

Best Management Practices for the New England Cottontail



**How to Create, Enhance,
and Maintain Habitat**

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A Regional Land Manager's Guide

Developed by the New England Cottontail Regional Technical Committee, Best Management Practices (BMP) Subcommittee, under the authority of the Young Forest Conservation Initiative Executive Committee. These groups include representatives from the U.S. Fish and Wildlife Service (USFWS), the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), the Wildlife Management Institute (WMI), the state universities of New York, New Hampshire, Rhode Island, and Connecticut, and state wildlife agencies from Connecticut, Maine, Massachusetts, New Hampshire, New York, and Rhode Island.

First published July 2013; revised January 2017, and approved by the Young Forest Conservation Initiative Executive Committee February 2017.

This publication is intended to provide guidance on how to create, enhance, and maintain habitat for the New England cottontail (abbreviated NEC) while incorporating Best Management Practices to minimize harm to existing cottontail populations. It summarizes problems faced by NEC; the species' habitat requirements; current accepted Best Management Practices; potential habitat types to be managed; and management options.

Best Management Practices and the habitat management options described herein will be useful to a wide variety of people and entities who manage land: public land managers, consulting foresters, land trusts, fish and game clubs, private landowners, town and county conservation commissions, and others. This publication serves as a guide. Managers can modify these guidelines based on the presence of or the need to manage for other wildlife species or natural resources, or to comply with federal, state, and/or local regulations. In some states, NEC may be protected under state endangered species laws; in these states, land managers should work closely with state wildlife agencies to make sure any management activities or actions are consistent with regulations.

As wildlife biologists study and monitor NEC populations and habitat use, new information continues to become available. These guidelines and BMPs are based on the current state of knowledge; periodic revisions may be necessary based on new research findings, monitoring results, and habitat practices being developed and used throughout the NEC's range. For state-specific recommendations, information on resource concerns, or additional guidance, contact state or federal habitat professionals. (See Contacts at the end of this document.)

Thanks go to all the members of the Best Management Practices Subcommittee, and others that contributed to the original July 2013 publication and the current revision. Special thanks go to the Connecticut Department of Energy and Environmental Protection Wildlife Division for their efforts on the original version and in revising this edition.

The development of these BMPs and the printing of this publication were supported by Wildlife Restoration Grant funds, through a grant administered by the U.S. Fish and Wildlife Service Division of Wildlife and Sport Fish Restoration.

Published 2017

Cover Photo: Victor Young/New Hampshire Fish & Game

Editing: Charles Fergus, WMI

Design: MajaDesign, Inc.

Production: Ghostwriters Communications, Inc.

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Introduction

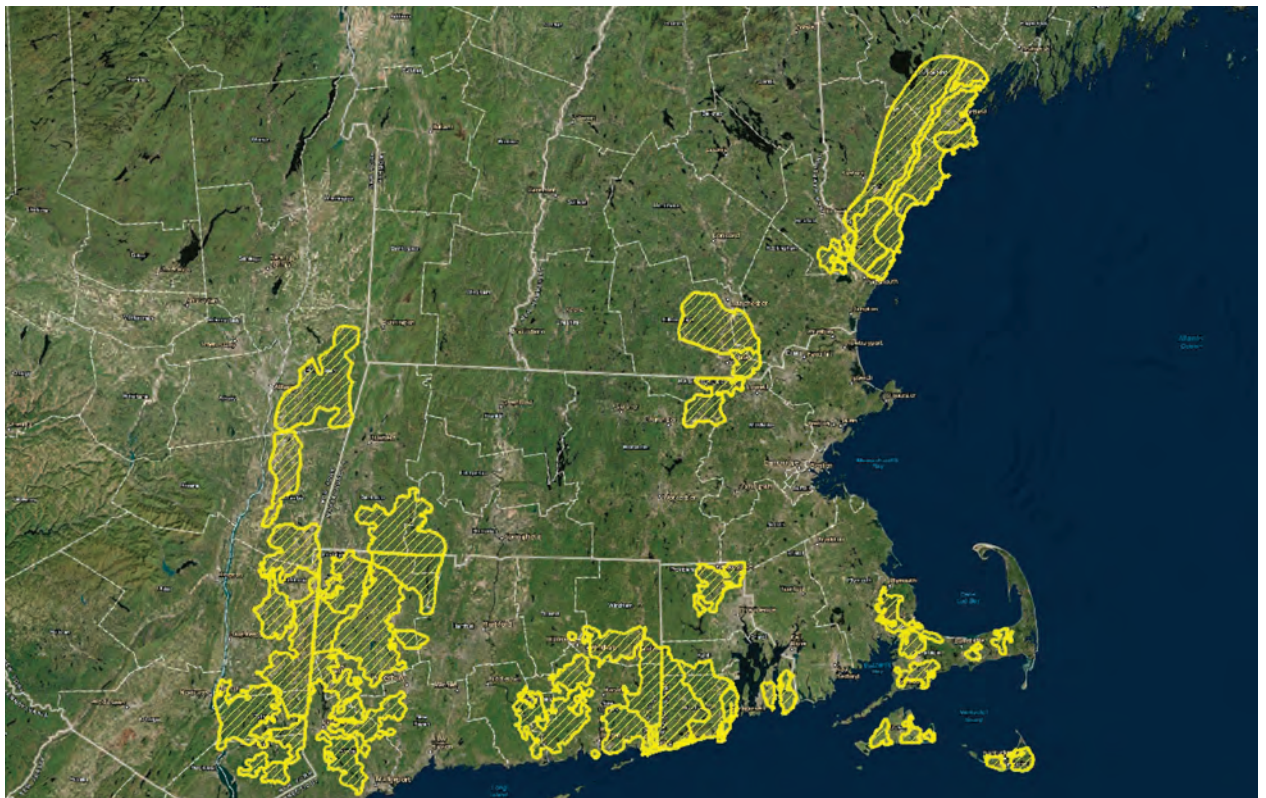
The New England cottontail (*Sylvilagus transitionalis*), abbreviated NEC, is the region's only native cottontail rabbit.

Historically, this species inhabited much of New England and eastern New York. As a result of widespread habitat loss, its range has been reduced by more than 86 percent, leaving five isolated populations in the region.

In response to this widespread habitat and population decline, in 2006 the U.S. Fish & Wildlife Service (USFWS) designated the NEC a candidate species for protection under the federal Endangered Species Act. State and federal biologists began organizing a conservation effort, and in 2011 the Regional New England Cottontail Initiative was formally established with support from state and

federal agencies, universities, and nonprofit organizations. The *Conservation Strategy for the New England Cottontail* was developed in 2012 with specific objectives and measurable outcomes. It provides guidance for restoration of the species through the year 2030. In 2015, the USFWS determined that the NEC did not need to be given threatened or endangered status, basing that decision on an evaluation of the conservation efforts that had been implemented on the species' behalf so far and that are expected to continue into the future.

Populations of NEC remain in parts of the following states: Connecticut, Maine, Massachusetts, New Hampshire, New York, and Rhode Island.

