New England Forests: The Path to Sustainability

CHAPTER 2 • GIVE WILDLIFE HOMES

A TECHNICAL REPORT BY NEW ENGLAND FORESTRY FOUNDATION

INTRODUCTION

This project documents both the existing value and potential of New England's working forest lands: Value – not only in terms of business opportunities, jobs and income – but also nonfinancial values, such as enhanced wildlife populations, recreation opportunities and a healthful environment. This project of the New England Forestry Foundation (NEFF) is aimed at enhancing the contribution the region's forests can make to sustainability, and is intended to complement other efforts aimed at not only conserving New England's forests, but also enhancing New England's agriculture and fisheries.

New England's forests have sustained the six-state region since colonial settlement. They have provided the wood for buildings, fuel to heat them, the fiber for papermaking, the lumber for ships, furniture, boxes and barrels and so much more. As Arizona is defined by its desert landscapes and Iowa by its farms, New England is defined by its forests. These forests provide a wide range of products beyond timber, including maple syrup; balsam fir tips for holiday decorations; paper birch bark for crafts; edibles such as berries, mushrooms and fiddleheads; and curatives made from medicinal plants. They are the home to diverse and abundant wildlife. They are the backdrop for hunting, fishing, hiking, skiing and camping. They also provide other important benefits that we take for granted, including clean air, potable water and carbon storage. In addition to tangible benefits that can be measured in board feet or cords, or miles of hiking trails, forests have been shown to be important to both physical and mental health.

Beyond their existing contributions, New England's forests have unrealized potential. For example, habitats for a wide variety of wildlife species could be enhanced by thoughtful forest management. Likewise, wood quantity could be increased and the quality improved through sustainable forest management. The virtues of improved forest management and buying locally produced goods are widely extolled, but what might that actually look like on the ground? More specifically, how could enhanced forest management make more locally produced forest products available to meet New Englander's own needs, as well as for export, improve the local and regional economies and provide the greatest social and environmental benefits?

The purpose of this project is to document that potential by analyzing what we know about how improved silviculture can enhance wildlife habitat, the quantity and quality of timber, recreational opportunities, and the environment. The best available data from the US Forest Service, state forestry agencies and universities was used to characterize this potential.

The technical reports produced for this project document the potential for:

- Mitigating climate change;
- Increasing timber production to support a more robust forest products industry;
- Restoring important wildlife habitat;
- Replacing fossil fuels with wood to produce thermal energy;
- Reducing greenhouse gas emissions, not only by substituting wood for other fuels, but also wood for other construction materials;
- Enhancing forest recreation opportunities and related tourism;

- Expanding production of nontimber forest products;
- Maintaining other forest values such as their role in providing clean air and potable water – taken for granted but not guaranteed;
- Enhancing the region's economy by meeting more of our own needs with New England products and retaining more of the region's wealth within the New England economy; and
- Other related topics.

These technical reports are viewed as "works in progress" because we invite each reader to bring their own contributions to this long term effort of protecting, managing and enhancing New England's forests. The entire set may be viewed at www.newenglandforestry.org. If you have suggested improvements please contact the New England Forestry Foundation to share your thoughts. These technical reports were used as the background to prepare a summary – *New England Forests: The Path to Sustainability*, which was released on June 5, 2014.

If you are not familiar with NEFF's work please visit www.newenglandforestry.org. Not already a member? Please consider joining NEFF – https://41820.thankyou4caring.org.

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The New England Forestry Foundation is a recognized leader in conserving working forests, educating the public about forestry, and assisting landowners in the long-term protection and stewardship of their properties. For almost 70 years, we have demonstrated that well-managed working forests can provide landowners and the community with the prime ingredients for healthy living: clean air and water, sustainable production of an array of forest products, healthy forests for hiking and relaxation, a diversity of wildlife and habitats, periodic income, and renewable natural resources that help support rural economies.

Our Mission is to conserve New England's working forests through conservation and ecologically sound management of privately owned forestlands in New England, throughout the Americas and beyond.

This mission encompasses:

- Educating landowners, foresters, forest products industries, and the general public about the benefits of forest stewardship and multi-generational forestland planning.
- Permanently protecting forests through gifts and acquisitions of land for the benefit of future generations.
- Actively managing Foundation lands as demonstration and educational forests.
- Conservation, through sustainable yield forestry, of a working landscape that supports economic welfare and quality of life.
- Supporting the development and implementation of forest policy and forest practices that encourage and sustain private ownership.


THE PATH TO
SUSTAINABILITY
KEEP NEW ENGLAND FORESTED
Conserve 90% of New England's existing forests
GIVE WILDLIFE HOMES
Provide critical habitat for 338 diverse species
PROVIDE MORE RECREATION
Contribute more than $5 billion to the New England economy
GROW AS MUCH AS WE USE
Meet our consumption with wood from local forests
YOU ARE HERE
SUSTAINABILITY
PROTECT US FROM CLIMATE CHANGE
Reduce extent and impacts of heat waves, floods, and drought
CLEAN & COOL THE AIR
Save $700 million per year in health costs and crop losses
REDUCE USE OF FOREIGN OIL
Displace $1.85 billion of oil annually with wood heat
GROW MORE WOOD
Enhance quality and double wood production
PURIFY OUR WATER
Save $6 billion in water treatment costs
PROVIDE MORE WOOD FOR BUILDINGS
Save 3.5 million metric tons of carbon
CULTIVATE NEW BUSINESSES
Create new cottage industries using non-timber resources
CREATE LOCAL JOBS
Retain 30k jobs and increase exports to more than $10 billion.
New England's forests have tremendous potential to provide economic, environmental, and social benefits to the citizens of the region. Right now, we're letting some of that potential slip away. Through 12 new research reports, New England Forestry Foundation has defined the benefits our region's forests could provide, and those benefits are summarized here along the Path to Sustainability, starting with the premise that we Keep New England Forested.
NEW ENGLAND FORESTRY FOUNDATION

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GIVE WILDLIFE HOMES: Potential of New England's Working Forests as Wildlife Habitat

Prepared by Jerry A. Bley

Part of a larger project on the potential of New England's forest lands coordinated by R. Alec Giffen for the New England Forestry Foundation. Component parts include the following of the larger effort:

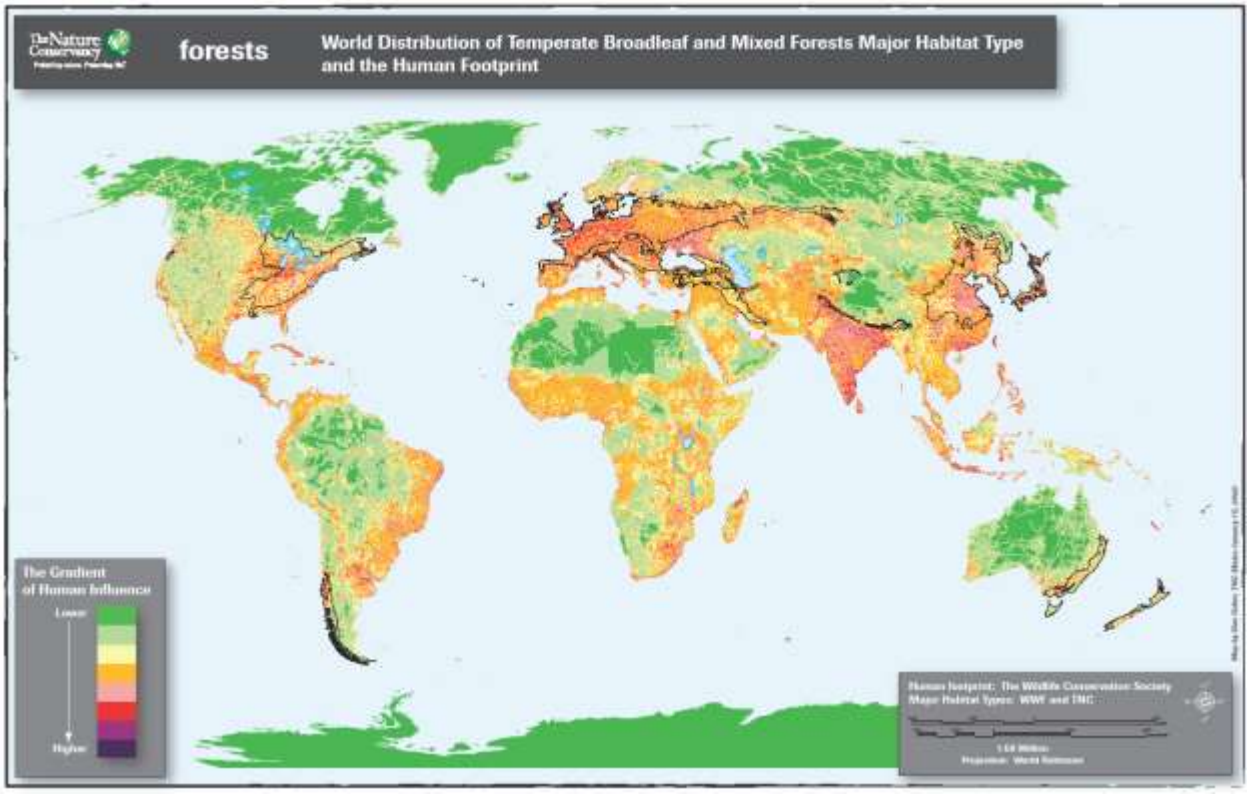
1. KEEP NEW ENGLAND FORESTED: Assessing the Current Conservation Status of New England's Forests by Jerry A Bley
2. GIVE WILDLIFE HOMES: Potential of New England's Working Forests as Wildlife Habitat by Jerry A. Bley
3. PROVIDE MORE RECREATION: Forest Recreation Trends and Opportunities in New England: Implications for Recreationists, Outdoor Recreation Businesses, Forest Land Owners and Policy Makers by Craig Ten Broeck and Aaron Paul
4. PROTECT US FROM CLIMATE CHANGE by R. Alec Giffen and Frank Lowenstein
5. CLEAN AND COOL THE AIR: Forest Influence on Air Quality in New England: Present and Potential Value by Aaron Paul
6. PURIFY OUR WATER: The Potential for Clean Water from New England Forests by Aaron Paul
7. GROW MORE WOOD: The Potential of New England's Working Forests to Produce Wood by R. Alec Giffen, Craig Ten Broeck and Lloyd Irland
8. CREATE LOCAL JOBS: Vision for New England's Wood-Based Industries in 2060 by Innovative Natural Resource Solutions, LLC and The Irland Group
9. CULTIVATE NEW BUSINESSES: New England's Nontimber Forest Products: Practices and Prospects by Craig Ten Broeck
10. PROVIDE MORE WOOD FOR BUILDINGS: The Greenhouse Gas Benefits of Substituting Wood for Other Construction Materials in New England by Ann Gosline
11. REDUCE USE OF FOREIGN OIL: The Potential for Wood to Displace Fossil Fuels in New England by Innovative Natural Resource Solutions, LLC
12. GROW AS MUCH AS WE USE: Production versus Consumption of Wood Products in New England by Craig Ten Broeck

