A Landowner's Guide to
New England Cottontail
Habitat Management

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Introduction

Pam Wells

Figure 1. New England cottontail

New England's only native cottontail rabbit species is in peril. Over the past few decades, the New England cottontail has seen significant declines throughout its range, and the ongoing trend of habitat loss will further threaten the species in coming years. Fortunately, private landowners are in a position to make a significant contribution to the restoration of the species. By managing some of their land as shrublands—the required habitat for New England cottontails—landowners can provide cottontails with the food and cover they need to survive harsh, cold winters and avoid predation. If enough landowners join in the effort, the New England cottontail might be saved from becoming a federally listed species. Information about the New England cottontail and how you can manage your land for habitat is included in this guide.

Biological Information

The New England cottontail (*Sylvilagus transitionalis*) is a medium-sized rabbit with a brown or buff-colored coat, overlain with a wash of distinct black-tipped fur that gives it a penciled effect. Unlike the snowshoe hare (*Lepus americanus*), the cottontail's fur remains brownish gray rather than transitioning to white in the winter. The New England cottontail's ears are heavily furred on the inside, with a line of black hair covering the inside edges and usually a distinct black spot between the ears.

A close relative to the New England cottontail is the Appalachian cottontail (*Sylvilagus obscurus*), which is found west of the Hudson River and south of the New England cottontail's range. Another similar species, the eastern cottontail (*Sylvilagus floridanus*), was introduced to New England during the early 1900s and is the only other cottontail found east of the Hudson River. It can be differentiated by its slightly larger body size, its longer, pointier ears, and the presence of a white spot instead of a black spot between the ears, although sometimes this "spot" is represented by only a few white hairs. New England cottontails range from 15 to 17 inches in length and 2.2 to 3.0 lbs in weight, while eastern cottontails are about 20 percent larger. These differences between species are often subtle and difficult to distinguish, even when handling the animals. To confirm identification of the New England cottontail, an expert can perform analysis on DNA extracted from fecal pellets, take detailed body measurements, or examine the rabbit's skull.

David Tibbetts/USFWS

Figure 2. New England cottontail

Joe Kosack/PGC Photo

Figure 3. Eastern cottontail

Carolyn Bryant

Figure 4. Snowshoe hare in summer

Hal Korber/PGC Photo

Figure 5. Snowshoe hare in winter

Reproduction

New England cottontails have relatively short lives which are mostly solitary, as their only associations with other individuals are related to reproduction. The breeding season lasts from March to September (with delayed onset in the northern cottontail populations), and each female can give birth several times during this period. Each pregnancy lasts only 28 days between conception and birth. New England cottontails average 2 to 3 litters per season, with each litter containing 3 to 8 young (5 on average). Immediately after giving birth, females are ready to breed again.

Nesting

Several days before birth, the mother cottontail builds a nest by creating a depression in the ground about 4 inches deep and 5 inches wide. She lines the nest with fur and grass, and then covers it with twigs and leaves. A large majority of New England cottontail nests are built in the brush or in herbaceous vegetation on the forest floor, with construction taking place at night.

Early Life

Cottontail offspring are born with eyes tightly shut and receive little maternal care aside from feeding. They mature rapidly, leave their mothers less than two weeks after birth, and may even breed during their first season. New England cottontail survival rates are not known, but research on eastern cottontails suggests that only 1 in 5 rabbits lives through its first year, and that the average lifespan is 15 months.

Mortality

Predation is thought to be the major cause of death for this species. Common predators include coyotes, red foxes, bobcats, fishers, domestic cats, and owls. Mortality rates from vehicle strikes, hunting, and disease are unknown.

For more detailed information on New England cottontail biology, a fact sheet can be downloaded from http://www.fws.gov/northeast/pdf/necotton.fs.pdf, and the full Candidate Species Assessment* can be accessed at http://ecos.fws.gov/docs/candforms_pdf/r5/A09B_V01.pdf

* Information on Candidate Species Assessments and the Candidate Conservation Program is listed in Appendix E.

Habitat Requirements

All photos by Margaret Arbuthnot, except top right photo by Bruce Hammond, and middle right by David Tibbetts/USFWS

Figure 6. Examples of suitable vs. unsuitable habitat.

Early-Successional Habitats

New England cottontails are dependent on early-successional habitats. (Succession refers to the natural replacement of one plant community by another, for example, the succession of fields into shrublands and eventually to forest.) In particular, New England cottontails require the dense, woody understory cover that occurs in shrub thickets and young regenerating forests. Unlike eastern cottontails, they are not likely to be found on golf courses, lawns, or active agricultural lands with insufficient hedge cover.

Examples of early-successional habitats that are suitable for New England cottontails include:

- idle agricultural lands reverting to "old field" habitats
- other areas that have been mechanically cleared and are growing back into dense woody cover, such as utility and railroad corridors
- young forests regenerating after natural or manmade disturbance
- shrub swamps and brushy areas near beaver flowages
- dense thickets of native shrubs, brambles, and greenbrier (*Smilax*)
- coastal shrublands where wind and salt spray inhibit the growth of forests

These habitat types provide all of the rabbit's food and cover needs for its entire life cycle. Once trees mature into mid- and late-successional forest, the tree canopy shades the ground, and the density of understory vegetation typically decreases. In more open habitat, New England cottontails are more vulnerable to predators.

Anne Schnell

Figure 7. New England cottontail in dense shrub habitat.

Clockwise from top left: Mary Ellen (Mel) Harte/Bugwood.org; Joy Viola (retired)/Northeastern University/Bugwood.org; Kelly Boland/USFWS; Carolyn Miller; Kelly Boland/USFWS; Pam Wells

Figure 8. Preferred cottontail food species. Clockwise from top left: Canada goldenrod, maple, highbush blueberry, lanceleaf plantain, alder, raspberry.

Cover Requirements

New England cottontails are extremely susceptible to predation and therefore have very strict cover requirements. They prefer large patches of habitat with dense cover and are reluctant to travel farther than 16 feet from cover, even for food. When it is available, they much prefer understory habitat with a density of 20,000 woody stems per acre, which is equal to about 46 stems in a 10 x 10 foot square area (only counting plants over 20 inches tall with a diameter of 3 inches or less). These dense, woody habitat types are generally referred to as thickets. If you are walking through these areas and are constantly finding yourself having to redirect your route, stoop under vegetation, or free yourself from some vegetation, then the habitat is probably suitable.

Appropriate cover can be provided by a diversity of plants—most often it is the height and density of the vegetation, rather than specific plant species and communities, which are used to describe New England cottontail habitat. Evergreen shrubs and trees provide important shelter and cover, especially during winter months when deciduous species are leafless. Therefore, retaining a few young conifer inclusions within a deciduous dominated landscape should be considered.

Food

New England cottontail feeding habits are closely related to the availability of plants as they develop throughout the year. The variety of plant materials eaten by cottontails includes bark, twigs, leaves, fresh fruits, buds, flowers, grasses, rushes, and sedges.

In late spring and summer, when tender green shoots start to appear, the cottontail's diet consists mostly of grasses and

Preferred Foods

Shrubs & Vines

Raspberry
Blackberry
Dewberry
Winterberry holly
Willow
Maleberry
Highbush blueberry
Lowbush blueberry
Silky dogwood
Native rose species
Spiraea
Chokeberry
Sumac
Greenbrier

Herbs & Grasses

Goldenrod
Rushes
Clovers
Lance leaf plantain
Chickweed
Sheep sorrel
Wintergreen
Buttercup
Wild strawberry
Cinquefoil
Violet

Trees

Red maple
Aspen
Gray birch
Apple
Choke cherry
Wild black cherry
Sugar maple
Oaks
White birch
Yellow birch
Black birch
Beech
Striped maple

herbs. In the fall, cottontails forage from a mixed variety of food sources as they gradually switch to their woody cold-weather diet. The first woody plants they turn to include raspberry, blackberry, highbush blueberry, and willow. These become unavailable when snow accumulates, forcing New England cottontails into their winter diet of bark, twigs, and buds, along with occasional dried stems and perennial grasses. The New England cottontail's winter diet is largely influenced by forage availability and predator avoidance, and often includes gray birch and red maple which provide food and cover during snowfall. Adequate winter food supplies are critical for cottontail survival.

Habitat Area Requirements

To sustain a population of rabbits, a patch of habitat must be sufficiently large to provide year-round food and protection. Studies show that the New England cottontail's mortality rate is twice as high on patches smaller than 6 acres than it is on patches over 12 acres. On small patches, the habitat may provide insufficient food to support the cottontails throughout the winter. In these conditions, New England cottontails either starve or risk predation in search of food outside the safety of dense cover. Habitat blocks of at least 25 acres in size (ideally much larger) and close to additional patches of habitat are necessary for the species to survive.

Factors Contributing to Species Decline

Loss of Habitat

Habitat loss is one of the principle causes of New England cottontail decline. While early-successional habitats have naturally disappeared because of the reforestation of New England, habitat has also been eliminated or fragmented by development. Coastal areas, old agricultural fields, and other prime cottontail habitats are under intense development pressure. As suburban sprawl continues, development in the Northeast is expected to result in 2 percent range loss per year for the New England cottontail, and 86 percent of its range has already been lost. Additionally, the expansion of development often results in the suppression of natural disturbances such as wildfires, beaver activity, and insect blight that historically created early-successional habitat.

John Litvaitis

Figure 9. Cottontail habitat lost to development.

Habitat Fragmentation

When patches of New England cottontail habitat mature or are converted to houses and roads, the remaining patches of early-successional habitat become disconnected. Small islands of habitat separated by expanses of unsuitable habitat will isolate cottontail populations. It is difficult for New England cottontails to find each other, given the species' tendency to make relatively small distance movements. Most of the habitat patches where New England cottontails have been observed in Maine, New Hampshire, Massachusetts, New York, and western Connecticut are less than 7.5 acres in size and support no more than 3-4 cottontails. These patches are too small and fragmented to support sustainable cottontail populations. Rabbits living in small, isolated populations are expected to become locally extinct.