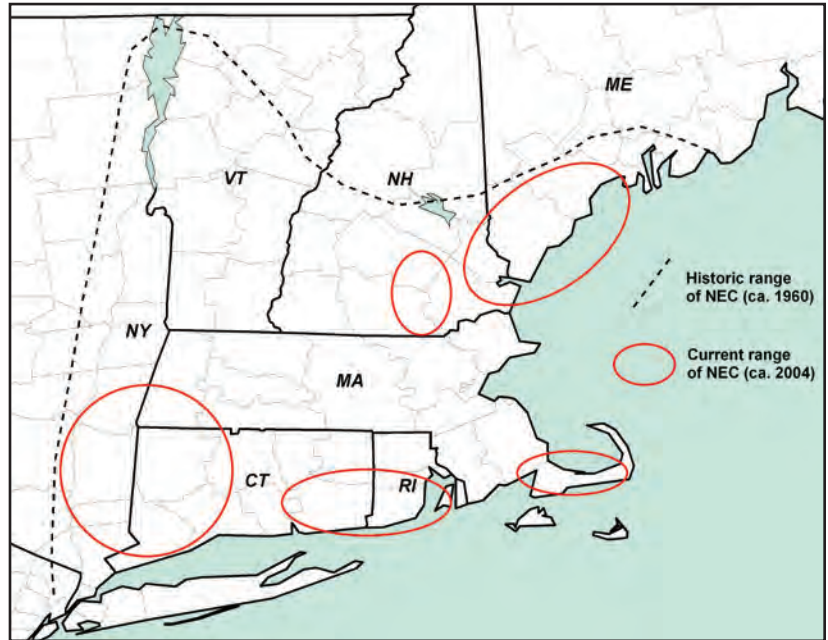


Conservationists are concentrating efforts to help New England cottontails by creating and refreshing young forest habitat in the Regional Focus Areas shown in yellow. NEC may also occur in other parts of the region. Credit: Lisa Wahle

In addition to the native NEC, this region also supports populations of the eastern cottontail, a nonnative cottontail introduced in the early 1900s to boost game numbers. Introduced eastern cottontail populations quickly expanded and became firmly established in New York and all of the New England states except Maine. Although similar in appearance, the NEC and eastern cottontail differ in their biology and habitat needs.

While the NEC requires large patches of dense shrubland or thickets (collectively referred to as “young forest” or “early successional habitat”), the eastern cottontail can use a much wider variety of habitats, including lawns, agricultural fields, and small brush patches. This ability to thrive in different – and smaller – habitats makes the eastern cottontail well suited to the region’s increasingly fragmented suburban landscape. The eastern cottontail has larger eyes than the NEC, which may help it detect and evade predators more easily than our native cottontail. Perhaps for these reasons, the eastern cottontail has displaced the NEC throughout much of its range. Currently, there is no evidence that the two species interbreed, and our understanding of how they interact is limited.

Habitat loss and degradation are the main causes of the NEC’s decline. As a habitat patch decreases in size and quality, individual rabbits may need to venture farther away from protective cover, leaving them vulnerable to a variety of mortality factors, primarily predation. The early successional habitat or young forest habitat that they need has been disappearing as old brushy fields naturally mature into closed-canopy forest, and as other prime cottontail habitat has been eliminated or fragmented due to intense development. Scientists believe that ongoing land development will result in



Historic range of the New England cottontail is indicated by the broken black line. Red circles show approximate range as of 2004. Credit: Pete Bowman

a 2 percent range loss for NEC each year. As humans expand their developments, we also work to suppress natural disturbances, such as wildfires, beaver activities, and flooding, that once created ample early successional habitat on the landscape. In addition, opposition by some members of the public to tree harvesting and prescribed burning make it increasingly challenging for land managers to conduct activities that create or maintain habitat for NEC.

To bring back the NEC, biologists have used field surveys and computer modeling to identify Focus Areas having the best potential for restoring populations. Forty-one Focus Areas have been delineated in the region, with the capacity to support 80 metapopulations of NEC. (A metapopulation is a group of populations separated spatially but which may interact when individuals move from one population to another.) Each Focus Area will have a number of habitat patches, with patch sizes ideally 25 acres or larger.



Many wild creatures use habitat created for New England cottontails. Credits, clockwise from upper left: eastern towhee, Bill Thompson; box turtle, Jonathan Mays; American woodcock, Tim Flanigan; fritillary butterfly, Richard Martin; brown thrasher, Ed Guthro

The USFWS has set a regional NEC habitat restoration goal of 27,000 acres, and all cooperating states developed habitat management goals that, in total acreage, exceed the USFWS goal. While the unprecedented conservation efforts put forth by cooperating states have combined to make great strides toward reaching the regional and individual state habitat restoration goals, habitat management work must continue to ensure that NEC populations remain secure and viable into the future.

Please note: Federal and state conservationists can work to restore NEC habitat on public lands. However, most of the land within the species' range is privately owned, and therefore private landowners must play a key role in securing a future for this species. By managing some of their land as young forest, landowners can provide cottontails with the food and cover they need to evade predators and to survive harsh, cold winters. Habitat suitable for NEC also benefits more than 60 other wildlife Species of Greatest Conservation Need in the states where NEC exist.

Habitat suitable for New England cottontails also benefits more than 60 other wildlife Species of Greatest Conservation Need.

NEC Habitat Requirements

Wildlife habitat is an area that, through its physical and biological features, provides the essential elements needed by wild animals to survive: food, water, shelter, and living space. It includes breeding, feeding, resting, migratory, and wintering areas. Habitat for NEC must meet the rabbits' year-round needs, supplying well-distributed cover to protect against inclement weather and predators, sufficient food in all seasons, and the opportunity for rabbits to disperse, or move, to other patches of suitable habitat, either to colonize those patches or to find mates.

Site-Specific Habitat Patch Characteristics

Good NEC habitat consists of dense horizontal and vertical woody cover 3 to 15 feet high, with multiple layers of vegetation and typically having a minimum stem density of 20,000 stems per acre. This provides adequate cover to avoid predators, and a food source during critical winter months. Woody cover shorter than 3 feet does not afford enough overhead cover, and trees taller than 15 feet tend to have larger crowns that shade out the dense



New England cottontails find food and cover in thick habitat such as this patch of shrubs in southern Maine. Credit: Kelly Boland



If vegetation is dense enough that it is nearly impossible for a person to walk through, it constitutes good NEC cover.

Harvesting timber spurs the regrowth of small trees and shrubs that offer dense cover in which New England cottontails can find food, breed, rear young, evade predators, and survive winter weather. Credit: Charles Fergus

vegetation at or near ground level. The ideal habitat patch is a tangle of sapling trees, vines, briars, shrubs, and broadleaved plants, interspersed with sunny openings where rabbits can feed on grasses and other herbaceous plants during summer. As a rule of thumb, if vegetation is dense enough that it is nearly impossible for a person to walk through, it constitutes good NEC cover.

In some parts of the species' range, NEC also may use more-mature canopied forest where shade-tolerant native or invasive shrubs offer suitably thick understory cover. Conifers with low-growing branches and ground juniper can provide excellent winter cover when leaves have fallen off deciduous plants and trees. NECs also need well-drained areas with dense cover for nesting.