A. Wildlife Values of New England's Forests

With approximately 338 species of mammals, birds, reptiles and amphibians, New England's forests support a diverse and fascinating array of wildlife including well-known conspicuous creatures such as moose, white-tailed deer, and bald eagles; to well-known but seldom-seen species such as black bears and bobcats; to common but little known species such as certain voles and salamanders; and finally, the truly rare species such as Canada lynx and Blanding's turtle (DeGraaf and Yamasaki 2001). All of these animals have established, or re-established themselves since the glaciers of the last ice age retreated from New England 12,000 years ago. As the climate warmed, vegetation migrated into the region creating habitat for the creatures that followed.

Ecologically, New England represents the **largest intact temperate broadleaf forest in the country, including almost 19 million acres in contiguous blocks of at least 25,000 acres in size.** When viewed globally, the world's major temperate broadleaf forest habitat is primarily located in areas where the human "footprint" has been greatest, such as Central and Eastern Europe and Eastern China. When viewed from this perspective, the New England forest stands out as exceptional because it remains largely intact despite the demands of modern society.

Figure 1. World distribution of temperate broadleaf and mixed forests major habitat type and the human footprint



Unlike other regions of the country, the New England forest is largely naturally regenerated with native species providing familiar habitat for wildlife species that have been historic residents over the millennia. However, changes in the forest, whether from natural occurrences such as periodic hurricanes and fire, or man-made influences such as land clearing for agriculture and timber management, have had profound impacts on species populations.

Beyond its intrinsic worth, the region's abundant forest wildlife provides a wealth of ecological, aesthetic, recreational and economic benefits. Ecologically, we know that wildlife species play specific and important roles in the functioning of New England's forest ecosystems even though our understanding of the intricate relationships is still evolving rapidly. The composition of forest vegetation dictates the shelter and food available for wildlife species whether it be the tall trees favored by bald eagles, the dense undergrowth favored by snowshoe hares, the drumming logs of a ruffed grouse, cavity trees occupied by flying squirrels, or a dead stump which is home to a white-footed mouse. In turn the forest wildlife can impact the surrounding forest growth. A beaver's handiwork can redirect water courses, flood lowland and upland forests changing the landscape for decades. Birds and rodents play a primary role of seed dispersal for many forest trees and herbaceous plants. Bats and birds feed on infestations of forest pests limiting the severity of their impact on forest vegetation.

From a human perspective, New England's forest wildlife provide an important amenity which is an essential part of the region's unique character. Whether it is watching a fox run across the road at dusk, turning over a rock to find a salamander, watching a moose gallop across a northern bog, or viewing the birds flocking to the winter feeder outside the kitchen window, the aesthetic presence of these creatures is a key attribute to the New England quality of life. In how many other locations around the country or indeed the world, can one leave an urban or suburban environment and be in near boreal habitats occupied by moose and lynx within just a few hours? From a consumptive perspective, hunting birds and mammals is an important New England tradition passed on from one generation to the next.

Both the passive and consumptive pursuits of forest wildlife is big business across the region ranging from traditional Maine sporting camps to guided bird-watching tours. Wildlife viewing and hunting together contribute approximately one billion dollars of direct economic impact annually to the region's economy. When looking at overnight recreational trips in New England states, visitor participation in wildlife viewing activities ranges from approximately 14% (Massachusetts and Rhode Island) to 32% (Maine).

Table 1. Direct annual economic impact (GDP) of wildlife related recreation (in dollars)

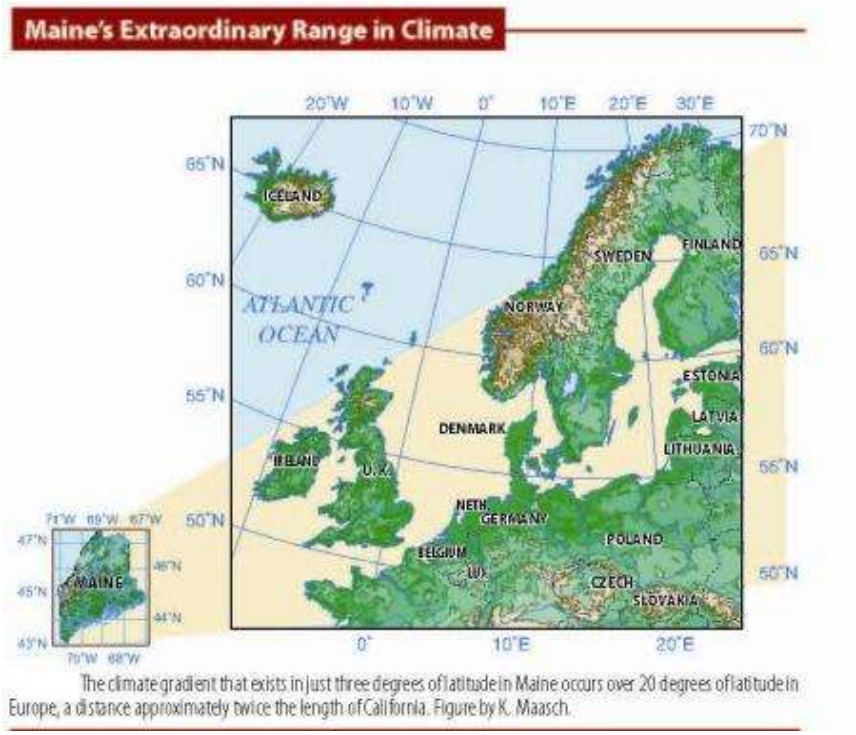
State	Hunting	Wildlife viewing	Total
Connecticut	$90,596,400	$90,138,633	$180,735,033.00
Massachusetts	$26,244,900	$98,136,970	$124,381,870.00
Maine	$60,791,700	$154,000,327	$214,792,027.00
New Hampshire	$18,173,400	$145,648,998	$163,822,398.00
Rhode Island	$5,492,400	$26,398,461	$31,890,861.00
Vermont	$87,698,400	$123,185,168	$210,883,568.00
TOTAL	**$288,997,200**	**$637,508,557**	**$926,505,757.00**

Source: NEFF Report: Provide More Recreation, prepared by Craig Ten Broeck and Aaron Paul.

B. Habitat Diversity in New England's Forests

The great variety of elevation, topography, moisture, soils, and climate found in New England from the Appalachian Mountains to the Atlantic Ocean give rise to the broad array of vegetative communities that exist throughout New England today and the animals which make their homes there. Work done by George Jacobson of the University of Maine demonstrates that the unusually large range of climatic conditions in just the State of Maine encompass the same range of climatic conditions that extend from central Europe to northern Scandinavia.