Predation

The cottontail's primary predators are coyotes and foxes. Bobcats, weasel, fisher, and domestic dogs and cats are its other known mammalian predators. Avian species such as barred owls, great horned owls, and red-tailed hawks have also been observed taking New England cottontails.

Although predation is a natural process, it has been indirectly increased through human induced land use changes. Habitat fragmentation leaves cottontails with insufficient food and cover, forcing them to undertake risky activities such as leaving their thicket. Mid-

Figure 10. Cottontail predators. Clockwise from top left: Red fox, red-tailed hawk, coyote, barred owl, domestic cat.

Clockwise from top left: Pam Wells; Joe Kosack/PGC Photo; Billie Cromwell/PGC Photo; Pam Wells; www.cepolina.com

sized predators forage along habitat edges, so smaller patches with proportionally more edge and less interior habitat are more dangerous locations for New England cottontails. New residential development often brings along domestic cats and dogs, which are known to kill New England cottontails and may be significant predators. Additionally, generalist predators often benefit from human activity, and coyotes and foxes are two such species whose populations have doubled with the presence of humans. Most managers will agree that if the right amount and quality of habitat is provided, predation will have limited negative impacts on the species.

Displacement by the Introduced Eastern Cottontail

Historically, the New England cottontail inhabited much of New England and was the only cottontail species in the region. Before 1930, the closest eastern cottontail population was located around the lower Hudson Valley and extreme western Connecticut, at the very edge of the New England cottontail's range (see Fig. 11).

In the 1920s through the 1950s, state wildlife management agencies and private hunting clubs conducted large-scale introductions of eastern cottontails into the northeast region, with the goal of augmenting game populations. These populations quickly expanded and became firmly established in all northeastern states except for Maine, where the eastern cottontail has yet to be observed.

Although not physically dominant over New England cottontails, eastern cottontails are able to exploit a wider variety of habitats types (lawns, agricultural fields, small areas) including thickets occupied by New England cottontails. The eastern cottontail tends to produce more young and is better at detecting and escaping from predators than the native New England cottontail. It may be for these reasons that the eastern cottontail has displaced the New England cottontail throughout much of its range, leading to declining populations of the native cottontail, while the introduced species continues to expand. Currently, there is no evidence that the two species are capable of interbreeding.

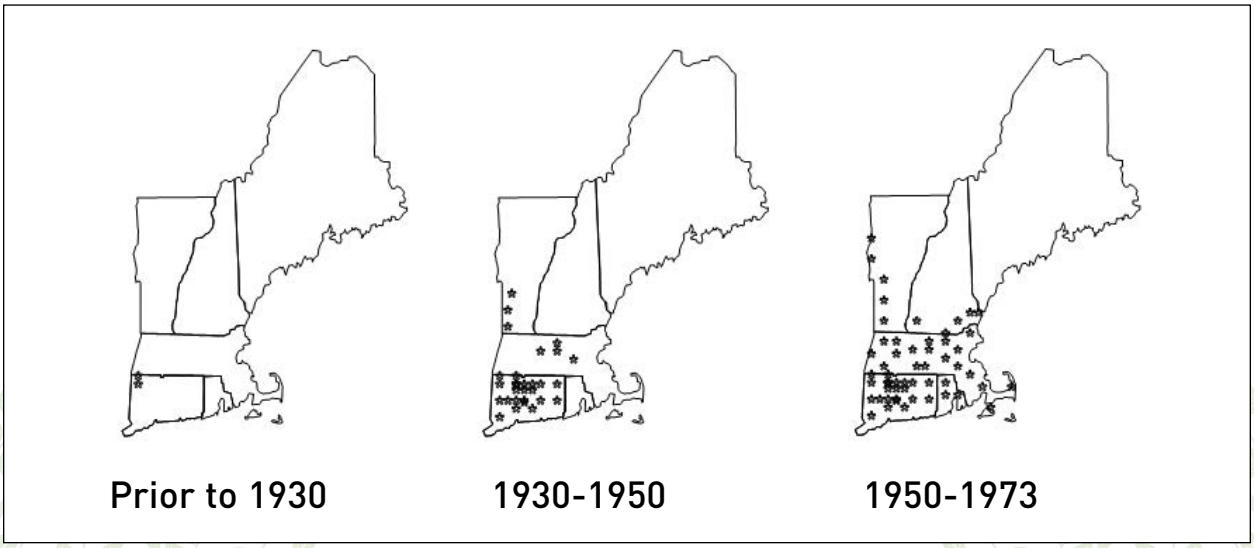


Figure 11. Historical range expansion of eastern cottontails into the northeastern United States. Each dot represents the collection of at least one rabbit. Source: Litvaitis et al. 2007, pg. 170.

Distribution

Prior to European settlement, New England cottontails probably inhabited areas that were prone to natural disturbances that created large forest openings, as well as sites where conditions discouraged the growth of trees. These areas included shrub swamps, coastal habitats, other areas with sandy soils, as well as forests regenerating after disturbances caused by beavers, wind storms, insect infestations, or lightning-caused wildfire. Coastal regions are especially prone to small-scale natural and human-caused disturbances, including Native American set wildfires and agricultural land clearing, which historically created early-successional habitats such as native shrublands, thickets, and young forests.

European settlement and forest clearing for farmland played a large role in the availability of shrub thickets and early-successional forest in New England. In the early 1800s, over 80 percent of New England's landscape was cleared and in active agriculture. As the century wore on, farmers moved to more fertile soils in the Midwest. Most New England farms were abandoned in the late 1800s and early 1900s, resulting in an enormous amount of land that entered into the first stages of forest regeneration. Within 10 to 25 years after abandonment, these old fields had grown into prime habitat for New England cottontails. Because of this increase in available habitat, the New England cottontail experienced range-wide population growth during the first half of the 20th century. At the peak of its population expansion, the New England cottontail occupied sites throughout southeastern New York (east of the Hudson River including Long Island), north through the Champlain Valley, all of Connecticut, Massachusetts, and Rhode Island, much of southern Vermont, the southern half of New Hampshire, and southern Maine. At its greatest extent the historic range spanned an estimated 34,750 mi^2.

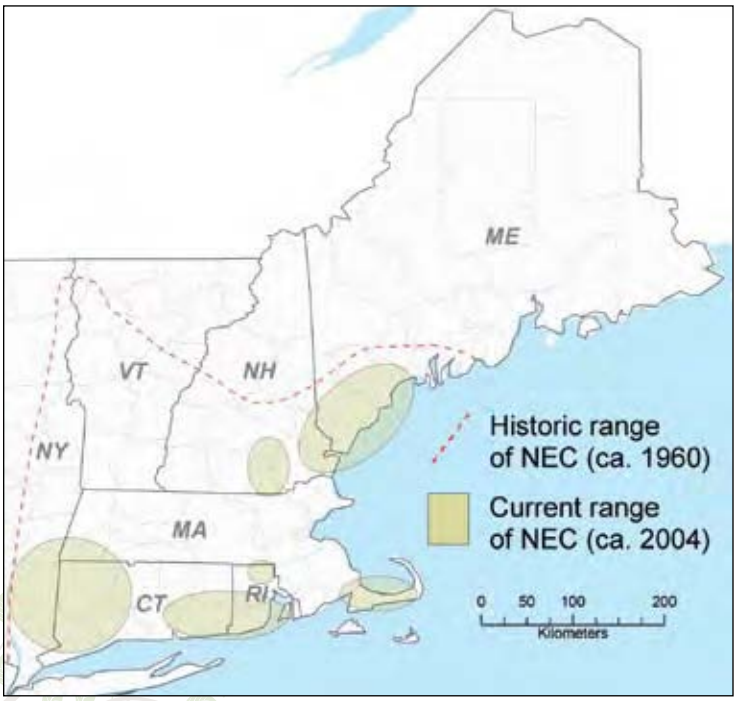


Figure 12. Current distribution of New England cottontails. Dashed line indicates historical range of the species. Current range represents 86 percent loss of historical range. Map by Jeffrey Tash, based on Litvaitis et al. 2006.

Over time, continued vegetational succession on abandoned farm lands resulted in the expansion of mature forests in the northeastern United States. As the forest canopies closed in, the dense understory required by New England cottontails disappeared, and the rabbit populations declined with it. By around 1960, most areas had matured and were no longer suitable for New England cottontails. The disappearance of early-successional habitat resulted in the rapid disappearance of cottontails. The remaining fragmented populations

combined currently span an estimated 4,703 mi², which is less than 14 percent of the New England cottontail's greatest extent of range prior to 1960. Its reduced range can be seen in Figure 12. The New England cottontail is now listed as a "Species of Greatest Conservation Need" in the Wildlife Action Plans of all seven states in its range, is listed as "endangered" under the State Endangered Species Act in both Maine and New Hampshire, and was identified as a Candidate Species for federal listing under the United States Endangered Species Act in 2006.

Determining Local Presence of New England Cottontails

Are New England Cottontails Found in Your Area?

First, determine whether your property is located within the historical range of the species. If so, contact your local state and federal wildlife agencies (see Appendix A) for a map of sites where New England cottontails have been documented recently—are you located near any of these sites? It is possible that New England cottontails might live in your area even if they have not been recorded. If you have dense shrub habitat and think you might have cottontails on your property, follow the steps below to determine whether the rabbits you see hopping about are in fact New England cottontails. You will need to consult with a professional wildlife biologist to be sure. However, even if you are not certain that New England cottontails occur on your property, managing your land to create and maintain early-successional habitat will still be beneficial for many species.