Habitat Patch Size and Dispersal Corridors

A habitat patch should be at least 10 acres in area, ideally 25 acres, and, where possible, located within 3 kilometers (approximately 2 miles) of other good habitat. Smaller habitat patches may also have value, especially if they are next to or near other suitable habitat. Patches should be wide and large enough to allow ample sunlight to reach the ground and

promote shrub growth and regeneration. Linear habitats such as riparian corridors (brushy areas along rivers and streams) and utility rights-of-way can provide cover that NEC can use when dispersing, and can connect the larger habitat patches needed to sustain populations over time. However, a long, narrow habitat patch that runs north-south will probably not receive enough sunlight to support dense shrub growth. Adding new patches adjacent to these corridors is an efficient way to increase habitat acreage and facilitate NEC dispersal.

Management in Habitat Occupied, Potentially Occupied, and Unoccupied by NEC

Habitats with thick understory should be treated as if they are occupied by NEC, and as if there is a potential for a local rabbit population to be harmed through management actions. If there is clear evidence that no NEC are present, management can be conducted using standard forestry BMPs and activities that comply with state or local rules and regulations. On occupied or potentially occupied sites, management should take place in incremental phases to ensure that some suitable habitat will be left for any local NEC

populations while work is completed on nearby or adjoining habitat. Where possible, at least 25 acres of good NEC habitat should remain in a local area at all times.

In areas occupied by NEC, avoid carrying out management operations during the rabbits' primary breeding and nesting season, from March through the end of August. Winter is often a good time to conduct management activities such as cutting trees and shrubs, since erosion will be minimized and vegetation should grow back thickly the following spring.

Making NEC habitat often involves removing trees whose shade prevents thick understory development, or cutting back "leggy" overmature shrubs that no longer provide enough food and cover. Cutting causes most shrubs and trees to grow back vigorously. When deciding how large of an area to cut or how large a habitat patch to create, managers should consider the quality and extent of adjacent suitable habitat. Also, an opening in the forest canopy smaller than 5 acres may not let in enough sunlight to promote the regrowth of a dense understory, especially if the cut is narrow.

Habitat patches for NEC should be at least 10 acres and ideally 25 acres in size. Smaller habitat patches may also have value, especially if they are next to or near other suitable habitat.



The sparse understory in most forests within the NEC's range does not offer enough food and hiding cover for rabbits. Credit: Judy Wilson

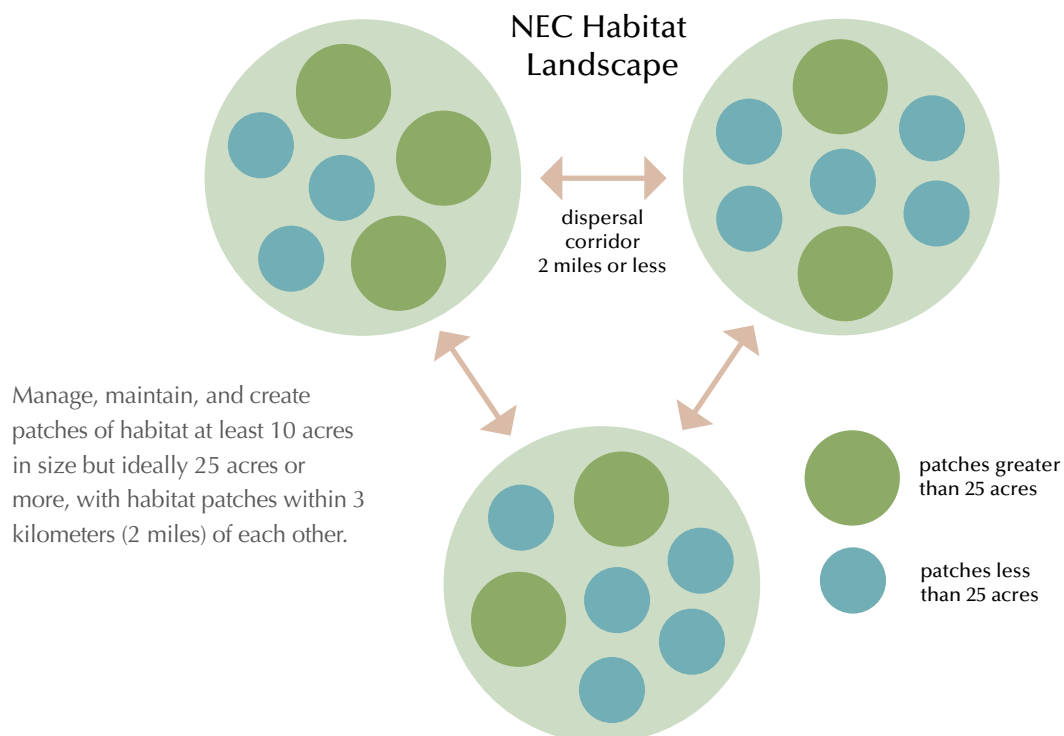


Some forests support a dense understory of smaller trees, shrubs, vines, and herbaceous plants that may provide New England cottontails with habitat. Credit: Judy Wilson

Best Management Practices

The following BMPs are designed to minimize harm to existing cottontail populations while creating, enhancing, and/or maintaining young forest and shrubland habitat for NEC. Before beginning a habitat project or carrying out a habitat management action, it is prudent to develop a management plan with input from natural resource management professionals such as foresters or wildlife biologists. When conducting habitat management activities, land managers and landowners should follow state forestry BMPs to minimize soil disturbance and maintain water quality. Follow all federal, state, and local laws, regulations, and ordinances pertaining to timber harvests, herbicide application, and/or prescribed burning, as well as BMPs for other wildlife species of concern, if applicable.

1. Manage, maintain, and create patches of habitat at least 10 acres in size and ideally 25 acres or larger.
2. On sites occupied or potentially occupied by NEC, conduct management in incremental phases, ensuring that enough suitable habitat is left while work is being completed on nearby or adjoining habitat. *Consult with your state wildlife agency for site-specific recommendations.*
3. Manage vegetation on known NEC sites from September to March to avoid disturbance during the species' nesting season. *Consult with your state wildlife agency to determine appropriate work windows.*





A mix of dense young trees, low-growing conifers, shrubs, and herbaceous plants offers habitat required by New England cottontails and many other kinds of wildlife. Credit: Jim Oehler



New England cottontail. Credit: Meagan Racey

4. Where possible, maintain at least 25 acres of good NEC habitat in a local area at all times.
5. Maximize the ratio of patch size to edge effect by creating roughly circular or square habitat patches rather than long linear ones.
6. Provide a minimum of 20,000 stems per acre of woody vegetation at a height of 3 to 15 feet to offer ample food and cover when converting mature forest to young forest habitat.
7. Where possible, create and maintain habitat patches within 3 kilometers (approximately 2 miles) of each other.
8. Where possible, create habitat patches connected by travel corridors (shrubby utility rights-of-way, shrubs growing along roadways, forests with dense shrub understories, streamside brush, shrub swamps, and forested swamps with a shrub understory) that NEC can use to disperse to other suitable habitat.

9. In old fields and shrublands, selectively remove trees larger than 3 inches in diameter at breast height (DBH) or 15 feet high to prevent them from shading out lower thick vegetation.
10. Where cover is limited or will be reduced following habitat management actions, construct brush piles to provide NEC with shelter from predators and inclement weather.