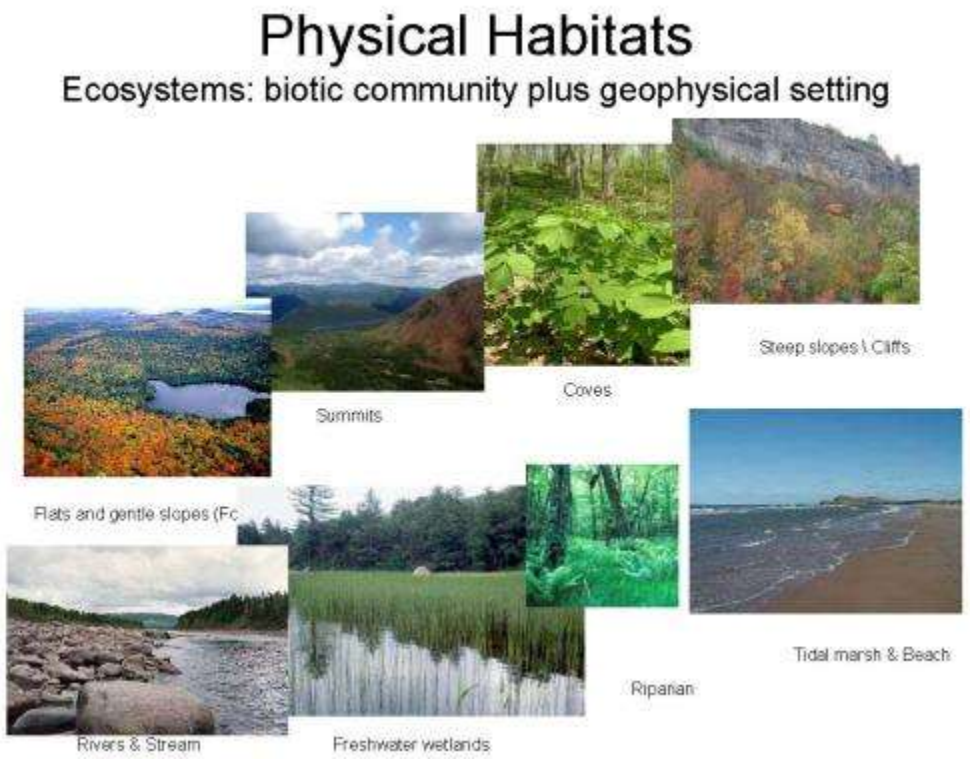
Figure 2. Maine's extraordinary range in climate



Source: Jacobson, et al. (2009).

As a result of this climatic diversity, New England is host to approximately 137 forest ecological community types (NatureServe 2013). Residing in these diverse forest habitats are 225 species of birds, 64 species of mammals and 49 species of amphibians and reptiles along with the multitude of invertebrate species and the fisheries and aquatic organisms in associated waters and wetlands.

Figure 3. Ecosystems: biotic community plus geophysical setting



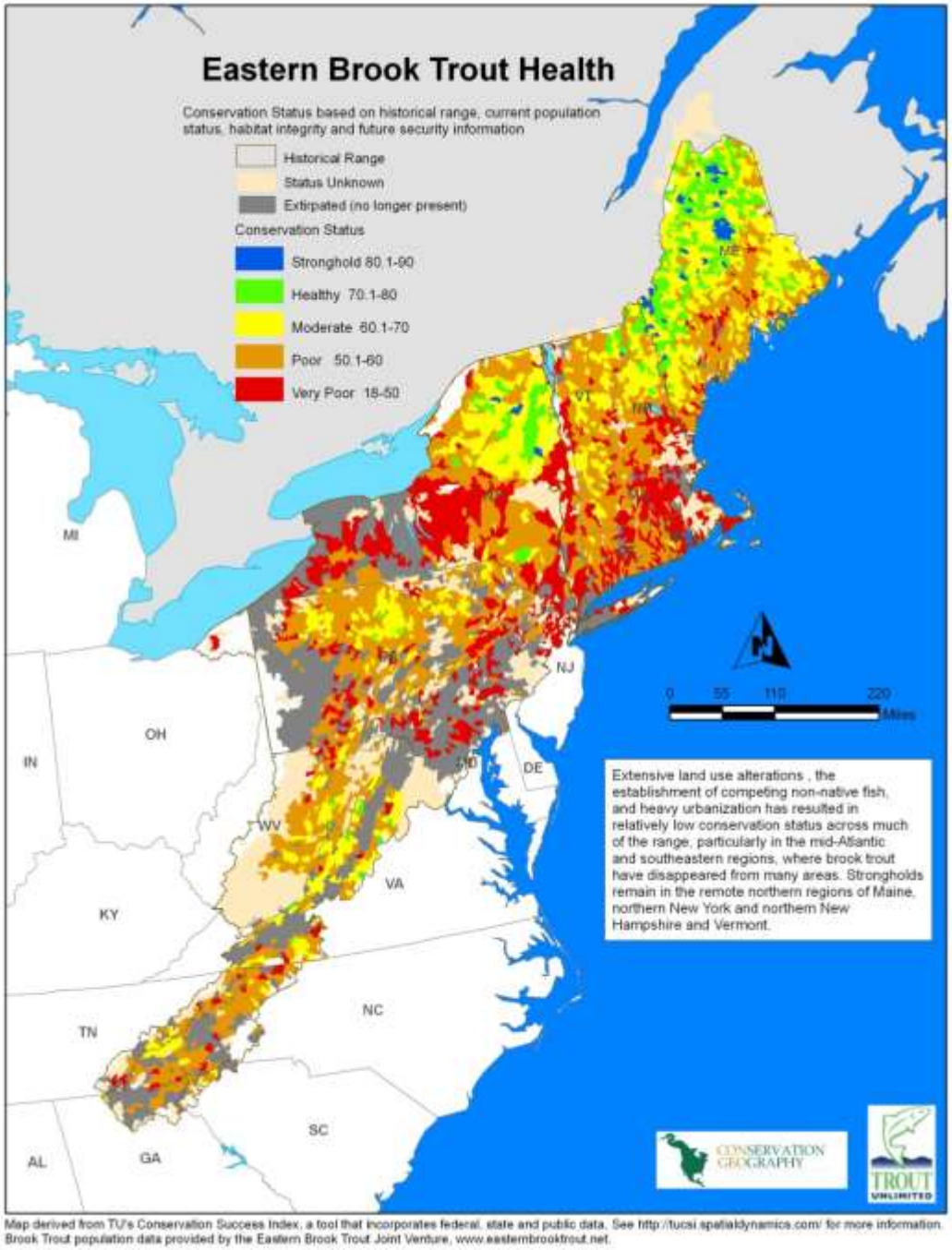
Source: Anderson (2010).

Some notable wildlife occurrences associated with New England's forests include:

- Moose – Northern New England supports the largest population of moose in the eastern US.
- Black bears – New England supports an estimated population of 37,500 black bears. (Black Bear Society 2011).
- Avian diversity – New England offers a tremendous diversity of forest birds ranging from coastal species to those found only on mountain tops, including 27 species of neotropical warblers; which spend the bulk of their lives in the tropics but take advantage of New England habitats for nesting and raising their young (DeGraaf 2001).

- Native wild brook trout and Atlantic salmon – New England supports the only self-sustaining runs of Atlantic salmon and the great majority of the native wild brook trout waters in the US (most notably in Maine).

Figure 4. Native range of brook trout



Source: Trout Unlimited (2005).

C. Opportunities to Enhance New England Wildlife

When considering wildlife management objectives for New England's forests, there is no fixed baseline from which to measure, nor single ideal which to strive for. Since the glaciers receded, wildlife populations have been in constant flux responding to changes in forest habitat. There is a prevailing notion that prior to the arrival of white settlers on the shores of New England, a mature old-growth forest blanketed the region. However, according to DeGraaf and Yamasaki (2003), in pre-colonial times, "there were native prairies in southern New England, natural and Indian-set fires periodically burned large areas and beaver flowages were extensive and imparted a substantial open character to much of the pre-settlement forest." While the extent of old growth forest in pre-colonial times is debated among respected biologists, there is little disagreement that New England's forests have undergone dynamic changes over the centuries both due to natural and human influence.

In this regard, it is necessary to distinguish between Northern New England, particularly the Northern Forest, where there remains a substantial timber industry and economy and the forests to the south where forest harvesting and management are far less prevalent. Up north, the primary challenge is to figure out how best to achieve wildlife objectives in an area owned and managed primarily for timber production. Conversely, in the south, a primary wildlife concern relates to early successional species whose populations are suffering from the lack of early successional habitat, which can be created through active forest management. According to the USFS forest inventory, at least 80% of forest stands in the three southern New England states are older than 60 years in age with less than 10% of stands younger than 40 years.

