

Connecticut's Forest Action Plan 2010
(Revised 2015)

*Building a better tomorrow for
Connecticut's forests today*



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Introduction and Purpose for State Strategies

With close to 60% of its 3,179,254 acres of land in forest, Connecticut is one of the most heavily forested states in the nation. Ironically, Connecticut is also one of the most densely populated states.

Connecticut's Statewide Forest Action Plan is a guidance document meant for the Connecticut Department of Energy and Environmental Protection's Division of Forestry, and our forest conservation partners in academia, extension, non-profits, regional, municipal, and private landowners.

Connecticut's forests and trees add immensely to the quality of life for the people of the state. They filter the air that is breathed, safeguard private and public drinking water sources, produce locally grown forest products, provide essential habitat for wildlife, and moderate summer and winter temperatures near homes. Whether people in Connecticut live in an urban, suburban, or rural setting, they are connected to the forest. Forests and trees are integral to the character of Connecticut.

The Assessment and Strategy is required per the Food, Conservation, and Energy Act of 2008, commonly referred to as the Farm Bill, which was enacted June 19, 2008. All States wishing to be eligible to receive direct financial assistance, apply for competitive grants, and accept other support from the United States Department of Agriculture (USDA) Forest Service through the Cooperative Forest Assistance Act (CFAA) must submit these reports by June 2010. State Assessments are intended to identify key forest-related issues and priorities to support development of the long-term State Strategies.

State assessments and strategies focus on three national S&PF themes:

1. Conserving working forest landscapes;
2. Protecting forests from harm; and
3. Enhancing public benefits from trees and forests.

State and Private Forestry Programs directly benefitting from CFAA and administered by the Division of Forestry and the Connecticut Agricultural Experiment Station improve the health, productivity, benefits and extent of rural, suburban and urban forests owned and managed by state, municipal, corporate, private organizations, and family landowners. These programs are as follows:

1. Forest Health – monitoring and managing harmful forest pests
2. National Fire Plan – training for local wildland fire fighters, administering grants to fire departments for wildfire suppression readiness, and maintaining a nationally deployable wildfire response team
3. Forest Stewardship – providing education and outreach to family forest owners encouraging them to retain their forest as forest
4. Urban and Community Forestry – improving urban and community forests by administering America the Beautiful grants and Tree City USA programs

5. Conservation Education – educating the next generation of environmental stewards through Project Learning Tree and supporting the No Child Left Inside® initiative
6. Forest Legacy – protecting “working forests;” those that protect water quality, provide habitat, forest products, opportunities for recreation and other public benefits through placement of conservation easements

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8. Numerous land trusts and other conservation minded non-profit organizations who work tirelessly to keep Connecticut's remaining forests as forest.
9. Individual Connecticut forest landowners who care for nearly 85% of Connecticut's forest land and whose land-use decisions leave a lasting legacy for future generations.
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The History of Connecticut's Forestlands¹

Forests provide wood and other forest products, watershed protection, wildlife habitat, diversity, a setting for recreation, and much more. They play a major role in both the history and culture of Connecticut. The state is one of the most densely populated in the nation, yet its forests remain as much a part of the landscape as its cities and towns. As the function of the forests become more understood, their importance to the wellbeing of Connecticut's inhabitants will increase.

Early settlers found nearly all of Connecticut covered by forests – in open, park-like conditions. For more than a thousand years before European settlement, the Native Americans of the region burned the forest in spring and fall to eliminate tangled underbrush. The forests that resulted provided a more suitable habitat for the game species on which they subsisted. Native populations were small, and had little impact on the forest ecosystems in which they lived. Once Europeans arrived, however, the landscape changed dramatically.

Clearing land for agriculture began slowly, as colonists built small subsistence farms. But, by the early 1800's, the establishment of farms spread rapidly as Connecticut's farmers began to supply food and wool to a rapidly growing nation. Extensive forestlands were cleared, towns were built, and wood was harvested for homes and barns, furniture and fuel. Thousands of small farms formed the basis for a strong, agriculturally based economy.

By 1820, only 25 percent of Connecticut remained forested. Substantial environmental changes to the forest followed, as black bear, elk, mountain lion, white-tailed deer, quail, grouse, and timber wolves disappeared from much of state. Both the loss of habitat and extensive harvesting of certain wildlife species – such as beaver and wild turkey – contributed to alter Connecticut's previously extensive woodlands.

Once thought to be unlimited, forests disappeared, and the State faced declining wildlife populations and timber shortages. Soil erosion from farms increased, and silt muddied the water in creeks that once ran clear. Because of the rapid runoff of storm water, springs that previously flowed all year began to dry during the summer.

In spite of these negative environmental impacts, farming continued to flourish. In the end, it would largely be economic rather than environmental reasons that would alter the landscape once again. In 1830, the Erie Canal opened and Connecticut's agricultural zenith passed. Within two decades, the small stony farms of Connecticut were unable to compete with the larger, more mechanized farms of western New York and the Ohio River Valley.

¹ The majority of this section was taken verbatim, with permission from Donald Smith, State Forester for CT DEP, from the publication "The Forests of Connecticut." Other contributions were taken verbatim from "Connecticut's Changing Forests" by Jeffrey S. Ward and J.P. Barsky, "Connecticut's Forests", by J.P. Barsky, and individual work done by David Irvin.

Much of the farmland became exhausted and unsuitable for continuous agricultural crops, and was soon abandoned. Farmers left marginal hillside farms to take jobs created in the cities by the industrial revolution. Finally, the opening of the West after the Civil War, and the added incentive of free land, hastened the pace of farm abandonment across New England. Before long, land went out of farming and forests began to return to much of Connecticut.

Without human interference, the vegetation of abandoned fields underwent a series of changes. Plants with seeds distributed by wind or birds were the first to germinate. These included many of the more common wildflowers – golden rod, New England aster, Queen Anne’s lace, Joe-Pye weed, butterfly weed, and blackberries, for example. Trees more suited to open, grassy patches followed, primarily white pine at first. Other species also established themselves on recently abandoned cropland, such as birch and red maple, the latter particularly in bottomlands. Then, as the pines grew and formed a protective canopy, the more climax deciduous types of oak, sugar maple, and hickory became established in the understory.

During the early 1900’s, the mature pine stands became the raw materials that began to feed a wood-hungry nation and world. Containers, shipping crates, boxes, pails and barrels were manufactured from the raw wood material supplied by Connecticut’s “Second Forest.” These were used primarily to ship fish products inland and overseas, an avenue of trade enhanced by the opening of the Panama Canal.

Up until about 1920, the harvesting of pine flourished. After this, much of the pine had been cut and the industry declined. But in the process, the understory of hardwoods had been released, contributing to today’s modern deciduous forest.

The late Nineteenth and early Twentieth Centuries also provided many other landscape-altering disturbances that had a major influence on modern forest composition. From the late 1800s to about 1920, entire hillsides were repeatedly clearcut to produce charcoal for the brick, brass, and iron industries. Stands were typically cut every 20-40 years when the trees were still small enough to be handled manually. Charcoal production fell dramatically with the advent of cheap coal and petroleum. Most of the forest in parts of Connecticut today had its origin in the charcoal production era and consists of even-aged stands approximately 100 years of age.

During the early 1900s, immense fires covering thousands of acres regularly roared over the countryside. Some of these fires were accidental, caused by sparks from railroads and industry. Others were deliberately set to clear underbrush in the forest and provide better pasture for livestock. Records from the early 1900s indicate 15,000 to over 100,000 acres (in 1915) of forest fires could occur annually in Connecticut. This destruction of resources spurred the legislature to create the position of State Forest Fire Warden in 1905 to coordinate control of fighting forest fires. Through the efforts of state and local fire fighters, the annual amount of forest damaged by wildfires was dramatically cut.

Major impacts during this period were not limited to cutting and burning. Prior to importation of the chestnut blight fungus, upwards of 25% of our forest was comprised of American chestnut trees. This extensive component of the forest vanished within just a few years. Disturbances to the forest floor and canopy from a combination of charcoal cuts, fires, and chestnut blight are

largely responsible for the dominance of oak species in Connecticut forests during the rest of the Twentieth Century.

Insects and disease have also affected other species in the past century. Dutch elm disease has largely removed American and slippery elm from Connecticut streets and woods. Butternut has mostly disappeared by a canker disease, red pine by insect attack, and now eastern hemlock is threatened by two exotic insect species. In the latter half of the Twentieth Century, gypsy moth outbreaks defoliated large areas of the state. More recently, the state will lose most of its ash trees due to the emerald ash borer.

Historical records suggest that severe hurricanes strike Connecticut every 100-150 years. It was estimated that the 1938 hurricane destroyed over 100,000 public shade trees, every mature white pine stand east of the Connecticut River, and almost one-fifth of the timber in the state. Nearly 55,000 acres of forest were flattened and salt damage was observed 45 miles inland. Other weather events that have caused widespread forest destruction include ice storms, microbursts, and tornadoes such as the one that destroyed Cathedral Pines in 1988.

Amidst a period of destructive influences on the forest, the turn of the Twentieth Century also marked the beginning of the conservation era in Connecticut. The very early Twentieth Century saw the creation of a state forestry agency, the first state forests, and the first real movements to protect and conserve natural resources. Enjoyment of the forest for active and passive recreation became a part of the state and national culture. In the 1930s, President Roosevelt created the Civilian Conservation Corps (CCC), which recruited thousands of young men to plant trees, suppress forest fires, and build a forest infrastructure legacy through our forests that includes many of the same state forest roads used in Connecticut today.

Despite the apparent dramatic changes the Connecticut landscape has undergone since European settlement, including repeated harvesting, large-scale land clearing, wildfire, hurricane, and introduced pests, the forest has shown its resiliency. Human attitudes toward the forest have also not been static. The history of Connecticut forests and the forests present today are a product of constant change and disturbance, both large and small, and ever-changing uses and interests in the forest. The forest of the Twenty-First Century will continue to change, as oak forests gradually diminish in favor of a conversion to maple, birch, and beech. Also changing will be Connecticut's population and attitudes about forests, which at close to 60% of the state's landscape, is diminishing in favor of suburban sprawl. This century will see all new impacts and pressures on the forest, as increasing populations place greater demands on a decreasing natural resource base growing on the only variable that is truly static: the land area.

PART 1. STATEWIDE FOREST RESOURCE ASSESSMENT

SECTION 1. Connecticut Forest Conditions and Trends

Introduction

Connecticut's framework for the Statewide Forest Resource Assessment follows the seven criteria of sustainability as listed in the Montreal Process Criterion and Indicators. This criteria is commonly used at the national and international levels to monitor the sustainability of temperate and boreal forests. As suggested in the Northeastern Area Association of State Foresters *Suggested Framework for Statewide Forest Resource Assessments*, these criterion are used because (1) "they provide broad goals for sustainable forest management, encompassing ecological, social, and economic aspects of forests; (2) they are agreed to and monitored at multiple scales (international, national, regional, in some states, and finer), (3) some related state-level data are compiled and will be available on-line. The Northeastern Area Association of State Foresters (NAASF) and the Northeastern Area (NA) have worked in partnership to assess and support forest sustainability at regional and state levels following the seven nationally-monitored criteria and 18 measurable base indicators of forest sustainability" (NAASF). A complete list of the base indicators and metrics used can be found in Appendix 1.

In addition, the Farm Bill and national guidance calls for the State Assessments and Strategies to be consistent with the three national S&PF themes: (1) conserve working forest landscapes, (2) protect forests from harm, and (3) enhance public benefits from trees and forests.

Criterion 1. Conservation of Biological Diversity

Importance: Biological diversity is about variety in the number and kinds of life forms in the forest ecosystem, in their genetic makeup, and in the habitats where they live. Generally, greater diversity means a greater potential to adapt to changes. To preserve biological diversity, animals and plants must be able to freely interact with one another and with their environment. There must be food, water, and shelter in sufficient amounts spread across the landscape. Biological diversity is often studied at ecosystem, species, and genetic levels. Diverse ecosystems are stable ecosystems (NAASF)²

² Most Importance statements contained in this document came directly from the NAASF *Suggested Framework for Statewide Forest Resource Assessments*.

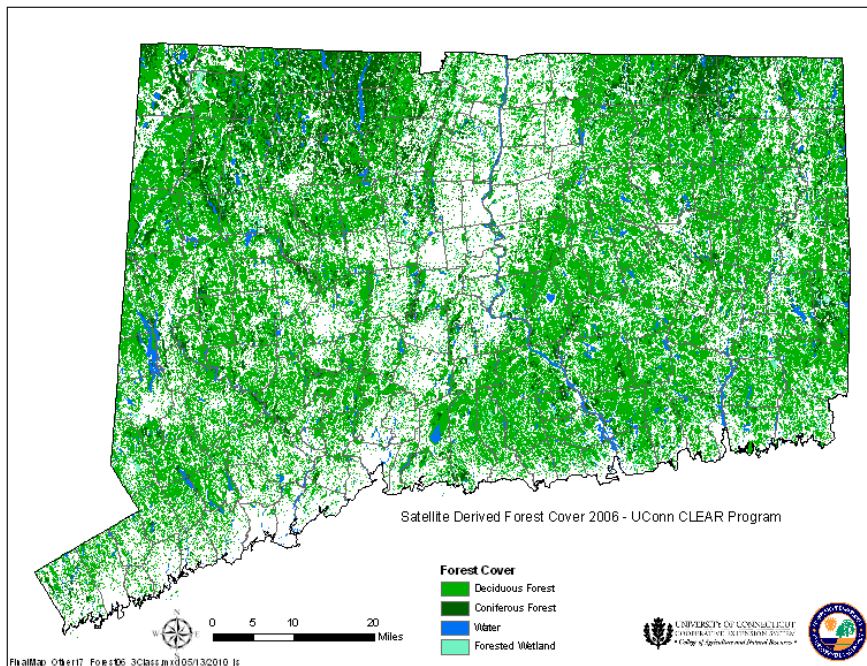
Indicator 1: Area of total land, forestland, and reserved forestland

Introduction: This Indicator assesses the percentage of the State that is forested, and the percentage of the forested area that is protected from development. The amount of forestland relative to other cover types provides an initial impression of the importance of the resource. The amount of protected forest indicates the degree to which the resource is sheltered from mismanagement or clearing for development.³

1.1 Forest and total land area

Connecticut contains approximately 3,179,254 acres of land, of which approximately 1,870,055⁴ acres, or 59%, is forested, based on satellite interpretation. This estimate of forest cover includes deciduous, coniferous, and wetland forests. It may include isolated scrub areas characterized by patches of dense woody vegetation, isolated low density residential areas, and some small water courses (UConn CCL). Other undeveloped classes include agricultural fields, grasses, non-forested wetland, tidal wetlands and barren. The remainder is developed (See Figure 1).

Figure 1. Statewide Land Cover 2006

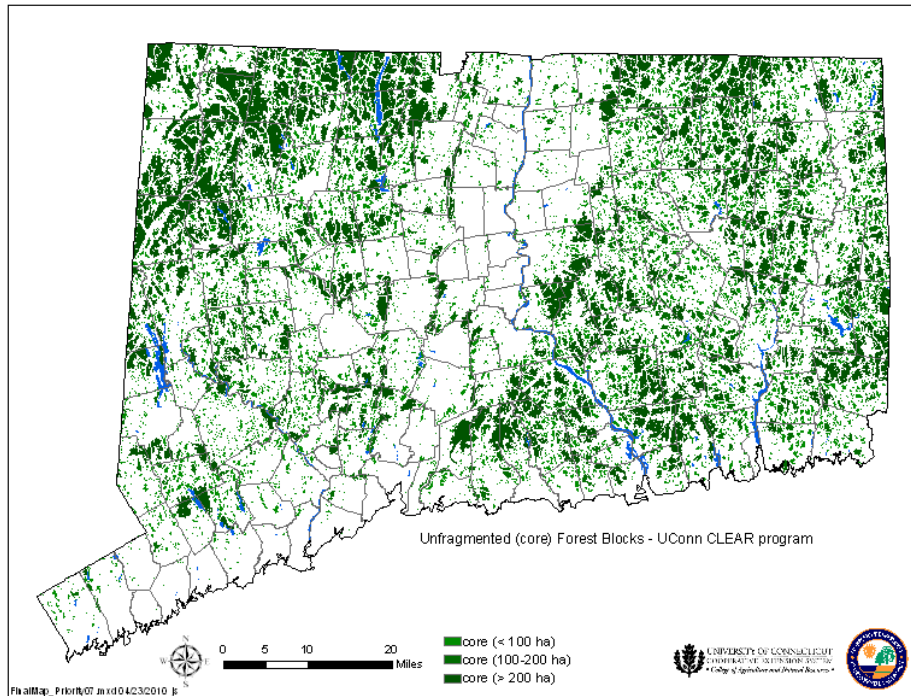


³ Most Introduction statements contained in this document were originally designed for the Delaware State Forest Assessment, and were used by Connecticut, with permission, due to applicability.

⁴ Estimates vary. USDA Forest Service Forest Inventory and Analysis data lists Connecticut forest cover to be approximately 1,769,291 acres as of 2014.

Of the forested land, approximately 858,256 acres, or 46%, is considered core forest (Figure 2), defined as being outside the "edge effect," or over 300 feet in all directions from non-forested areas (Wilson and Arnold 3).

Figure 2.
Unfragmented
Core Forest Blocks



1.2 & 1.3 Forest density and Forest land and population

Connecticut ranks thirteenth among the fifty states in percentage of land that is under forest cover (UConn FF). Connecticut is also one of the most densely populated states in the country, ranking fourth nationwide (CWCS). According to the U.S. Census, Connecticut's population increased from 3.3 million in 1990 to 3.4 million in 2000, a 3.6% increase (UConn FF). As of 2014, Connecticut's population was estimated at 3.6 million, with an average population density of 739 persons per square mile (US Census Bureau).

1.4 Reserved Forestland

According to 2014 USDA Forest Service Forest Inventory and Analysis data (FIA) data, reserved forestland is defined as forest lands withdrawn from timber utilization by law or administrative regulation. Estimates are that 31,575 acres are reserved in Connecticut, all at the local (county, municipal, etc.) level.

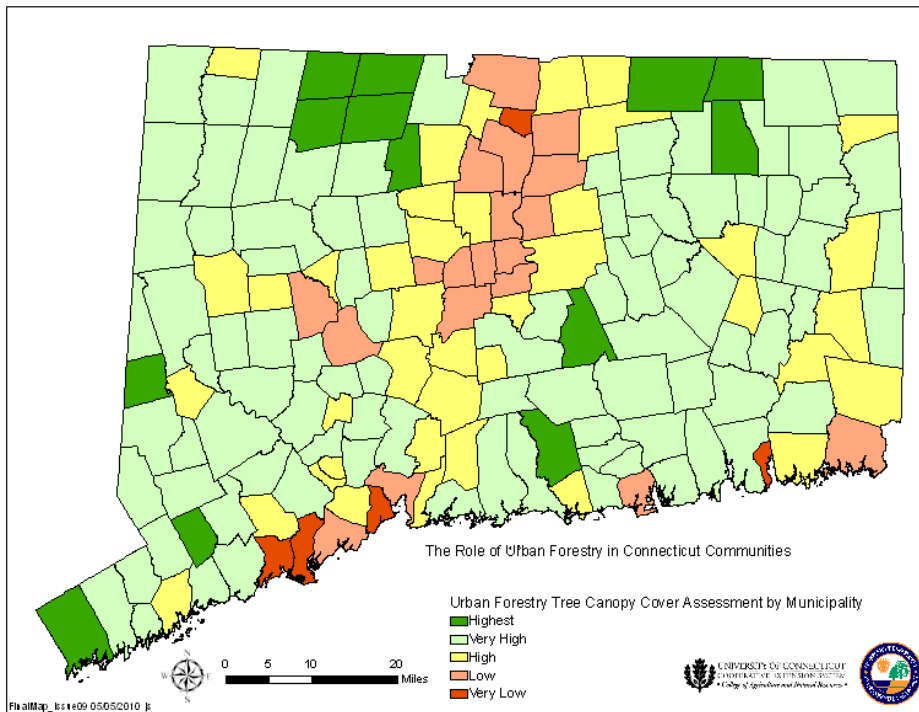
Although there are no areas owned by the State that are classified as reserved forestland, there are areas designated as Natural Area Preserves by the Governor, which are not actively managed for timber. Management activities can be performed in these areas provided there is an approved management plan which supports Preserve goals. In addition, the Division of Forestry (DOF) uses unofficial classifications called either "Administrative Natural Area" or "Old Forestland Management Site" which withdraws forestland from timber utilization for the span of a management plan (10 years). It can be continued indefinitely with succeeding plans. There is also an unofficial policy of no timber harvesting on State Park lands unless the harvesting is salvage related. That unofficial policy has been in place since the mid-1980s.

1.5 Urban Forests

Urban forest canopy cover varies greatly within Connecticut. According to the 2008 Urban & Community Forestry Report for Connecticut by David Nowak & Eric Greenfield, using urban areas based on population density and delimited by the US Census definitions of urbanized areas and urban clusters, tree canopy cover is approximately 2,248.4 km² (868.1 mi²), or 49.3% of the urban land area.

Figure 3 below shows the Urban Forestry Tree Canopy Cover by municipalities. Rankings are comparative based on municipal size and population density.

Figure 3. Urban Forestry Tree Canopy Cover by Municipalities



Conclusion: Currently, almost 60% of Connecticut is forested, highly impressive based on the dense population of residents in the state. While there is such a high percentage of existing forestland, continued increases in population statewide are exerting more pressure on this valuable resource.