Juniper, an evergreen shrub, often grows in old fields. Credit: Charles Ferguson

11. Where possible, retain low-growing native shrubs, low-branching conifers, evergreen shrubs with limbs close to the ground, and rock piles, all of which provide good hiding cover for NEC.
12. Where appropriate on a given property, maintain 10 to 20 percent, or a minimum of 10 acres, in young forest or shrubland habitat less than 15 years old.

Habitat Types

This table describes broad habitat types that typically can be managed to create, maintain, and enhance habitat for NEC and numerous other wildlife Species of Greatest Conservation Need that require young forest and shrubland.

Habitat Type	Habitat Description
Forest (>20 years old) with Native Shrub Understory	Closed-canopy deciduous-dominated forest with trees typically greater than 6" DBH with an understory of primarily native shrubs and tree seedlings that may be providing food and cover. Minor to no invasive understory component. Potentially occupied by NEC.
Forest (>20 years old) with Nonnative Invasive Shrub Understory	Closed-canopy deciduous-dominated forest with trees typically greater than 6" DBH with an understory of primarily invasive shrubs and tree seedlings that may be providing food and cover. Potentially occupied by NEC.
Forest (>20 years old) with Sparse Shrub Understory	Closed-canopy deciduous-dominated forest with trees typically greater than 6" DBH with little understory providing no or poor habitat. Unlikely to be occupied by NEC.
Successional Forest with Trees 3" to 6" DBH	Area is dominated by deciduous trees between 3" and 6" DBH. This is no longer ideal habitat due to tree-canopy closure and accompanying decline in stem density. Potentially occupied by NEC.
Seedling-Sapling Forest	Area is dominated by deciduous trees less than or equal to 3" DBH and less than or equal to 15' in height. Potentially occupied by NEC.
Pitch Pine – Scrub Oak Woodland or Pitch Pine – Oak Woodland	Area is dominated by a canopy of pitch pine and oaks, often with a dense understory of scrub oak, huckleberry, blueberry, and bearberry. Occurs on coarse sandy substrates that drain rapidly, or on ridgetops with shallow, droughty soil and exposed bedrock. Fire-dependent/adapted community. Potentially occupied by NEC.
Shrubland, Native Dominated	Area is dominated by native multi-stemmed woody shrubs and some tree seedling/sapling trees less than 15' in height. Potentially occupied by NEC.
Shrubland, Nonnative Invasive Dominated	Area is dominated by invasive shrubs such as bush honeysuckle, Japanese barberry, autumn olive, and/or multiflora rose, and young seedling or sapling trees less than 15' in height. Potentially occupied by NEC.
Old Field	Transitional habitat dominated by grasses and forbs, with some shrubs and small trees. The vegetative makeup will vary with the area's management history and length of time since abandonment. May contain a combination of native and nonnative invasive shrubs. Potentially occupied by NEC when near suitable forest or shrub cover.
Grassland, Meadow, Wet Meadow	Area is dominated by broadleaved herbs, grasses, sedges, and other herbaceous vegetation, with or without a very small woody component. Potentially occupied by NEC when near suitable forest or shrub cover.
Forested or Shrub-Dominated Wetlands	Hardwood-dominated swamp with a shrub understory or shrub-dominated wetlands. Potentially occupied by NEC.

Note: NEC typically live in deciduous forests; however, mixed forest stands and small patches of conifers can also provide habitat.

Habitat Management Options

Throughout the remaining pages, habitat management options for various habitat types are organized under broad descriptive headings (Forest Harvesting, Controlling Invasive Plants, etc.). Best Management Practices should be taken into consideration when applying all habitat management options. Although each practice may be used on many of the general habitat types, specific recommendations are provided for different habitat types. (Note: Unique plant communities are not discussed here, such as coastal scrub, mountain laurel thickets, and

If you want to improve habitat in an area where NEC may live, do not carry out shrub mowing, tree thinning, or controlled burning throughout the entire habitat patch all at once. Instead, refresh or enhance habitat over several years, so there is always enough thick cover in place for cottontails.



New England cottontail habitat created by conservationists' management practices. Credit: Judy Wilson

Remember: If you want to improve habitat in an area where NEC may live, do not carry out shrub mowing, tree thinning, or controlled burning on the entire habitat patch all at once. Instead, manage habitat over several years, so there is always enough thick cover in place for NEC. Consult your state wildlife agency to learn whether a given habitat patch may be occupied by NEC. Follow all federal, state, and local laws, regulations, ordinances, and Best Management Practices for other wildlife species as applicable.

alder stands, which may call for site-specific management prescriptions that can be provided by technical experts.)

Natural Regeneration/ Succession

Natural regeneration and succession is the process by which habitats such as forests and shrublands will grow back to the desired ideal density of 20,000 stems per acre following management actions such as cutting and mowing. Because habitat has been dwindling

rapidly for NEC and other young forest wildlife, it may make sense to let native shrubs and trees expand and dominate largely open areas, such as old fields and grassland/meadow/wet meadow habitats. If these habitats are allowed to regenerate, follow up as necessary with mowing and mulching, herbiciding to control invasive shrubs and other plants, or prescribed burning to keep these areas in a young forest or shrub-dominated state. When stem density decreases to the point where the site no longer provides high-quality food and cover (typically when trees reach 15 to 20 feet in height), it may be time to cut the trees and allow them to resprout again, and so that grasses, forbs, vines, and shrubs can grow and spread.

Consult with professionals before attempting to control a heavy infestation of nonnative invasive plants. On some sites, managing invasive shrubs as NEC habitat may be warranted, particularly where the site and adjacent lands are overwhelmingly dominated by invasives.



Even-aged timber harvest (sometimes called a clear-cut) spurs regeneration of small trees and other plants that will provide good cottontail habitat for 10 or more years. Credit: Judy Wilson

Tree and Shrub Cutting

Tree/Shrub Cutting Using Handheld Equipment

Cutting by hand with a chainsaw can be a useful technique for managing small areas of existing habitat or for gradually expanding an area of habitat. Habitat types where this approach typically works well include reverting fields, shrublands, and shrub-dominated wetlands. The goal is to cut and fell trees that are beginning to shade out shrubs and herbaceous plants in the understory; generally trees greater than 3 inches DBH or taller than 15 feet should be targeted for removal. Overly mature shrubs that no longer provide cover or food at ground level, or are leggy or spindly and offer little vegetative cover near the ground, should also be removed. Undesirable trees and shrubs can also be killed in place by girdling. Cuttings (downed woody material and slash) can be removed from the site or left where felled. On management projects larger than a few acres, machines such as skid steers and excavators fitted with mulching or mowing heads are more effective and efficient at refreshing habitat than cutting by hand.

Consider keeping some trees and shrubs that produce mast (nuts and fruits); forest overstory canopy where there is suitable existing understory protective cover; and low-branching conifers, evergreen shrubs, snags and cavity trees, and shallow-rooted buttressed trees that provide cover for wildlife. In habitat types where little or no understory cover is present and where occupation by NEC or other state or federally listed wildlife species is not a concern, the project can proceed without limitations.