How New England's forests are managed in the coming decades will play a critical role in the abundance and distribution of desired wildlife populations. Two notable examples from across the region include the following:

1. Lynx and American Marten as Umbrella Species: A Case Study

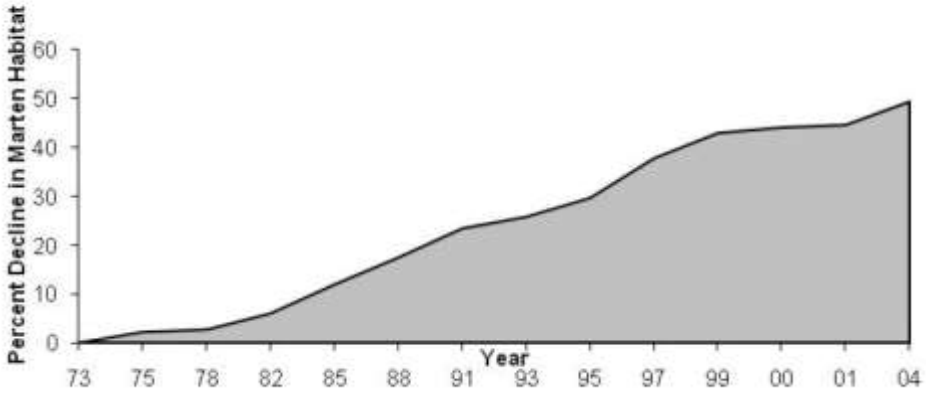
Forest practices in the Northern Forest have been a source of ongoing public debate for decades. In particular, the use of large-scale clearcuts has been a divisive issue leading to public policies in Maine and elsewhere that discouraged such harvesting practices in favor of partial harvests. While the aesthetic issues associated with clearcutting are straightforward, the wildlife implications are more complex. Take the federally threatened Canada Lynx whose range includes the Northern Forests of Maine, New Hampshire and Vermont. The lynx prefers young dense softwood forests which offer prime habitat for the lynx's preferred prey, the snowshoe hare. This young conifer regeneration is common after clearcuts, the final harvest in shelterwood silviculture (two or three stages of removal) or natural disturbances resulting in large scale mortality of mature softwood stands (McCoullough 2007).

However, other species such as the American marten (a/k/a pine marten), a member of the weasel family, require a very different type of forest habitat. Marten, which spend much of their time in treetops, need large tracts of mature forest and a lattice-work of tree cover (Frazer 2011). Both species have large spatial requirements and respond to habitat change at a landscape level. Together, their habitat requirements represent a range of ecological conditions spanning early to mid/late successional forests (Harrison, et al. 2006). Used in tandem as "umbrella species,"

forests that are managed to protect the habitat of these two species will benefit approximately 111 out of 135 (85%) of other forest mammals, birds, reptiles, and amphibians (Patterson, pers. comm.), including such species as spruce grouse, red squirrel, hermit thrush, moose, and blackburnian warblers. About 71% of forest vertebrates are benefited by conservation of marten habitat and 48% are benefited by lynx habitat (with some redundancy between the two). Management for both species is complementary and can be used as surrogates to effectively manage a landscape for biodiversity (McCoullough, 2007), along with targeted conservation of habitats required by more specialized species.

Research being done at the University of Maine and applied on The Nature Conservancy's (TNC) St. John River Forest is looking at how the habitat needs of lynx and marten could be used to develop a forest management regime that optimizes habitat for a wide spectrum of wildlife that inhabit the North Woods while also allowing for sustainable forest management. TNC looked at various forest management options on its 185,000 St. John Forest, located along 40 miles of the St. John River in northern Maine. The land, acquired by TNC in 1998, had a history of industrial forest management including a major spruce-budworm infestation and large clearcutting operations. University of Maine researchers determined that marten habitat on the TNC ownership declined precipitously between 1973 – 2010, leaving only about 11% of the landscape as quality marten habitat (Fuller and Harrison 2011).

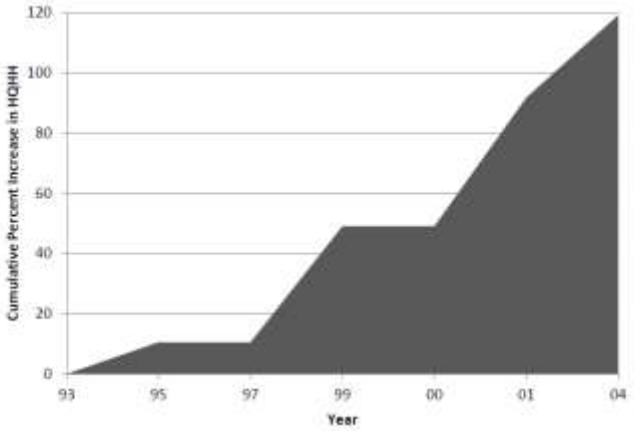
Figure 5. Cumulative percentage decline of marten habitat on The Nature Conservancy's St. John lands between 1973 – 2004 (TNC took ownership in 1998)



Source: Fuller and Harrison (2011).

In contrast, low amounts of high quality snowshoe hare habitat (essential to viable lynx populations) existed prior to 1988. Since that time, quality snowshoe hare habitat increased greater than four-fold supporting substantial lynx habitat. According to the University of Maine researchers, "the current supply of lynx habitat likely exceeds historical levels, is likely an anomaly associated with a myriad of factors including strong wood markets, expanding mill capacity, developing forest road networks, a shifting changing political environment, and an extensive spruce budworm outbreak during the 1970's and 1980's."

Figure 6. Cumulative percentage increase in high quality snowshoe hare habitat on The Nature Conservancy's St. John lands between 1993 – 2004 (TNC took ownership in 1998)

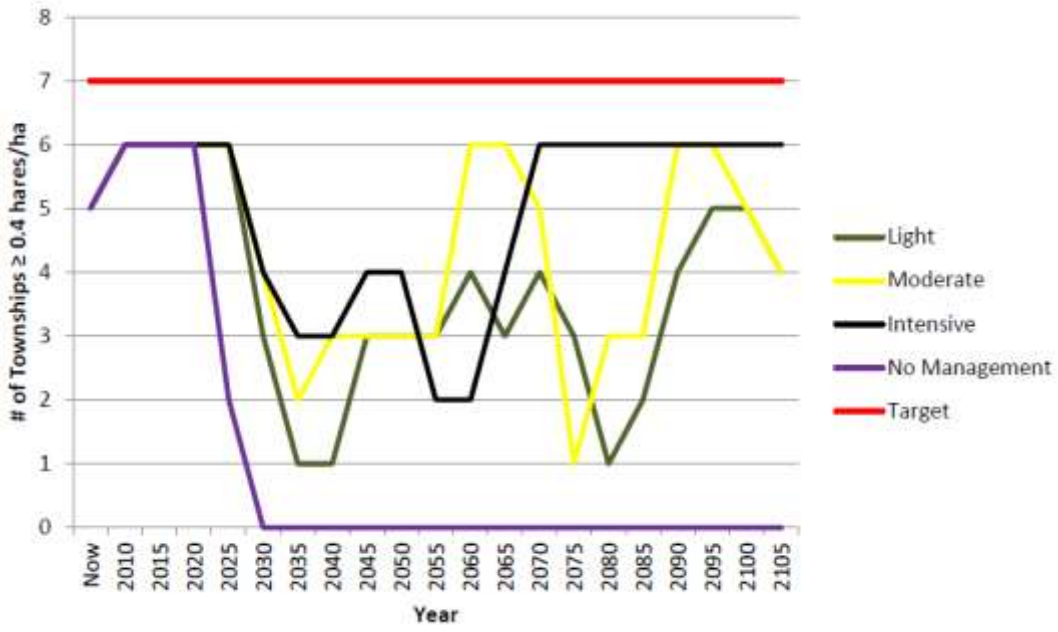


Source: Fuller and Harrison (2011).

Armed with this baseline information, Fuller and Harrison (2011) utilized modeling to predict how different management regimes over the next century would impact marten habitat, lynx habitat and timber production. The researchers looked at no management, light management, moderate management and intensive management scenarios. Intensive management was defined as using silvicultural practices such as pre-commercial thinning, clearcutting, and herbicide spraying.

None of the modeled scenarios were able to maintain lynx habitat at current levels, lending support to the belief that current lynx habitat is at or near a historic high on this ownership and other industrial forest lands with similar operational history. The 'no management' alternative proved to have the most severe adverse impact on lynx habitat due to the scarcity of young softwood stands required by snowshoe hare. Conversely, the intensive management regime provided the best outcome for the lynx.

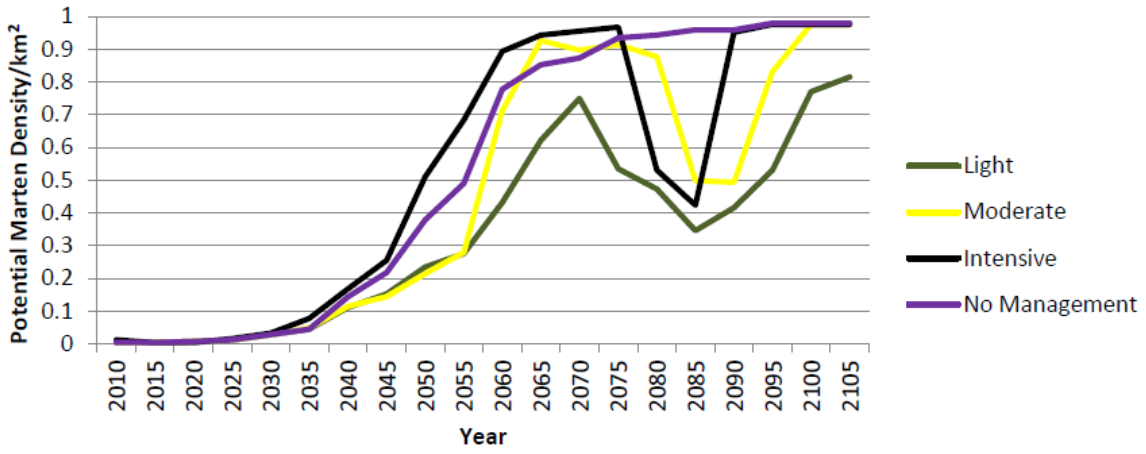
Figure 7. Number of townships that have potential to support at least one lynx breeding unit (> 0.4 snowshoe hares/ha) across The Nature Conservancy's ownership from 2010 to 2110. The management scenarios evaluated include natural succession (no management), as well as light, moderate and intensive management



Source: Fuller and Harrison (2011).