Tracking New England Cottontails

Since New England cottontails spend most of their time in dense thickets, they may be hard to spot. However, they do leave clues about their presence, including fecal pellets, tracks, gnawed tree bark, and twigs browsed at 45-degree angles (Fig. 13-17). These clues can be analyzed to determine whether the animal that left them was a cottontail.

Two to four days after a fresh snowfall is the ideal time to look for cottontail clues. The rough, round brown pellets are more visible on top of the snow than on the ground, and animal tracks remain imprinted in the snow days after they were made. Searching around clumps of shrubland or other early-successional habitat would be your best bet for finding New England cottontail tracks.

Once you find a set of tracks, you will have to distinguish them as cottontail, since snowshoe hares make very similar tracks (Fig. 15). Because cottontails are smaller than snowshoe hares, measuring the hind footprints can determine whether the print was made by a cottontail (2 ¾ – 4 inches in length) or a snowshoe hare (3 ¼ – 6 inches in length). Cottontail hind footprints are also shaped more like a long oval, while snowshoe hare hindprints are more triangular or snowshoe-shaped.

Fecal pellets are sometimes easier to find than tracks. If found near tracks, they can be used to distinguish the animal from a squirrel which might leave similar prints, but without DNA analysis you will not be able to distinguish New England cottontail pellets from eastern cottontail and snowshoe hare pellets. Contact your regional Fish & Wildlife office to find out whether there are any ongoing DNA studies to which you could submit pellet samples for testing.

Figure 13 (top left). Cottontails gnaw on woody branches during the winter.

Figure 14 (top right). Cottontails clip twigs at a 45 degree angle.

Figure 15 (middle). Distinguishing cottontail from snowshoe hare tracks.

Figure 16 (bottom left). Comparison of deer (left) and cottontail pellets.

Figure 17 (bottom right). New England cottontail pellets on snow.

Left: Margaret Arbuthnot; Right: Kelly Boland/USFWS

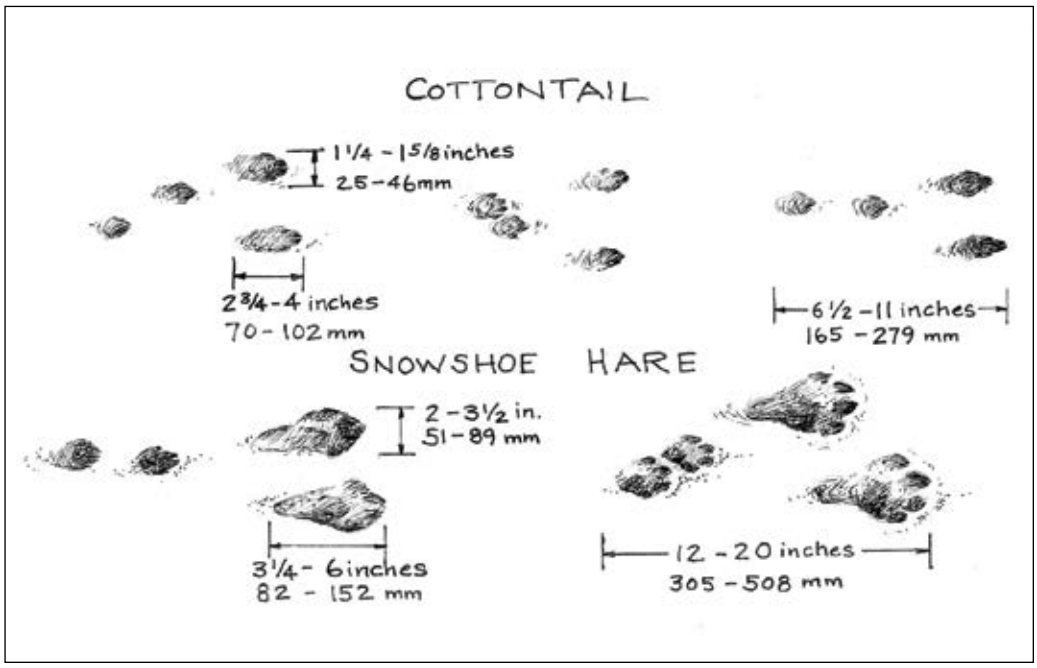


Illustration by Mark McCollough

Both photos by Margaret Arbuthnot

The Importance, Pleasures, and Practical Benefits of Shrub Habitat

Some species, such as the New England cottontail, spend their entire lives in early-successional habitat and are dependent upon its existence. Many declining bird species, such as the eastern towhee, American woodcock, and chestnut-sided warbler, use this habitat for nesting. As shrubland habitat declines in the Northeast, so do the populations of many birds, reptiles, rare moths and butterflies, pollinating bees, plants, and mammals that benefit from this habitat. Because of habitat loss, many species that rely on early-successional habitat are now extinct, threatened, or declining to the point of "special concern." Shrublands and regenerating forests are primary habitats for many New England Species of Greatest Conservation Need, including northern black racers, several species of turtles, and dozens of breeding bird species (see Appendix D for a complete list).

We can no longer depend on natural disturbances to create enough early-successional habitat to reverse the trend of species loss. Rather, habitat must be actively and continuously maintained and regenerated through human intervention if current population levels of many declining species are to be sustained or improved. Habitat management techniques described in this guide will improve habitat for New England cottontails and many other declining species.

Many landowners are learning that well-managed shrublands and other early successional habitats offer the landowner many rewards. Shrubby habitats allow for a sweeping view of the landscape while requiring less maintenance than a lawn. Shrubs can also provide privacy or serve as wind and noise screens without reducing sunlight. A habitat patch or strip that provides New England cottontails with a travel corridor might serve as a buffer

Figure 18. Other early-successional dependent species in decline. Clockwise from top left: prairie warbler, blue-spotted salamander, ruffed grouse, indigo bunting, American woodcock.

Clockwise from top left: Steve Maslowski/USFWS; James DeBoer; Jacob W. Dingel/PGC Photo; Dave Menke/USFWS; Pam Wells

Clockwise from top left: Noel Zia Lee; Bruce Hammond; Betsy Alexander; Bruce Hammond

Figure 19. Native shrubs. Clockwise from top left: red osier dogwood, choke cherry, winterberry, sweet pepperbush.

from a road, reduce erosion into a stream, or solve a trespass problem. On top of all these functional values, native shrubs are easy to grow and are low maintenance, and many produce beautiful foliage, flowers, berries, and seasonal colors. For example, the bright red bark of red osier dogwood and the bright red berries of winterberry holly can add a splash of color to your property in winter, while the creamy white flowers of arrowwood and shadbush are a spring delight. Finally, in addition to the New England cottontail, shrublands also provide critical habitat for other desirable wildlife species, including game species such as woodcock and grouse, as well as beautiful songbirds and important pollinators such as butterflies, native bees, and bats.

Although the thick nature of brushy habitat makes it difficult for people to move through, providing habitat for New England cottontails does not mean you have to give up access to your property. A road through the habitat patch for access to your woodlot or fields, or trails through the area for recreational activities are compatible with providing cottontail habitat. Hunting, berry picking, bird watching, and other wildlife viewing are activities that can be enjoyed in habitat areas.

Overview of Early-Successional Habitat Management

Managing early-successional habitat for New England cottontails and other species can take many forms, depending on the acreage and current condition of your land and how much effort you are willing to put into management. Existing shrublands can be maintained rather easily with the right equipment, while establishing new or restoring former habitat areas can take time and effort. Depending on your soils and vegetation, you might consider mechanical cutting, prescribed burning, herbiciding, or planting your habitat areas to create and maintain optimal conditions for cottontails. These tools and techniques are described in more detail in Appendices B and C. A qualified natural resource specialist (Appendix A will help guide you to available resources) can help you decide what would work best for your land and your personal goals.

Some management actions (such as brush-hogging a field, clearcutting a forest, or burning an alder stand) will temporarily eliminate habitat, so you should ensure that cottontails on your property will always have a sufficient amount of other suitable habitat available. A rotational management scheme that distributes restorative treatments over time and space can be used to maintain a shifting mosaic of early-successional habitat that is likely to meet the cottontail's long-term needs. If you have enough land, treatment units should be at least 25 acres in size. Landowners should make sure that new habitats are available and being used by cottontails before "recycling" old habitats. Landowners with

smaller parcels will want to coordinate with neighbors who are also managing habitat, to ensure that patches are located close enough together for cottontail dispersal, and that restoration work is spread out over time.

The ecology of different habitat and forest types differs. Guidelines for promoting early-successional habitat in various types of vegetative cover—from fields to shrubs to forests—are found in the following sections. Contact a qualified natural resource specialist (see Appendix A) to determine the most suitable treatments for your land.

Managing and Maintaining Existing Early-Successional Habitat

Typical shrublands in the Northeast need regular management in order to prevent their succession to forest. Most shrubland habitats are relatively short-lived and will mature into forest after 20 to 25 years of inactivity. Generally, annual monitoring of stem density and plant diversity, coupled with maintenance management every 5 to 15 years (depending on method, soil, and vegetation type) should be sufficient to maintain appropriate habitat for the New England cottontail and associated species. As described below, wetlands and coastal shrublands may require less frequent management.

Restorative management is generally only necessary when invasive plants are dominant or when stem density falls below 30 stems per 10 x 10 foot block. In these cases, the shrubland will need to be cut and allowed to re-grow to achieve an appropriate density. A combination of techniques is often used to hinder growth of invasive and other undesirable plants in restored shrubland (see page 19). Keep in mind that it is much easier to monitor for and to control invasive plants before they become well-established, than it is afterward. Also, by going in and selectively removing young trees as they emerge above the shrub canopy, you can delay the need to mow the whole patch by many decades. This is a good approach if you have limited land, as it can help avoid the need to have multiple areas that get clearcut on a rotating basis.

In addition to upland shrub thickets, appropriate early-successional habitat can take many forms, including the vegetation types listed below.