Cutting by hand using a chainsaw can be an effective way to manage smaller habitat areas. Credit: Ted Kendziora

Heavy-Duty Mowing/Mulching

Old Fields/Shrublands/Successional Forests/Pitch Pine

Heavy-duty mulching and mowing can be used to maintain and/or restore suitable structure and density of woody vegetation in a variety of habitat types, including old fields, shrublands, successional forests, and pitch pine stands, and to create brushy transitional zones at field edges. This is a valuable technique for restoring large areas of overly mature, sprawling shrubs that no longer provide high-quality dense habitat. To reinvigorate shrubs, conduct brush mowing during the winter dormant season. Periodic brush mowing of log landings, skid trails, and firebreaks will extend the life of herbaceous forage plants on those habitat features. Brush mowing can also be used to restore successional forest that is growing beyond the desirable size and age class by completely removing all the overgrown trees and shrubs and allowing new growth to restart.



Selectively mow or cut taller vegetation while leaving behind shrubs and low-branching conifers. Credit: Judy Wilson



Leave some thick habitat for local cottontails when conducting management activities. Credit: Judy Wilson



High-speed forestry mulching head on a tracked machine can reduce non-native invasives so that more-desirable plants can compete. Credit: Richard Martin

Mowing can be used to eliminate invasive or otherwise undesirable understory plants in forested, reverting field, and shrubland habitats. A forest understory dominated by nonnative invasive shrubs can be cleared prior to overstory removal; then, when the invasives resprout, they can be treated with an appropriate herbicide. Mow invasives in the winter, apply herbicide during the next growing season, and harvest trees the following winter.

In occupied or potentially occupied NEC sites, this technique should be used in incremental stages. Consider retaining some mast-producing trees, apple trees, scrub oak, low-branching conifers, evergreen shrubs, snags, cavity trees, and shallow-rooted buttressed trees. Forestry mulching and mowing heads mounted on a skid steer, excavator, tracked crawler carrier, or rubber-tired machine can carry out this work effectively and efficiently, given the typical size and density of woody material to be removed. In areas where the material is small and not too dense, a tractor and brush hog may be adequate to mow down woody material.

Field Mowing

This practice is most commonly conducted on grasslands, meadows, and wet meadows. The primary value of open-field habitat for NEC is as a spring and summer food source. NEC feeding habits depend on plant availability, and in spring and summer, tender herbaceous vegetation is in abundant supply. Plants growing on such sites may include warm- and cool-season grasses, sedges, rushes, clover, goldenrod, wild strawberry, chickweed, cinquefoils, and violets.

To maintain grasses, forbs, and small woody plants, mow fields as needed, preferably outside the March-through-August breeding



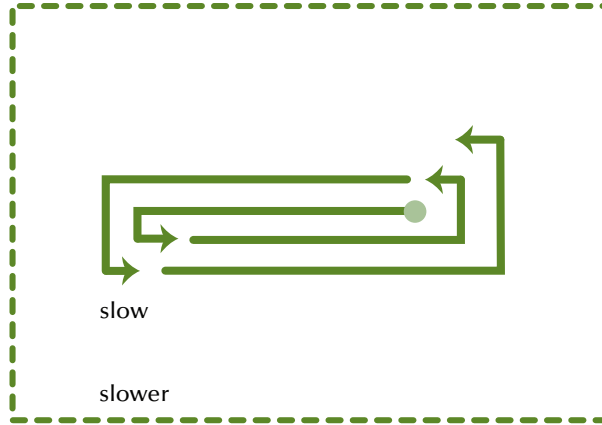
Mow open areas periodically to keep them functioning as old-field habitat for cottontails. Credit: Denyce Gagne

and nesting season. If these habitats are dominated by grasses and herbaceous plants, a tractor with a brush hog will be able to effectively mow the area. If the vegetation includes a dense woody component, the use of a forestry cutting or mulching head mounted on a tracked skid steer may be required.

To avoid concentrating and then injuring field-dwelling wildlife, mow from the center of a field outward. Reducing mowing speed, especially on the last 50 feet of a field's perimeter, can further minimize harm.

Forest Harvesting (Commercial and Non-Commercial)

Cutting areas of mature trees with closed canopies can create patches of young forest habitat comprised of dense seedling and sapling trees, shrubs, and herbaceous plants. Generally, cutting trees greater than 3 inches DBH allows full sunlight to reach the forest floor, stimulating the growth of vigorous, dense new vegetation. A limited number of trees with significant wildlife, silvicultural, or aesthetic value may be left in a forest opening while still creating a thick understory. Such “leave trees”



To reduce harm to wildlife, mow from center of field outward, slowing down at the edges.

may include den and cavity trees, important seed or mast producers, and snags. A variety of silvicultural systems, including reserve tree, seed tree, shelterwood, and coppice harvests, can be used to create young forest habitat for NEC. Typically, it may take five or more years before a harvested site regrows to become suitable habitat. Within 10 to 15 years, the



This grapple skidder can quickly and efficiently create large patches of young forest. Credit: Judy Wilson



Sign informs visitors that this timber harvest will create habitat for wildlife. Credit: Charles Fergus



Rotational cuts are being done on this forest so there is a large block of NEC habitat in the desired age and size class at all times. Credit: Connecticut DEEP

trees can exceed 15 feet in height (and 3 inches in DBH), casting shade on lower vegetation and causing its density to drop below desirable conditions. At that time, managers can decide whether the same habitat patch should be recut, or whether that patch should be left to mature while another location is chosen for creating new young forest habitat.

Creating large patches of young forest habitat is most effectively and efficiently accomplished using heavy-duty forest harvesting systems with equipment that may include a skidder, mechanized harvester, and/or forwarder. Landowners should consult a professional forester to determine whether the trees on a potential harvest site have commercial value; the silvicultural system best suited to the forest type; and any other site-specific conditions that should be considered before carrying out a timber harvest.