Looking at the future potential for marten populations (and its related suite of species) on the TNC lands, the researchers found increases in populations under all scenarios as the forest recovered from past management practices and stands grew older. Because of its affinity for undisturbed mature forest stands, the modeling indicated that the 'no management' scenario would provide the optimum outcome for marten populations. However, marten populations will occupy managed forest stands when forest practices maintain abundant forest structure such as downed woody debris and snags (Payer and Harrison 2003) and adequate amounts of more or less continuous crown cover. Setting aside forest reserves appears to be an important element for maintaining robust populations of marten and other species with similar habitat requirements. Under the active harvest scenarios, the intensive harvest approach was favored slightly by marten over the light and moderate harvest regimes likely due to harvests being concentrated in smaller areas leaving more undisturbed areas, with intact crown closure, at any one time.

Figure 8. Potential marten density (martens/km²) under natural succession (no forest harvesting), as well as under light, moderate and intensive management scenarios over The



Source: Fuller and Harrison (2011).

TNC's management planning for their St. John Forest places primary importance on ecological considerations while taking advantage of timber management and production opportunities consistent with this priority. When considering TNC's overall objectives, the researchers concluded, "When we applied the portfolios of intensive management with existing reserves and light management with existing reserves, we were able to most effectively optimize our multiple biodiversity objectives for martens, lynx, forest harvest levels and forest productivity." Put more simply, a combination of reserves and actively managed forest lands provided an effective balance for achieving both wildlife and timber production goals.

In terms of timber stocking levels, the intensive management approach resulted in 9% higher stocking than the light management approach because harvests were concentrated on a smaller number of acres. The intensive management approach resulted in slightly higher annual harvest levels (.236 cords/acre versus .226 cords/acre). However, the cost of intensive management practices (such as pre-commercial thinning and herbiciding) may outweigh the benefits.

The timber production levels predicted on the TNC lands falls short of what commercial forest landowners expect from their lands (typically > .33 cords/acre), due, in part, to the acreage placed in no-harvest reserves on the TNC lands. Without the reserve component, harvest levels and lynx habitat both increase substantially, however marten populations and the suite of vertebrate species which require mid-late successional forests are adversely impacted. The researchers conclude that, "marten habitat, contiguous areas of mid-late successional forest, and old forest habitat would not likely persist if TNC were to adopt an industrial management model that increased harvest volumes consistent with expectations of some commercial and investment oriented landowners."

The joint research efforts by the University of Maine and The Nature Conservancy offers a number of important insights into managing forests in northern New England including:

- The use of tandem umbrella species, with different habitat requirements, offers a promising management tool for forest landscapes to maintain or enhance biodiversity;
- Excessive focus on the habitat needs of targeted threatened and endangered species (i.e., lynx) could have adverse impacts on a suite of other species with very different habitat needs (i.e., marten and those species which require mid-late successional forest);
- The future abundance of lynx in the North Woods is largely dependent upon active forest management practices that create large openings that will become high quality snowshoe hare habitat. While natural phenomena such as blowdowns and disease create openings that provide hare habitat, it is at a much smaller scale than commercial harvesting;
- Forest management regimes that are dominated by partial harvest practices will not optimize habitat for either marten or lynx and the respective suite of species that have similar habitat requirements; and
- The populations of some species, such as marten, could be enhanced by setting aside reserve lands where harvesting and other management activities is not permitted.

On any one ownership, it may not be possible to optimize both marten habitat and lynx habitat while at the same time maximize timber output. However, when looked at in a landscape context with a multitude of forest landowners – preserved public and private conservation lands, timber contractors, long-term forest land investors, and family owners – there is the potential of utilizing collaborative planning among landowners to achieve landscape-wide objectives for wildlife and timber production while allowing individual landowners to realize their own parcel-specific objectives.

2. Increasing Early Successional Habitat in Central and Southern New England

Over the past century, the greatest change to forest habitat and wildlife in New England has been the regeneration of cleared lands to forest. European settlers cleared much of the New England landscape for agriculture and fuelwood, e.g. it is estimated that over 70% of Connecticut, Vermont and Rhode Island were cleared for agriculture at one time. That began to change towards the end of the nineteenth century as farmland was abandoned and reverted or was replanted back to forest – a pattern that continued all the way through the twentieth century. At the peak of regeneration, around the middle of the twentieth century, up to 60% of woodlands may have been shrublands and young forest (Brooks 2003). Today, according to federal forest inventories, that figure is under 10% in every New England state except for Maine and approximately 11% across the Northeast.

Figure 9. Percentage of land in agriculture in New England, 1850-1982

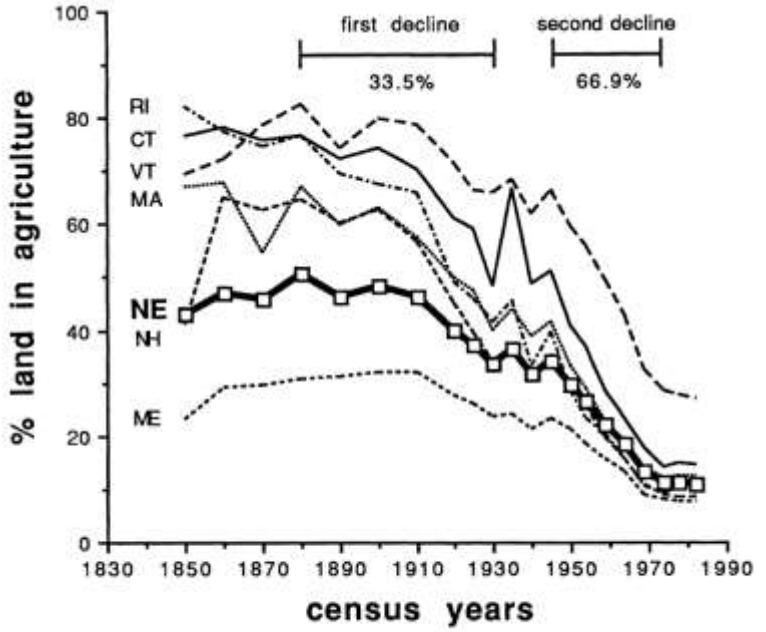
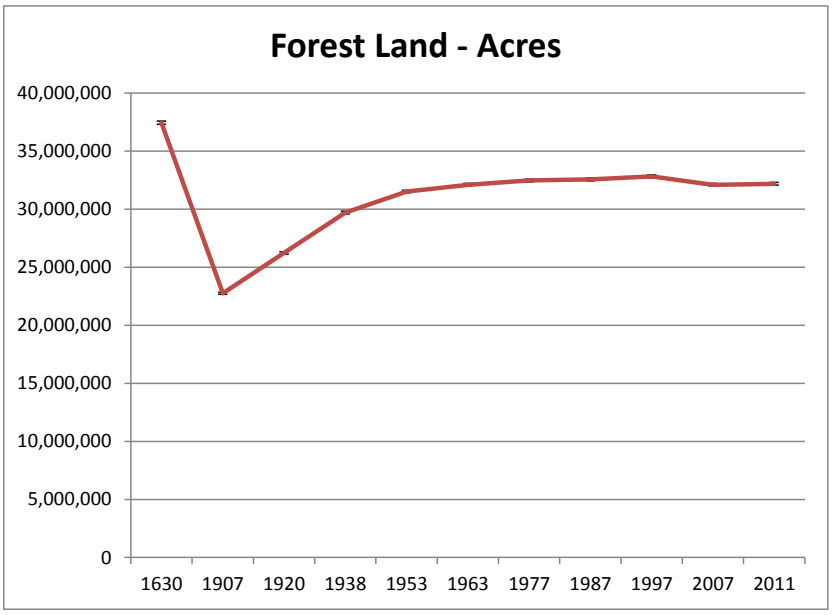


FIG. 7—Percentage of land in agriculture in New England 1850–1982. *Sources:* Historical Statistics of the United States: Part I (Washington, D.C.: Government Printing Office, 1974), 460; 1974 Census of Agriculture: Vol. 1, Part 51, United States Summary and State Data (Washington, D.C.: Government Printing Office, 1976), table 1; 1982 Census, text footnote 26, table 1.