David Tibbetts/USFWS

Figure 20. Coastal shrubland.

Coastal Shrublands

Between the high salt marsh of New England coasts and the adjacent upland vegetation, or on the backside of dune and cobble beaches, you can often find coastal shrublands. These shrubby areas occur above the average high tide line but can be flooded by storm tides. Wind, flooding, and heavy salt spray keep the seaward vegetation in a shrubby state by suppressing succession. Vegetation exposed to these conditions may remain in a shrub state indefinitely, and will just need to be monitored periodically to prevent invasion by exotic species.

Margaret Arbuthnot

Figure 21. Coastal shrubland.

In less exposed areas, coastal shrublands will grow more densely and will need management similar to that of other upland areas. Coastal shrublands are rare habitat types, which provide high quality foods for many types of wildlife.

Shrub Swamps

Wetlands dominated by dense woody vegetation less than 20 feet tall are known as shrub swamps. Common scrub-shrub species in these habitats include alders, buttonbush, red osier dogwood, and willows. Soils are seasonally or permanently flooded with up to 1 foot of water. These shrub habitats are less prone to succession than some upland shrub areas because they are often too wet for trees to grow at their normal rate of maturation. New England cottontails use shrub swamp habitat for shelter and feeding year-round, including the harsh winter and the summer breeding season. To make these environments more suitable for cottontails, large individual trees should be cut to provide sunlight to the shade-intolerant shrub species. They do not need to be extracted from the swamp, however, because the fallen trunk adds diversity to the understory and becomes habitat for many species.

Both photos by Margaret Arbuthnot

Figure 22. Shrub swamps.

Alder thickets provide particularly good habitat for New England cottontails. American woodcock can also benefit greatly from management of this habitat type. This hardy shrub species grows at a high density in a variety of soil types. Since alders suffer from shading, removing the overtopping trees in a wetland forest or brush cutting in shrub swamps will often result in rapid alder sprout growth, particularly in winter and spring. Dormant season cutting of alders is also a beneficial management tool since alders are capable of vigorous growth from stump sprouts. In the early spring, prescribed fires that kill only the aerial stems are also recommended for regeneration of speckled alder. Prescribed fire intervals of about 9 years are adequate to keep alder stands in the desired condition. Alternatively, alder can be propagated by planting seeds, seedlings, or possibly cuttings from an existing alder tree (see http://plants.usda.gov/plantguide/doc/cs_alinr.doc for more information).

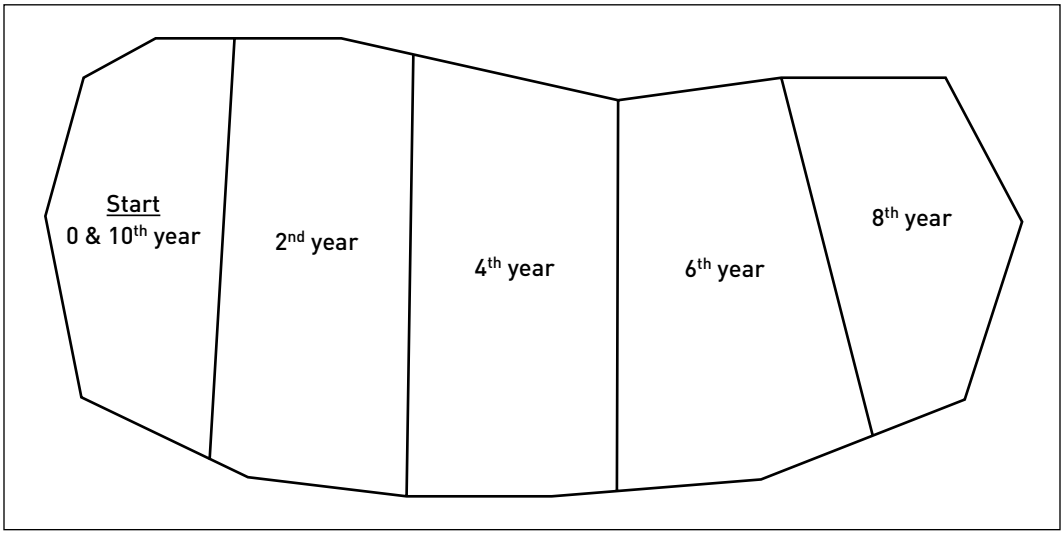


Figure 23. Example of 10-year Rotational Management of Alders
Strip cuts should be as wide as possible. If alder patches are small, consider reducing the number of strips to two or three and increasing the time between mowing adjacent strips to 4 or 5 years. Source: Jeff Norment/NRCS.

Anthony Tur/USFWS

Figure 24.
Pine barrens.

Pitch Pine – Scrub Oak Barrens

Pine barrens are shrubby habitats characterized by pitch pine, scrub oak, and low-growing woody shrub and heath species such as blueberry, wintergreen, and black huckleberry. They typically occur on dry coastal sand plains or on former New England coastal pastures with nutrient-poor soils. When exposed to occasional wildfire or prescribed fire, pitch pine and scrub oak communities have the ability to suppress forest regeneration and tree development, resulting in habitat that can benefit New England cottontails and other shrub obligate species for centuries. Some old pine barrens that have experienced an absence of fire for 50-100 years are undergoing forest succession, with the arrival of white pine and hardwoods such as red maple, red oak, and beech. However, in pine barrens where fires occur at least every 40 years, fire-adapted species such as pitch pine and scrub oak remain dominant. Fire clears away the leaf litter on the forest floor and eliminates fire-intolerant species that have invaded the community. After fire suppression is implemented, shrubs and groundcover re-grow quickly, while pitch pine and scrub oak re-sprout at higher densities than before.

To maintain pine barrens as New England cottontail habitat, the recommended management includes the careful use of prescribed fire once every 10-40 years. In communities that have become overgrown with hardwoods, 3-5 annual burns will initially be necessary to exclude the unwanted species, followed by a regular 10-40 year burn cycle. In suburban

areas or lands adjacent to residential development, prescribed burning can be challenging. In these areas, cutting or brush hogging scrub oak and pitch pine will maintain dense cover, since both species re-sprout vigorously from cut stems.

Bruce Hammond

Figure 25.
Old field.

Old Fields

In Maine, a majority of the sites occupied by New England cottontails are old fields such as idle agricultural lands, indicating that they are a preferred habitat for the species. Most cottontails are found in old fields approximately 10 to 25 years after farming or tree-cutting activities are stopped.

Old fields are relatively stable and will naturally persist as good habitat for 20 to 25 years. We recommend annual monitoring for invasion of exotic plants, but otherwise, occasional management actions such as selective cutting, mowing, or selective removal of fast-growing species such as aspen and undesirable trees should be all that is required to maintain the field in an appropriate environment. If these activities are performed about once every 5 to 15 years, they should prevent trees from becoming too large while still providing forage and cover plants, thus ensuring decades of early-successional habitat.

Reclaiming old fields more than 25 years post-disturbance requires more aggressive initial management. Grown trees (including all saplings over 3 inches in diameter) can be removed using a tree shear, hydro-ax, Brontosaurus, or other heavy-duty land clearing equipment. Afterwards, the area can be maintained by removing saplings and performing the treatments mentioned above every 5 to 15 years. More productive areas will require more frequent attention, with maintenance activities taking place every 1 to 3 years. A more exact management schedule should be determined based on the properties of each individual site. Contact a qualified natural resource specialist to determine the best course of action for your land (some contacts are listed in Appendix A).

In some instances, it is undesirable to wait for an old field habitat to succeed into a shrub dominated habitat. This is particularly true in croplands and grasslands that were intensively grazed or in previously developed areas, where shrublands will develop very slowly without some intervention. If travel corridors need to be established quickly, or a particular vegetative species composition is desired, planting can help jump-start the areas into suitable habitat. In areas where invasive, non-native species are dominant, planting shrublands may help prevent the establishment of a non-native monoculture. For more information, see Appendix C: Planting Shrublands.

Old Orchards

Abandoned orchards provide great food, cover, and nesting opportunities for a multitude of species. Interspersed with the apple trees are clumps of shrubs and seedling or

Margaret Arbuthnot

Figure 26. Old orchard.

Paul Bolstad/University of Minnesota/Bugwood.org

Figure 27. Young aspen stand.

sapling trees as well as a thick blanket of herbaceous ground cover. Bats, snakes, and many small mammals make their homes in this habitat. Once the area becomes dominated by overtopping hardwoods, however, there is a decline in early-successional wildlife species. Landowners can return an orchard to its early-successional state by removing overtopping trees and any trees larger than 3 inches in diameter, while leaving all apple trees. Invasive exotic plants can be treated with herbicide to control their growth and inhibit them from taking over the orchard. To maintain a mosaic of natural shrubs and trees, the orchard should be mowed or brush-hogged every 5 to 7 years.

Young Aspen Stands

Aspen saplings are known habitats for New England cottontails. During the herb/shrub stage of an aspen stand, which typically lasts only a year or two, aspens grow at high densities of 4,000 to 6,000 stems per acre. The aspen's underground system of root suckers sends up new sprouts on a regular basis, resulting in large colonies of trees that all originated from a single seedling. In order to maintain biodiversity and keep habitat in an early-successional stage, intensive initial management and frequent upkeep of aspen-dominated lands are required.

First, a half acre of land surrounding an aspen tree should be clearcut, including all other aspens in the area. The hardy root system, which can even survive intense forest fires, will produce seedlings up to a half acre from the single standing tree. Most regenerating sprouts appear within two years of disturbance, and many come from stump re-sprouting. Clearcutting and prescribed burning will promote growth of other seedling species in addition to aspen, resulting in a diverse young stand of habitat within just a few years. Management must involve frequent cutting in order to prevent the area from maturing into a closed-canopy forest.