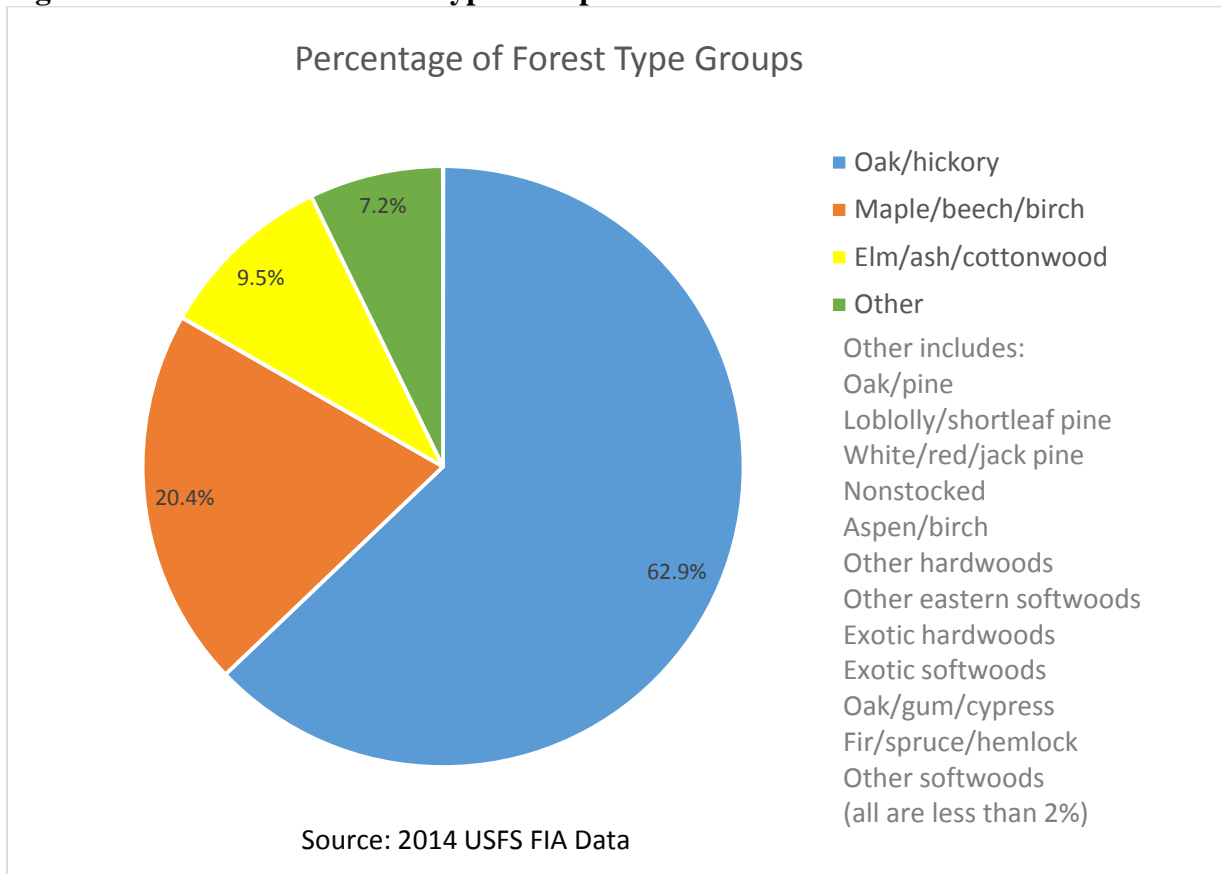
Indicator 2: Forest type, size class, age class, and successional stage

Introduction: This indicator provides a view of the overall forest resource in the State. Periodic forest inventories are used to develop reports that describe the basic biological characteristics of our forests and the trees they contain. Ideally, the state's forest resource will contain a mixture of native forest types and, within each type; there is a balance of tree size and age classes.

2.1 Forest Cover Type Groups

Forestland within a state or region is often classified by forest type. Forest types are named for the predominant live tree species cover for the field location. Hardwoods and softwoods are first grouped to determine predominant group, and Forest Type is selected from the predominant group (FIA). Connecticut's forest type groups as listed below are based on inventories performed by the USDA Forest Service through its FIA Program.

Figure 4. Connecticut's Forest Type Group

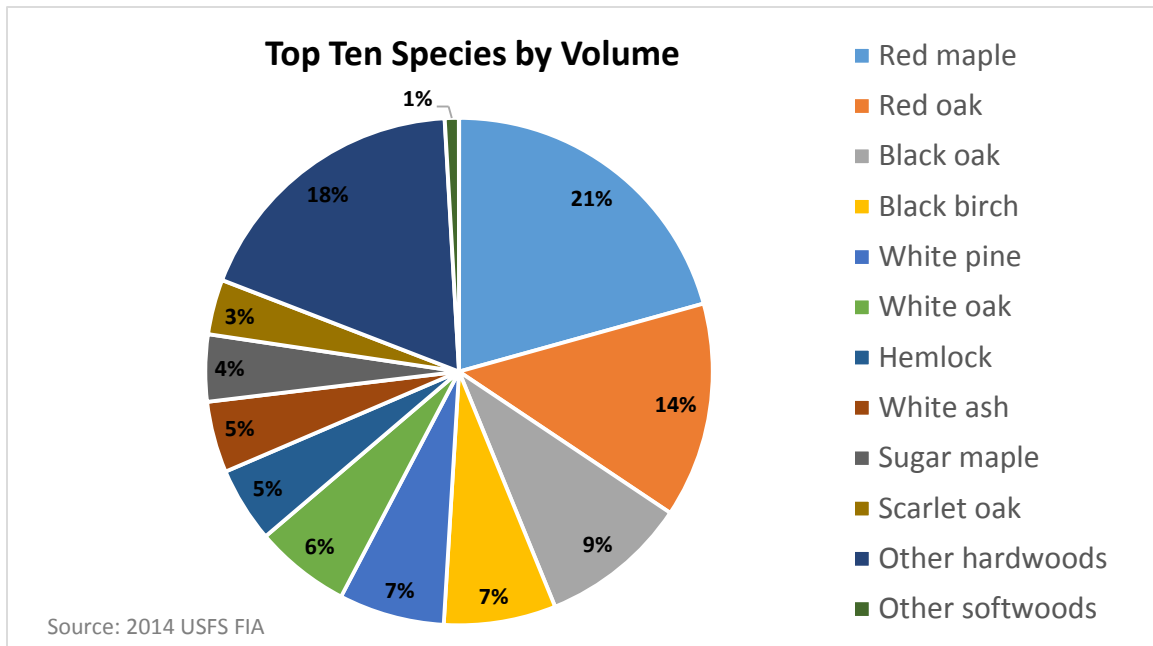


Almost 63% of Connecticut's forests are classified as an oak/hickory forest type group. An oak/hickory forest type group is made up of several forest types including:

- Post oak/blackjack oak
- Chestnut oak
- White oak/red oak/hickory
- White oak
- Northern red oak
- Yellow-poplar/white oak/red oak
- Sassafras/persimmon
- Sweetgum/yellow-poplar
- Scarlet oak
- Yellow-poplar
- Black walnut
- Black locust
- Southern scrub oak
- Chestnut oak/black oak/scarlet oak
- Red maple/oak
- Mixed upland hardwoods

According to 2014 FIA estimates, Connecticut’s forests contain approximately 4.5 billion ft³ of volume in trees over 5” in diameter, and 789 million trees over 1” diameter. These trees constitute a diverse mix of species. The 2008 FIA inventory identified 60 tree species, although many of these are uncommon. The ten most common species, listed below in Figure 5 account for 82% of the total net volume of live trees.

Figure 5. Top Ten Species by Volume

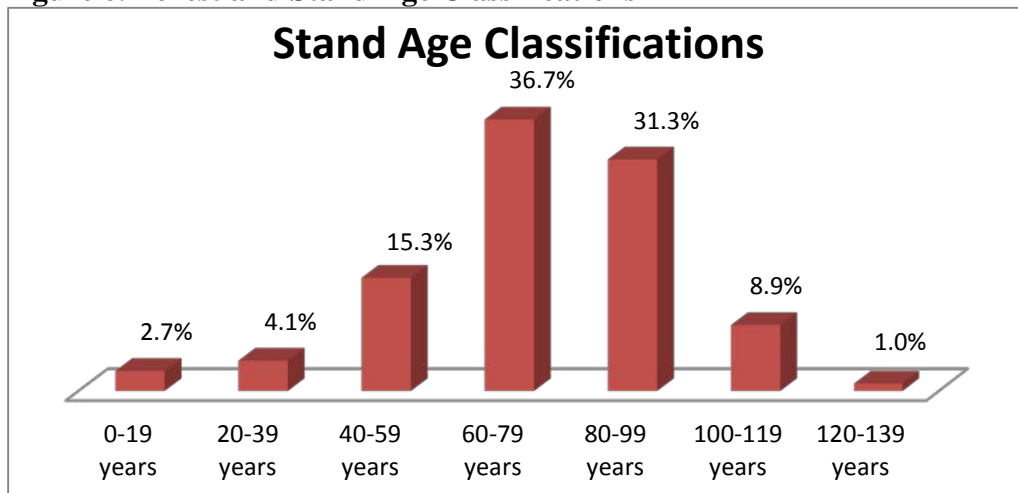


When ranked by volume, red maple is the most prevalent species followed by northern red oak, which held the top spot in previous inventories in the 1970s and 1950s (TREND). Ongoing high-grading of oak stands during harvesting on private land, high oak mortality following gypsy moth caterpillar outbreaks, and lack of oak regeneration are significant factors in this change (TREND). Red maple also retains the top spot due to the variety of habitats it occupies. The “other” species category is a compilation of different species that occur in small amounts across the state.

2.2 & 2.3 Size Class & Age Group

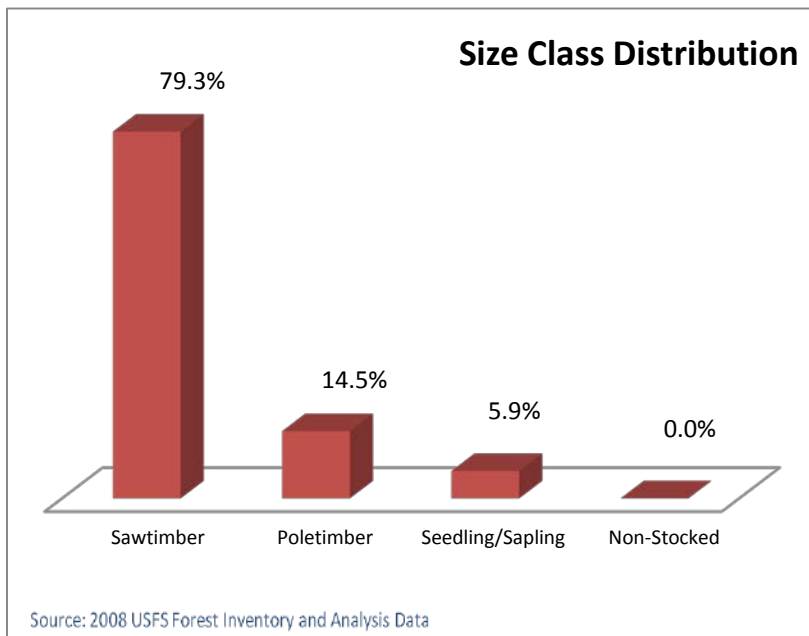
Connecticut’s forests, which were cut over repeatedly in the nineteenth and early twentieth century’s, began the most recent period of regrowth during the early part of the 1900s. This was due to several factors converging at once. The early 1900s saw the creation of a state forest agency, the first state forests, and the first real efforts to protect and conserve natural resources. The creation of the Civilian Conservation Corp (CCC) in the 1930’s brought about large scale tree plantings, suppression of large forest fires, and the development of the state forest road infrastructure. The 1938 hurricane destroyed almost one-fifth of the timber in the state, with nearly 55,000 acres flattened. These factors, accompanied by the large scale farm abandonment that occurred around the same time, all contribute to the fact that Connecticut’s forests are primarily maturing forests based on the forest type, with 78% of the trees being over 60 years old (Figure 6).

Figure 6. Forestland Stand Age Classifications



Source: 2008 Forest Inventory and Analysis Data

Due to the age of Connecticut's forests, the forests are overwhelmingly composed of the sawtimber size class (over 11" diameter at breast height) (Figure 7). This trend has been steadily increasing since the early part of the last century, and is an increase of approximately 9% since 1998 (TREND). Although this is a positive for many wildlife species and the lumber industry, there are potential detrimental effects for forest product sustainability, for protection against catastrophic weather or insect and disease outbreaks, and for wildlife species that depend on early successional habitats. As the trees in a stand get larger and become sawtimber, a gap may appear in the number of trees in the pole timber size class. Seedling and sapling stocked areas have remained fairly constant statewide over the last decade. This is in part due to active management on both public and private lands that sustains early successional habitats for those species in need. However these acres have lagged behind sustainable amounts and the ability to make the forest resilient to catastrophic weather or other devastation.



Source: 2008 USFS Forest Inventory and Analysis Data

Figure 7. Forest Land Stand-size Class Distribution

In order to create an ecologically resilient ecosystem, Connecticut needs to be more active in creating a range of age and size classes within forests.

Stocking is defined as a measure of the number and size of trees on each acre of forests. According to the 2008 Connecticut FIA data, 42% of Connecticut's forests are considered fully stocked, and over 83% of Connecticut's forests are considered either fully or medium stocked. A small amount (3%) is considered overstocked, 11% is considered poorly stocked, and 2% is non-stocked.

Conclusion: Forest is the single largest land cover category in Connecticut. The dominant forest type group is oak/hickory, and the most prevalent species is red maple. This trend will most likely continue into the near future. Forests that contain all stand-size and age classes provide diverse habitats for wildlife, an even flow of forest products, and will be more resistant to insect and disease outbreaks (TREND). Currently Connecticut's forests are not well balanced in terms of either size or age of the forests; young forests and very old forests are under-represented. To maintain a balance of forest types, tree sizes, and ages, a greater effort needs to be invested in promoting a range of age classes within forests, especially in regards to maintaining early successional habitats. The use of forest management practices can influence the future composition of forests either positively or negatively. More emphasis should be placed on making sure management practices positively affect the environment.

Indicator 3: Extent of forestland conversion, fragmentation, and parcelization

Introduction: While it is important to study the amount of forestland within a state or region, it is also necessary to understand the rate at which forests are lost through conversion to other land uses. Also important is the degree to which the remaining forest is fragmented, or broken into smaller contiguous blocks. Forest fragmentation leads to additional challenges that degrade forest health and sustainability. Invasive plant species that displace native plants often become established around forest edges, and reduced forest parcel size results in less interior forest for plants and animals that require this specific habitat. A third concern is the reduction in the average forest ownership size (parcelization) as large parcels are subdivided into multiple ownerships. The resulting increase in the number of forest landowners requires more technical forestry assistance to manage the same forested acreage and makes large-scale forest management more difficult.

3.1, 3.2 and 3.3 Forest fragmentation, Forest land developed and Net change in forest land

Forest fragmentation, "which is the breaking up of large forested tracts into smaller and smaller pieces, is considered by forestry, wildlife and water experts alike to have serious implications for the health of our natural resources" (Wilson and Arnold). "The quantity of the forest is not necessarily equal to the quality of the forest, which is greatly impacted by proximity to non-forested areas" (Wilson and Arnold).

The University of Connecticut Center For Land Use Education and Research did a twenty-one year study on forest fragmentation in Connecticut. According to the "Forest Fragmentation in Connecticut 1985-2006" report, in the timeframe of 1985-2006, in addition to the loss of 185

square miles of forest to development, Connecticut also lost 264 square miles of core forest (defined previously). Other terms used to describe the quality of forest land include perforated, edge, and patch forests. “Perforated forests make up the interior edge of small non-forested areas within a core forest, such as a house built within the woods. Edge forests make up the exterior periphery of core forest tracts where they meet with non-forested areas. The most disturbed category, called patch forest, are small fragments of forest that are completely surrounded by non-forested areas” (Wilson and Arnold).

The report goes on to say that “the fact that core forest loss is greater than the overall loss of forest seems counterintuitive at first. However, this number includes not only core forest lost to development, but also core degraded to one of the other three (impacted) categories” (Wilson and Arnold). As can be seen in Figure 8, these three categories either stayed constant or increased slightly over the 21-year period, as core forest was fragmented into these other qualitative types of forest.

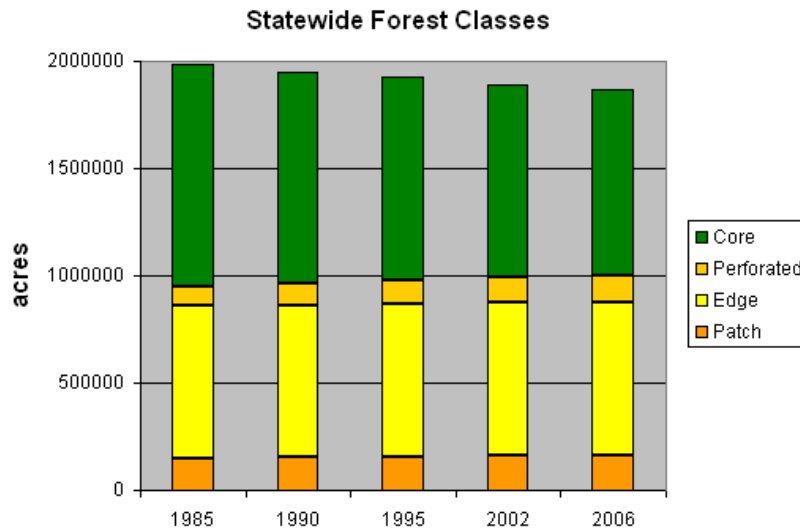


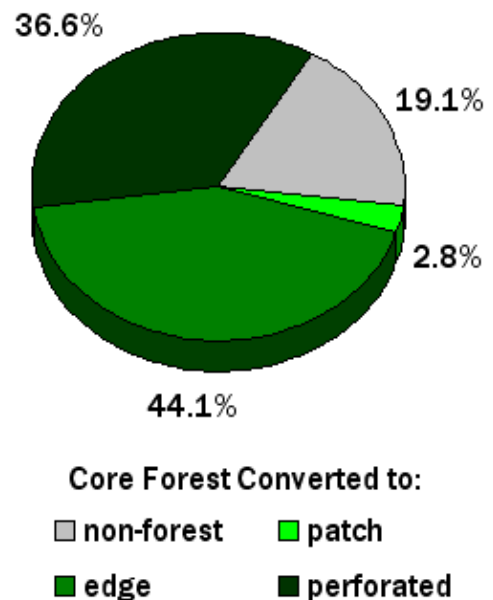
Figure 8. Statewide Forest Classes

Source: UConn CLEAR

Furthermore, “A closer look at exactly what happened to core forest in the twenty-one years shows that while a significant portion was converted completely to non-forest (19.1%), most of the core forest was converted to perforated (36.6%) or edge (44.1%) forest by the encroachment of nearby development (Figure 9). This seems to reflect the prevalent patterns of development in Connecticut during this period, where areas of development in the form of low density subdivisions are “punched” into the forested landscape” (Wilson and Arnold).

Figure 9. Core Forest Converted 1985-2006

Source: UConn CLEAR



Lastly, Wilson and Arnold state that “within the core forest, there were changes over time in the relative distribution of the three size categories used to indicate the viability of the core patches with respect to the size of the patch. These three categories used are: small (< 250 acres), medium (250-500 acres), and large (>500 acres). Again, all areas designated as “core” are greater than our “edge width” of 300 feet away from non-forested areas. As seen in Figure 10, while the acreage of all three core patch sizes is decreasing over time, the acreage of large core patches (>500 acres) is dropping at a much faster rate. These large forest patches have declined about 3.6% compared to 1985 levels, versus 1.3% for medium patches and only 0.4% for small patches.”

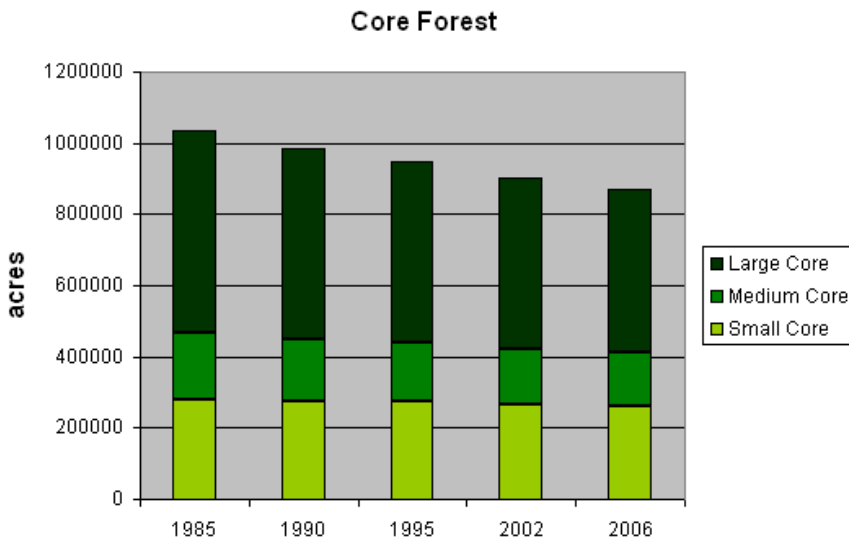


Figure 10. Core Forest (acres)

Source: UConn CLEAR

This loss of core forest contributes greatly to concerns about overall forest ecosystem health in Connecticut. Forest health is not only dependent on the size of forest blocks, but also on their proximity to non-forested areas.