Rotational Considerations for Forest Management

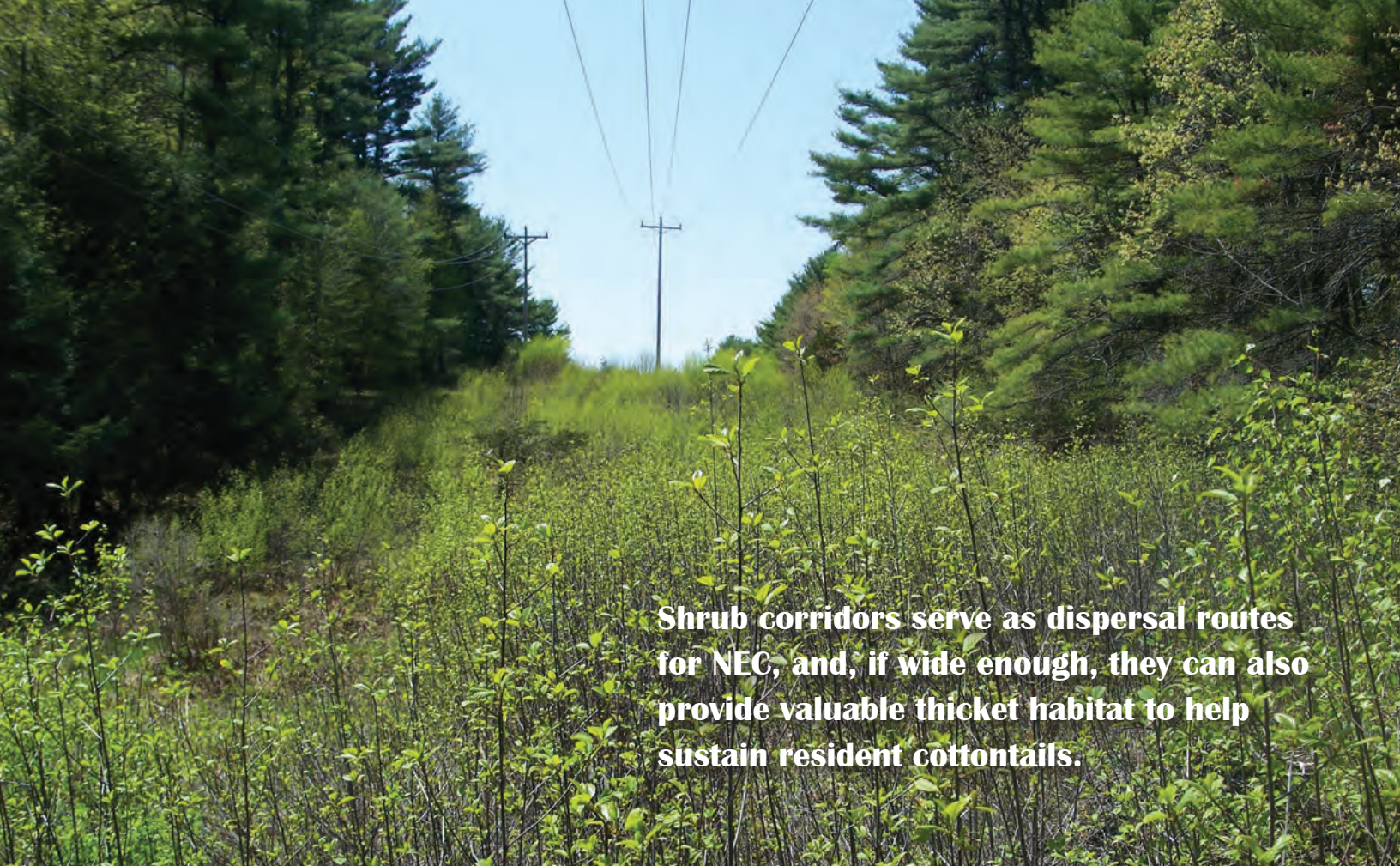
A rule of thumb for large parcels (greater than 100 acres) is to keep 10 to 25 percent of the forest in a size class where trees are 3 to 15 feet tall (or less than 15 years old), while retaining a minimum of at least 10 acres of suitable NEC habitat at all times through carefully planned rotational harvests. On parcels smaller than 100 acres, look for opportunities to create a rotation in combination with adjacent lands or those within NEC dispersal distance (around 2 miles) to provide habitat patches of at least 10 acres.

Downed Woody Material/Slash Management

When working in forested habitats, consider leaving fine, coarse, and large material (branches, tree crowns, logs, and other woody debris) on the ground to provide cover for a variety of wildlife, including reptiles, amphibians, small mammals, and birds. Leaving woody debris can deter deer from browsing on regrowing trees and shrubs, and replenish soil nutrients. Check to determine if state laws or regulations govern how to treat downed woody material/slash. If reentry is planned to manage the site again in the near future (through mowing, herbiciding invasive plants, etc.), or if aesthetics or other factors are a consideration, more downed wood and slash can be removed as allowed by local forestry laws and regulations or Best Management Practices.



Woody debris and logging slash left on the ground will provide cover for a wide range of wildlife. Credit: Charles Fergus



Shrub corridors serve as dispersal routes for NEC, and, if wide enough, they can also provide valuable thicket habitat to help sustain resident cottontails.

Powerline rights-of-way afford extremely valuable habitat to many kinds of wildlife, including NEC, if utility companies agree to maintain them in a low, brushy state. Credit: Jim Oehler

Corridor Management/ Rights-of-Way

Forest stands next to shrub- and grass-dominated corridors along which NEC and other wildlife can travel are important for linking nearby or adjacent large habitat patches. Shrub corridors serve as dispersal routes for NEC, and, if wide enough, they can also provide valuable thicket habitat to help sustain resident cottontails. Maintain corridor habitat stem density by reducing tree cover or by rejuvenating shrubs through brush hogging, herbicide application, or other suitable management techniques. Regularly inspect such corridors for possible recutting of trees to keep the habitat thick. Consult with the appropriate utility company prior to working in a corridor right-of-way, or crossing one with heavy equipment.

Establishing Stable Native Shrublands

By using techniques similar to those employed by some power companies to manage their rights-of-way, land managers can establish and maintain stable thicket habitat. Where feasible, selectively mow trees and invasive shrubs and use herbicide on resprouts, while leaving native shrubs in place. It can take a lot of effort to develop thicket habitat using this technique, but the result can be a habitat that remains stable for decades as thick shrub cover helps to prevent trees from becoming established.

Edge Enhancement

Wildlife, including cottontails, often live in or travel through brushy cover that grows where forested habitats meet fallow or farmed fields. Along field margins, cut or mow a minimum



Wildlife, including cottontails, often live in or travel through brushy cover that grows where forested habitats meet fallow or farmed fields.



A nonnative invasive alien shrub, bush honeysuckle, has been flagged for removal. Both photos credit: Charles Fergus

50-foot-wide swath to encourage the dense growth of shrubs, young trees, vines, and other plants. Such edges can also be created through plantings or by letting natural regeneration take place. A tiered or “feathered edge” approach provides a varied vegetative structure, with shorter to taller vegetation grading from field to forest.

Controlling Invasive Plants

Annual monitoring on all habitat types for the presence of invasive plants – and removing them as they are encountered – is the best way to control the spread and establishment of invasives. Monitoring is especially important after vegetation management activities, because invasive plants can be brought in to an area on equipment. Soil disturbance from management actions can create an entry point for invasives, and changed site conditions (including soil warming, increased sunlight, and reduced competition from native plants) can also increase the likelihood of invasive species establishing themselves on a site. Use a high-pressure washer to thoroughly clean the exterior, undercarriage, and tires or tracks of all equipment before it is brought in from another location.

Unfortunately, in many cases invasive plants may be providing the only cover sustaining NEC in a given area. In NEC-occupied sites where invasive plants are well-established but controllable, it is best to treat the invasives in incremental stages. As implied, control does not mean eradication, but rather reducing the invasive species’ numbers and coverage to the point where annual monitoring and plant-removal efforts are minimized and can be effective at keeping the invasives from taking over the site.

It is critical to ensure that those responsible for invasive species control have appropriate licensing, knowledge about effective control methods, the ability to identify nonnative species versus native species, and enough experience to deal with the scope and complexity of an invasive control effort. While a landowner may be able to efficiently and effectively treat a light infestation of invasives on a small area, treating heavy infestations over a larger area may require the services of a professional licensed herbicide applicator.