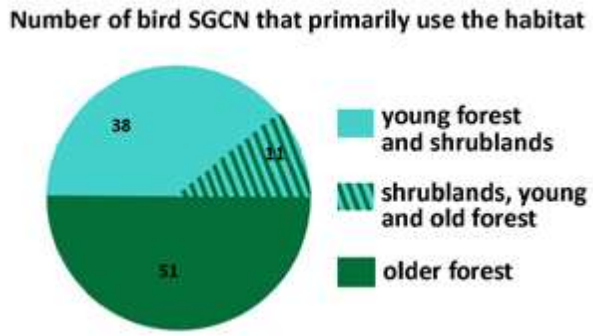
Figure 10. Acres of New England forest over time



Source: 1630 to 1997 is the US Forest Service 2007 RPA publication. 2007 and 2011 is direct from US Forest Service FIA database – estimate includes forest land classified as Site Class 7 to be consistent with historical data.

Not surprising, those wildlife species dependent upon early successional habitat flourished in the early twentieth century only to have their populations fall rapidly beginning around 1960 as the forest matured – the first such overall decline in these species since European settlement (DeGraaf, et al. 2006). At least 65 species of birds, mammals, and reptiles identified as Species of Greatest Conservation Need (SGCN) by Eastern States depend on young forests or shrublands. One of these species, the New England cottontail, has become so rare that it may be placed on the Endangered Species List. As indicated by the figure below, almost 40% of SGCN bird species need early successional habitat during at least part of their life cycle.

Figure 11. Number of bird SGCN that primarily use the habitat



Source: Gilbart (2012).

Young forest and shrublands tend to have a greater variety of fruiting shrubs and herbaceous vegetation than mature forests of any species composition. Seasonally or year-round, many kinds of wildlife, including mammals and young birds that have recently left the nest, feed on these plants and the insects they attract. While mature-forest wildlife can tolerate various disturbances to the overstory, animals of young forest and shrublands are habitat specialists that disappear when a forest stand reaches about 20 years of age (Gilbart 2012).

In much of New England, specifically southern New England up through southern Maine, increased timber harvesting will be needed to restore populations of certain species like New England cottontail and birds which rely on young forests for breeding which have been in decline for decades.

Figure 12. Current distribution of New England cottontails

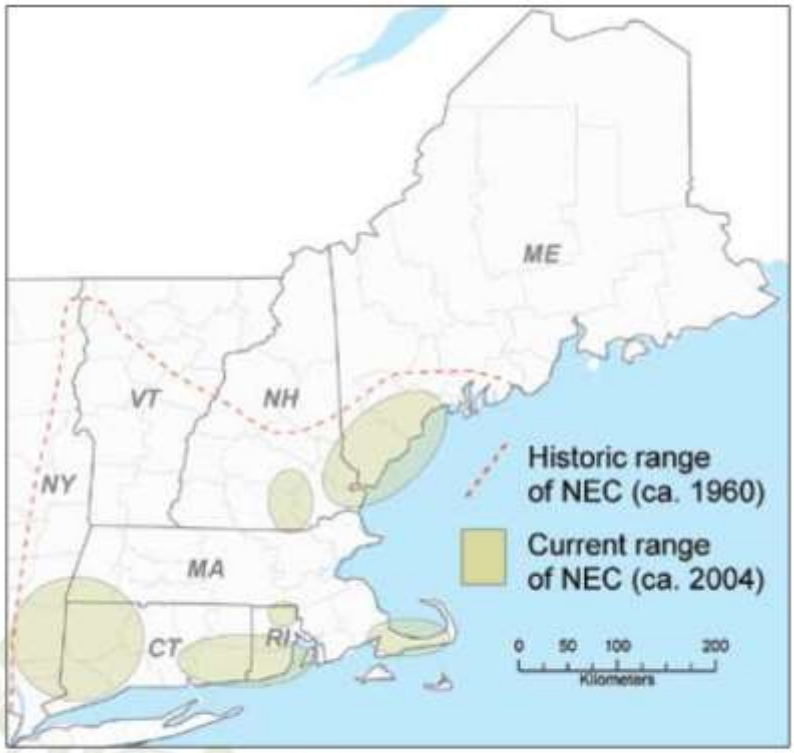
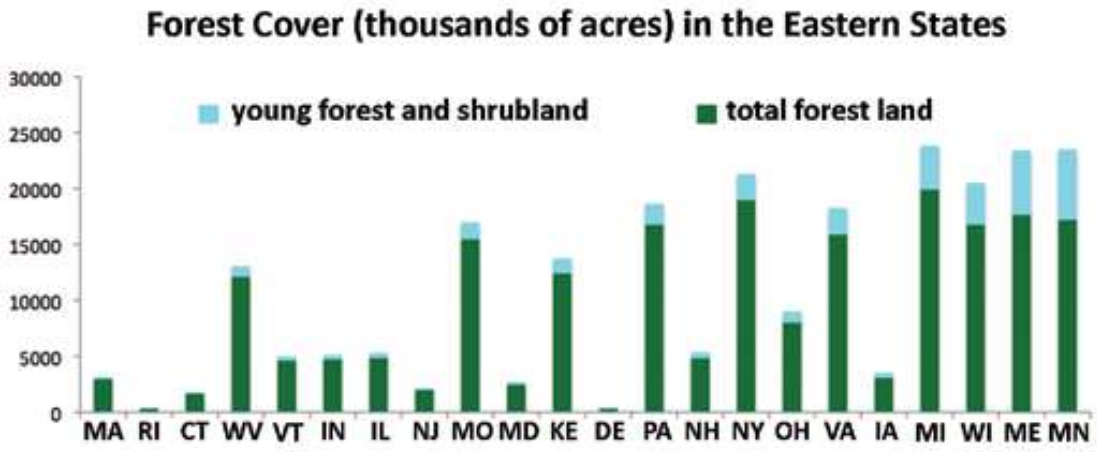


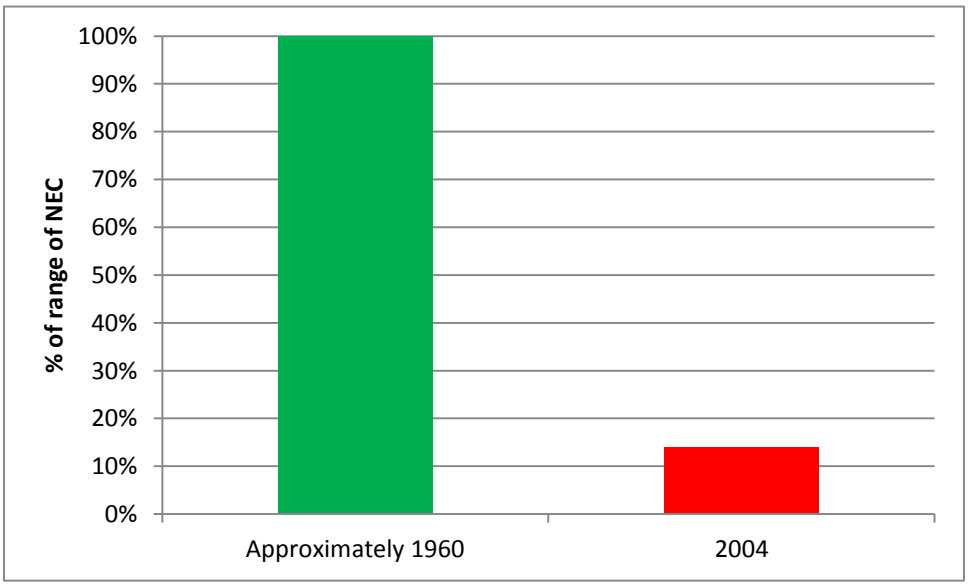
Figure 12. Current distribution of New England cottontails. Dashed line indicates historical range of the species. Current range represents 86 percent loss of historical range. Map by Jeffrey Tash, based on Litvaitis et al. 2006.

Figure 13. Forest cover (thousands of acres) in the Eastern States



Acreages of young forest and shrublands and total forest cover for the eastern states were retrieved using the USDA Forest Inventory Analysis data from 2005 to 2009.

Figure 14. Percent of range of New England cottontails



For many years, the prevailing wisdom was that early successional wildlife species were generalists that flourished at edges and needed no specific management actions. However wildlife biologists have come to understand that early-successional species are not generalists at all; rather they are specialists in vegetation structure or area requirements (DeGraaf 2003). The misperception arose from the abundance of these species in the middle part of the twentieth century when their preferred habitat was prevalent across the landscape. However, as that habitat has diminished, there is a greater understanding that early successional species have very specific habitat requirements. For example, New England cottontails favor young stands of 10-25 years in age after which time they decline rapidly when stands begin to mature and thin out. Some bird species, typically associated with older forests, utilize early successional forest at specific times, such as fattening up in the post-fledging/pre-migration period.