3.4 Additions to and conversions from forest land

Between 2000 and 2009, Connecticut’s population has increased 3.3%, following a trend that has existed for decades. The combination of this continued increase in population, coupled with the extremely dense nature of this population existing in a small, heavily forested state, has led to an overall decrease in forest cover as development and urban sprawl infringe upon the forestlands in Connecticut. Figure 11 shows how in the twenty-one year GIS based land cover analysis study mentioned above; the amount of forestland has continuously dwindled, while the amount of developed land has definitively increased. (UConn CCL)

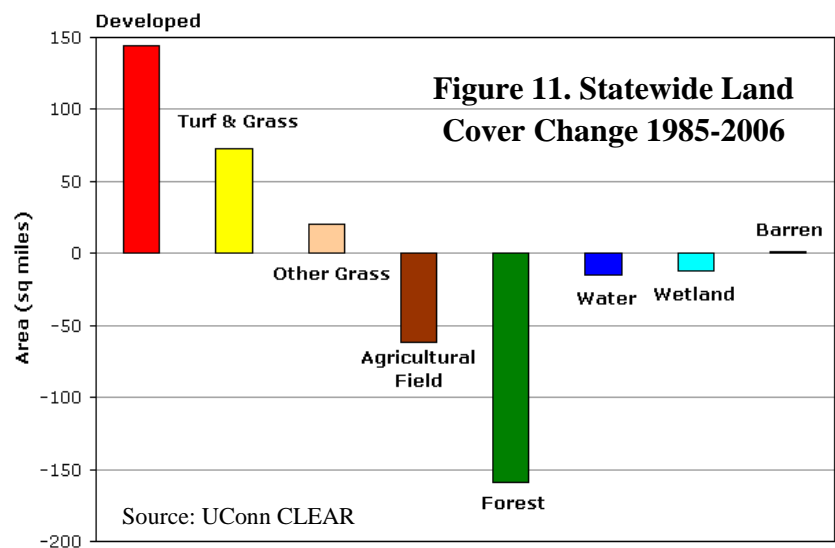
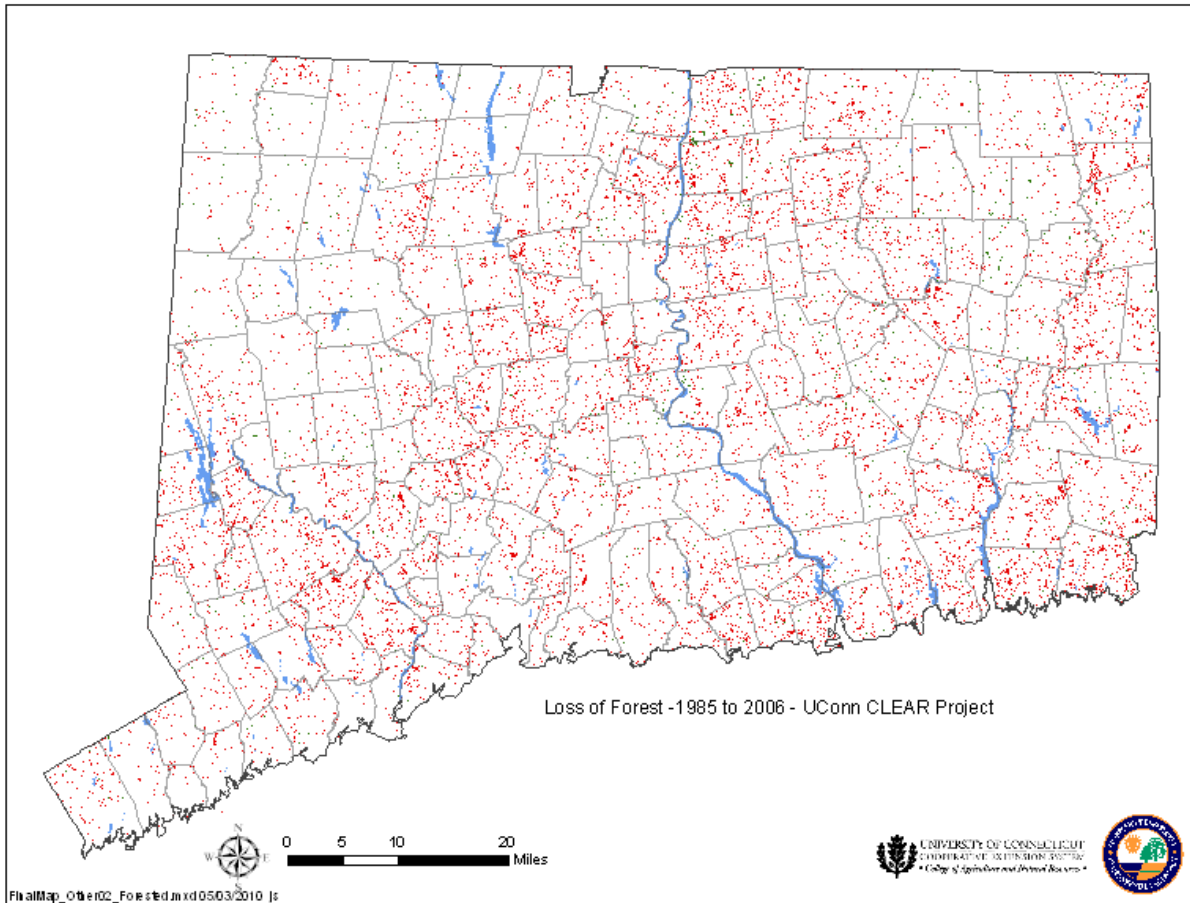


Figure 11. Statewide Land Cover Change 1985-2006

Source: UConn CLEAR

In this timeframe, Connecticut lost about 185 square miles of forest to development, and other uses; about 3.7% of the forest that existed in 1985. It is important to note that the 185 square miles of forest lost is not limited to one region of the state. Figure 12 shows how widespread the loss of forestland in that twenty-one year period was. The red signifies areas where forest cover was lost, according to satellite interpretation.

Figure 12. Loss of Forest Cover-1985 to 2006



3.5 Forest Parcel Sizes

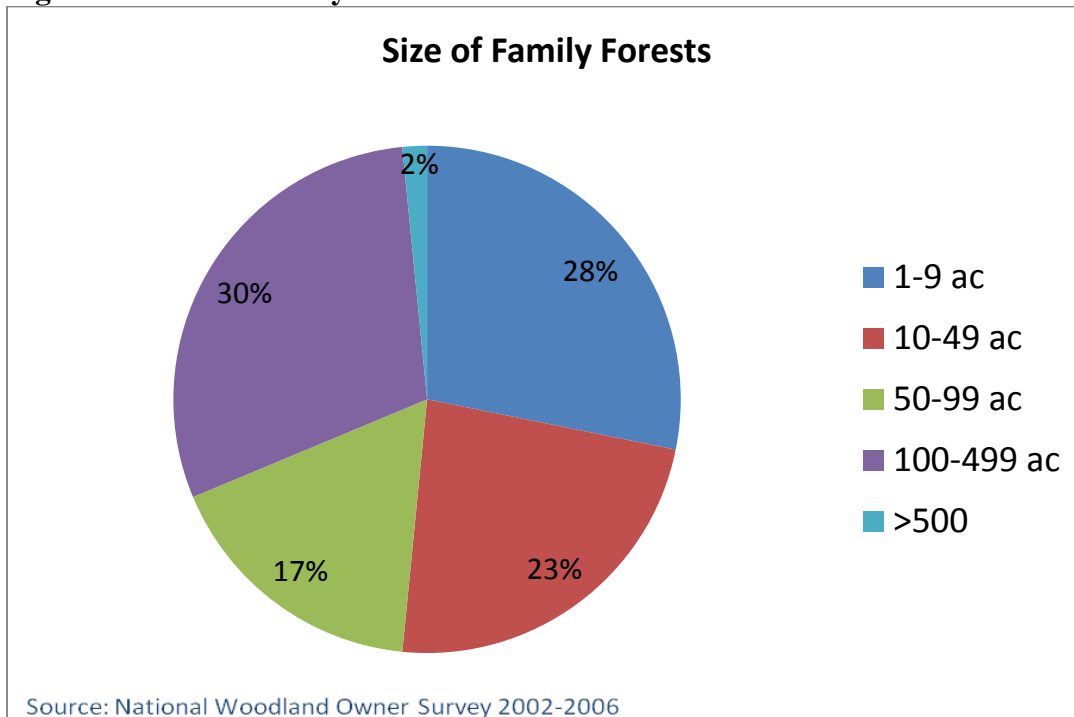
Parcelization, the division of larger blocks of forest land into smaller blocks with multiple owners (Kilgore and MacKay 2007) is a concern in Connecticut. Being that so much of Connecticut's forests are privately owned, what those owners do with their land greatly impacts all residents of Connecticut. Over the years, as larger forestland parcels have been broken into smaller parcels, there has been a corresponding increase in the number of landowners associated with those smaller sized forestland parcels.

As mentioned in the Kilgore and MacKay report, research has shown that decreases in the size of forestland parcels can affect the economic viability of managing forests for wood products, both on the part of the buyer and landowner, as well as have adverse impacts on wildlife habitat,

water quality, and forest recreational opportunities. Parcelization can contribute to and accelerate the processes of fragmentation and conversion of forestland.

Figure 13 below shows the average size of family owned forests. As the largest forest landowner group in Connecticut (73% of all forest land), these family forest landowners have a huge impact on the current and future status of Connecticut’s woodlands.

Figure 13. Size of Family Forests



These privately owned woodlands play a critical role in supplying economic, ecological, and quality of life values. “An increasing number and assortment of forest landowners with varying interests controlling the forest land base makes it more likely that disruptions to the values mentioned above will occur. Most effects of parcelization are seen as negatively impacting recreation opportunities, forest health, local communities, and timber-based economies” (Gobster and Rickenbach). In addition, parcelization increases the likelihood that forest land will be converted to some type of developed use.

Conclusion: While Connecticut currently contains almost 60% forest cover, forest land is being lost in the state at a steady and continuous rate. Not only is forest land being lost, but the quality of forest land is being diminished. The ability of Connecticut’s forests to provide quality wildlife habitat, clean water, clean air, recreation, tranquility, and economically viable forest products is at least partially dependent on our ability to maintain sizeable tracts of unfragmented forest. As the remaining forestland continues to be broken into smaller parcels of forests, natural resource managers are faced with an expanding and diverse list of issues and demands. Educations of landowners, additional tax incentives, payments for ecological benefits, and technical assistance to promote on the ground forestry are all ways to address these concerns.

Indicator 4: Status of forest/woodland communities and associated species of concern.

Introduction: Forests provide habitat for a wide variety of animals and plants. Some rare plants are found only in specific types of forest, and some rare animals require certain forest habitat for their survival. Protecting and conserving the wide range of forests native to Connecticut is vital to the survival of many plant and animal species – both rare and common. Recognizing and understanding the rare, threatened, and endangered species of plants and animals found in our forests is the first step in their conservation. There is a need to recognize the importance of large blocks for forest birds like the cerulean warbler and wood thrush. In addition, the return of the forest cover to much of what was once farmland has helped create conditions for the comeback of species like black bear and fisher. Finally, New England cottontail is a species of greatest conservation need which have been reduced to 20% of their historical range, the major portion of which still remains in Connecticut. These animals are highly dependent on young forests, mixed with shrublands, thickets, and old fields. Actively managing for young forest habitat through ecologically appropriate silviculture is an extremely important tool in ensuring that this species is not listed as Threatened or Endangered (Wilson). As of September 11, 2015, the results of the conservation efforts worked well enough that the New England cottontail does not need protection under the Endangered Species Act.

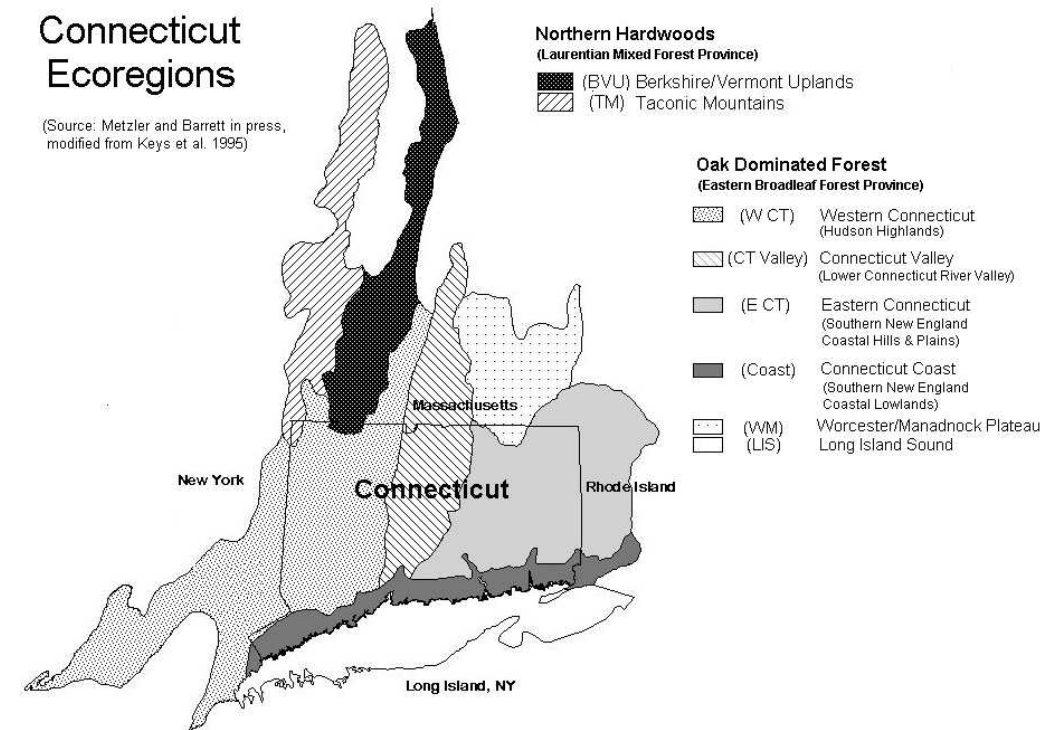
4.1 Forest and Woodland Communities

Connecticut's wildlife is remarkably diverse for a small state. There are 84 species of mammals, 335 species of birds, 50 species of reptiles and amphibians, 169 species of fish and an estimated 20,000 species of invertebrates according to the 2015 Connecticut Wildlife Action Plan (CTWAP). (The 2015 CT Wildlife Action Plan was submitted to the US Fish & Wildlife Service in October 2015 and should be reviewed by early 2016.) "This diversity is due to the state's wide range of landscapes, waterscapes, and habitat diversity, from the coastal plain and Long Island Sound in the south to the northwest hills. The state's varied climate, geology, soil types, topography, and watersheds support a wide range of vegetative communities that provide diverse habitats for its wildlife" (CWCS).

Over the years, several ecosystem classification systems have been applied to Connecticut's landscape. The most current ecoregion classification for Connecticut, which is utilized in Connecticut's 2005 Comprehensive Wildlife Conservation Strategy (CWCS), was developed by Metzler and Barrett. They modified Keys et al., "Ecological Units of the United States" (1995) to develop this ecoregion classification system. This system consists of eight classifications:

- Berkshire Vermont Uplands (BVU)
- Taconic Mountains (TM)
- Western Connecticut [Hudson Highlands] (WCT)
- Connecticut Valley [Lower Connecticut River Valley] (CT Valley)
- Eastern Connecticut [Southern New England Coastal Hills and Plains] (ECT)
- Connecticut Coast [Southern New England Coastal Lowlands] (COAST)
- Worcester/Monadnock Plateau (WM)
- Long Island Sound (LIS)

Figure 14. Connecticut Ecoregions



Source: CT DEEP, CWCS

Within these ecoregions, the 2015 Connecticut Wildlife Action Plan identified 10 Key Habitats, and 46 sub-habitats associated with the identified wildlife Greatest Conservation Need species in Connecticut (detailed below).

Four of the Key Habitat types and many of their sub-habitats are of particular interest to this assessment. *Upland Forests Habitats* include the sub-habitats Oak Forests, Calcareous Forests, Coniferous Forests, Old Growth Forests, Northern Hardwood Forests, Mixed Hardwood Forests, Young Forests, and Maritime Forests. *Upland Woodland and Shrub Habitats* include sub-habitats Red Cedar Glades, Pitch Pine-Scrub Oak Woodlands, and Reverting Field and Early Successional Shrubland. *Forested Inland Wetland Habitats* include sub-habitats Atlantic White Cedar Swamps, Red/Black Spruce Swamps, Northern White Cedar Swamps, Floodplain Forests, and Red Maple Swamps. In the *Unique, Natural or Man-made Habitats*, sub-habitats Vernal Pools and Public Utility Transmission Corridors are also of interest to this assessment. A complete list of the Key Habitats and vegetative communities can be found in Appendix 5.

To further delineate important habitats in Connecticut, Critical Habitats have been identified across the state. Critical Habitats provide the identification and distribution of a subset of twenty-five important (rare and specialized) wildlife habitats identified in the CWCS. These 25 habitat types were taken from the “Key Habitats of Greatest Conservation Need” listed above. “These habitat types have a long history of conservation interest and have been documented and studied as being among the most rare, unique, and threatened in the state” (CWCS). Critical habitats are of various sizes.

It is important to note that two forested community types are included in the listed Critical Habitats. One community type is the Palustrine Forested Areas, which include “swamps that are seasonally and/or permanently flooded by freshwater, characterized by a dominance of trees with overlapping crowns forming between 60-100% canopy cover”. Subtypes include Atlantic White Cedar Swamps, Acidic Red/Back Spruce Basin Swamps, Circumneutral Northern White Cedar Swamps, and Floodplain Forests (CT ECO)

Also included are Terrestrial Forested Areas including “upland forests and woodlands that are not influenced by surface or groundwater flooding, and are characterized by a dominance of trees with overlapping crowns forming between 60-100% canopy cover.” Subtypes include Coastal Woodland/Shrublands, Dry Acidic Forests, Dry Circumneutral Forests, Dry Subacidic Forests, Old Growth Forests, and Subacidic Cold Talus Forest/Woodland (CT ECO)

A statewide map, and more specific data on these and other Connecticut Critical Habitats can be found at the Connecticut Environmental Conditions Online website at www.cteco.uconn.edu.

4.2 Forest associated and all species

The 2015 Connecticut Wildlife Action Plan lists a total of over 20,000 animal species found in Connecticut. This includes 84 mammal species, 335 bird species, 50 species of reptiles and amphibians, 169 species of fish, and an estimate of 20,000 invertebrates. A full list of all species and their statuses can be found in the 2005 CWCS-Appendix 1b. The quality of information on distribution and abundance varies greatly.

No comprehensive list of forest associated species has been compiled in the CWCS, although in lieu of this, the forest associated species listed in The Matrices in the “New England Wildlife Habitat, Natural History, and Distribution” by DeGraaf and Yamasaki (2001) provides a basis from which to work.

In addition, the Southern New England Gap Analysis Program (SNE-GAP) (Zuckerberg et al) provides a map of predicted distribution of species diversity in Southern New England, which can be used as a reference for mammals, birds, reptiles, and amphibians. The purpose of the SNE-GAP is to “provide a regional assessment of the conservation status of native vertebrate species and natural land cover types, and to facilitate the application of this information to land management activities.” Although it does not break out forest associated species, data from the maps can be useful in making some assumptions. See Appendix 3 for maps. Data on fish distribution included in Appendix 3 came from the CT DEEP Stream Survey 1988-94, and the Distribution of Benthic Macro-invertebrates in Connecticut map came from the CT DEEP Bureau of Water Management Rotating Basin Strategy.

4.3 Forest associated species of concern by taxonomic group

Regarding species of concern in Connecticut, the following chart summarizes the total number of wildlife species and their associated statuses. Appendix 4 contains an updated list of the Connecticut Endangered Species List (2010).

Figure 15. Status of Wildlife Diversity in Connecticut

Taxa	Species Found in CT	State Listed	Federally Listed	Imperiled Range-Wide
Mammals	84	11	2	1
Birds	335	50	2	0
Reptiles & Amphibians	50	22	5	2
Fish	169	13	2	0
Invertebrates	20,000 estimate	192	4	11
Total		288	15	14

Source: DEEP Wildlife, 2015 CTWAP

The map below (Figure 16) shows the general areas of concern for State and Federally Listed Species included in the Connecticut Endangered Species List 2010. The CT DEEP publishes a new version of this Natural Diversity Data Base (NDDDB) map twice a year. The general locations of species and communities are symbolized as shaded areas on the maps. Exact locations have been masked to protect sensitive species from collection and disturbance and to protect landowner's rights whenever species occur on private property. In some cases an occurrence represents a location derived from literature, museum records, and specimens (NDDDB).

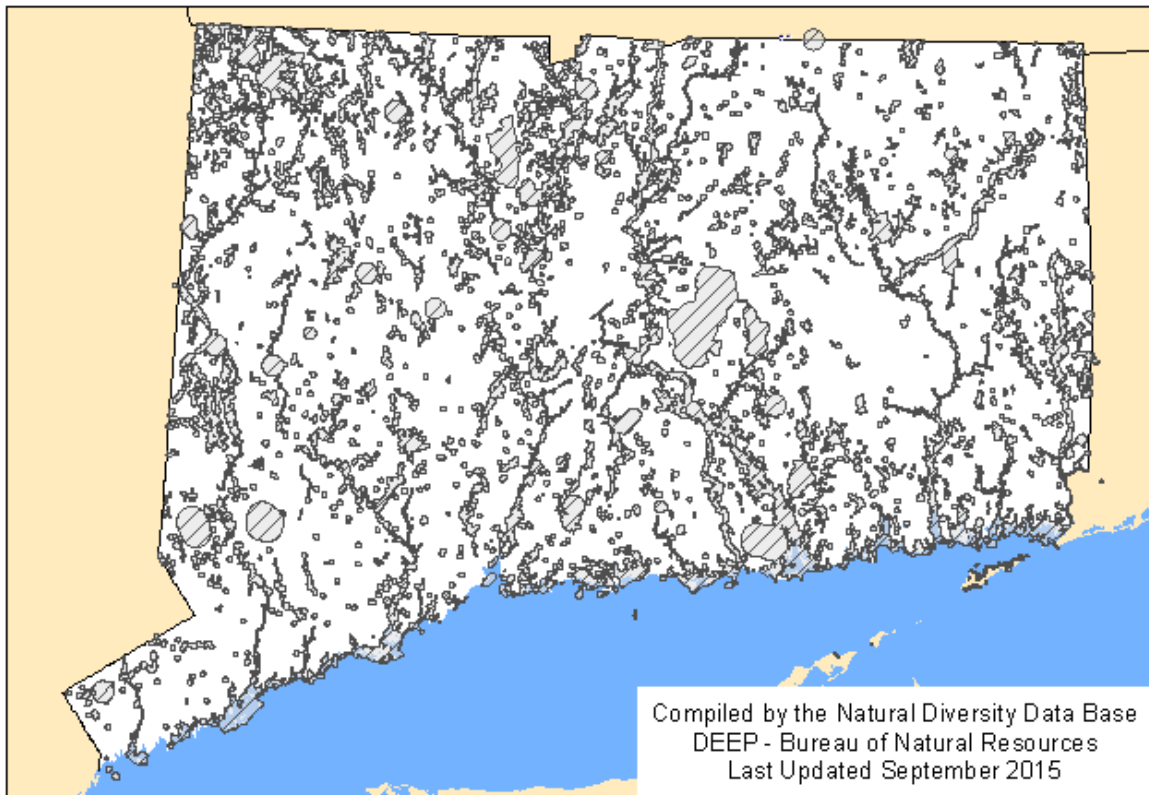


Figure 16. Areas of Concern for State and Federal Listed Species and Significant Natural Communities

The CTWAP has identified species that are thought to be of Greatest Conservation Need (GCN). A variety of factors were considered in determining GCN species including status, abundance, distribution, and habitat associations. Figure 17 below summarizes Connecticut’s GCN species. Full details can be found in the 2015 Connecticut Wildlife Action Plan (www.ct.gov/deep/wildlifeactionplan).