Aspens occur naturally on a variety of dry and wet sites. Opening up an aspen stand on a sandy or gravelly dry site often results in an abundance of shrubs and herbs, including blueberry, beaked hazel, and wintergreen. Wet-site shrubs in aspen stands with fine-textured sediments and poor drainage include highbush blueberry, mountain holly, common winterberry, alders, viburnums, wood sorrel, and goldthread. This type of habitat will require frequent management including annual selective cutting, but will ensure quick regrowth of a dense understory favorable to cottontails.

Invasive Shrub Species and Methods for Control

New England cottontails often occupy habitat patches that contain exotic shrub species. Many of these invasive species (such as autumn olive, multiflora rose, Japanese barberry, buckthorn, and bush honeysuckle) contribute to the density of understory cover, but often spread at the expense of native species that may provide a better source of food for the cottontail. While the impact of exotic vegetation species on the New England cottontail is still being researched, exotic species pose well-known risks to other species and natural ecosystems. Therefore, when undertaking management work for the New England cottontail, it is important to avoid any actions that may promote the spread of invasives, and proactive monitoring and management are recommended to prevent exotic species from dominating a particular site.

If your site already has invasive, exotic plants, consult with a natural resource professional to evaluate your options. Removing all invasive plants at once may be detrimental to cottontail and other wildlife populations. A plan for sequential removal of exotic plants over a period of years may be warranted.

Since invasive plants can come to dominate an area within just two or three years, landowners should conduct annual inspections for the presence and spread of these species, and they should preferably be removed prior to seedset. If control of well-established invasive plants is deemed appropriate, landowners should follow species-specific guidelines. Manual, chemical, and biocontrol techniques can be found in "Invasive Exotic Plants in Early-Successional Habitats," Chapter 8 in *Managing Grasslands, Shrublands and Young Forests for Wildlife: A Guide for the Northeast* (Oehler et al. 2006) and on The Nature Conservancy's invasive species website, http://tncinvasives.ucdavis.edu. All other habitat management activities should also be carefully evaluated for their effect on exotic species, since activities such as cutting and burning can inadvertently lead to invasive seed dispersal or creation of habitats more favorable to invasives. For assistance in identifying the invasive plants of New England, visit www.ipane.org.

Multiflora Rose | Honeysuckle | Barberry | Oriental Bittersweet

Invasive Shrub Species

Clockwise from top left: Jim Oehler; Pam Wells; Kelly Boland/USFWS; Bruce Hammond; Bruce Hammond; Kelly Boland/USFWS; Margaret Arbuthnot

The Field-Forest Interface

The New England cottontail uses edge habitat (areas where two or more habitat types come together), such as the transition from forest to field, as long as it is in a thick and shrubby condition. As previously discussed, herbaceous food comprises the majority of the rabbit's diet during the summer season; therefore, open herbaceous areas proximal to shrub habitat may be beneficial if properly managed. Often the border or edge between forest and open land is straight and abrupt and does not provide optimum habitat conditions for the New England cottontail. In this case, landowners may want to manage or plant field borders to improve availability of high quality foods.

Cut-back borders or feathered edges can be used to create a softer transition between field and forest. An ideal cut-back border will exhibit a rough, irregular edge and the interior will be composed of a variety of shrubs, trees, blackberry, raspberry, vines such as greenbrier, and herbaceous plants. To create a cut-back border from an area with predominantly tall growing tree species, the following two methods will produce a tiered or layered result (Source: NRCS, West Virginia):

Toby Alexander/NRCS

Feathered edge.

Triple Tier Method:
Choose your desired border width. Cut all plants in the first one-third of the border that are greater than 1 inch in diameter. Within the next third, cut trees over 2 inches in diameter. In the final third, cut and remove all trees and shrubs over 4 inches in diameter.

Selective Tier Method:
Cut all trees in a selected strip that are of a height that, if felled in the direction of the field, would extend beyond the edge. This method results in cutting progressively larger trees as you move from the field to forest.

For both methods, desirable trees and shrubs (e.g., dogwoods, viburnums, serviceberry, etc.) should be retained. Border width may vary, but a minimum width of 50 feet is recommended and much wider borders are preferred. Once the cutback border is fully mature or the transition zone becomes abrupt, it may be necessary to re-establish the border.

Linear habitat features such as forest-field borders, hedgerows, and riparian (riverbank) buffers can serve as important travel and dispersal corridors for New England cottontail and help connect rabbit populations, thereby reducing fragmentation effects. By themselves, feathered edges are unlikely to provide suitable long-term conditions for New England cottontails. Please contact your local NRCS Service Center (http://offices.sc.egov.usda.gov/locator/app) for more information regarding the establishment of field borders, hedgerows, or riparian forest buffers.

Creating Young Forest Habitat

Forest owners also have the opportunity to manage habitat for New England cottontails, since the seedling stages of aspen, birch, northern hardwood, and red maple forests are especially important as some of the cottontail's preferred winter habitats. Management can be done on a small scale by constantly maintaining a patch of forest to keep it at an early-successional stage, or it can be integrated into larger forestry operations, which incorporate rotations of patch cuts to ensure that at least one patch is always suitable to cottontails. Smaller areas (5 to 10 acres) may be maintained as satellite patches as part of a larger, multi-property New England cottontail habitat management plan. A larger timber harvest to create early-successional habitat could be pre-commercial, break-even, or commercial, depending on the quantity and quality of forest products generated. Because the harvesting of timber and the size and distribution of clearcuts is regulated by many states and towns, landowners should contact local and state officials prior to harvesting timber to ensure their harvest will comply with all regulations. When considering forest management for wildlife habitat or any other management objective, landowners should consider hiring a licensed forester to write a forest management plan for their property and to administer any harvest. This will help ensure that best management practices are used to minimize the potential negative impacts of the harvest; that all applicable federal, state, and local regulations are followed; and that landowners are paid fairly for the wood harvested.

Ken Canfield/Maine Forest Service

Figure 28. Hardwood forest regeneration after forest cutting.

Maintaining Continuous Young Forest Habitat

Although most trees are late-successional species, dense, regenerating stands in the seedling/sapling stage provide good cover for early-successional obligates like the cottontail. There is a 10- to 15-year window during which regenerating hardwood forests provide suitable understory habitat before the tree canopy closes. Establishing early-successional forest with adequate understory density for the cottontail will, under most circumstances, require the intensive initial effort of clearcutting a tract of grown forest and allowing the trees and shrubs to re-sprout or grow from seed. Small patch cuts or small group selection cuts will not create the same habitat type, as remaining trees will expand their canopies quickly, blocking needed light from reaching the forest floor. Only larger clearcuts (5 or more acres in size) will enable shade-intolerant herbaceous plants, shrubs, and vines to grow, resulting in thicker ground cover.

In a mature maple forest, for example, a dense

understory can be created by clearcutting a tract of the forest and then allowing a few years of re-growth. During the initial clearcutting phase, individual trees larger than 3 inches in diameter can be cut with a chainsaw, and the remainder can be mowed with a brush hog, or a feller buncher can do both at once. After this initial treatment, the stand should be re-entered every 1 to 3 years in order to remove undesirable trees. As long as the tree canopy is kept open, appropriate habitat should be able to grow on the forest floor.

To maintain a constant supply of young forest habitat with less frequent management, forests should be managed on a rotational schedule. When one patch begins to enter the mid-successional stage, a more recently clearcut patch will be developing a dense understory of saplings ideal for cottontail use. Maintaining two or three patches of 10 or more acres each on a rotating schedule of management once every 5 years will ensure constant habitat for New England cottontails (see Fig. 29). Each type of forested community regenerates differently, so it would be best to consult your local forester to find recommendations most suitable for your land.

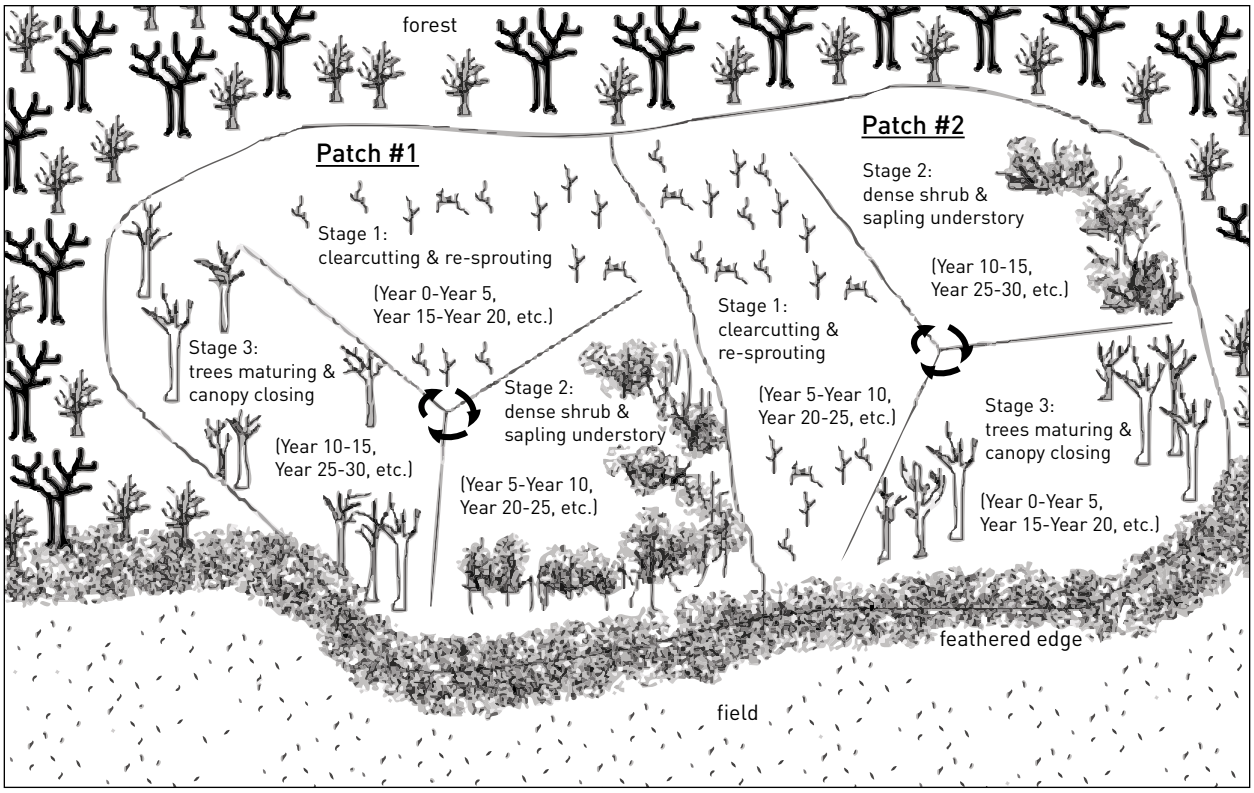


Figure 29. Two adjacent rotations of habitat management, with each patch growing for 15 years before the rotation is restarted. Source: Margaret Arbuthnot.