According to DeGraaf, et al. (2006), "One of the most important wildlife habitat issues in New England is the decline of early-succession habitats and the species associated with them. For the first time since European settlement, early-successional species are declining across eastern North America, and especially in New England. Species that thrive in mature forest, such as squirrels and fishers are abundant, but most early successional ones such as field sparrows, whip-poor-wills, eastern towhees, and New England cottontails are disappearing quietly as the remaining patches of young forest mature. All brushland species are in decline; some such as the yellow-breasted chat, are gone already, victims of benign neglect." Research also suggests that in addition to providing nesting habitat for shrubland species of high conservation concern, wildlife openings may be important habitat for mature-forest birds during the post-fledging period after the young fledge and prior to migration (Labbe 2014).

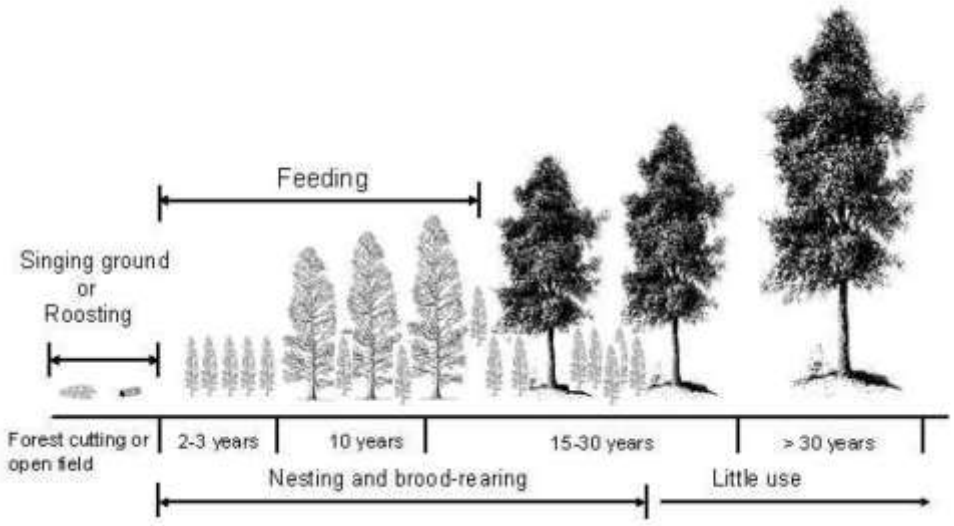
Table 2. New England states where wildlife species that utilize shrubland and young forest are designated as Species of Greatest Conservation Need (including many that would benefit from the same habitat needed by woodcock)

	CT	MA	ME	NH	RI	VT
Alder Flycatcher	X					
American Redstart	X		X			
American Woodcock	X	X	X	X	X	X
Black-and-white Warbler	X		X		X	
Black-billed Cuckoo	X		X		X	X
Blue-winged Warbler	X	X	X		X	X
Brown Thrasher	X	X	X		X	X
Canada Warbler	X	X	X	X	X	X
Chestnut-sided Warbler	X		X		X	X
Dark-eyed Junco	X					
Eastern Kingbird	X		X		X	
Eastern Towhee	X	X	X	X	X	X
Field Sparrow	X	X	X			X
Golden-winged Warbler	X	X		X		X
Gray Catbird	X					
Hermit Thrush	X				X	
Indigo Bunting	X				X	
Magnolia Warbler	X					
Mourning Warbler		X				
Nashville Warbler					X	
Northern Bobwhite	X	X			X	
Olive-sided Flycatcher	X		X			X
Prairie Warbler	X	X	X		X	X
Rose-breasted Grosbeak	X		X		X	
Ruffed Grouse	X	X	X	X	X	X
Rusty Blackbird			X	X		X
Spruce Grouse			X	X		X
Tennessee Warbler			X			
Veery	X		X	X		X
White-eyed Vireo	X					
White-throated Sparrow		X	X			
Willow Flycatcher	X	X	X		X	
Yellow-billed Cuckoo	X		X		X	
Yellow-breasted Chat	X				X	
Yellow Warbler					X	
Bobcat	X	X		X	X	X
Canada Lynx			X	X		X
Moose		X		X		
New England Cottontail	X	X	X	X	X	X
Short-tailed Weasel	X					
Snowshoe Hare					X	
Southern Red-backed Vole	X					
Woodland Jumping Mouse	X					
Eastern Box Turtle	X	X	X	X	X	
Five-lined Skink	X					X
North American Racer	X	X	X	X		X
North American Rat Snake	X	X			X	X
Smooth Green Snake	X			X		X
Spotted Turtle	X	X	X	X	X	X
Timber Rattlesnake	X	X	X	X	X	X
Wood Turtle	X	X	X	X	X	X

Source**:** Gilbart (2012).

Regionally and nationally, major initiatives to re-establish populations of woodcock, a popular game bird, have focused on expanding the acreage of early successional habitat required by the species. Conservation biologists consider woodcock to be an "umbrella species" which means that creating habitat for woodcock simultaneously helps more than 50 other mostly non-game species of wildlife that require early successional forest habitat (Wildlife Management Institute 2010) as indicated in Table 2. Surveys of woodcock indicate that populations have dropped precipitously across the New England region since the 1970's corresponding with the reduction of young forests as described above. This decline is inevitably reflected in the populations of the other wildlife species that share the habitat needs of woodcock.

Figure 15. Key habitat components required by woodcock in relation to forest succession



Source: Kelley, et al. (2008).

The table below indicates forest management activities which will be required to create the early successional forest habitat required to restore populations of woodcock and the many related species which also require young regenerating forest habitat.

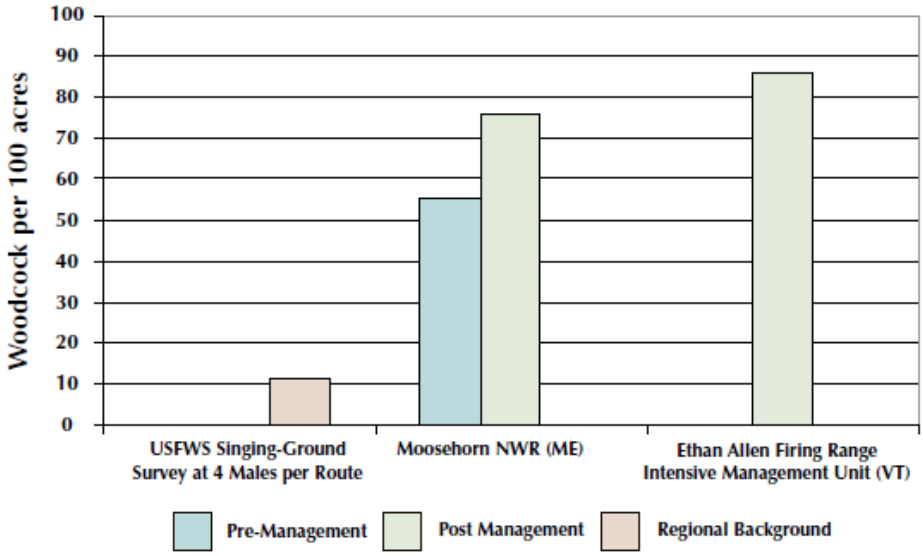
Table 3. Potential to restore woodcock populations

State	Acres of young forest that need to be created or restored annually to stop woodcock population decline	Acres of young forest that need to be created or restored annually to return to 1970's level of woodcock populations by 2022
Connecticut	716	3,492
Maine	248,686	344,312
Massachusetts	962	4,703
New Hampshire	20,408	33,857
Rhode Island	N/A	N/A
Vermont	19,354	39,060
TOTAL	290,126	425,424

Source: Wildlife Management Institute (2010).

The figure below compares woodcock densities from the Moosehorn National Wildlife Refuge (Maine) before and after woodcock management; the Ethan Allen Firing Range (Vermont) following intensive habitat management; and the national Singing-Ground Survey (Upper Great Lakes region, northeast US and southern Canada) representing the estimated population density across most of the woodcock's breeding grounds. The graph shows how intensive habitat management can dramatically increase local woodcock populations (Wildlife Management Institute 2009) and benefit the other 50 species that share their habitat needs. Woodcock density in the actively managed areas was over five times that typical of population densities throughout the woodcock's range. As an umbrella species, this research on woodcock suggests the potential for increasing populations of a larger suite of wildlife requiring early successional forest habitat.

Figure 16. Theoretical woodcock densities at different management intensities



Source: Wildlife Management Institute (2009).

The figures above describe the potential for habitat management to benefit woodcock populations; however, such practices could benefit a broad array of wildlife. According to the Wildlife Management Institute (2010), “As we work to reverse the woodcock’s population decline, we help wild animals, both uncommon and abundant, that share the habitat: reptiles and amphibians, birds, and mammals. Some of the many species that benefit from creating and restoring young forest are snowshoe hare, New England cottontail, bobcat, white-tailed deer, ruffed grouse, whip-poor-will, golden-winged warbler, willow flycatcher, indigo bunting, box turtle, bog turtle – as well as a host of insects and plants.”

The public’s aversion to timber harvesting, particularly clearcutting, limits the availability of early successional habitats in New England that are essential to a broad range of wildlife. Silvicultural practices that minimize the size of openings or lengthen rotation age and re-entry periods inhibit the creation and maintenance of young forest habitats (DeGraaf 2006). Thus, there is a tremendous opportunity to expand commercial forest management across the region,

generating valued jobs and economic benefits, while creating critical wildlife habitat for vertebrate species that have been in decline for decades.