Figure 17. Summary of Connecticut’s GCN Species

Taxa	State Endangered	State Threatened	State Special Concern	Total GCN Species^	Total Species in CT
Mammals	6	0	5	26	84
Birds	18	12	18	95	335
Herpetofauna	6	5	11	31	50
Fish	4	1	8	73	169
Invertebrates	33	44	115	242	>20000*
Total	67	62	157	467	

* Invertebrates are underrepresented on lists of rare species because they are poorly studied compared to vertebrate taxa.

^ Total GCN includes species that are not currently state-listed, but are still species of greatest conservation need.

4.4 Bird populations

Connecticut’s primary measure of bird species population trend data is the Breeding Bird Survey (BBS), compiled by Partners in Flight (PIF). PIF is a cooperative effort between public and private entities for the conservation of bird species. Connecticut is primarily located in the PIF Southern New England physiographic area (#9), covering parts of northern New Jersey, southern New York including Long Island, the majority of Connecticut, all of Rhode Island, most of eastern Massachusetts, the southeastern corner of New Hampshire, and south-coastal Maine. There is a small region of the state that is located in the PIF Northern New England physiographic area #9. (PIF)

Partners in Flight provides USGS North American Breeding Bird Survey (BBS) data on 135 of the more than 200 breeding species in the region. Of the Connecticut woodland breeding species sampled by BBS, 14 species are listed in decline, with 7 of them having “declined significantly” since 1966. A total of 10 Connecticut early successional and scrub breeding birds have seen decline during that same period, with 9 of them having seen significant decline.

Lack of early successional/disturbance habitat is particularly noteworthy in Connecticut, compared to New England as a region. Overall, New England has 16% of forestland in “young” habitat, whereas Connecticut and the rest of Southern New England are only about 5% early successional/young forest. This is a dramatic drop in the habitat type as forests matured in the past half-century. The estimated young and disturbed habitat for Southern New England during the 1950s is 36% (Brooks).

Also in the northeast area, forest and shrubland birds are in need of habitat due to “insufficient disturbance” (Dettmers).

Only 15 species of woodland and early successional birds show increasing population trends, as opposed to 24 in decline just since 1980. A majority of species on the increase fall into two categories, either those associated with mature forests, or species that have adapted particularly well to human activities or development. Increasing forest birds include several regionally important species such as Cerulean Warbler, Worm-eating Warbler (since 1980), and Yellow-bellied Sapsucker. Species associated with human activities include those using bird feeders or nest boxes, as well as those that breed in urban wetlands or conifer plantations (e.g. Pine Warbler, Hermit Thrush, and Myrtle Warbler)” (PIF).

As described in the 2008 Connecticut State of the Birds, Connecticut can be a refuge for declining species. “Like many birds that depend on mature forest, Cerulean Warbler populations have increased in Connecticut and the Northeast over the last 40 years. However, their overall population has been declining at among the fastest rates of any songbird in North America. Whether or not Connecticut can continue to serve as a refuge for this declining species and support healthy populations of other forest birds is an open question and will depend on forest policy and open space preservation decision that we make over the next few years.”

In addition to the BBS, the Connecticut DEEP Wildlife Division conducts several annual surveys including the Forest Interior Bird Survey, a Shrubland Bird Survey, the Night Bird Call Back Survey, an annual American Woodcock Survey, a Ruffed Grouse Survey, and the Wild Turkey Brood Survey. The forest interior and shrubland surveys are done to not only assess distribution, but, more importantly, to relate habitat and management actions with productivity

The Connecticut Ornithological Association conducts a Summer Bird Count each summer. This bird count is an important indicator of long-term trends in breeding birds in Connecticut.

Audubon Connecticut has identified Key Bird Habitats in Connecticut. For information on Audubon Connecticut’s Important Bird Areas Program, and Key Bird Habitats in Connecticut see Criterion 7. Audubon Connecticut also has developed a list of priority bird species, which is listed in their strategic plan, available at www.ctaudubon.org.

To help determine overall forest ecosystem health, the Connecticut Forestlands Council Forest Ecosystem Health Committee developed a list of Avian Forest Health Indicator Species (Appendix 4) that can be used as indicators in identifying both positive and negative areas of forest ecosystem health.

Many of the aforementioned forest wildlife species are likely at risk in the longer term because so much of Connecticut’s forestland is privately owned and at risk of development. (UConn FF). In addition, many of the other woodland species including woodland plants, reptiles and amphibians, and insects are also at risk due to deer overbrowsing, fragmenting of habitat, and lack of knowledge of about species specific requirements, respectively.

Conclusion: Connecticut’s range of landscapes, waterscapes, and habitat diversity leads to a remarkably diverse set of wildlife species for such a small state. For many of the species, much

remains to be learned about their status, distribution and relationship to habitat, especially in the highly populated landscape of Connecticut. There are also many questions regarding the status of some of our rarer species, such as some of the small mammals including bats and many of the insects. Opportunities exist to improve on these information gaps. Efforts by the Connecticut DEEP and its partners have provided much needed information on the types and locations of key habitats for many important taxonomic groups. Identifying these areas should help guide conservation efforts at a state and local level.

Summary: The vast forestlands of Connecticut are one of the defining features of the state's landscape and culture. While there is such a high percentage of existing forestland within the state, continued increases in population statewide are exerting more pressure on this valuable resource, and forest land is being lost at a continuous rate. The loss of both overall forestland and core forest land are of concern, as the remaining quantity of forestland does not always equate to quality forestland. The ability of Connecticut's forests to provide wildlife habitat, clean water, and economically viable forest products is at least partially dependent on our ability to maintain sizeable tracts of unfragmented forest. Furthermore, Connecticut's forests need to be balanced in size and age classes in order to perform many important functions including providing diverse habitats for wildlife, providing for an even flow of forest products, and being resistant to insect and disease outbreak. Despite these concerns, Connecticut's range of landscapes, waterscapes, and habitat diversity has continued to support a diverse set of wildlife species. Although much is known about the types of species found across the forestlands of Connecticut, and the key habitats associated with them, the data available regarding distribution and abundance of these groups is varied.

Criterion 2. Maintenance of Productive Capacity of Forest Ecosystems

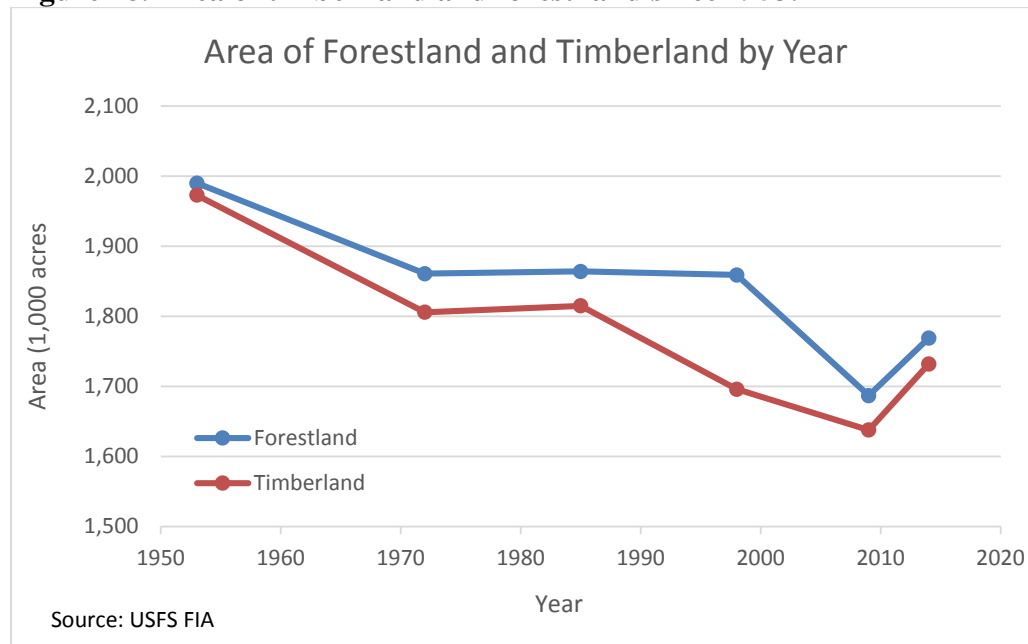
Importance: Productive forests supply important goods and services to society. They help prevent soil erosion, produce oxygen, filter pollutants, protect and enhance water quality, and offer a haven for recreation and spiritual renewal. Forests supply lumber and wood for homes, furniture, papermaking, and fuel. Other products include cones, boughs, herbs, medicines, and foods such as mushrooms and berries. Forest productivity varies according to the amount of forest land available, its fertility, health, environmental pollutants, location along the urban to rural continuum, past and current uses, and management. Managing forests sustainably means balancing resource production with the ecosystem's capacity to renew and sustain itself. Measuring and tracking the amount of forest land available for producing goods and services, the productivity of that forest land, and the amount, quality, and type of trees and other plants growing there is critical to determining whether we are balancing production and long term ecological health, and the capacity of the forest products industry to utilize timber and other forest products.

Indicator 5. Area of timberland

Introduction: Timberland is defined as any forestland capable of producing commercial crops of timber (FIA). The amount of timberland in the State defines the total forest land base available to produce goods and services for the benefit of society.

In Connecticut, according to USFS FIA estimates, timberland accounts for approximately 1,732,000 acres, or 98%, of all forestland in the state.

Figure 18. Area of timber land and forest land since 1953.



Conclusion: An overwhelming portion (98%) of Connecticut’s forestlands is considered timberland. Between 1985 and 2009 timberland area in Connecticut declined by 177,000 acres due in large part to conversion of forest to non-forest. Between 2009 and 2014 there has been some recovery with timberland area increasing by 94,000 acres.

Indicator 6. Annual removal of merchantable wood volume compared with net growth

Introduction: Forests provide valuable products that can be periodically harvested. Forests are also composed of living trees with quantifiable rates of growth. To a large extent, the difference between rate of growth and rate of removal determines whether the resource base is being used in a sustainable manner.

According to the USFS Forest Inventory and Analysis data, the net volume of growing stock trees in Connecticut was approximately 4.074 billion cubic feet in 2014, an increase of nearly 361 million cubic feet from 2009. The annual estimate of net growth of growing stock trees for the same time period is approximately 100.3 million cubic feet per year. The annual estimated mortality of growing stock trees is 14.1 million cubic feet per year, while the estimated annual harvest removals of growing stock trees are approximately 11.9 million cubic feet per year and other removals of growing stock trees are approximately 2.5 million cubic feet per year. While useful, these FIA numbers have a large sampling error associated with them (i.e. harvest removals estimate has a 31.9% sampling error while the other removals estimate has a 73.1% sampling error).

The Forest Practices Activity Reports submitted annually to the Connecticut DEEP Division of Forestry (DOF) by forest practitioners in compliance with their certification provides information from a different perspective. Based on the submitted data, the reports indicate annual timber harvesting occurring on Connecticut’s forestlands in the same time period (2004-2008) to be an average of approximately 39 million board feet per year. This number represents removals performed only by members of the certified forestry community on commercial forest practices (see Criterion 7 for details on certification). This does not represent those who failed to file an annual report, or filled it out incorrectly. This also does not represent work carried out by uncertified practitioners, land clearing operations, or operations totaling less than 25,000 board feet. The Division does not track these types of timber removals.

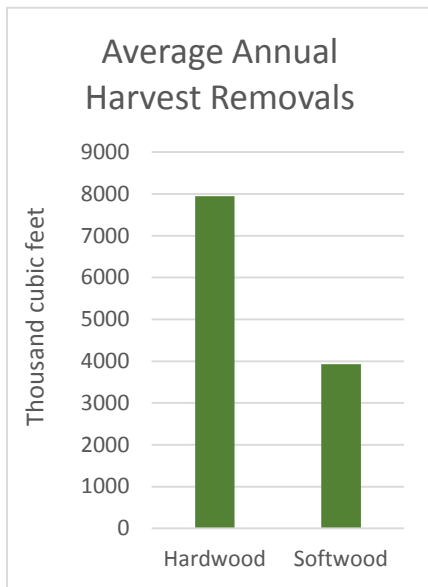


Figure 19. Average Annual Softwood vs. Hardwood Removals

Using those same categories, information in the Annual Forester Reports for Connecticut show an average removal rate of approximately 70% for hardwoods and 30% for softwoods which is close to the 67% for hardwoods and 33% for softwoods from the FIA data.

Conclusion: Connecticut annual net growth of growing stock trees and annual removals of growing stock are at acceptable levels in relation to each other. The majority of removals are hardwood species, which is expected, given the significant hardwood component of Connecticut’s forests. Opportunities exist to better track sustainability through growth and removal data regarding the timber resources of the state.

Summary: Connecticut’s timberland areas, as compared to the forestlands, have remained relatively high over the last few decades. In the last 30 years, the total amount of timberland has declined approximately 83,000 acres. In order to maintain sustainability of the resource base, Connecticut must continue to balance resource production with the ecosystem’s health and capacity. Recognizing that the majority of timberland is privately owned, there is a need to help private landowners realize the value of their forests, and work to find ways that continue to make forests an attractive investment to the private sector.

Criterion 3. Maintaining Forest Ecosystem Health and Vitality

Importance: Forest health describes the overall condition of forests and trees and how well they recover from stress. Many factors affect forest health. Some are natural, including insects and diseases. Others include severe weather or catastrophic events such as ice storms, tornados, hurricanes, floods, and droughts. Some are human induced, such as development, which causes changes in soil hydrology and reduces the size of forest patches, in effect destroying habitat for native species. Combinations of stressors cause the greatest problem, much as we are more likely to get sick when our resistance is down. Stresses come and go, making forest health difficult to

assess at a single point in time. For example, the amount of damage from native insects varies from year to year and decade to decade, depending upon weather, natural population cycles, and other factors.

Indicator 7. Area of forest land affected by potentially damaging agents

Introduction: Damaging agents include insects and diseases that have significant impact on forests, as well as wildfires, drought, ice storms, and other natural forces. Damaging agents can alter species composition, reduce growth rates, and disrupt normal forest management activities. While forces of nature cannot be prevented, it is important to anticipate problems whenever possible, and to develop vigilant early detection programs when new insect and disease threats become apparent.

7.1 Tree Mortality and Damage type

The Annual Aerial Detection Survey results from 2009 showed that in Connecticut, “nearly 32,530 acres were mapped as damaged, compared to 42,340 acres in 2008. This was due to a decline in gypsy moth defoliation in 2009. Discoloration was the major type of damage observed; leaf spot diseases affected 14,845 acres and hemlock woolly adelgid caused damage on 1,280 acres. The second major cause of tree damage was insect defoliators. Gypsy moth damage accounted for 6,709 acres, orange-striped oakworm caused 5,210 acres of damage, and forest tent caterpillar was responsible for 1,902 acres of damage. In December 2008, a severe ice storm hit the New England area, affecting 1,711 acres throughout Connecticut.” Overall tree mortality was charted at 646 acres (Frament and Lilja).

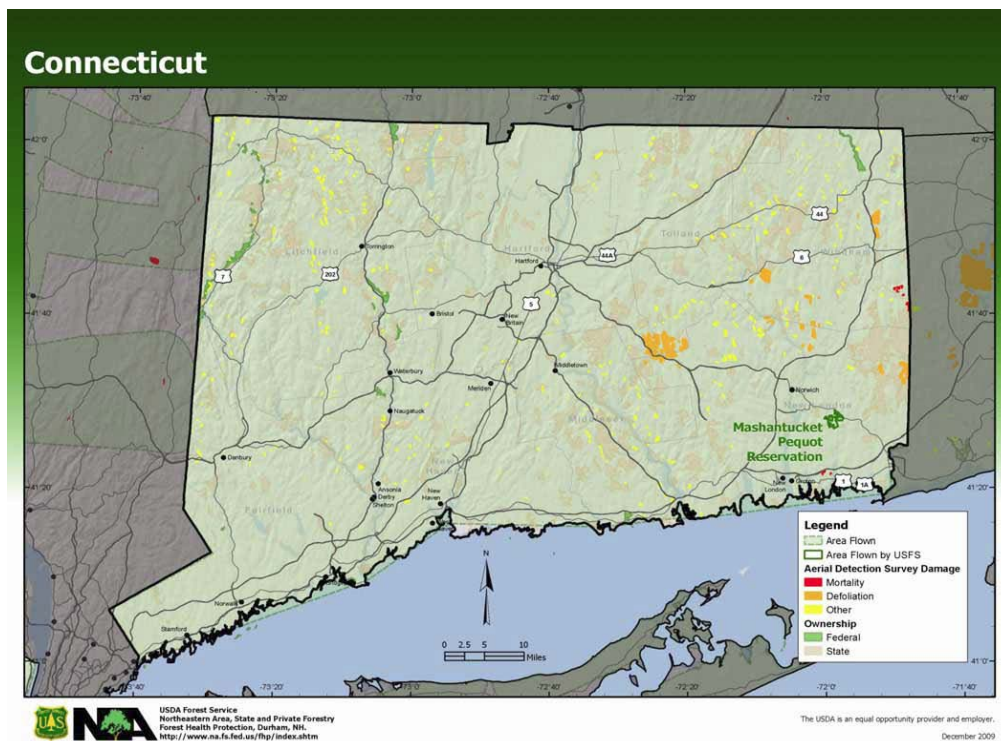


Figure 20. 2009 Aerial Detection Survey Damage

7.2 Wildfire

Wildfire events are often weather dependent. Most of the fires and acreage is burned during the traditional spring fire season, normally mid-March through mid-May. During the past 10 years the annual acreage burned has ranged from 137 acres to 1,733 acres. Five of those years have seen individual fires over the 100-acre threshold.

The northeast and northwest corners of the state are predominantly rural and forested. Other large sections of rural landscape are in the southeast corner and south central parts of Connecticut. The northwestern part of Connecticut has the steepest terrain. Fuels are primarily hardwood leaf litter, as over 80% of the woodlands are of hardwood species. Volatile fuels of concern are mountain laurel, huckleberry, greenbrier, and phragmites. Mountain laurel often grows on the drier sites under the oak canopy and often on south/southwest slopes.

Initial attack is done by the local fire departments. The State Division of Forestry has statutory responsibility to assist fire departments upon request. Firefighters come from the State Park and Forest facilities and the Division of Forestry staff. Policy, training, safety and equipment standards are developed and facilitated by the Division of Forestry.

7.3 Drought

Drought is defined as the absence of rainfall for a period of time long enough to cause depletion of soil moisture and damage to plants. Connecticut has experienced from time to time extended periods of dry weather sufficient to cause soil moisture depletion and plant damage. Droughts have occurred most recently during the growing seasons of 2005 and 2007 (though the actual symptoms on trees may not become apparent until one to two years later). On average Connecticut receives 4 inches of precipitation per month as verified by the Connecticut Agricultural Experiment Station. The year 2001 was also considered a drought year being 4.8 inches below the 30 year average (just under 48 inches/year).

Drought causes primary and secondary physical damage as well as physiological changes in trees. The primary physical effect of drought or dry soil conditions is direct damage to the roots and root death. Non-woody feeder roots, usually located in the top 15 inches of soil, are particularly sensitive and are the first ones affected. When these roots dry, shrivel, and become nonfunctional, a water deficit develops because the roots cannot provide water to the top of the plant. In addition, many metabolic changes occur which substantially alter the physiology of drought-stressed trees. Among these are changes in hormone levels and other physiological factors (e.g., factors that influence the number of leaf initials in buds for the next year or that are responsible for the closing of stomates).

From a wildfire perspective, forest fires during drought conditions usually result in ground fires where the fire burns down into the soil profile, consuming any available organic materials. Ground fire is a cause for concern as it can kill tree roots, soil microbes, and other beneficial organisms. It is also very difficult and time consuming to extinguish a ground fire and dramatically increases the cost of fire suppression.

Other Weather Events

Dramatic weather events play a role in the health of Connecticut's forests. Examples include hurricanes, tornados, ice storms, heavy wet snow storms, hail and microbursts. All of these events are irregular in occurrence but are not unusual. Effects can include individual trees suffering minor damage to dramatic instances of a complete forest cover type change. Examples include a 1989 tornado that flattened hundreds of acres of forestland, a 2008 ice storm that affected hilltops in numerous towns, several small micro bursts that affected several towns in the mid-1990s, and three feet of heavy snow in 1984 that broke the tops of many pole- sized hemlocks statewide. In the mid-1980's an unusual snow in early October damaged deciduous trees still in full leaf in western Connecticut.

In 2011, Tropical Storm Irene and the October snow storm, and in 2012 Superstorm Sandy, all caused significant widespread damage to the forests of Connecticut.

7.4 Insects, diseases, animals and plants

Insects and Diseases

Connecticut has endured many outbreaks of forest pests and diseases over the last century. Significant pest issues have mostly been introduced from Europe and Asia. The impact of such diseases and pests such as Dutch elm disease, Chestnut blight, and gypsy moth are well documented. Periodic outbreaks from native pests are normally of short duration and of minor economic and ecological significance.

In the past forty years, the Gypsy moth (*Lymantria dispar*) has been one of the most visible and detrimental introduced insects in Connecticut. Devastating outbreaks in the mid-1970s and early 1980s defoliated most of Connecticut and helped kill many oak trees. Outbreaks in 1989-1990 and in 2005-2006 were naturally controlled by a disease-causing fungus known as *Entomophaga maimaiga*, first introduced in 1910-1911 to control gypsy moth and rediscovered by Connecticut Agricultural Experiment Station (CAES) scientists in 1989. The gypsy moth fungus, *E. maimaiga* has become a significant regulator of gypsy moth populations in Connecticut at both low and high densities, but activity is highly dependent upon rain and the fungus will not prevent all outbreaks or hotspots during some years, including much of the most recent significant outbreak in 2015.

