastern mole	*Scalopus aquaticus*
Eastern pipistrelle	*Pipistrellus subflavus*
Ermine	*Mustela erminea*
European hare	*Lepus europaeus*
Fisher	*Martes pennanti*
Gray fox	*Urocyon cinereoargenteus*
Hares	*Lepus spp.*
Hoary bat	*Lasiurus cinereus*
House mouse	*Mus musculus*
Indiana myotis	*Myotis sodalis*
Least shrew	*Cryptotis parva*
Little brown myotis	*Myotis lucifugus*
Long-tailed weasel	*Mustela frenata*
Masked shrew	*Sorex cinereus*
Meadow jumping mouse	*Zapus hudsonius*
Meadow vole	*Microtus pennsylvanicus*
Mink	*Mustela vison*
Moose	*Alces alces*
New England cottontail	*Sylvilagus transitionalis*
Northern long-eared bat	*Myotis septentrionalis*
Northern short-tailed shrew	*Blarina brevicauda*
Norway rat	*Rattus norvegicus*
Porcupine	*Erethizon dorsatum*
Pygmy shrew	*Sorex hoyi*
Raccoon	*Procyon lotor*
Red bat	*Lasiurus borealis*
Red fox	*Vulpes vulpes*

Red squirrel	*Tamiasciurus hudsonicus*
River otter	*Lontra canadensis*
Silver-haired bat	*Lasionycteris noctivagans*
Snowshoe hare	*Lepus americanus*
Southern bog lemming	*Synaptomys cooperi*
Southern flying squirrel	*Glaucomys volans*
Striped skunk	*Mephitis mephitis*
Virginia opossum	*Didelphis virginiana*
Water shrew	*Sorex palustris*
White-footed mouse	*Peromyscus leucopus*
White-tailed deer	*Odocoileus virginianus*
Woodchuck	*Marmota monax*
Woodland vole	*Microtus pinetorum*