Integrating Habitat Management into Forestry Operations

Habitat management for New England cottontails is very compatible with long-term or large-scale forestry operations, as long as the rotational cutting scheme ensures that a patch of suitable habitat will be available at any given time.

Figure 30 depicts an example of an effective plan—a 100-year rotation of an 80 to 90 acre tract, consisting of five 10 to 15 acre even-aged forest stands centered around a 10

acre alder swamp. The goal is to eventually have adjacent forest stands differing in age by approximately 20 years, with at least 16 percent of the tract in regenerating early-successional forest integrated with permanent shrub refugia. The alder swamp is managed by brush-hogging half the stand every 5 to 10 years to maintain high quality habitat for New England cottontail. Within any 20-year period, a forested stand may be entered repeatedly to remove insect infested and/or diseased, malformed, or lesser quality trees to improve a stand. These treatments may create canopy gaps that will also create additional early-successional habitat. Snags and cavity trees can be retained to provide additional important wildlife habitat. When a stand reaches the 80 to 100 year age class it is ready for a clearcut harvest. Consult your local forester about forest management options suited to your forestland and your management objectives.

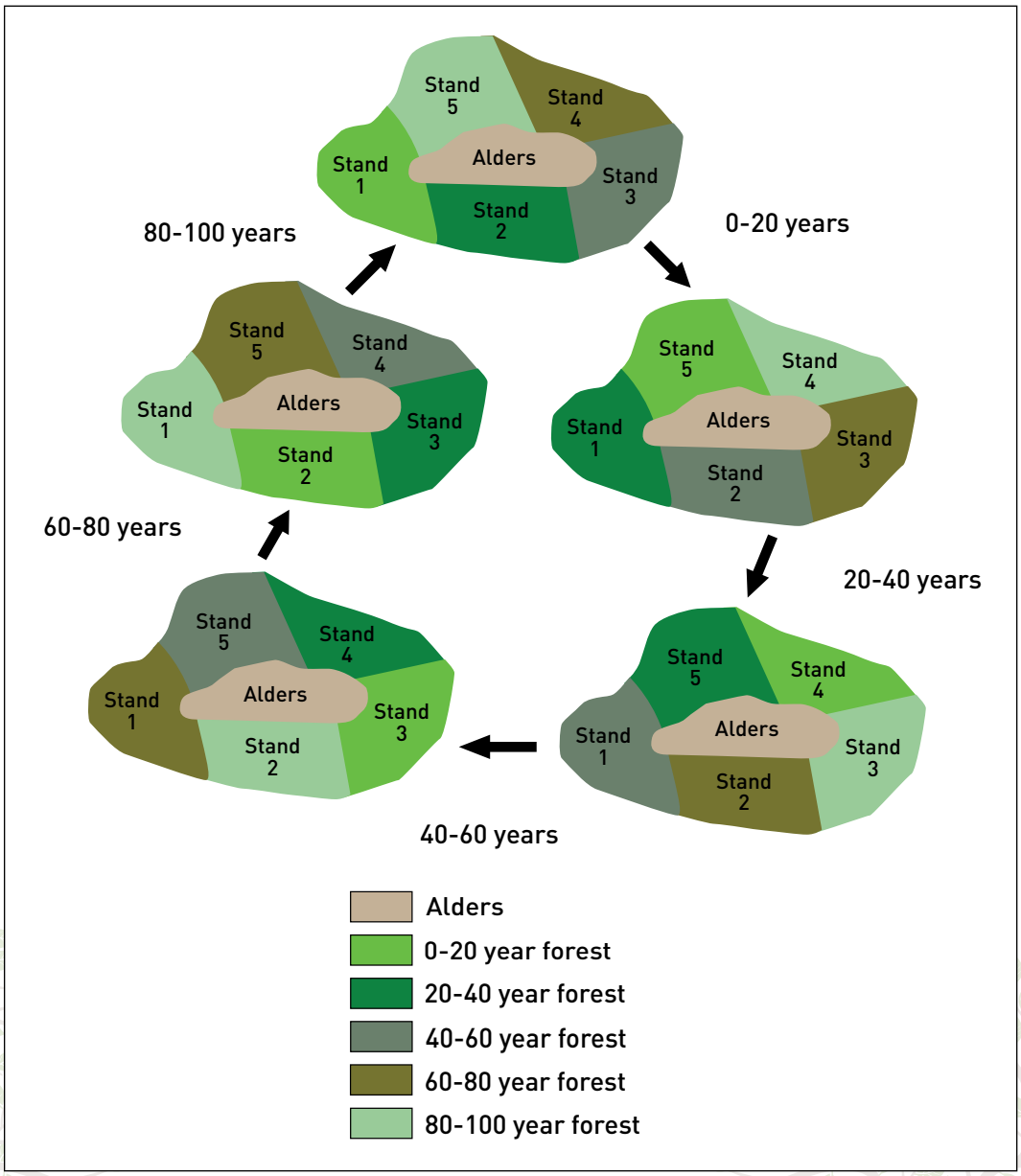


Figure 30. Conceptual 100-year rotational management of even-aged clearcut Northern hardwood stands adjacent to managed shrubland. The tract is approximately 80-90 acres in size with each management unit somewhere between 10 to 15 acres in size. Source: Jeff Norment/ NRCS.

Constructing Burrows and Brush Piles for New England Cottontails

Burrows

During extreme cold periods, cottontails benefit from underground dens or burrows that enable them to live below the frost layer. New England cottontails do not dig their own dens, but instead depend on burrows made and abandoned by woodchucks, foxes, and possibly coyotes. Additionally, old stone foundations and some rock walls can provide denning sites for cottontails. When these are not available, you can help by making artificial burrows using a corrugated plastic drainage pipe (see images below).

Both photos by Rod Sayler

Experimental burrow construction for Columbia Basin pygmy rabbits.

Brush Piles

When located close to other dense, shrubby habitat, brush piles may provide New England cottontails with additional shelter from predators and severe weather. Cuttings from forest management activities can be used to construct brush piles according to the guidelines below. Be sure to leave space at the bottom for cottontails to enter the piles, and place them near shrub habitat so that the rabbits are not trapped inside. Building a brush pile on top of an artificial burrow may provide extra protection for cottontails during winter.

NRCS

To construct brush piles:

- Lay at least four 6 foot logs, 6-10 inches in diameter, parallel to each other and 8-12 inches apart.
- Lay an equal number of similarly sized logs on and perpendicular to the base layer logs, creating a sturdy crisscross structure 12-20 inches in height.
- Pile smaller limbs and branches on top, and then crown it with loose brush to create an intertwining, tangled structure 4-6 feet in height.
- Maintain brush piles by periodically adding new limbs and branches.

Adapted from NRCS Fish and Wildlife Habitat Management Leaflet No. 4 (1999).

Setting Goals and Objectives

Assuming you have already determined that New England cottontails are located on or within half a mile of your land, you should keep the following issues in mind when developing a habitat management plan:

☑ ***Manage large areas.*** Since New England cottontails experience low survival in habitat patches less than 12 acres in size, the most valuable areas under management for the species will be at least this size. Blocks of 25 acres or more are preferred, since this is the minimum amount of habitat thought to sustain cottontail populations.

☑ ***Maintain dispersal corridors.*** If you plan to manage smaller satellite patches of habitat, corridors linking these patches to a larger core patch will be essential for the cottontails' population stability. Corridors can be narrow strips of shrubs along field edges, streams, or roads.

☑ ***Create a rotational management plan.*** Most New England cottontail habitat needs to be periodically restored by cutting, which usually makes the habitat unsuitable for the species for several years. Alternating management activities on two or more patches will ensure that the cottontail will always have suitable habitat.

☑ ***Coordinate with neighbors.*** Landowners with smaller properties can still contribute to New England cottontail habitat restoration by combining and coordinating their efforts. Contact neighboring landowners who might also be interested in managing for New England cottontail habitat, especially those with significant open space or shrubland habitat. Coordinate your timetable for management activities so that appropriate habitat will always be available.

☑ ***Conduct annual habitat reviews.*** Monitor the presence of invasive species, which can completely dominate your habitat area within 2 or 3 years if left unchecked. Avoid setbacks and maintain native plant diversity by removing exotic species on a yearly basis (see page 19). You should also monitor the density and height of the vegetation in your management areas. If stem density becomes too thin or tall trees begin to block sunlight from other plants, it is time to restore the shrubland habitat.

☑ ***Enjoy your cottontails and other early-successional wildlife.*** Periodically visit your thicket to check for cottontail pellets, especially at the end of a long winter. Maintain burrows or brush piles. Cut trails so you can access different areas of your thickets. Take your friends and family on excursions through the thicket to discover the wildlife using your habitat!