“More recently, the hemlock woolly adelgid (HWA), *Adelges tsugae*, an exotic insect from Asia, first appeared in south central Connecticut in 1985. The insect now occurs in almost all of Connecticut. The adelgid has caused branch dieback and tree mortality, often in combination with other insects like elongate hemlock scale (another exotic species) and hemlock looper (a native defoliator). Alternatives for managing the adelgid, particularly in forests, are limited. Suppression of HWA by the Connecticut Agricultural Experiment Station working with the USDA Forest Service has been provided by research on systemic insecticides and the release of the adelgid predator *Sasajiscymnus tsugae*. At the beetle release sites, hemlocks in previously damaged areas have recovered and show healthy crowns. Targeted chemical strategies developed by an Experiment Station scientist working with the USDA Forest Service and others, has

protected hemlock trees throughout the range impacted by HWA until biological interventions can be fully implemented (Stafford)”

Presently, the pests that are of greatest concern and appear to have the greatest potential for significant impact are the Asian longhorned beetle (ALB) *Anoplophora glabripennis* and Emerald Ash Borer (EAB) *Agrilus planipennis*. ALB infestations are in New York and Massachusetts, and appear to be contained through Federal Quarantine. The risk of this beetle being in or introduced to Connecticut is considered high (Stafford). Regarding EAB, however, the beetle was first detected in Connecticut in the town of Prospect in 2012, and by the end of the October of 2015 had been found in 76 towns in seven counties. It is having a major impact on the state’s ash trees (CAES). Notable defoliation by the winter moth, *Operophtera burmata*, was observed along coastal New London County in 2014. The southern pine beetle, *Dendroctonus frontalis*, was detected in Connecticut in spring 2015 and several hard pines, particularly pitch pine, are vulnerable. Black oak gall wasp (Cynipid gall wasp), *Callirhytis ceropteroides*, was discovered in the Stonington area in 2014.

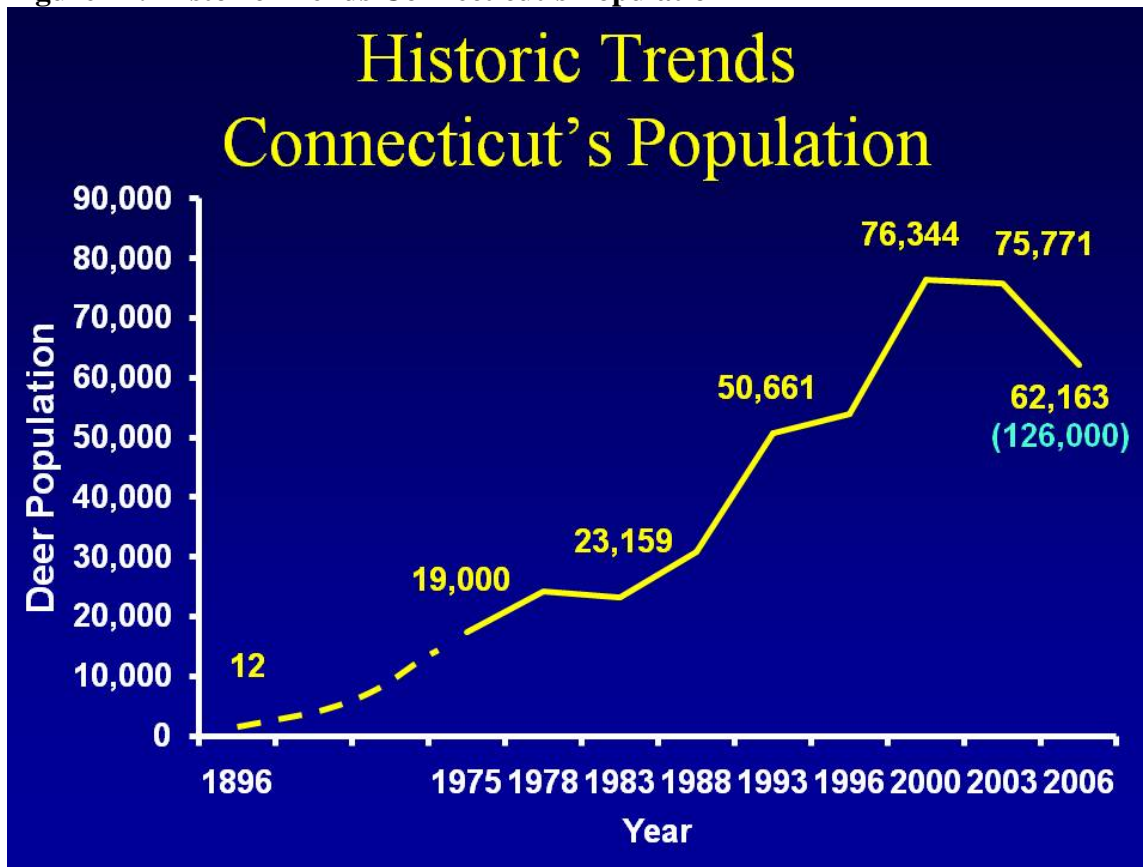
Another organism that is not known to be in Connecticut yet, but is being monitored very closely is *Phytophthora ramorum*, which is also known by the common name of Sudden Oak Death (SOD). It is not known whether SOD can survive in Connecticut.

Surveys for all of these potential pests and others are conducted annually. The Connecticut Agricultural Experiment Station (CAES) has the lead in survey work. The Connecticut Agricultural Pest Survey (CAPS) coordinates many agencies in pest survey work including CAES, Federal Agricultural Plant Health Inspection Service (APHIS), Plant Protection Quarantine (PPQ), UConn, and the DEEP (see description under The Forest Health Monitoring (FHM) Off-Plot Program in Criterion 7).

Animals (Deer Damage)

Deer populations in Connecticut were historically controlled by large predators. They were almost extirpated with the loss of mature forests and unrestricted hunting in the late 1800s. Citizens reported only 12 deer in Connecticut in 1893. With increased suburbanization, maturing oak forests, and an overall decline in hunting, the deer population has grown exponentially. (Gluck 2). Their population is currently conservatively estimated at around 65,000, based on deer observed during aerial survey. Additional research has shown that for a more realistic estimate of deer populations, a correction factor of two (2) needs to be used to account for deer concealed in vegetation and not observed during surveys, but are known to exist. That places the current deer population estimates to be more likely at around 126,000 deer (Kilpatrick).

Figure 21: Historic Trends Connecticut's Population



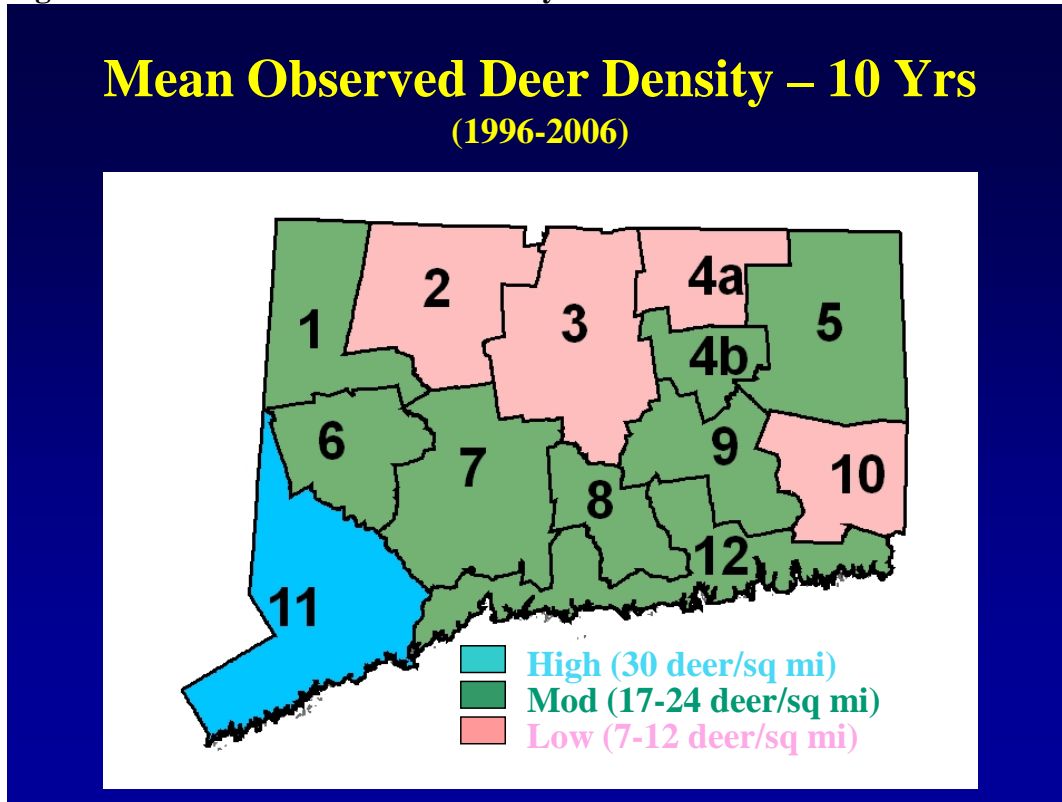
Source: Howard Kilpatrick, DEEP Wildlife Division, 2009

As shown by the graph above, deer population growth appears to have leveled off, and even slightly declined in the past ten years. This is due to a series of changes that occurred within the hunting laws that first began in 1992. These changes effectively increased the limits and means of harvesting deer. A combination of continual liberalizations of the hunting season, hunters becoming more aware of new opportunities, and additional private, municipal, and state-owned lands being open to deer hunting, have started to curb deer population growth in the early 2000's (Kilpatrick).

In addition to aiding the spread of invasive plants by depositing their seeds throughout the forest, an abundance of deer can impact the composition of the forest. Deer often browse heavily on oak seedlings but avoid species such as black birch, which contains a chemical component that deer dislike. Deer are also large consumers of oak mast which many foresters believe is compounding the forest regeneration problem. Besides the negative effect on the oak population, deer can impact the forest structure and composition, which affects many other wildlife species within Connecticut's forests, including threatened or endangered species. They have also been known to browse the native understory plants so much that it allows an opening for invasive plants to germinate. (Gluck 2).

This ability of deer to change the composition of the forest may be more likely in some areas of Connecticut versus others, based on differences in deer densities across the state. The graph below shows the mean observed deer density statewide over the ten year period of 1996-2006. This graph does not include a correction factor, so it is likely that the estimates are approximately two times higher than what is shown below.

Figure 22: Mean Observed Deer Density Over 10 Years



Source: Howard Kilpatrick, DEEP Wildlife Division, 2006

Area number 11, shown to have the highest mean observed deer density in the state, is also the most populated area, with the least amount of remaining forestland.

Continuing to expand responsible hunting and minimizing additional conversion of forest to conventional subdivisions could help stabilize and reduce an excessive deer population and revitalize the plants favored by deer. (Gluck 2).

Plants

In addition to the animal pests and diseases listed above, there are also many plants that are of concern in Connecticut. In accordance with PA 03-136 (an Act Concerning Invasive Plants), the Connecticut Invasive Plants Council has compiled a list of species that have been determined by floristic analysis to be invasive or potentially invasive in the State of Connecticut. The list was most recently revised in July 2009. See list attached in Appendix IV.

There is no established protocol for controlling and eradicating invasive plant species on State Lands. Foresters handle invasive encroachments individually as time, personnel and extent of the

problem dictate. Some methods that have been used include the use of herbicides, the use of a backpack propane torch to kill Japanese barberry, and manually selectively cutting bittersweet vines. In the past, the DOF has used contracted harvesters to perform timber stand improvement during harvesting activities, but that option is no longer available as the Division is unable to trade timber for services.

Listed DOF state lands strategies and actions include controlling and eradicating invasive plants within stands, and using prescribed burning as one means for ecosystem maintenance/restoration to control/eradicate invasive plants. Unfortunately, due to limited staffing and funding to perform the manual labor needed, invasive species are gaining a better foothold on state lands. There are opportunities to combat this issue through research, planning, and funding.

Eradication and control of invasive species on private lands is minimal and sporadic.

Conclusions: Connecticut has many established programs to monitor and maintain forest ecosystem health and vitality. Programs and personnel keep a vigilant watch for existing and potential agents affecting Connecticut. Connecticut's forests can be significantly altered from climatic/weather events, wildfire, and the introduction of both native and non-native invasive plants and animals.

Summary:

Established monitoring and maintenance programs include the Annual Aerial Detection Surveys, as well as various other pest surveys led by the Connecticut Agricultural Experiment Station (CAES). The CAES also monitors drought information, while the Division of Forestry oversees policy, training, and safety and equipment standards for wildland firefighting. The DEEP Wildlife Division monitors the deer populations in Connecticut, and develops the hunting regulations to guide harvesting means and limits. The Connecticut Invasive Plant Council developed and updates the Invasive Plant list. The DEEP Division of Forestry State Lands program strives to control and eradicate invasive plants on state lands, but is lacking personnel and funding to effectively follow through. Many opportunities exist to help control and limit the damaging effects of invasive plants, insects, and diseases, as well as deer overpopulation.

Criterion 4: Conservation and Maintenance of Soil and Water Resources

Importance: “Within the State’s borders there are approximately 450,000 acres of wetlands, 6,000 miles of streams and rivers, over 2,000 lakes and reservoirs, and 600 square miles of estuarine water in Long Island Sound” (DEEP CW). The forests of Connecticut protect these water systems by reducing sedimentation and erosion. Forests enhance water quality by filtering sediments and pollutants that enter the system from other land use activities before reaching the groundwater. Managing these precious resources for today and tomorrow is one of the DEEP’s most critical missions.

Indicator 8: Soil quality on forestland

Introduction: Prior to settlement, the soils of Connecticut supported forest growth across 95% of the state. Since that time, the land has been cleared for agriculture, been subjected to repeated timber harvesting and/or converted to other land uses. To understand and maintain forest health and water quality, it is important to understand the interaction of forest and soils.

8.1-8.5 Soil pH, Total soil carbon, Estimated bare soil, Bulk density, and Calcium-aluminum ratio

Currently there is little or no published data for soil properties such as pH, bare soil, or bulk density for Connecticut soils. Available estimates have been modeled based on other ecological data sets.

8.1 Soil pH

The pH of soil is important because soil solution carries nutrients that are essential for plant function. The pH of a soil solution needs to rise above a certain threshold for a particular nutrient to be made available to a plant. For example, the pH of a soil solution needs to be greater than 5.5 in order for nitrogen to be made available (Spector). In Connecticut, the soil pH is generally well suited for the growth of deciduous and coniferous trees.

8.2 Total soil carbon

Estimates of carbon in forests are essential in planning carbon management. The Carbon On-line Estimator (COLE) calculates that almost half (46%) of the total forest carbon stock of Connecticut's forests (Figure 32) is contained within the soil (Van Deusen and Heath, 2010). Non-stocked forest stands have a mean of 94.17 (metric tons/hectare) contained in the soil, while stocked stands had a mean of 61.56 (metric tons/ hectare) (Van Deusen and Heath, 2010).

8.3 Estimated bare soil

This does not appear to be an issue in Connecticut.

8.4 Bulk density

The measure of bulk density is used as an indicator of soil compaction. It is calculated as the dry weight of soil divided by its volume. High bulk density, an indicator of compaction and low porosity, may restrict plant growth and water flow (SQI). In general, forest soils have lower bulk densities, which increase their ability to reduce runoff and erosion.

Calcium-aluminum ratio

Citing a recent study conducted by the USFS, "Acid rain and other anthropogenic factors can leach calcium from forest ecosystems and mobilize potentially toxic aluminum in soils. Because calcium competes with aluminum for uptake, soil calcium deficiency would also increase the likelihood of aluminum toxicity and associated damage. Considering the unique role calcium plays in the physiological response of cells to environmental stress, we propose that depletion of biological calcium would impair basic stress recognition and response systems, and predispose plants to exaggerated injury following exposure to other environmental stresses. Diminished stress response would be particularly problematic now because numerous human activities (e.g., pollution production, ozone depletion, climate change, the spread of exotic pests and pathogens,

etc.) are simultaneously subjecting forests to an increasing level and diversity of stresses. Because calcium competes with aluminum for uptake, soil calcium deficiency would also increase the likelihood of aluminum toxicity and associated damage” (NRS FDP).

The relationship between calcium and aluminum may serve as a critical indicator to tree health and should be studied at greater depth. To date, this information is not available in Connecticut. In order to better monitor forest health this should become a priority.

Conclusion: Overall, there is lack soil data on topics such as pH, bare soil, or bulk density for Connecticut soils. To date, the state has not studied total soil carbon and calcium-aluminum ratios for indicators of the overall soil health and its relationship with tree growth. This will become a need in the future.

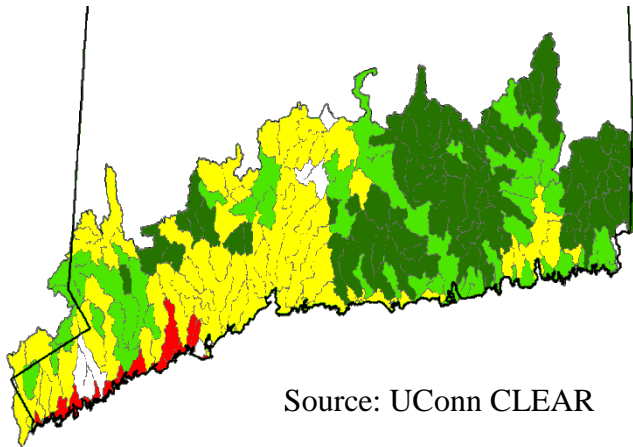
Indicator 9: Area of forest land adjacent to surface water and forest land by watershed.

Introduction: Forestland enhances water quality by acting as a natural filter to groundwater and surface water systems. Forests provide shade to streams and help stabilize stream banks. Tree roots absorb soil nutrients which maintain a balanced soil chemistry preventing leaching of excess nutrients into the groundwater.

9.1 Forested Riparian Areas:

In 2005 and 2006 the UConn Center for Land Use Education and Research (CLEAR) “looked at land cover and land cover change within watersheds and riparian corridors of coastal Connecticut. Riparian and streamside corridors are known to be critical to stream stability, pollutant removal and both aquatic and terrestrial wildlife habitat” (CLEAR, 2006). Within this report, stream health was evaluated for the southern half of Connecticut. Figure 23 and Figure 24 correspond to one another.

Figure 23. Stream Health and Vegetated Buffer Zones in CT



Source: UConn CLEAR

Figure 24. Stream Health and Vegetated Buffer Zones in CT

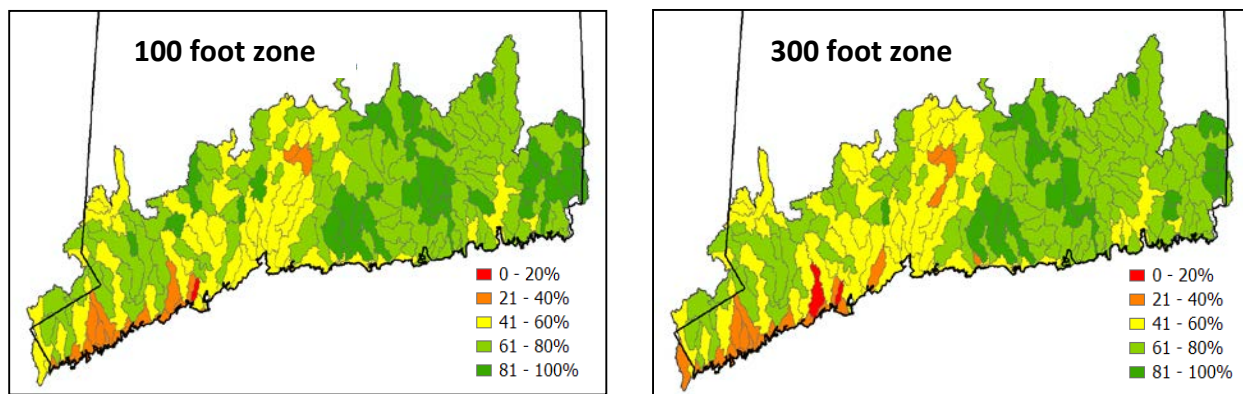
Stream Health	% Impervious entire basin	% Natural Veg. 100 ft. buffer
Excellent	<= 6%	>= 65%
Good	<=10%	>=60%
Fair	10-25%	40-60%
Poor	>25%	<40%

Source: UConn CLEAR

Referring to the table (Figure 24 above), stream health has been rated based on the percentage of impervious surface within the basin, and the percentage of Natural Vegetative Cover within a 100' buffer of the waterway. Natural Vegetative Cover “consisted of the deciduous forest, coniferous forest, forested wetlands, non-forested wetlands, and tidal wetlands classes. This natural vegetative class was seen as the most environmentally desirable condition of a riparian area” (CLEAR, 2006).

According to the study, the highest percentage of natural vegetation was found in the 100' corridors. “The status of riparian corridors for individual basins is summarized in Figure 25 below, which shows the percent of natural vegetation within the 100 foot (left) and 300 foot (right) buffer zones, symbolized by a color ramp in increments of 20% coverage (note: the entire basin is colored for the purposes of legibility of the map). The color gradations of the map are not related to any specific land cover thresholds, since the literature linking watershed or waterway health to riparian cover alone is not robust” (CLEAR, 2006). The results provide “circumstantial but compelling evidence that Connecticut’s tidal wetlands and inland wetlands and watercourses land use regulations are having an impact on the intensity of development in riparian corridors (CLEAR, 2006)”.