Chemical Treatment

Effective control of invasive plants is most likely to occur when the right chemicals are selected and then applied correctly. After an initial treatment, one or two additional chemical

applications are almost always needed. It may require waiting several years after the first treatment to let invasive plants reach a size where locating them will be possible, and when applying chemicals will be less likely to harm nearby native plants. Some of the most common invasive species put out leaves earlier in spring and hold onto their leaves later in the fall than native plants, making it possible to find and flag the invasives. On heavily infested sites, it may take years to exert a level of control to the point that invasives no longer dominate the habitat.

The type of herbicide (broad-spectrum or selective) and method of application (foliar, cut-stem, or basal bark) will depend on the target species, the size of the vegetation, and the desired outcome. Many chemicals are state-controlled substances whose use requires the services of a trained, state-licensed herbicide applicator. Federally approved and state-licensed chemicals must always be applied according to label instructions.

Before a timber harvest, conduct invasive plant control treatments to prevent an explosive release of invasives that can follow the removal of the forest canopy and any soil disturbance. In thickets made up mainly of invasive plants, conversion to native plants is preferred but not



Backpack sprayer directs herbicide at target plants, limiting exposure of other plants in vicinity. Credit: Connecticut DEEP



Conservationists mowed and used herbicides to suppress invasive shrubs, then planted native ones. Thick habitat remaining on both sides will sustain cottontails while native shrubs fill in. Credit: Judy Wilson

always practical. Where safe to do so, consider leaving the skeletons of dead standing invasives to provide temporary cover for wildlife.

Depending on the scale and type of invasives to be treated, a variety of equipment may be used to apply herbicides. Backpack sprayers, mist blowers, and other methods are used by both landowners and professionals. Trucks, tractors, and tracked vehicles outfitted with spray rigs can be used to treat large areas.

Mechanical Treatment

Mechanical devices and tools for treating invasive plants include brush saws, chainsaws, tractors, brush hogs, heavy duty mowing and mulching machines, and flail mowers. Handheld equipment can be used to attack individual plants or small patches. Management can restore large areas grown up with overmature shrubs or infested with invasives. Treated areas should be assessed annually and selectively re-treated as needed. In habitats dominated by tall, dense invasives such as multiflora rose, bush honeysuckle, and buckthorn, machines can be used to reduce the overall plant biomass and to stress target plants before herbicides are applied.

In dense successional forests and shrubland habitats dominated by invasives, it is difficult to remove only the invasives through mowing, since both desirable and undesirable vegetation usually intermix. The best practical way to



Weed wrenches and other similar tools can uproot invasive shrubs if the plants are not too large. Credit: Rachel Stevens



A worker uses a propane flame torch to heat-girdle stems of Japanese barberry. Credit: Christopher Riley

treat such areas is to mow or mulch the entire area, then, when invasives resprout, treat them with herbicide. In thick native-shrub habitat, cutting out individual invasive plants or mowing down discrete patches of invasive vegetation, followed by herbicide application, may prove practical.

Additional Mechanical Treatment Options for Small-Scale Projects

Because the treatments described in this section are labor intensive, they are generally not practical for treating large areas of young forest or dense thicket habitat. These practices are most appropriate for small infestations of invasives or on larger areas where invasive plant densities are low. They can also be used where sensitive natural resources need to be protected. When using any invasive plant control method, be sure to reassess annually and selectively treat invasive plants as needed.

Hand Pulling/Weed Wrench

Hand pulling or using a weed wrench or other similar tool can be effective where invasive plants are not too large and where their densities are low enough that individual plants can be targeted. This approach works well on invasives growing in moist soil.

Flame Torch

Propane torches or flame weeders can effectively control certain shrub species such as Japanese barberry. High-intensity heat from a flame is directed at the base of the shrub clump to heat-girdle the stems and kill basal buds at the top of the root crown. There is no need to treat the upper branches or leaves. As a precaution, always have water available to douse any inadvertent flare-ups.

Girdling

Girdling individual invasive trees (glossy or common buckthorn, black locust, tree-of-heaven) may be effective, especially when followed by the use of herbicides.

Planting and Seeding

Planting Shrubs

For NEC, the main objective is to establish native shrubs to make or improve thicket habitat. Secondary objectives may include controlling invasive plants, stabilizing soils, and improving soil and water quality. Planting options include using containerized shrubs, bare-root stock, wattles, whips, or live stakes. Shrubs can be planted following timber harvesting if tree regeneration is expected to

be less than adequate, if other site-specific conditions warrant it, and, in some cases, after invasive control. When revegetating larger open areas, interspersing shrub clusters with existing cover, stone walls, foundations, and brush piles can improve a site's habitat value.

To determine whether planting shrubs makes sense, consider site conditions and drainage and what species of shrubs may already be growing there. Always choose native shrubs and avoid planting state-prohibited species.

Plantings need to be watered until they are established, and, in some locations, may need to be protected from deer browsing by putting up fencing or individual tree shelters.



Plant native shrubs in old fields to improve their habitat value for NEC. Credit: Jane Seymour

When revegetating larger open areas, interspersing shrub clusters with existing cover, stone walls, and brush piles can improve a site's habitat value.

NEC hide from predators in crevices in stone walls. Preserve these important habitat features when conducting management projects to benefit cottontails. Credit: Charles Fergus

Seeding With Grasses and Other Herbaceous Plants

To provide forage for NEC and other wildlife, seed small areas within or adjacent to a suitable habitat patch using a warm- or cool-season grass and forb mix. Periodic mowing will be needed to maintain herbaceous habitat. (Mow after August to avoid the prime nesting season for NEC and other wildlife.)

After a timber harvest, broadcast seed on log landings, skid trails, roads that receive sunlight, and areas of exposed soil. Use a seed mix suited for the intended purpose and local site conditions.

Creating Additional Cover

Constructed features such as brush piles and rock piles, and existing structures like stone walls, can provide valuable escape cover and hiding habitat for NEC following timber harvests and mowing and mulching operations.

Brush Piles

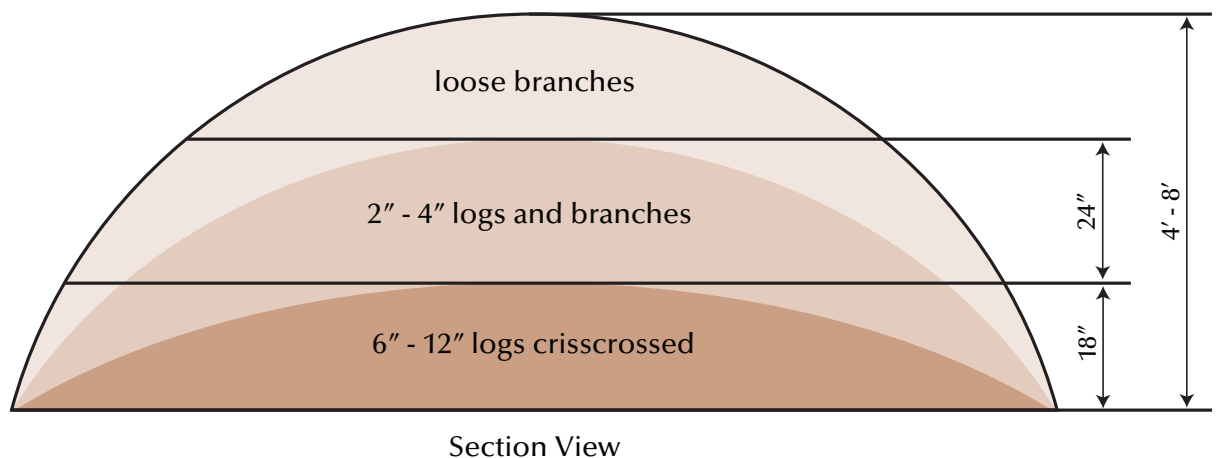
Where natural cover is limited, NEC will use brush piles for nesting, resting, escaping from predators, and protection from harsh weather.