Obtaining Financial and Technical Assistance

Creating and maintaining New England cottontail habitat may require labor or specialized equipment not available to you. Not to worry—state, federal, and private agencies are often looking for landowners who want to manage their land for early-successional habitat, and are willing to provide financial and technical assistance. The U.S. Department of Agriculture's **Natural Resources Conservation Service** has financial and technical assistance programs to help private landowners manage habitat for wildlife. **U.S. Fish & Wildlife Service**'s Partners for Fish and Wildlife Program provides financial and technical assistance for landowners looking to establish a long-term habitat management project. **State agencies** such as the Department of Fisheries and Wildlife or the Department of Conservation might also be able to provide technical support or suggest funding sources for your project. **Nonprofit conservation organizations** may be able to provide technical advice and assistance, and **land trusts** can help landowners protect habitat while also realizing tax or other practical benefits. For more specific ideas, see Appendix A: Resources & Assistance. We also suggest printing the updated list of resources available in your state from www.edf.org/cottontail and stapling the list to the last page of this publication for easy reference.

Obtaining Assurances Regarding Endangered Species Regulations

New England cottontails are found primarily on private land, which means that their survival will depend largely on the actions of private landowners. While many landowners are eager to manage their property to provide wildlife habitat, some may also be concerned that providing a home for wildlife that is currently or potentially listed under the state or federal Endangered Species Act will create regulatory headaches. Fortunately, there are good options under the Endangered Species Act for addressing those concerns.

The federal Endangered Species Act authorizes so-called Candidate Conservation Agreements with Assurances (CCAAs). Under this program, if a landowner agrees to restore habitat for a species that is a candidate for federal listing (like the New England cottontail), the landowner will not face any additional regulatory requirements should that species end up getting listed. By voluntarily agreeing to restore habitat on their property, landowners under a CCAA can work with wildlife experts to develop a habitat restoration plan that is compatible with the landowner's other goals for his or her property—and can rest assured that they will not have to take any additional steps for the species if it ends up getting listed. A similar program, called a Safe Harbor Agreement, is available for species that are currently federally listed. Some states also offer parallel programs under state law.

More information about Candidate Conservation Agreements with Assurances and Safe Harbor Agreements is available on the web at:
http://www.edf.org/cci
http://www.fws.gov/endangered/pdfs/listing/ccaa.pdf
http://www.fws.gov/endangered/factsheets/harborqa.pdf

Contact your local U.S. Fish and Wildlife Service office if you are interested in exploring how one of these programs might work on your property (see Appendix A or http://www.edf.org/cottontail for contact information).

Appendix A: Resources & Assistance

Note: For a more detailed list of contacts in your state, visit http://www.edf.org/cottontail. We recommend that you print this updated, state-specific list of contacts and staple it to the inside back cover of this guide.

U.S. Department of Agriculture

Natural Resources Conservation Service (NRCS)

NRCS provides technical and financial assistance that enable people to care for their land and to be good stewards of the nation's soil, water, and related natural resources on non-federal land. NRCS helps deliver multiple USDA incentives-based conservation programs such as the Wildlife Habitat Incentives Program, Environmental Quality Incentives Program, and Conservation Reserve Program, to name a few. NRCS also has programs with conservation easement options such as the Farm and Ranchland Protection Program, Wetlands Reserve Program, and Healthy Forests Reserve Program. Please find and contact your local NRCS Service Center using the Service Center Locator, http://offices.sc.egov.usda.gov/locator/app, to determine which programs are available and appropriate for your conservation goals. USDA is an equal opportunity provider and employer.

U.S. Fish & Wildlife Service

For assistance with habitat restoration projects or Candidate Conservation Agreements with Assurances, please contact the Partners for Fish and Wildlife Program or the Endangered Species Program.

Partners for Fish and Wildlife Program

Northeast Region: (413) 253-8614

The Partners for Fish and Wildlife Program provides technical assistance and delivers on-the-ground restoration projects, particularly to private landowners, farmers, ranchers, and corporations. The Program can assist with projects in all habitat types which conserve or restore native vegetation, hydrology, and soils associated with imperiled ecosystems such as longleaf pine, bottomland hardwoods, tropical forests, native prairies, marshes, rivers and streams, or otherwise provide an important habitat requisite for a rare, declining or protected species. The Program's locally-based field biologists work one-on-one with private landowners and other partners to plan, implement, and monitor their projects. Program field staff help landowners find other sources of funding and help them through the permitting process, as necessary. This personal attention and follow-through is a significant strength of the Program that has led to national recognition and wide support. See http://www.fws.gov/partners/docs/783.pdf for more information.

Endangered Species Program

The Endangered Species Act of 1973 (ESA) gives the Secretary of the Interior responsibility for making a very important decision: determining whether to place an animal

or plant on the Federal list of endangered and threatened species. This responsibility is delegated to the Director of the U.S. Fish and Wildlife Service (FWS) and is administered through the Endangered Species Program in the various Ecological Services Field Offices throughout the country. The purpose of the Endangered Species Act is to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved, to provide for their conservation and to take steps to safeguard the Nation's heritage in fish, wildlife, and plants. These steps can include Cooperative Conservation efforts with landowners, as detailed in Appendix E.

Endangered Species Program
New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03224
Phone: (603) 223-2541

Endangered Species Program
Maine Field Office
1168 Main Street
Old Town, ME 04468
Phone: (207) 827-5938

Endangered Species Program
New York Field Office
3817 Luker Rd.
Cortland, NY 13045
Phone: (607) 753-9334

National Fish and Wildlife Foundation

The National Fish and Wildlife Foundation (NFWF) is a 501(c)(3) non-profit that preserves and restores America's native wildlife species and habitats. In 1984, Congress tasked NFWF with a mandate to direct public conservation dollars to the most pressing environmental needs and match those investments with private funds. The Foundation has launched a 10-year initiative focused around the conservation of early-successional habitat and that specifically targets the New England cottontail as a priority. Funding may be available for habitat restoration, management, research, land protection or other activities through many of the Foundation's grant programs including Keystone Grants, National Wildlife Refuge Friends Group Grants, Native Plant Conservation Grants, Pulling Together Initiative and Acres for America. For more information visit www.nfwf.org/wildlife.

State of Maine

Department of Inland Fisheries & Wildlife
Resource Assessment Section, Bangor: (207) 941-4466
http://maine.gov/ifw

State of New Hampshire

Department of Fish & Game
http://www.wildlife.state.nh.us

State of Vermont

Department of Fish & Wildlife
http://www.vtfishandwildlife.com

State of New York

Bureau of Wildlife, Department of Environmental Conservation
http://www.dec.ny.gov/animals/263.html

State of Massachusetts

MassWildlife (Division of Fisheries & Wildlife, Department of Fish & Game)
http://www.mass.gov/masswildlife

State of Connecticut

Wildlife Division, Bureau of Natural Resources, Department of Environmental Protection
http://www.ct.gov/dep

State of Rhode Island

Division of Fish & Wildlife, Department of Environmental Management
http://www.dem.ri.gov/programs/bnatres/fishwild

Environmental Defense Fund

Center for Conservation Incentives
New England regional office: (617) 723-2996
The Center for Conservation Incentives (CCI) is an Environmental Defense Fund initiative to develop and expand landowner incentives for the conservation of natural resources and rare plants and animals. Our focus is on working farms, ranches, non-industrial forestlands and other private lands. We work with landowners across the nation and partner with local and national conservation organizations, producers and producer organizations, state and federal agencies, universities and extension services, and more. Our work includes both on-the-ground conservation projects and policy work on the state and national levels. Visit http://www.edf.org/cci for more information.

For a more extensive and up-to-date list of the resources and contacts in your state, visit http://www.edf.org/cottontail.

Scott Richardson/Wells Reserve

Toby Alexander/NRCS

Figure 31 (top). A hydro-ax cuts down 10 acres of mature alder to create regenerating habitat for New England cottontails.

Figure 32 (bottom). Early-successional habitat restoration with a Brontosaurus.

Mechanical Treatments

Individual trees that are invading shrublands can be removed with a chainsaw or brushsaw, and/or with mowing, grinding or chipping equipment. Aside from pitch pine, scrub oak, and apple trees, all trees larger than three inches in diameter should be removed, unless they serve valuable uses to other wildlife by providing dens or producing fruit. Once trees have been removed, the site can be maintained through periodic use of heavy-duty mowing equipment. Trees three inches or less in diameter can be cleared with most commercially available brush hogs. In some instances, machinery larger than a tractor and brush hog may be needed to remove saplings, tangles of multiflora rose, or other vegetation that is difficult to remove. A heavy duty Brontosaurus, hydro-ax, or other suitable equipment may be required. Any type of mower should be set at least six inches off the ground.

The timing of management mowing and brush-hogging is important. Winter treatments, performed when shrubs are dormant, are less likely to harm wildlife and more likely to promote shrub regeneration. You should only perform mechanical treatments during the growing season if you are trying to get rid of invasives. Site-by-site treatments will vary; therefore, you are advised to contact a qualified natural resource specialist before performing management activities.

Controlled Burning

Prescribed burning is a less frequently used yet often effective technique to maintain shrubland habitats in the Northeast that are favorable to many early-successional obligate species. Burning once every 2 to 4 years is an effective way to restore or reclaim shrublands with a heavy tree component. The timing of the burn is important—burning in the early spring or when the plants are dormant in the fall will help maintain the current vegetative state by top-killing young trees and shrubs, allowing them to re-sprout. Contact your state forestry agency concerning applicable laws, liability, and permit requirements associated with open burning. Obtain the services of a certified fire specialist to prescribe a burn plan, and to oversee all burning to ensure the prescriptions are met.