Figure 25. Amount of natural vegetation within the 100 foot (left) and 300 foot (right) riparian corridors in 2002, depicted by coloring in the entire basin. Source: CLEAR

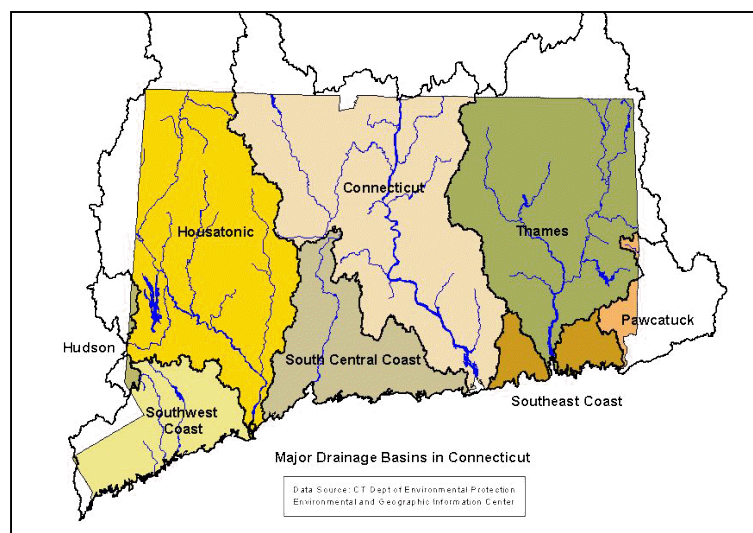


In the near future, CLEAR researchers plan to expand this study using updated information and tools, and apply the analysis to the whole state.

9.2 Forest land by Watershed:

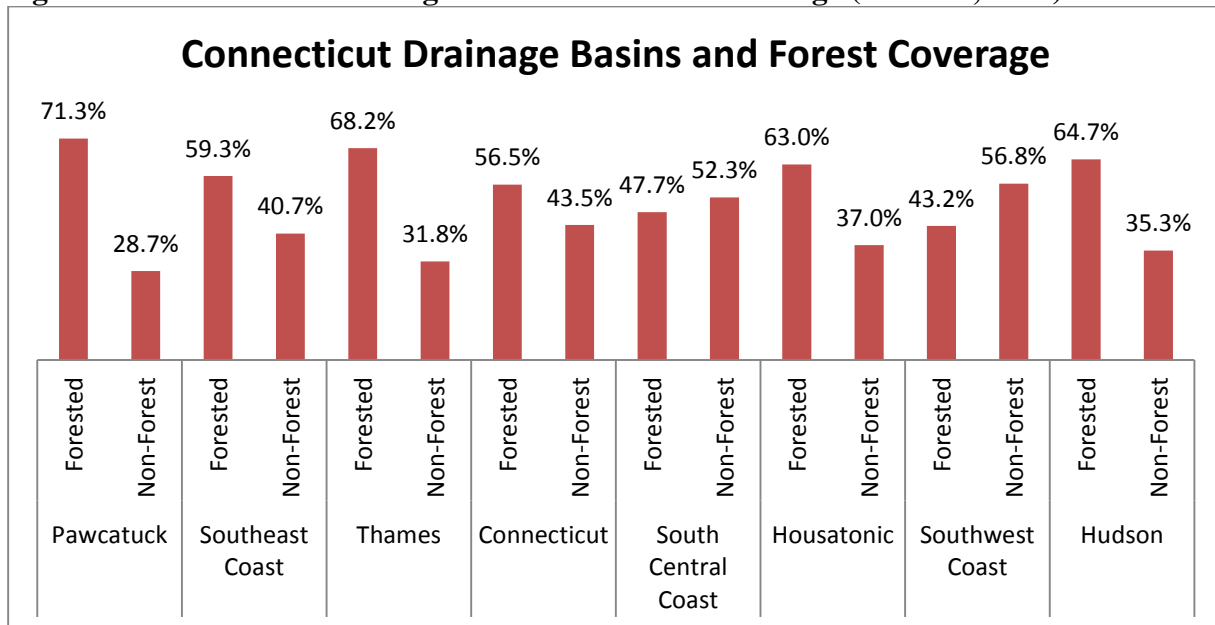
Connecticut has been divided into eight major drainage basin management areas which encompass 5,009 square miles (Figure 26).

Figure 26: Major Drainage Basins in Connecticut



The map and graph below (Figure 27) illustrates these drainage basins and the percentage that is forested within each basin. Four of the eight drainage basins are considered to be forested at greater than 60%. Two of the remaining four are slightly below 60% and two basins, the South Central Coast, and Southwest Coast, are 48% and 43% forest cover. This is not surprising as the development pressure along the southwestern Connecticut is extremely high considering its location the New York City (CLEAR, 2010).

Figure 27: Connecticut Drainage Basins and Forest Coverage (CLEAR, 2010)



A 2002 study conducted by the Trust for Public lands stated that “(water) treatment costs decreased as forest cover within a watershed increased” (Ernst, et al., 2010). The study sites that for every 10% increase in forest cover, up to 60% cover, water treatment and chemical costs decrease by approximately 20%.

Maintaining or increasing the forest cover within the watersheds of Connecticut will help to reduce treatment costs and help to maintain a source of affordable water for the people of the state in the future.

In a USDA June 2009 regional publication entitled “Forest Water and People” (NRS FWP) posts the following summaries regarding Connecticut watersheds:

- All of Connecticut’s watersheds ranked above average in their ability to produce clean water, providing surface drinking water supply and having private forests on important watersheds, and were among the highest in the Northeastern Area for high-quality watersheds under development pressure.
- Despite Connecticut’s small size all of the State’s watersheds ranked above average in their ability to produce clean water. The highest ranking watersheds in with the mean ability to produce clean water, are the Pawcatuck-Wood (in the Pawcatuck drainage

basin) and Westfield (Massachusetts) watersheds. The Westfield watershed breaches Connecticut at the state line, above the Connecticut drainage basin.

- Connecticut ranked above average in the ability of its watersheds to provide drinking water because more than 2 million surface water consumers depend on drinking water supplies. Those watershed supplying drinking water to the largest populations are the Lower Hudson and Middle Hudson watersheds (reaching into Connecticut's western boundary from New York).
- Due to the large percentage of private forest among forested lands in general and across the state overall, Connecticut ranked above average because its watersheds are mainly comprised of private forests important for providing drinking water supply. Western Connecticut ranked highest in importance of watersheds and drinking water for private forest supply.
- Overall, 10.6 percent of private forestlands on high-quality watershed areas are subject to development pressure by 2030. However, three of Connecticut's watersheds, the Pawcatuck-Wood, Lower Hudson and Middle Hudson, ranked in the top 2 percent of all the region's watersheds because these watersheds are at high risk for development and also provide high-quality drinking water.

Conclusion: Forest riparian areas and the watersheds in Connecticut are ranked above average according to the US Forest Service report. With the majority of forest land in the state being privately owned, it is essential that planners and municipal authorities are trained in the value of forests and water quality. Their ability to work with private developers will be crucial in protecting the functionality of forest riparian areas and forest cover within the watersheds. As the state continues to face development pressures, it is imperative that regulations are in place to protect the water resources of the state.

Indicator 10: Water quality in forested areas.

Introduction: "When it comes to water quality, forests are the best possible use of land. There's no pavement sending contaminated runoff to streams, no septic systems to fail, no erosion or sedimentation to speak of. In fact, forests actually clean our water, and forested wetlands serve as giant sponges that prevent flooding by absorbing rainfall and regulating its flow" (Broderick and Kane, 1997).

10.1 Water quality in forested areas

In the 2008 State of Connecticut Integrated Water Quality Report (DEEP WQR) the DEEP Water Division reported that there are approximately 5,830 miles of rivers in Connecticut. Based on probabilistic sampling employed by the DEEP Water Division, it was reported in the 2008 Water Quality Report that 71% of Connecticut's waters fully support aquatic life and 85% support recreational uses. The Water Quality Standards and Criteria (WQS), included in the report, are an important element in Connecticut's clean water program. The WQS set an overall policy for management of Connecticut's surface and groundwater's in accordance with the directives provided by Section 22a-426 of the Connecticut General Statutes and Section 303 of the Federal Clean Water Act.

The WQS have several purposes;

- provide guidance about existing water quality in the state as well as DEEP's goals for maintaining or improving that quality
- indicate the general types of discharges allowed
- ensure the segregation of drinking water supplies from waters used for waste assimilation
- show areas of conflict between usages, and areas where ground and surface waters are degraded
- provide the standards for toxicity consideration to protect aquatic life
- provide a framework for the establishment of priorities for pollution abatement
- dispensation of State funding, remediation goals
- provide clear guidance for location decisions for business and industry as well as other economic developments (DEEP WQR).

Prior watershed management has focused on protecting the riparian areas along larger waterways while ignoring small streams. Current research has shown that the “the greatest volume of runoff water, and therefore the greatest volume of pollutants, enters most watersheds from small streams” (Ernst, 2004). However due to their small size, smaller streams are rarely mapped and thus ignored in planning (Ernst, 2004).

Water quality on Connecticut’s State Forests is maintained through the use of Best Management Practices (BMPs.). These include seasonal restrictions on harvesting, and controlling runoff on access road and skid trail systems by: using temporary bridges, culverts, riprap, post-harvest seeding, geo-textile, water bars and armored stream approaches. The BMPs are enumerated in timber sale contracts. DEEP foresters monitor and enforce all harvesting activity in the State Forest. In addition, the DEEP requires certification of and continuing education for forest practitioners (foresters, supervising harvesters, harvesters). Local inland wetland commissions are responsible for reviewing and approving local harvests in town.

In 2007, the DEEP published a booklet to assist certified forest practitioners, private landowners and municipal officials towards a better understanding of the best management practices (BMPs) associated with the harvest of forest products. BMPs for water quality are the minimum standards to be taken to ensure water and soil quality (see Criterion 7 for more details).

In addition to protecting surface runoff into streams, Connecticut’s forests also play an instrumental role in protecting aquifers which supply the state’s public drinking water. Connecticut’s Aquifer Protection Area Program is in charge of designating Aquifer Protection Areas around the state which protect critical sand and gravel aquifers. Restrictions are in place to restrict development of land use activities that store, handle or dispose of hazardous materials (DEEP APP).

The Connecticut DEEP’s 2006 Integrated Water Quality Report to Congress provides the following: “Water quality in Connecticut has improved over the last few decades as a result of protective laws, remediation efforts and a substantial investment in improved wastewater treatment. There are still gains to be made in these areas. Further improvements are needed with respect to stormwater management and nonpoint source pollution control.

The incremental improvements in recent years speaks to the fact that the remaining causes of impairment of Connecticut rivers are now often much more difficult to identify (e.g., “cause unknown”) and/or correct (e.g., CSOs, urban stormwater runoff). Future management efforts will need to focus not only on wastewater treatment, collection and infrastructure, but also on control and mitigation of nonpoint pollution sources and coordinated watershed efforts. Initiatives will require input from the numerous public and private interests that regulate and oversee land use management and environmental policy, especially at the local level” (DEEP IWQ).

10.2 Stream miles impaired by percentage of watershed forested

Using spatial data and imagery the University of Connecticut’s Center for Land Use and Research (CLEAR) has derived estimates for percent forested and non-forest buffer zones along watercourses for the southern half of Connecticut. Within a buffer zone of 300 feet, 63% of watercourses were estimated to be forested and 37% were estimated to be non-forested (Figure 28)

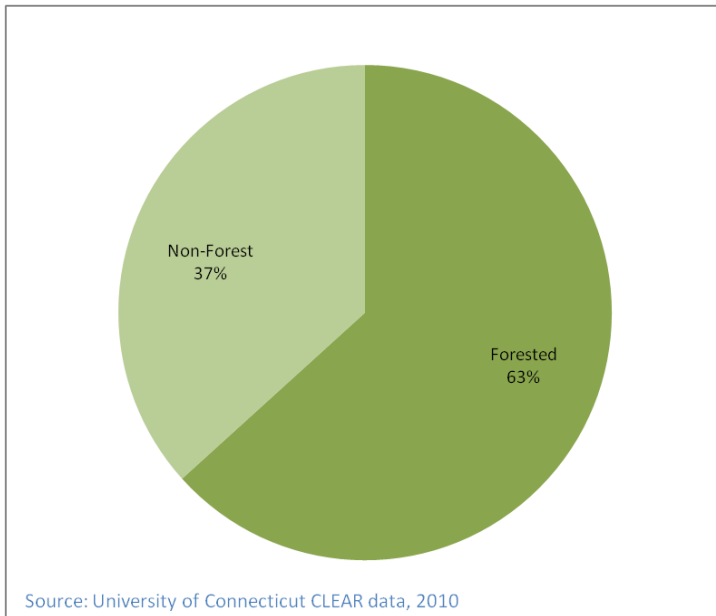
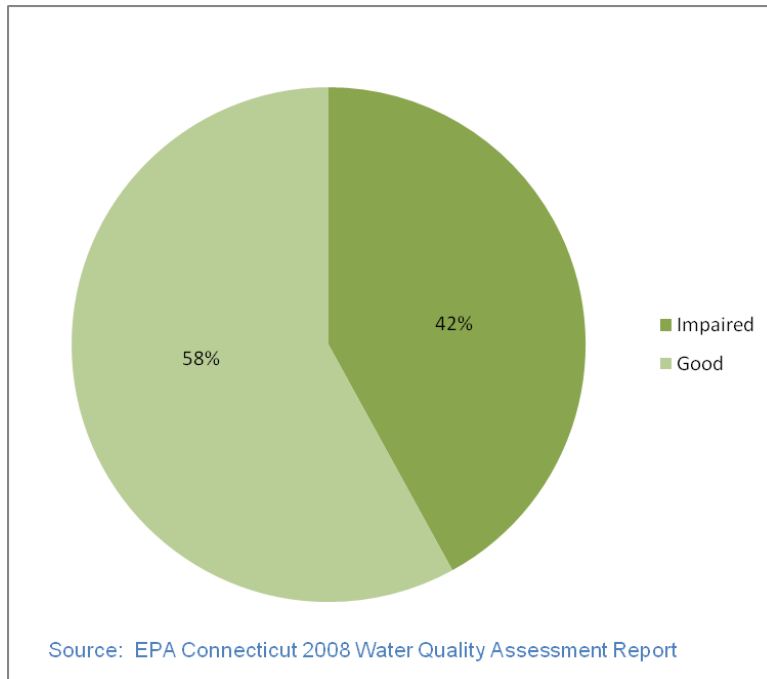


Figure 28. Percent Forested and Non-Forested within 300 feet of a Watercourse for the Southern half of Connecticut



The EPA 's Connecticut 2008 Water Quality Assessment Report listed 42% of the 2098 miles assessed as impaired, 39% as good, and no miles reported as threatened (Figure 29) (EPA WQA).

The probable sources contributing to impairment are summarized in Figure 30.

Figure 29. 2008 Assessment of Rivers and Streams

Figure 30. Probable Sources Contributing to Impairments for Reporting Year 2008

Probable Source Group	Miles of Rivers or Streams
Agriculture	57.3
Construction	37.9
Habitat Alterations (Not Directly Related To Hydromodification)	21.3
Hydromodification	111.1
Industrial	109.3
Land Application/Waste Sites/Tanks	49.6
Legacy/Historical Pollutants	48.8
Municipal Discharges/Sewage	223.1
Natural/Wildlife	8.9
Other	106.6
Recreation And Tourism (Non-Boating)	22.2
Recreational Boating And Marinas	
Resource Extraction	20.6
Spills/Dumping	28.7
Unknown	766
Unspecified Nonpoint Source	2.1
Urban-Related Runoff/Stormwater	224.1

Conclusion: To date, the value of forests and riparian areas are not included in water quality reports. There is a need for additional information regarding the value of these areas and the benefits derived by the public sector. In addition, the total stream miles impaired by the percentage of watershed forested are not available on a statewide level.

Individual watershed plans have been written and this information can be extracted for some of the minor watersheds in the state. As an example, the USDA, NRCS wrote the Broad Brook Watershed Report in May 2010 citing that 41% of the watershed is forested and contains 7.2 miles of impaired streams (NRCS BB). In order for this information to become available, a coordinated effort between DEEP and NRCS to identify the value of such information is needed. Further, the establishment of a standardized format for data to be extracted is crucial for watershed analysis.

Summary: As the state continues to face development pressures, it is imperative that regulations are in place to protect its soil and water resources. Focus has changed from targeting the watersheds of larger rivers to understanding the importance of smaller streams. Proper management and protection of the forested buffers along these watercourses will be a coordinated effort between state, local, private organizations. Land conservation and continued education will also be needed to permanently protect significant forested areas. Identifying information needs as well as improving access to data between decision makers will enhance overall management efforts.

Criterion 5. Maintenance of Forest Contribution to Global Carbon Cycles

Importance: Carbon-containing gases such as carbon dioxide and methane are among the so-called “greenhouse” gases that are strongly implicated as contributors to global climate change. The composition of our atmosphere has changed since the 18th century due to increases in the relative percentage of these carbon-containing greenhouse gases. As a consequence, the earth’s surface is warming. Some of the greenhouse gases also thin the ozone layer that shields the earth from harmful solar radiation.

11.1 Forest ecosystem biomass

Introduction: Trees are about 50 percent carbon. As forests grow, trees and other plants store carbon in their wood, other tissues, and in the soil. In the forest, carbon fixed by trees is held out of the atmosphere until the wood is burned, decays or is otherwise metabolized in some form. Wood products from harvested trees also hold this stored carbon out of the atmosphere throughout the life of the product. In general, forest activities that encourage net tree growth will increase the storage of carbon. Events such as fire and decay release carbon back into the atmosphere, although usually as part of a cycle in which the carbon is again captured as the trees and other vegetation grows. Forest soils are also a large reservoir for carbon. The conversion of forest soils to non-forest uses tend to release large amounts of forest carbon back into the atmosphere.

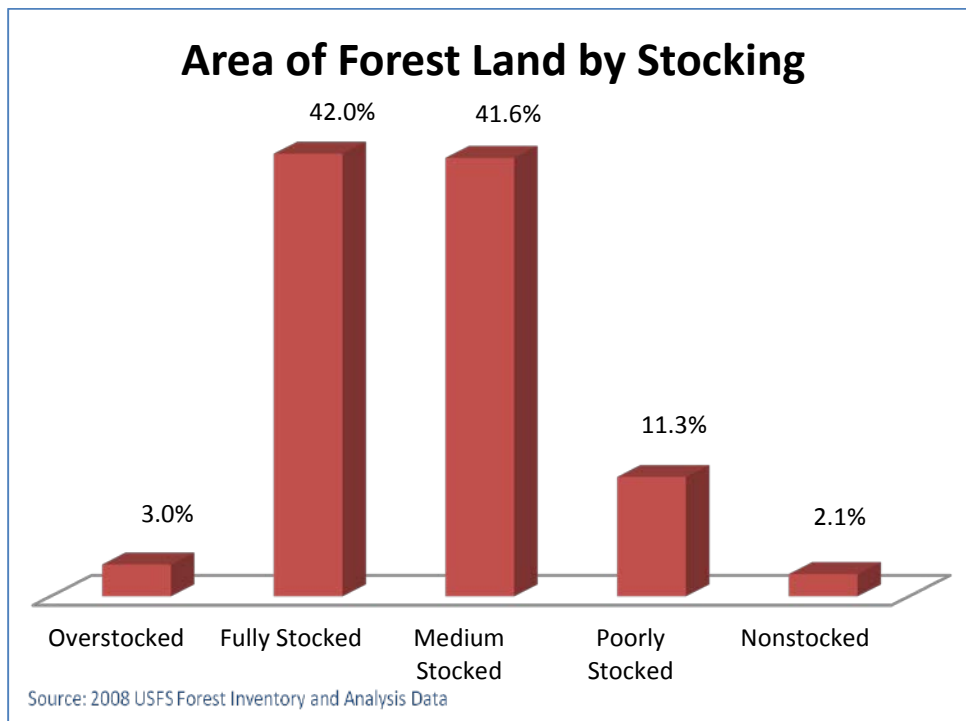
Keeping forests as forests and encouraging their health and growth is an easy way to help keep carbon out of the atmosphere. In addition to the active sequestering of carbon that occurs in

forests and the carbon that is stored in the trees and forest soils, the fact that the land is in forest also means that the land is not converted to some other energy consumptive land use, such as residential use. Trees outside of the forest also continue to sequester and store carbon. They also shade buildings, thus reducing energy demand and helping to mitigate against climate change deriving from greenhouse gas emissions from fossil fuels.

Connecticut is approximately 59% forested. According to FIA data (Figure 4, Criterion 1), the predominant forest type is oak-hickory forest (72%), with elm-ash-cottonwood the second most common forest type (8%).

Figure 6 (Criterion 1) illustrates the distribution of age categories of Connecticut's forest resources. Although Connecticut's forests are considered mature, with 78% of the trees being over 60 years old, from a carbon perspective, Connecticut's forests are considered young forests. More than half of the forest is considered to be less than fully stocked (Figure 31).

Figure 31. Area of Forest Land by Stocking



These observations point to 1) a forest base that is relatively high in its ability to sequester and store carbon, 2) that is still growing, and 3) that has the capacity to continue to store even more carbon in the decades to come.

Further analysis has shown that forest management activities can be applied to Connecticut's forests in a manner that can increase the capacity of the forest to sequester carbon and store it, both as live trees and in forest products (Hohl and Oliver 2008).

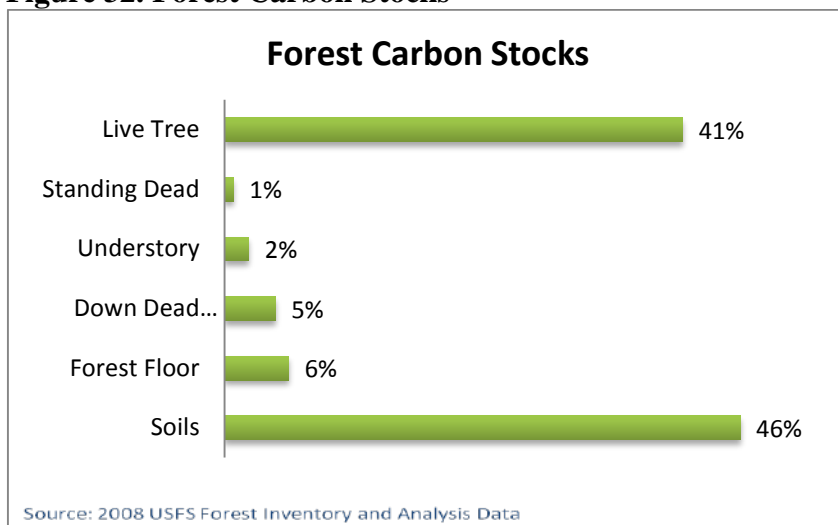
Conclusion: Connecticut's forests are well suited to sequester and store carbon. This will continue as the State's forests mature. Management of Connecticut's forests can improve capacity of sequestration and storage.