Brush piles can be built quickly and economically when tied in with a timber harvest or other planned forestry operation. Credit: Richard Martin

Brush piles can be built in a variety of habitat types. They should not be built on sites that will undergo prescribed burns, as they would need to be protected from the fire. Where appropriate, build one to three brush piles per acre. Each should be 10 to 20 feet on a side and 4 to 8 feet high, with bottom logs spaced 10 to 12 inches apart in a maze-like configuration, leaving room for easy wildlife access. Lay a second layer of smaller-diameter logs on top and roughly perpendicular to the base layer. Repeat with increasingly smaller logs, and top the pile with smaller branches, loose brush, and pine boughs. New material can be added to the top to extend the life of a brush pile over time.

Piles can be built using a small tractor with forks to lift and place the larger bottom logs, with the smaller materials layered on by hand. Brush piles can be economically and easily constructed in conjunction with a planned



forestry operation: heavy equipment will already be on site, and trees and branches not removed for wood products can be used to build the piles. Brush piles built along field edges can provide important escape cover. They should be spaced to minimize the distance NEC are exposed to predators (usually about 100 feet apart, depending on site conditions) when the rabbits travel between sources of shelter. If plants such as greenbrier and wild grape are growing near brush piles, they can provide extra cover overhead.

Rock Piles and Stone Walls

Maintain or build stone walls or rock piles with plenty of crevices and interior spaces where rabbits can hide. During timber harvests, avoid flattening or removing existing stone walls. A stone wall or rock pile can also be incorporated into the base of a brush pile.

Prescribed Burning

Managers can use prescribed burning to maintain or improve a variety of habitats for NEC, including grasslands, shrublands, and rare plant communities such as pitch pine/scrub oak woodlands. Prescribed burning can be used as a stand-alone practice or in combination with techniques such as mowing, disking, tree harvesting, and herbiciding. The timing of a burn is important. Burning in the early spring or when plants are dormant in the fall can help maintain vegetation currently on the site and increase stem densities by top-killing young trees and shrubs, which causes them to resprout. A prescribed burn plan should be developed and carried out by an experienced state or federally licensed professional known as a “burn boss.” When considering a burn, contact your state forestry agency concerning applicable laws, liability risk, and planning, permitting, and implementation requirements.



Prescribed burns should be planned and carried out by experienced state or federally licensed professionals. Credit: Joel Carlson

Managers can use prescribed burning to maintain or improve a variety of habitats for NEC, including grasslands, shrublands, and rare plant communities such as pitch pine/scrub oak woodlands.

Useful Resources

The *Young Forest Guide* is a 28-page nontechnical overview useful for anyone considering making habitat for NEC. It includes “Young Forest Success Stories” on how landowners have created habitat: <https://youngforest.org/resource/young-forest-guide>

Websites

<https://www.newenglandcottontail.org/>
<https://timberdoodle.org/>
<https://www.youngforest.org/>
<http://www.ct.gov/deep/youngforestinitiative>
<https://www.fws.gov/northeast/newenglandcottontail/>

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Visit <https://newenglandcottontail.org/documents> to download these and many other pertinent publications and communications products:

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Professional Contacts

If you live in a New England Cottontail Focus Area (see map on page 1) and want to create habitat for this native rabbit, contact the following agencies or natural resources professionals.

Connecticut

Connecticut Department of Energy & Environmental Protection, Wildlife Division, 860-424-3011

- Nancy Ferlow, NRCS, nancy.ferlow@ct.usda.gov
- Lisa Wahle, WMI/CT DEEP, lisa.wahle@ct.gov
- Judy Wilson, CT DEEP, judy.wilson@ct.gov

Maine

Maine Department of Inland Fisheries and Wildlife, 207-287-8000

- Gary Donovan, WMI, gdonovan46@msn.com
- Walter Jakubas, MDIFW, walter.jakubas@maine.gov
- Andrew Johnson, MDIFW/WMI, andrew.johnson@me.usda.gov
- Kate O'Brien, USFWS, kate_obrien@fws.gov
- Cory Stearns, MDIFW, cory.r.stearns@maine.gov
- Jeff Tash, USFWS, jeffrey_tash@fws.gov

Massachusetts

Massachusetts Division of Fisheries & Wildlife, 508-389-6300

- Marianne Piché, MassWildlife/NRCS, marianne.piche@state.ma.us
- David Scarpitti, MassWildlife, david.scarpitti@state.ma.us
- Beth Schreier, NRCS, beth.schreier@ma.usda.gov

New Hampshire

New Hampshire Fish & Game, 603-271-3421

- Haley Andreozzi, UNH Extension, haley.andreozzi@unh.edu
- Kelly Boland, NRCS, kelly.boland@nh.nrcs.gov
- Heidi Holman, NHFG, heidi.holman@wildlife.nh.gov
- Ed and Julie Robinson, WMI, julesprobinson@comcast.net

New York

New York State Department of Environmental Conservation, Division of Fish and Wildlife, 518-402-8924

- Elaina Burns, NYDEC, elaina.burns@dec.ny.gov
- Nathan Ermer, NYDEC, nmermer@gw.dec.state.ny.us
- Kim Farrell, NRCS, kim.farrell@ny.usda.gov
- Paul Novak, NYDEC, pgnovak@gw.dec.state.ny.us
- Kaylee Resha, NWTF, kresha@nwtf.net

Rhode Island

Rhode Island Department of Environmental Management, Division of Fish and Wildlife, 401-789-0281

- Jennifer Brooks, RIDFW, jennifer.brooks@dem.ri.gov
- Gary Casabona, NRCS, gary.casabona@ri.usda.gov
- Cindy Corsair, USFWS, cynthia_corsair@fws.gov
- Suzanne Paton, USFWS, suzanne_paton@fws.gov
- Tanner Steeves, RIDFW, tanner.steeves@dem.ri.gov

Rangewide

US Fish and Wildlife Service Partners for Fish and Wildlife Program, New England Field Office, 603-223-2541

- Ted Kendziora, USFWS, ted_kendziora@fws.gov
- Anthony Tur, USFWS, anthony_tur@fws.gov
- Steve Weber, WMI, sweber56@roadrunner.com

For additional contacts, see: <https://newenglandcottontail.org/content/people-contact>

Photographs on back cover, clockwise from top: young forest with flowering apple trees, Charles Fergus; removing invasive buckthorn at Rachel Carson National Wildlife Refuge, USFWS; New England cottontail hiding in cover, Charles Fergus; biologists examine habitat in holding pen for captive-bred New England cottontails, Charles Fergus; autumn shrubs, Kelly Boland. Center photo: yellow warbler, Tom Berriman.