Herbicide Application

Herbicides can be an effective tool against the invasion of undesirable plants, especially invasive species that cannot be controlled simply by cutting or burning. Herbicide treatments are often coupled with treatments described above for greatest effect. Additionally,

USFWS photo

Figure 33. A prescribed burn to restore early-successional habitat.

timing of chemical application may be critical for control of certain species. All chemical use must be compliant with state and federal law, so be sure to follow label instructions carefully. Special precautions must be taken to ensure that only target species are affected, especially near wetlands or open water. It is important to carefully select herbicides that are the least toxic, the least persistent, and the least mobile. The cut-stem method of spraying or painting stumps of selectively cut trees or shrubs is an effective technique with a low probability of affecting non-target species. For smaller trees and plants with smooth bark, painting a 6 to 12 inch band of herbicide around the trunk about one foot off the ground is also an effective, targeted technique. Another alternative utilizes a specialized hatchet with a concentrated supply of herbicide that is applied when the hatchet comes into contact with the target. These methods use a high concentration of active ingredients, so any excess that runs off may contaminate the surrounding environment. Herbicides should only be used as part of an Integrated Pest Management Plan and should only be used to control problem species.

For more detailed information, consult "Habitat Management Tools," Chapter 10 in *Managing Grasslands, Shrublands and Young Forests for Wildlife: A Guide to the Northeast* (Oehler et al. 2006), accessible online at http://www.wildlife.state.nh.us/Wildlife/Northeast_Hab_Mgt_Guide.htm.

Appendix C: Planting Shrublands

To plant a shrubland, nursery stock from container grown plants can be used—the advantage is that these plants are generally a couple years old, but the disadvantage is that they can be pricey. Bareroot stock can also be used, and is generally much less expensive, but is often younger and may take a bit longer to grow. However, since it is so much less expensive, it can be affordably planted at a higher density.

Be sure your stock is from a reputable native plant source and is truly native. Plant materials should exhibit certain minimum standards for purchase. The following guidelines are provided by United States Department of Agriculture's Natural Resources Conservation Service.

Coniferous Bareroot Seedlings

Characteristics	
Minimum Stem Length	≥ 8 in.
Minimum Root Collar Diameter	≥ 3/8 in.
Tap Root Length	≥ 7 in.

Hardwood Bareroot & Containerized Tubing (plugs)

Root Collar Diameter	1/4 - 3/8 in.
Stem Length	12 - 18 in.

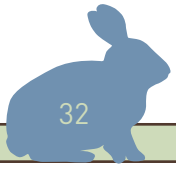
Cuttings

Characteristics	Dormant Cuttings	Willow Whips	Live Stakes
Length	8-12 in.	4-8 ft.	1-3 ft.
Diameter	1/2 - 3/8 in.	3/8 - 5/8 in.	3/8 - 5/8 in.

Balled or Burlapped Saplings

Characteristics	Good	Bad
Overall Form	well formed	poor form
Branches	well spaced, strong crotches	poorly spaced, weak crotches
Foliage	full, good color & condition	sparse, poor color & condition
Bark	tight	slipping
Roots	adequate space	root bound, cut roots, > 1 in. diameter

Site preparation prior to planting is critical, especially when sod-forming grasses are well-established. The process may involve laying-back narrow strips of sod (i.e., scalping) to create furrows with exposed soil, band or spot spraying of herbicides, or fall tillage. Sometimes herbicides are used in conjunction with mechanical site preparation techniques. Site prepa-



ration is often performed during fall, with a spring planting. If soil compaction is a problem, use a subsoil ripper or shank plow in the planting row immediately prior to planting.

Proper handling of bareroot stock is also critical to maximize survival potential. During transportation, handling and planting, seedlings should be kept: loosely covered, out of direct sunlight, from wind and temperatures below freezing or above 50°F, separated from petroleum products or fumes, stacked no more than two bundles deep and provided with adequate ventilation, moist by watering root collars twice a week unless coated with clay slurry or otherwise treated. If not planted within 5 days, seedlings should be kept in cold storage at 35° to 38°F. No seedlings should be stored more than 10 calendar days after lifting.

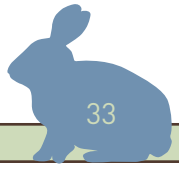
In large-scale restorations, a tractor-mounted auger is helpful to drill planting holes for container-sized plants. Smaller whips or bareroot stock can be planted with a planting shovel or dibble stick, planting tools commonly used by foresters.

Bareroot and containerized seedlings should be planted vertically with straight roots, and should be firmly packed. Plant roots must be in contact with soil, so use the shovel to back-fill or close any gaps which result from your planting hole. Containerized seedlings should be planted with soil up to and slightly covering the root plug. Burlapped or larger containerized plants ideally should be placed in holes 3 to 5 times the width of the rootball and deep enough so the top of the rootball is even with the soil surface. Remove all synthetic or treated components (i.e., wire, nylon, or treated burlap) from the rootball; otherwise, remove degradable material from the upper $^1/_3$ of the rootball and all material surrounding the trunk. Do not cover the top of a rootball with soil. Cuttings should be planted during the dormant season. Three quarters of a live stake or unrooted cutting should be placed underground, with the buds properly oriented skyward.

In general, spring planting prior to May 30th or late fall planting is desirable so plants will have time to establish before the harsh, dry summer arrives. In initial plantings, the plants should be watered in and the soil tamped down to prevent air pockets. Afterward, watering the plants during dry spells or until dormancy and controlling competing herbaceous and woody vegetation will boost survival.

Finally, pick your species to plant carefully, choosing plants which will thrive given your site conditions. For wet areas, dogwoods, alders, viburnums, willows, buttonbush, winterberry, maleberry, and highbush blueberry are best. In drier areas, aspen, juniper, gray birch, native roses, greenbrier, and staghorn or smooth sumac provide winter food for cottontails.

Another alternative to planting shrublands involves direct seeding. This can be an extremely cost effective way to establish new shrublands, especially over larger areas. First, it requires a rigorous evaluation of the site. Familiarity with the soils, hydrology, herbivore pressure, and other factors must be understood. With this information, along with knowledge of the growth habits of various species of native shrubs, a prescription for seeding the area can be developed (a procedure best left to someone with experience).



Appendix D: Species of Greatest Conservation Need in New England that Require Young Forest and Shrubland Habitats

SPECIES	SCIENTIFIC NAME
American Redstart	*Setophaga ruticilla*
American Woodcock	*Scolopax minor*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Black Racer	*Coluber constrictor*
Blue-spotted Salamander	*Ambystoma laterale*
Blue-winged Warbler	*Vermivora pinus*
Brown Thrasher	*Toxostoma rufum*
Chestnut-sided Warbler	*Dendroica pensylvanica*
Common Gray Fox	*Urocyon cinereoargenteus*
Eastern Hognose Snake	*Heterodon platirhinos*
Eastern Towhee	*Pipilo erythrophthalmus*
Field Sparrow	*Spizella pusilla*
Golden-winged Warbler	*Vermivora chrysoptera*
Gray Catbird	*Dumetella carolinensis*
Indigo Bunting	*Passerina cyanea*
New England Cottontail	*Sylvilagus transitionalis*
Northern Bobwhite	*Colinus virginianus*
Prairie Warbler	*Dendroica discolor*
Ruby-throated Hummingbird	*Archilochus colubris*
Ruffed Grouse	*Bonasa umbellus*
Savannah Sparrow	*Passerculus sandwichensis*
Spotted Turtle	*Clemmys guttata*
White-eyed Vireo	*Vireo griseus*
White-throated Sparrow	*Zonotrichia albicollis*
Wood Thrush	*Hylocichla mustelina*
Yellow-billed Cuckoo	*Coccyzus americanus*
Yellow-breasted Chat	*Icteria virens*

Adapted from: *Northern Forest Woodcock Habitat Initiative: Other Species with Similar Habitat Requirements*, http://timberdoodle.org/index.php?option=com_content&view=article&id=61:other-species-northern-forest&catid=44:northern-forest&Itemid=91.

Appendix E: The U.S. Fish & Wildlife Candidate Conservation Program

The U.S. Fish & Wildlife Service's Candidate Conservation Program uniquely bridges the non-regulatory and regulatory approaches to species conservation. Two key elements:

- Conducting assessments to identify species most in need of the Endangered Species Act's protection.
- Working through partnerships to conserve these species by improving habitat and removing threats.

Species Assessments—These assessments identify candidates for listing under the Endangered Species Act and provide conservation recommendations that can reduce or remove threats so that listing the species will be unnecessary. A fact sheet summarizing the Service's findings regarding the New England cottontail can be downloaded from http://www.fws.gov/northeast/pdf/necotton.fs.pdf, and the full Candidate Species Assessment for the New England cottontail can be accessed at http://ecos.fws.gov/docs/candforms_pdf/r5/A09B_V01.pdf

- Process emphasizes coordination with states to obtain the best available information on species status and recommendations for conservation.
- Provides the foundation for planning and implementing voluntary conservation efforts that are most likely to be effective in making listing unnecessary.

Cooperative Conservation—Through a broad suite of public and private partners, the Cooperative Conservation Program provides technical assistance and leverages funding for conservation of candidate and other at-risk species.

- Provides information to guide strategic approaches to ensure voluntary efforts occur where they are most needed and most likely to be effective in making listing unnecessary.
- Facilitates development and implementation of Candidate Conservation Agreements and Candidate Conservation Agreements with Assurances.

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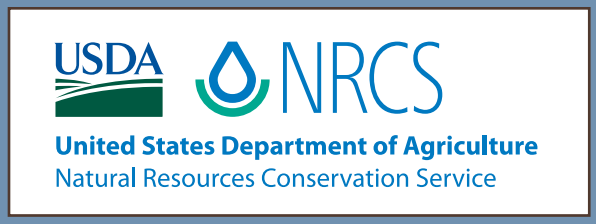
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