3. Forest Reserves as Part of the New England Landscape

The above discussions of lynx, marten and woodcock habitat show the potential wildlife benefits of active forest management, when done with clear ecological objectives and outcomes in mind. They demonstrate that commercial forest management and wildlife conservation when looked at from a landscape perspective are mutually supporting, rather than conflicting objectives.

Notwithstanding the significance of these opportunities, there remains an important ecological need to have an established system of ecological preserves. From a purely informational and research perspective, undisturbed forest reserves provide scientists the best laboratories to investigate and monitor the intricate and complex ecological relationships and processes of forest ecosystems. They provide critical ecological benchmarks to compare with managed forest stands. Such reserves are particularly important in light of projected climate change and the resulting changes to natural communities and wildlife habitat across the New England landscape. Insights gained from such research provide understandings of forest ecosystems that will benefit future forest management, both commercial and ecological.

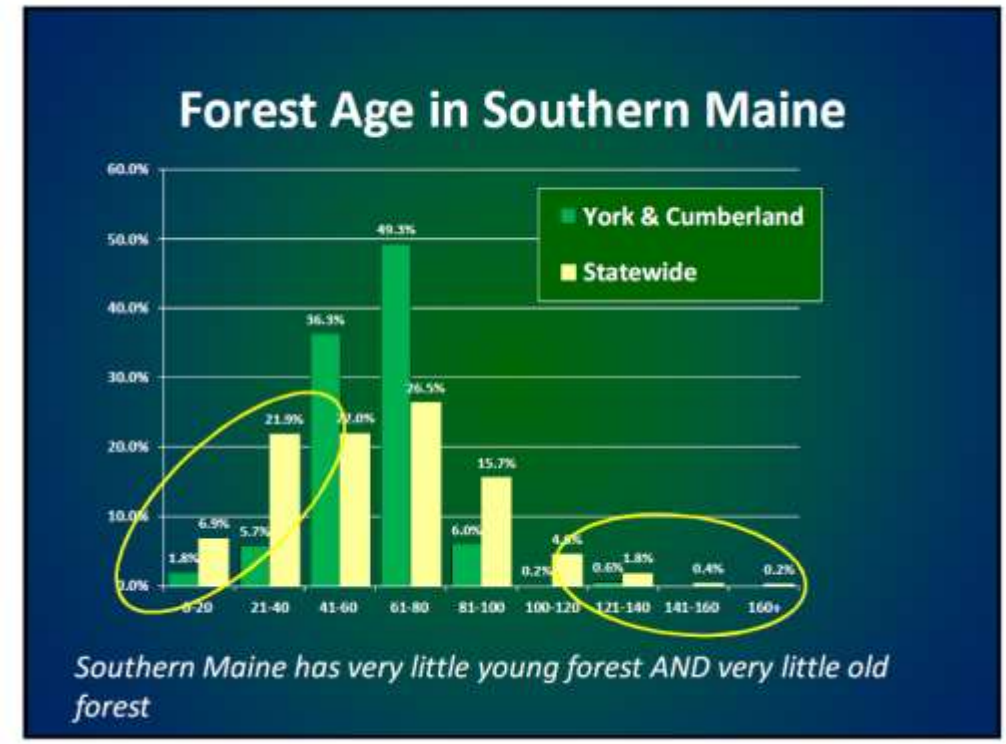
Moreover, preserving the remnants of old growth forests and maintaining truly late successional forest habitats throughout the region help to ensure that the full biodiversity of the region's forests are maintained. While, no native birds and mammals in New England are known that require old growth habitat, studies have documented bird, mammal, and amphibian species that occur in greater abundance in late successional and old growth forests. For example, one avian study of Northeastern forests found fifteen bird species whose abundance was much greater in old growth forests than managed forests including Swainson's thrush, solitary vireo, brown creeper, and black-throated green warbler (Haney and Schaadt 1996, cited in Lapin 2005). In his literature review of old growth ecosystems, Lapin (2005) also cites research of northern flying squirrels which have been found to be more abundant in mature and old growth forests likely due in part to the abundance and diversity of cavity trees, both alive and dead.

Research looking at invertebrate species, while limited, further substantiates the ecological significance of old-growth forests. Studies of beetles, in New England and Northern European forests in old growth forests indicates greater species diversity and abundance in old growth stands compared to managed stands (Chandler 1987, Chandler and Peck 1992, cited in Lapin 2005). Studies in other forest ecosystems in Canada, Europe, Japan and Australia have found that a number of beetle, fungus, gnat, butterfly and other invertebrate species are old-growth specialists.

Another fundamental purpose in maintaining a system of forest reserves is to preserve the genetic diversity of native plants and animals. Research from old-growth white pine forests that were recently logged indicates that genetic erosion had occurred in the harvested populations (Buchert, et al. 1997 cited in Lapin 2005). Seventy-five percent of the standing trees were harvested from the studied stands, and that resulted in a 25% reduction of the genetic diversity in the residual stand with a higher percentage of the rare and infrequent genes in the population being lost. Reduction in genetic variability can potentially compromise the ability of tree species to respond effectively to shifting environmental conditions, ranging from climate change to invasive plants, to introduced pests and diseases.

And while there is growing concern about the loss of early successional habitat in central and southern New England, this should not lead one to the conclusion that there is an abundant old growth forest. As the graph below of age distribution in the forests of southern Maine indicates, there is both a scarcity of early successional forests and older forests, with the bulk of forest acres being middle-aged.

Figure 17. Forest age in southern Maine



Source: Cutko, 2014.

For these and other reasons, the Wildlands & Woodlands initiative of the Harvard Forest has recommended that ten percent of New England's forests (approximately three million acres) be set aside as forest reserves where natural processes are allowed to proceed unfettered by human activities. Based upon available data, approximately two million acres, or two-thirds of the Wildlands & Woodlands target are currently either legally or administratively set aside as

reserves. However, acres, in and of themselves, will not provide for a reserve system that meets the above-stated objectives. For example, of the two million acres of existing preserves over ten percent is in one location – Baxter State Park in northern Maine, which, while a valued ecological gem, does not address the biodiversity needs of central or southern New England.

Moreover, the establishment and management of reserves needs to factor in the world's changing climate. The Nature Conservancy has begun an initiative to target "resilient" landscapes of key geophysical settings, where conservation is most likely to succeed over centuries as the world experiences dramatic climate changes. The Nature Conservancy's resilience analysis develops an approach to conserve biological diversity while allowing species and communities to rearrange in response to a continually changing climate.

Location, configuration and connectivity are all critical considerations of a well-designed reserve system. Recent public initiatives to develop state wildlife action plans along with private efforts, such as The Nature Conservancy's identification of eco-regional priorities, provide a strong informational base to make strategic decisions about the design of a region-wide reserve system. Integral to optimizing the future productivity of New England's forest – both for timber and non-timber outputs – is a well-designed forest reserve system, based upon sound scientific principles and information.

D. Conclusions

This paper provides some insights into the type of opportunities that exist to enhance the productivity of New England's forests for wildlife in the future. A key finding is that management of New England's working forests offers very significant opportunities to provide the habitat needs for both New England's current suite of wildlife species and restore populations of those which were historically more prevalent. It also raises some clear warning signs about a potential disconnect between public attitudes and policies on one hand and the actions that may be necessary to improve forest habitat and biodiversity. For example:

- In southern New England and the southern portions of Vermont, New Hampshire and Maine, the reduction in natural forest disturbances (such as fire and beaver activity) in combination with the preference for forest preservation over sustainable harvesting has already and will continue to cause declines in wildlife populations that require young forests and clearings. This already threatens the extinction of species like the New England cottontail, and other species will face a similar fate if forest management activities on both public and private lands continue to decline in southern and central New England.

- In northern New England, attention to maintaining large blocks of both early successional and intact mid to late successional forests will be needed to retain or restore the full suite of wildlife species. Forest practice regulations that strongly encourage landowners to harvest selectively over extensive areas rather than focus heavier harvests, including clearcutting where it is the most appropriate form of management, could threaten the future viability of the Canada Lynx and other species that favor early successional habitats as well as those species, like pine marten, which prefer large blocks of intact closed crown forest.

Other findings include:

- The examination of the habitat needs of lynx, marten, and woodcock, and the suite of species that have similar habitat requirements, suggest that maintaining diverse and robust wildlife populations need not conflict with expanding commercial timber production and other forest uses.
- Having a diversity of ownership types and objectives on actively managed forest land will be important to maintaining habitat for the full range of forest species.
- Even in a landscape of abundant forests, a system of forest reserves is needed both to protect the plants and animals that thrive within them and the information these reserves hold about the many mysteries of forest ecosystems – but it needs to be a strategic system that provides a full and rich representation of the region's forest communities.

Through a combination of retaining an expansive forest land base, conducting wildlife-friendly management of working forest lands, having a diversity of ownership types and objectives, and strategically preserving forest reserves it is possible to enhance the forest wildlife resources of New England over the coming decades.

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