11.2 Forest carbon pools

Introduction: Carbon pools are reservoirs that have the ability to store or release carbon (ASK). Carbon stocks are the quantity of carbon stored in biological and physical systems (EIA). Within a forest system, various materials sequester and store different amounts of carbon.

Generally, in northeastern forest, approximately half of the forest carbon is stored either in the forest floor or in the forest soils (Figure 32). Thus, one of the more compelling reasons for keeping forests as forests is to maintain the critical storehouse of carbon that exists below ground. In addition, the regenerative capacity of the ecosystem is largely in the soils.

Figure 32. Forest Carbon Stocks



In Connecticut, over the past 400 years, the area of forestland has declined from perhaps as high as 95% of the state in the early 1600's (around 3 million acres) to a low of about 30% (around 750,000 acres) in the early to mid-1800's, before rebounding to a recent high of about 60% of the state, or 1.9 million acres. (Foster and Aber).

Data from the Center for Land Use Education and Research at the University of Connecticut shows that, over the two decades from 1985 to 2006, the percentage of total land area in the state classified by satellite imagery as deciduous forest has decreased by 3.2%. Coniferous forest cover has decreased 0.3% and agricultural fields have decreased by 1.2%. Meanwhile, the percentage of state land that is developed has increased by 2.9% and that in turf and grass by 1.5% (Figure 33).

Figure 33. Statewide Land Cover and Land Cover Change

	1985		1990		1995		2002		2006		Change	
	sq. miles	percent	sq. miles	percent	sq. miles	percent	sq. miles	percent	sq. miles	percent	sq. miles	percent
<u>Developed</u>	797.4	16.00%	862.3	17.40%	885.5	17.80%	922.8	18.60%	942.1	19.00%	144.8	2.90%
<u>Turf & Grass</u>	308.9	6.20%	325.9	6.60%	341.7	6.90%	362.5	7.30%	381.7	7.70%	72.8	1.50%
<u>Other Grasses</u>	65.3	1.30%	68.7	1.40%	76.1	1.50%	82.4	1.70%	86	1.70%	20.8	0.40%
<u>Agricultural Field</u>	425.2	8.60%	403.9	8.10%	391.8	7.90%	371.8	7.50%	363.4	7.30%	-61.8	-1.20%
<u>Deciduous Forest</u>	2467	49.60%	2410.5	48.50%	2379.7	47.90%	2338.2	47.10%	2307.3	46.40%	-159.8	-3.20%
<u>Coniferous Forest</u>	455.9	9.20%	452.4	9.10%	449.5	9.00%	445.2	9.00%	441.1	8.90%	-14.8	-0.30%
<u>Water</u>	173.1	3.50%	168.8	3.40%	164.1	3.30%	161.1	3.20%	161.2	3.20%	-11.9	-0.20%
<u>Non-forested Wetland</u>	20.2	0.40%	21.2	0.40%	21.2	0.40%	21.7	0.40%	21.1	0.40%	1	0.00%
<u>Forested Wetland</u>	183.8	3.70%	177.8	3.60%	174.9	3.50%	173.8	3.50%	173.7	3.50%	-10.1	-0.20%
<u>Tidal Wetland</u>	22.6	0.50%	22.9	0.50%	23	0.50%	23.2	0.50%	22.9	0.50%	0.3	0.00%
<u>Barren</u>	32.1	0.60%	37.3	0.80%	44.4	0.90%	49.1	1.00%	51.4	1.00%	19.2	0.40%
<u>Utility (Forest)</u>	17.6	0.40%	17.3	0.30%	17.3	0.30%	17	0.30%	17.1	0.30%	-0.5	0.00%

Source: UConn CLEAR

This trend is at the expense of the total biomass that is typically stored in forested ecosystems above and below ground. In some cases this negatively affects the ability of the land to regenerate a forest and to sequester carbon at its previous level, due to land use conversion.

The vast majority of forests in Connecticut are under private ownership (73%) (Figure 41, Criterion 6). Any efforts to maintain the major pools of forest carbon in the state will have to engage the owners of these lands.

A different type of carbon pool can be explored in relation to the urban forest. Connecticut is a heavily urbanized state. According to Forest Service analysis, 36.4 % of the land area of the state is urban (1.13 million acres), with 87.7% of the population, nearly 3 million people, living in these urban areas (FIA).

Despite the high population concentration in these areas, these same lands have a fairly high degree of tree cover, with a percent canopy cover of nearly 50%. These urban trees are storing about 22.5 million tons of carbon, and continue to sequester carbon at the rate of about 744 thousand tons per year (FIA).

A more detailed study of the City of Hartford was undertaken in 2007. This study showed that the trees in Hartford store about 143 thousand tons of carbon, and continue to remove carbon from the atmosphere at a rate of around 2,440 tons per year. This rate of removal is approximately the equivalent of removing the emissions of 400 cars per year from the roads within Hartford (HUF).

The City's trees also help reduce energy consumption within the City by about 1,800 megawatt hours per year. Since the average Connecticut household uses about 8.4 Megawatt hours per year, this balances the energy impact of over 200 households. This is a saving of about 2,400 barrels of oil not burned in local power plants (HUF).

Hartford's Urban Forest - a Summary
Number of Trees: 568,000
Number of Larger Trees (over 20" in diameter): 55,000
Most Common Trees: red maple, tree of heaven, black cherry, American elm and red oak
Tree Canopy Cover: 26%
Amount of Carbon Removed by Hartford's Trees Annually: 2,440 tons
Amount of Major Air Pollutants Removed Annually: 73 tons
Oil Saved due to Energy Reduction by These Trees: 2,400 barrels a year
Replacement Cost for These Trees: \$590 million dollars

Figure 34. Hartford's Urban Forest – A Summary

Source: "Hartford's Urban Forest, the Challenge" Available at http://www.ct.gov/deep/lib/deep/forestry/urban_forestry/ufore_flyer_letter.pdf.

Conclusion: The continued loss of forestlands in Connecticut, due to conversions to other uses significantly impacts the amount of carbon that is being sequestered and stored. A compelling reason to keep forests as forests is to maintain the critical storehouse of carbon that exists below ground, as well as the carbon sequestration and storage capabilities of the existing trees.

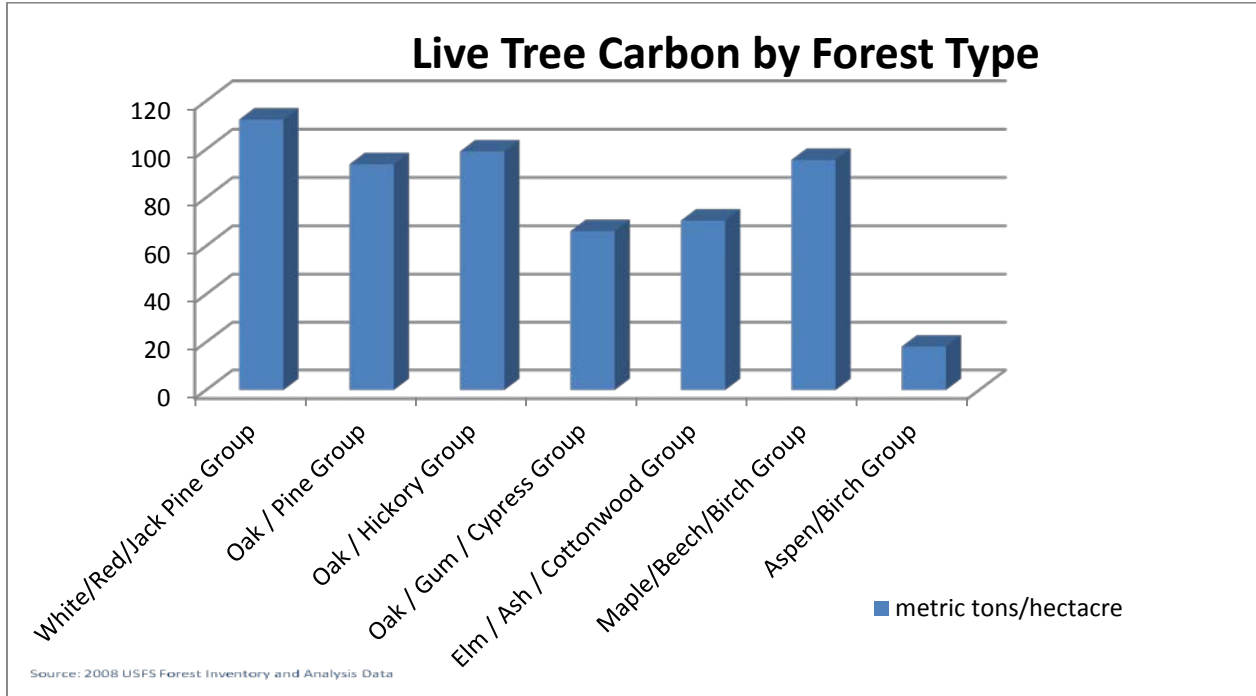
From an urban standpoint, high levels of tree cover in urban settings, in addition to sequestering and storing carbon at an impressive rate, provide other measurable public benefits that result in environmental benefits and cost savings.

11.3 Forest Carbon by forest type

Introduction: Carbon sequestration rates vary by tree species, soil type, regional climate, topography and management practice (EPA). Therefore, the overall carbon sequestered by different forest types vary, making some forest types more valuable than others in terms of carbon sequestration and storage.

As indicated earlier, the oak-hickory group is the predominant forest type in Connecticut (Figure 4, Criterion 1). According to FIA data, this forest type is relatively efficient at storing carbon (Figure 35).

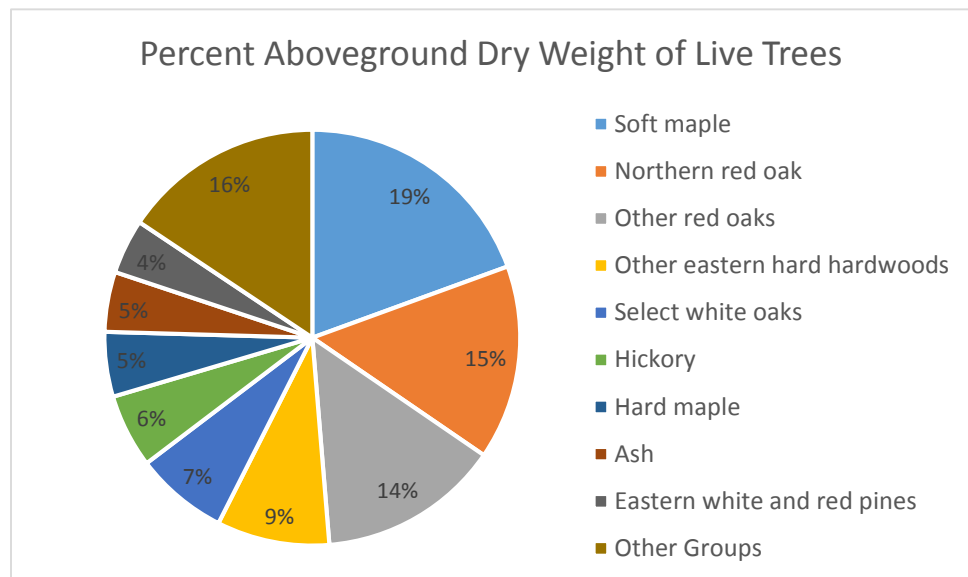
Figure 35. Mean live tree carbon density (metric tons per hectare) by forest type 2003-2008



The best forest type in Connecticut for live tree carbon storage and sequestration is the White/Red/Jack Pine group. This forest type accounts for only 1% of Connecticut’s forest type land cover. The Oak/Hickory and Maple/Beech/Birch groups also store fairly significant of carbon per hectare. These forest types occupies about 63% and 20% of Connecticut’s forests, respectively (Figure 4, Criterion 1).

Despite oak/hickory being the most prevalent forest type in Connecticut, red maple is the most common tree in Connecticut, as evidenced in Figure 5 (Criterion 1). Figure 36 below shows that red maple is a significant aboveground live tree carbon source as well.

Figure 36. Percent Aboveground Dry Weight of Live Trees by Species Group



Since Connecticut's forests are relatively young in terms of having the ability to store carbon, and are, taken in aggregate, not fully stocked, they contain the opportunity for increasing forest carbon storage capacity in the future, as long as these areas remain forested.

Conclusion: Connecticut's Oak/Hickory and the Maple/Beech/Birch forests are significant contributors to live tree carbon. The White/Red/Jack Pine group has the ability to sequester and store carbon at higher rates.

11.4 Change in forest carbon

Introduction: Connecticut's forests are under great pressure from competing interests, including interests that can lead to the forest being developed or fragmented. As these forces and interests affect the forest, they also affect the landscape's ability to sequester and store carbon, which in turn may have significant impacts on the state at some point in the future.

Beyond keeping forests as forests, and so largely keeping intact the ability of these forests to fix and store carbon, forest managers can also increase the forests' ability to reduce atmospheric carbon through active management programs. A study of the potential sustainable yield on the State Forests of Connecticut, found that "As the forest ages, both the average growth rate (in percentage terms) and the net volume growth will decline. If no harvesting or natural disturbance occurred during the next fifty years, the standing volume would increase to 11.5 mbf/acre, volume increment would fall to 0.08 mbf/acre/year, and growth rate would fall to 0.8%/year" (Hohl and Oliver).

In this study, the authors modeled how three different silvicultural regimes, two based on thinning protocols and one using shelterwood regeneration, would affect volume and growth. While in all three the rate of annual growth was less than it would be if no harvest occurred, in each of the three scenarios substantial volumes of merchantable timber are produced (Hohl and Oliver). Assuming a significant useful life for these forest products, this stored carbon should stay out of the atmosphere longer when the forests are managed than it would if the forest were allowed to achieve its maximum standing volume.

Conclusion: The ability of Connecticut's forests to continue to sequester and store carbon at an optimum level depends on the state's willingness to keep forests as forests. Active management is an option that can be used to facilitate this goal.

Summary: Currently, Connecticut's forests, which are primarily of an oak/hickory forest type, are well suited to sequester and store carbon. This will continue as the State's forests mature. The future ability of Connecticut's forests to continue to sequester and store carbon is in question, depending on the ability to keep forests as forests. The continued loss of forestlands in Connecticut, due to conversions to other uses, significantly impacts the amount of carbon that is being sequestered and stored. Not only is it imperative to conserve the forests for the trees, but also to maintain the critical storehouse of carbon that exists below ground. Active management is an option that can be used to facilitate carbon sequestration and storage. In the urban environment, high levels of tree cover sequester and store carbon, as well as provide other measurable public benefits that result in environmental benefits and cost savings.

Criterion 6. Maintenance and Enhancement of Long-Term Multiple Socioeconomic Benefits to Meet the Needs of Societies

Importance: This criterion addresses economic values people place on trees and forests for meeting their forest products, recreational, cultural, social, psychological, and spiritual needs. Many people depend on forests for their livelihood and/or for their personal physical and mental well-being, and forests in urban and rural areas contribute significantly to many community's economic base. In addition, urban and community trees and forests provide cooling, storm water reduction, and other benefits. Tracking these values, as well as monitoring shifts in demand for products and services, provides useful insights for the future. Changes can indicate potential drains on the forest resource or highlight management opportunities.

The region's forests produce a multitude of goods and services; including everything from timber and mushrooms to recreation and water. Sustainable forestry requires diverse, strong markets for a wide variety of products. Market forces are often the dominant influence on resource-based goods and services, but nonmarket forces such as the desire to sustain biological diversity or the opportunity to dwell in or visit a natural place, are also important factors influencing investments in goods and services. Most forests can provide multiple goods and services simultaneously. However, there will always be situations where multiple activities and desired uses are incompatible.

Indicator 12. Wood and wood products production, consumption, and trade

Introduction: Wood products have always been a critical component of Connecticut's economy. Lumber remains the primary building material for new houses. Pulp, paper, and other forest products provide many of the household goods often taken for granted. In 1962, the total consumption in the United States of solid wood products, paper, and pulp was 11.6 billion cubic feet. By 1998, consumption of these products had grown to 19.6 billion cubic feet, an increase of 69 percent (McKeever 2002). Connecticut's appetite for wood and wood products continues to grow. It is important that our state maintain a sufficient forest base and the technology to help meet this demand, both in a regional context, and in the context of helping to reduce global pressures by producing and providing locally.

12.1 Value of wood-related products

According to the 2007 U.S. Census Bureau, Economic Census information, the total value of Connecticut's wood product manufacturing was almost \$244 million in 2007. In 2013 this was down to \$154 million (http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ASM_2013_31AS101&prodType=table). The total value of Connecticut's paper manufacturing was \$1.79 billion in 2007 and \$1.57 billion in 2013. In 2007, they totaled over \$2 billion in value, but in large part due to the recession this total is down to \$1.7 billion. Due to the small number of establishments (5) related to wood office furniture manufacturing within the state, value could not be disclosed in the Economic Census for this category, and therefore this information is not being reported in the total value mentioned above. As of 2002, the Census Bureau no longer collects value data for logging, so this information is not included above either. (US CB)

12.2 Production of roundwood

According to the 2007 Connecticut Primary Processor Directory, produced by the DEEP Division of Forestry, the average annual timber harvest resulting from commercial forest practices between 1997 and 2006 is 41,000 tons of roundwood, broken down as 16,000 tons of softwood, and 25,000 tons of hardwood material (DEEP PPD). According to the 2013 Connecticut Primary Processor Directory, the average annual timber harvest resulting from commercial forest practices is 37,500 tons of roundwood (28,000 tons of hardwood and 9,500 tons of softwood). These numbers do not include land clearing operations. DEEP Forestry “estimates that nearly half of all timber harvesting conducted in CT annually is land clearing.” (DEEP PPD)

The USDA Forest Service FIA Timber Products Output Survey provides trend data on production of roundwood between 1996 and 2006 (Figure 37).

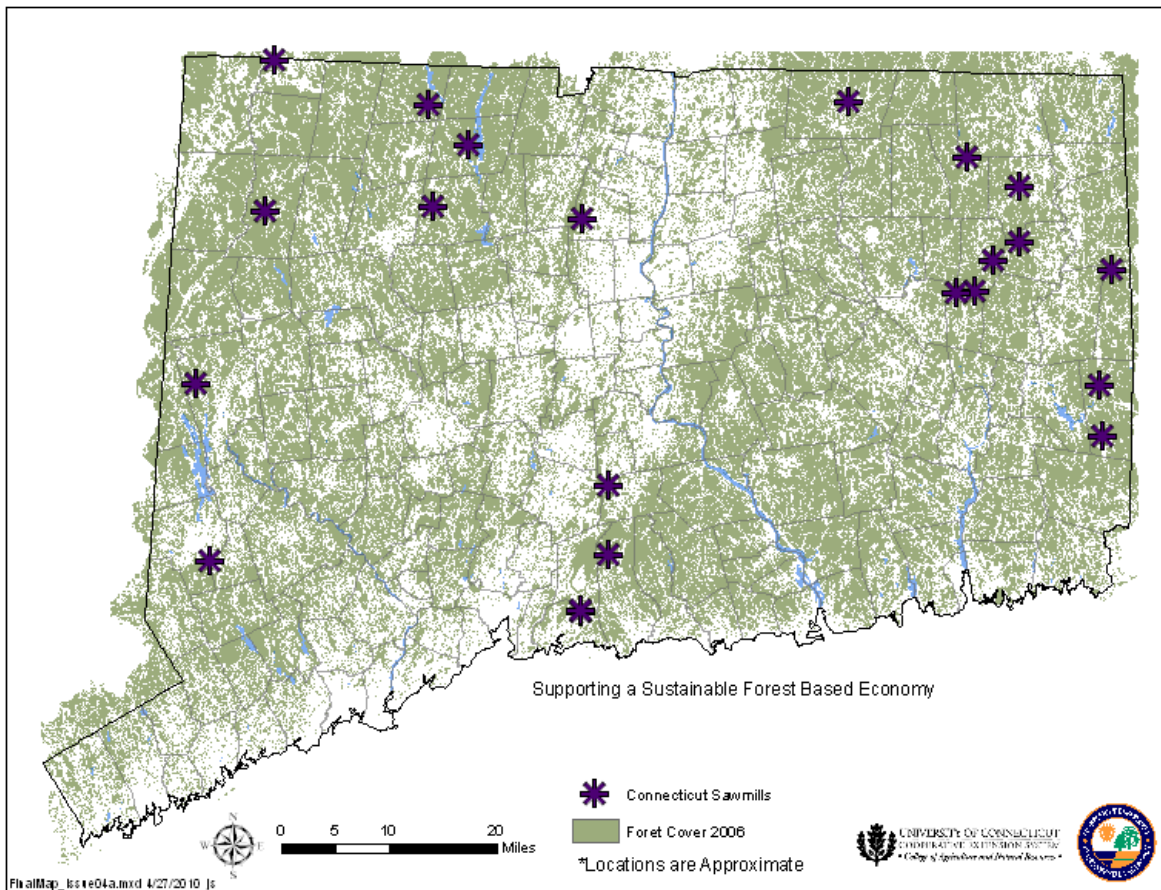
Figure 37. Average volumes of roundwood products by product and years

Product	1996	2001	2006	Average
<i>thousand cubic feet</i>				
Softwoods				
Saw logs	3,302	3,302	922	2,509
Veneer logs	0	0	0	0
Pulpwood	252	252	17	173
Composite panels	0	0	0	0
Fuelwood	51	51	22	41
Posts, poles and pilings	0	0	0	0
Other Industrial	39	39	0	26
Total Roundwood Output	3,643	3,643	961	2,749
Utilized Byproduct Output	1,999	1,999	1,264	1,754
Hardwoods				
Saw logs	6,996	6,996	4,287	6,093
Veneer logs	0	0	0	0
Pulpwood	1	1	176	59
Composite panels	0	0	0	0
Fuelwood	16,770	16,770	7,223	13,588
Posts, poles and pilings	0	0	0	0
Other Industrial	0	0	0	0
Total Roundwood Output	23,768	23,768	11,686	19,740
Utilized Byproduct Output	4,012	4,012	1,515	3,180
Total Roundwood Output	27,410	27,410	12,648	22,489
Total Utilized Byproduct Output	6,011	6,011	2,779	4,933

Source: FIA Data, Timber Products Output Survey

A map of the location of Connecticut's Sawmills is listed below in Figure 38.

Figure 38. Location of Connecticut Sawmills



12.3 Production and consumption of roundwood equivalent

Utilizing the national wood products consumption data available from the USDA Forest Service, Forest Products Laboratory, it is estimated that the national rate of consumption per person is 22.77 board feet annually (FPL). Using Connecticut 2009 population estimates to project regional rates of consumption, the total annual Connecticut rate of consumption is estimated at 80.4 million board feet.

12.4 Recovered paper

Recovered paper rate is the ratio of the total recovered paper used in paper and paperboard mills relative to the total product produced. Estimates of recovered paper were difficult to obtain. According to the U.S. Census Bureau, Economic Census data for Connecticut 2007, converted paper rates value of shipments totaled \$824 million dollars, and a had a value added of \$380 million dollars.

The table below in Figure 39 shows the amounts and types of residues produced for 2006. It appears that most by-products produced, whether it be fiber, fuel or miscellaneous are then reused. While hardwood byproducts have complete reuse rates, the softwood ration is approximately 82%. (TPO).

Figure 39. Weight of bark and wood residue by type of residue, softwood, hardwood, and use for CT 2006.

Source	Species Group	Fiber by-product	Fuel by-product	Misc. by-product	Not used by-product	All by-products
<i>thousand dry tons</i>						
Bark Residue	Softwood	0	1	6	1	8
	Hardwood	0	0	7	0	8
	Total	0	1	13	1	15
Wood Residue (coarse)	Softwood	0	2	4	2	8
	Hardwood	3	1	3	0	8
	Total	3	2	8	2	15
Wood Residue (fine)	Softwood	0	0	6	1	8
	Hardwood	0	2	6	0	8
	Total	0	2	12	1	15
Wood Residue (all)	Softwood	0	2	11	3	15
	Hardwood	3	2	9	0	15
	Total	3	4	20	3	31
All Residues	Softwood	0	2	17	4	23
	Hardwood	3	3	17	0	23
	Total	3	5	33	4	46

Numbers in rows and columns may not add to totals due to rounding.

From a consumer standpoint, despite a national decline in paper production and in the collection of recovered paper, the percentage of recovered paper utilized is at an all-time high. Connecticut's estimated population of 3.5 million in 2009 recycled roughly 70% of consumed paper products. Best estimates of the overall quantity indicate that 570 thousand tons of paper products were recycled in 2009. As waste management infrastructure improves, the rate of collection is expected to rise at a conservative rate.

12.5 Bioenergy

The most recent Connecticut estimates for sustainable woody biomass potentially available for renewable energy production are those from the forest, industrial facilities (e.g. sawmills, pallet shops, and other primary producers) and urban sources. The amount of forest residues annually available ranges from 109,000 tons to 204,100 tons depending on delivered price and the amount of mill residues available annually ranges from 40,000 tons to 91,000 tons depending on delivered price. Urban residues range from 246,938 tons to 411,563 tons again depending on delivered price (USFS BIO).

Two proposed significant biomass energy plants are currently going through the permitting process in Connecticut. One 37.5 megawatt project is located in eastern Connecticut (Plainfield) and the other, a 30 megawatt project, is located in western Connecticut (Watertown) (DED). If

these plants come on-line they will need an estimated 675,000 tons of woody residues per year (WBNS). This may present an opportunity to conduct forestry stand improvement activities that were previously economically unfeasible, and to provide additional jobs to local communities.

Currently, there is a BioBrick plant in Berlin. BioBricks are compressed sawdust designed to burn as a substitute for firewood in a conventional wood stove. Right now the plant is utilizing waste wood from manufacturing, but they are actively exploring the use of roundwood and the use of dryers (Emmerthal). In addition, pellet manufacturing companies outside of the state are entering Connecticut to facilitate collection of raw materials for their facilities. (Emmerthal)

In the future, demands from various industries could outstrip supply in Connecticut.

Conclusion: Wood materials play an important role in both providing products, and contributing substantially to Connecticut's economy. While we are currently at a healthy balance of production versus consumption, this delicate balance will be put under additional pressure with new wood related markets evolving in the state and the region.

Indicator 13. Outdoor recreational participation and facilities

Introduction: In addition to forest products such as lumber and paper, forests provide many non-extractive benefits. Public recreation is one such benefit. The recreational infrastructure and the degree to which people are using forests for recreation help us understand the importance of recreational opportunities in our forests.

Connecticut's residents enjoy a wide assortment of outdoor recreational activities. They visit state parks and forests, local parks and facilities, privately held properties, and commercial enterprises. During the course of the year, Connecticut's residents take part in land-based, water based, and winter activities. The level of participation indicates that the demand for outdoor recreation in Connecticut is high and is increasing (SCORP). "For every 10,000 residents, Connecticut has 964 acres of recreation land. In terms of land alone, Connecticut provides approximately a tenth of an acre of recreational land for every citizen of the state. However, that land is not evenly distributed" (SCORP 79).

13.1 Participation in outdoor recreation

Best estimates for statewide participation in outdoor recreation activities in Connecticut are taken from the Statewide Comprehensive Outdoor Recreation Plan 2005-2010 (SCORP). As of 2004, these numbers included:

- Connecticut's 100 State Parks (consisting of 33,911 acres) hosted 5,939,000 day use visitors and 284,000 campers.
- Connecticut's 32 State Forests (consisting of 169,800 acres), hosted 1,716,000 day use visitors and 43,200 campers.
- Connecticut has 112,000 registered boats, 85% of which are trailered and used for boating and fishing (SCORP 17)

Department of Energy and Environmental Protection 2009 Licensing records indicate that:

- 168,535 fishing licenses were sold, which is a 9.61% increase from the previous year, due to the introduction of a new saltwater fishing license in July of 2009.
- Connecticut hunting license sales for 2009 were 53,539, which was a 6.94% increase from the previous year.

In addition, according to information contained in the SCORP document, the seven project areas owned by the U.S. Army Corp of Engineers in Connecticut that are all open to recreation, have an annual visitation rate of 1,000,000 visits annually (see below for details)(SCORP 15).

As part of the SCORP development, a Citizen Demand Survey (CDS) was administered to ascertain demand for thirty land based, water based and winter sports outdoor recreational activities. The CDS results show that almost all households in Connecticut (93.8%) participate in land-based recreational activities, 85.3% of households participate in water-based activities, and 54.2% participate in winter activities (SCORP iv). While this data cannot be used specifically to determine how much use occurs in Connecticut's forestlands, it is likely that many of the types of recreation listed occurred in state or municipal owned open space settings.

Results from the CDS, presented in Figure 40, show all thirty activities by decreasing order of the percentage of individuals participating.

Another measure of the importance of outdoor recreation to Connecticut's residents is the vast array of organizations that support or provide recreational opportunities. These include the presence of approximately 103 fish and game clubs, 117 local land trusts, a Friends of Connecticut State Parks volunteer organization, non-profit organizations including Audubon Connecticut and the Connecticut Audubon Society, which both have trails and other recreation facilities on some of their parcels, and the Connecticut Forest and Park Association, who's history dates back to 1895 (SCORP 24).

It is evident from the data, that outdoor recreation is an important component of the lifestyles of Connecticut's residents. Therefore, the land and water base on which this recreation occurs is of significant value.

Figure 40. Outdoor Recreational Activities by Individual Use and % Household Use

Outdoor Recreational Activities	% Individuals	% Households
Running, walking or hiking	72%	86%
Activities at the beach	64%	68%
Visiting historic sites or museums	57%	65%
Swimming in freshwater/saltwater	57%	62%
Swimming in pools	56%	60%
Road biking / biking in neighborhoods	38%	49%
Bird watching or wildlife viewing	37%	46%
Sledding	36%	40%
Overnight camping	31%	36%
Canoeing, kayaking, or tubing	27%	35%
Basketball or volleyball	24%	36%
Motor boating	24%	30%
Downhill skiing or snowboarding	23%	31%
Ice skating or hockey	23%	30%
Freshwater fishing or ice fishing	23%	34%
Golf	22%	39%
Tennis	21%	30%
Baseball or softball	19%	30%
Saltwater fishing	18%	30%
Rollerblading or skateboarding	18%	29%
Mountain biking or trail biking	18%	27%
Soccer	16%	25%
Cross country or snowshoeing	14%	21%
Sailing	13%	19%
Snorkeling or scuba diving	12%	19%
Water skiing or jet skiing	12%	18%
Football, lacrosse field hockey or rugby	12%	20%
Motorized biking	11%	18%
Hunting or trapping	10%	18%
Horseback Riding	10%	17%

Source: SCORP, Chapter 7

13.2 Federal land open to recreation

Connecticut does not have a significant amount of federally owned lands. According to 2008 FIA estimates, just over 1% of all forestland in the state is federally owned, much of that by the National Park Service.

National Park Service

The National Park Service (NPS) owns two properties in Connecticut, which are open to the public:

- Weir Farm National Historic Site, totaling 110 acres, located in Wilton & Ridgefield, with an average of 15,000 visitors annually.
- Appalachian National Scenic Trail, which totals 51.6 miles of linear trail mileage in five towns, with a total corridor of 6,488 acres (with another 1,044 acres in scenic easements) (see description below in 13.4 for more information).
- A third nationally designated area, The Last Green Valley, Inc. (formally known as the Quinebaug & Shetucket River Valleys National Heritage Corridor), is administered by the NPS, but not owned by them.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service owns and oversees two National Wildlife Refuges within Connecticut:

- The Stewart B. McKinney National Wildlife Refuge encompasses over 800 acres and is comprised of 10 separate units spanning 70 miles of Connecticut's coastline. Headquartered in Westbrook, the refuge offers various wildlife-based recreational opportunities for the public, including environmental education, hunting, fishing, interpretation, photography, and wildlife observation (USFWS).
- The Silvio O. Conte National Fish and Wildlife Refuge encompasses the entire 7.2 million acre Connecticut River Watershed in Vermont, New Hampshire, Massachusetts and Connecticut. The refuge was created to conserve, protect and enhance the diversity and abundance of native plants, fish and wildlife, and the ecosystems upon which they depend within the watershed (MA DER). To date, two parcels have been purchased in Connecticut totaling 315.75 acres (Parrish). Wildlife-based recreational opportunities may include environmental education, hunting, fishing, interpretation, photography, and wildlife observation.

U.S. Army Corp of Engineers

The U. S. Army Corp of Engineers owns seven large flood control dams & 4,000 acres of related open space. They accommodate an average of one million visitors annually. Although different activities accommodated at the Corps sites vary, in aggregate they support fishing, picnicking, hiking, canoeing, swimming, and camping (SCORP).

13.3 Recreational facilities on State land (SCORP 17-20)

Connecticut DEEP owns and manages a total of 251,000 acres through their system of Parks, Forests, and Wildlife Management Areas and of that, SCORP states that 216,480 acres of recreational land open to camping, fishing, hunting, boating, and other sports (SCORP 78). These consist of:

- 121 boat launches on rivers, lakes and Long Island Sound
- 21 swimming areas
- 222,613 acres of land in State Forests, Parks, and Wildlife Management areas that are open to hunting
- 13 campgrounds totaling over 1,400 campsites

Specialized user group areas for youth and horse camping, shelters for backcountry camping, and public pavilion

13.4 Trails

Connecticut is a state rich in trails, encompassing many different types of recreational uses. Below is a summary of the various trail opportunities in Connecticut. This is not all encompassing, as there may be local trails that are not widely known or advertised.

Blue-Blazed Hiking Trails

Connecticut has approximately 1,000 miles of hiking trails (SCORP), of which 825 miles, stretching over 88 towns, are part of the Blue-Blazed Hiking Trail system (CFPA). Established by the Connecticut Forest & Park Association (CFPA) in 1929, the Blue-Blazed Hiking Trail System is one of the “most visible and lasting contributions to the recreational life of the state” (CFPA). Trails are managed and maintained by CFPA volunteers, including 100 Trail Managers and hundreds of volunteer assistants who dedicate approximately 7,500 hours to trail work every year. The majority of the Blue-Blazed Hiking Trails are on private land and exist only through the goodwill and cooperation of the landowners. Changes in land use, change in owners, and the spread of development have created a serious threat to the Blue-Blazed Hiking Trail System. CFPA is a private non-profit organization dedicated to the conservation and broad public enjoyment of forests, parks, and hiking trails in Connecticut. For more details on CFPA, see description in Criterion 7 or go to their website at www.ctwoodlands.org.

Other Hiking Trails

There are numerous hiking/walking trails located across the state. Opportunities on state parks and forest lands can be accessed at the CT DEEP website at <http://www.ct.gov/deep/parkmaps>. Multi-use trails include hiking, mountain biking, equestrian, and other non-motorized uses. All trails in Connecticut State Parks and Forests are multi-use unless posted otherwise. Trail use information is included in the explanation on individual park and forest maps.

DEEP supports the Connecticut Forest & Park Association’s “WalkCT” initiative which promotes recreation on both state and private property (see <http://www.walkct.org/>).

National Scenic Trails

Connecticut is fortunate to have two nationally dedicated scenic trails which have portions located within the state boundaries:

The Appalachian National Scenic Trail

The Appalachian National Scenic Trail, often referred to as the Appalachian Trail (AT), is “the nation’s longest marked footpath, at approximately 2,178 miles” (ATC). It is a privately managed unit of the national park system that traverses 14 states. The Appalachian Trail route traverses across the northwestern corner of Connecticut for 52 miles and spans elevations of 260—2,316 feet (ATC CT). The trail is maintained by the Appalachian Mountain Club-Connecticut Chapter, and overseen by the Appalachian Trail Conservancy.

The New England National Scenic Trail

The New England National Scenic Trail (<http://www.newenglandtrail.org/>) was designated on March 30, 2009 as part of Public Law 111-11 Section 5202. The 2009 Omnibus Public Lands Act included the designation of much of the Metacomet-Monadnock-Mattabesett (MMM) Trail system in Connecticut and Massachusetts as the New England National Scenic Trail. The route is approximately 215 miles long, and crosses 39 communities spanning central Connecticut, western Massachusetts, and southern New Hampshire (NENST). Since 1931, the Metacomet and Mattabesett Trails have been maintained as Blue-Blazed Hiking Trails by volunteers of the Connecticut Forest & Park Association (CFPA), and will continue to be maintained by CFPA. (CFPA). A "Trail Stewardship Council" will be established to oversee maintenance and protection of the Trail's national scenic values, with additional funding and technical assistance from the National Park Service (NENST).

Officially Designated Connecticut Greenways

In addition to what is normally considered trails, Connecticut also has a vast system of Greenways across the state. Each year, The Connecticut Greenways Council can designate new greenways around the state. (DEEP) Not all Greenways are trails, but many are, such as the Blue Blazed Hiking Trail System mentioned above (<http://www.ct.gov/deep/cwp/view.asp?a=2707&q=323852>).

According to CGS section 23-100, a Greenway is "a corridor of open space that (1) may protect natural resources, preserve scenic landscapes and historical resources or offer opportunities for recreation or non-motorized transportation, (2) may connect existing protected areas and provide access to the outdoors, (3) may be located along a defining natural feature, such as a waterway, along a man-made corridor, including an unused right-of-way, traditional trail routes or historic barge canals or (4) may be a greenspace along a highway or around a village. (CGS section 23-100)" (DEEP).

Dirt Bikes/Motorcycles

Connecticut offers limited opportunities for off-road vehicle use on State property. The Pachaug State Forest Motorcycle Trail is a 60 mile trail system available for off-road motorcycles using a combination of forest roads and trails. Motorcycles must be street-legal and registered with the DMV and riders must have a DMV operator’s license (DEEP ATV).

“Cockaponset State Forest in Haddam and Shenipsit State Forest in Stafford both offer opportunities for dirt bike enthusiasts to participate in privately-organized enduro races once or twice a year. These competitive events are typically one day in duration and sponsored by a

regional motorcycle club. Motorcycles must be registered, street legal and drivers must be licensed” (DEEP ATV).

“In recent years, the dramatic increase in all-terrain vehicle (ATV) sales has generated a significant demand for riding areas. Currently, riding an ATV on state or municipal property is illegal. The level of illegal use on DEEP lands and impacts on natural resources and other recreational users have made it necessary to formalize a position on ATV use. To address this concern on state land, the Department of Energy and Environmental Protection has developed an “ALL TERRAIN VEHICLE POLICY AND PROCEDURES” manual (http://www.ct.gov/deep/lib/deep/outdoor_recreation/atv/atvplan_final.pdf), which will not become effective until supporting legislation is passed by the Connecticut General Assembly” (DEEP).

Off of state property, limited opportunities for all terrain vehicles exist as well. The US Army Corp of Engineers Thomaston Dam has designated trails for two wheeled trail bikes, seasonally. **Three and four wheel vehicles are not permitted.** A cooperative agreement for trail management has been in place since 1979 with the www.pathfindersmc.org/blog/ (ACE).

Winter Activities

Other trails located on State owned lands include ski touring, downhill skiing, and snowmobiling. In addition, Mohawk Mountain, a facility leased from the DEEP, is one of the State's only ski areas for downhill skiing. Cross country skiers can choose from a variety of parks and forests that offer excellent terrain and miles of trails. There are 11 designated areas within Connecticut State Forests where the use of snowmobiles on established trails and forest roads is authorized. Information on all of these activities can be found at the DEEP website at www.ct.gov/deep/. Local organizations across the state also support these types of activities.

Equestrian Trails

There are many equestrian trails across the state. Connecticut DEEP has several trails on State-owned lands, and even administers horse camping areas in Pachaug and Natchaug State Forests. Locations of trails for equestrian use can be found on the DEEP website www.ct.gov/deep/. As a way of “giving back”, the Connecticut Horse Council has partnered with the Department of Energy and Environmental Protection to create the Volunteer Horse Patrol (VHP) to “ride and serve in State Parks & Forests, helping to patrol and provide assistance to the DEEP staff and public visitors to our State Forests and Parks”(CHC). In addition to patrol duties, the VHP also performs maintenance of various state owned trails. The CHC has lists of equestrian trails statewide on their website <http://cthorsecouncil.org/>.

13.5 Campgrounds

According to SCORP municipal survey results, there are a total of 88 campgrounds in the state, including public and private facilities (SCORP Ap. 1). Included in that total is Connecticut’s state park and forest system campgrounds (13) with a total of 1,400 campsites collectively (DEEP OR).

13.6 Recreational facilities in national forests

There are no National Forests in Connecticut.

Conclusion: Connecticut's residents have an established history of outdoor recreation. Residents have a strong recreation ethic, as evidenced by their participation in various activities and organizations. A solid infrastructure of recreational facilities abounds in Connecticut, addressing citizen's recreational needs. As recreation pressures increase, multi-use concerns will become more prevalent.

Indicator 14. Investments in forest health, management, research, and wood processing

Introduction: Maintenance of healthy forests requires funding. Surveys for insects and diseases, monitoring of forest conditions, tree planting, and research in forestry all require time and money. Furthermore, landowners and communities require technical forestry assistance to maintain and manage their forest resources. Likewise, forest industries must invest in their operations if they are to remain competitive and continue to provide employment opportunities. Tracking the public and private funds invested in these various operations (forest health, management, research, and wood processing) is a good indicator of the likely success and long-term sustainability of forests and forestry in the state.

14.1 USDA Forest Service Northeastern Area State and Private Forestry funding

Connecticut has long benefitted from funding provided through the USDA Forest Service Northeastern Area State and Private Forestry (NA S&P) Program. Several key DEEP Division of Forestry programs depend on this funding source to operate. These programs include the Service Forestry Program, the Urban Forestry Program, the Fire Program, and the Forest Legacy Program. Outside DEEP, another Connecticut program affected is the Forest Health Management Program run by the Connecticut Agricultural Experiment Station. Competitive grant funding, and partner funding also comes through the NAS&P funding (USFS FA).

Overall, core funding levels have remained fairly consistent over the last few years. Fiscal Year 2010 funding currently stands at \$2.4 million dollars to be obligated. Funds received are distributed through the Forest Health Management (FHM), Cooperative Fire Protection (CFP), and Cooperative Forestry (CF) programs.

Currently, there are no cost share program funds administered by the USDA FS State and Private Forestry Program. The last program implemented through the Division of Forestry and Connecticut Forest and Park Association was the Forest Land Enhancement Program (FLEP), which ended in 2006. Cost share money allocated from the Forest Land Enhancement Program totaled \$163,228 over the four years it was in existence for work on approximately 22,000 acres.

The Natural Resource Conservation Service (NRCS) currently administers cost share programs. The chart below shows the estimated amount of NRCS funds that have been allocated on Connecticut forestlands since program inceptions. This information is current through May 2010.

In 2014, Connecticut State Forestry staff from DEEP and UConn Extension, as well as staff from the USFS and NRCS were honored with the "Two Chiefs' Partnership Awards" recognizing "significant improvements assisting private landowners through coordinated interagency delivery

of forestry and conservation assistance for working forests.” (DEEP/NRCS/USFS Press Release March 18, 2014)

14.2 State forestry agency funding

For FY 2014 the Division of Forestry received \$1,612,740 from the General Fund to cover for personal services and expenses. For FY 2015 the Division of Forestry received \$692,473 in core funding from the US Forest Service for urban forestry, stewardship, Forest Legacy, and state and volunteer fire assistance. In addition to the core funding, a Forest Legacy Project was funded with \$2,505,000 to protect private working forestland with conservation easements.

Figure 41: Estimated NRCS EQIP funding allocated to Connecticut

Year	Approx. Dollars
2011	\$ 300,000
2012	\$ 468,000
2013	\$ 640,000
2014	\$ 500,000
2015*	\$ 392,000
Total	\$ 2,300,000

Source: NRCS

*additional \$ available if everything is allocated

-Proposed 2016 amount is \$600,000

14.3 & 14.4 Funding for forestry research at universities and USDA Forest Service Research Funding

The two leading forestry associated universities in Connecticut are the University of Connecticut and Yale University. Both are active partners within the Connecticut forestry community.

The University of Connecticut receives funds for the UConn Cooperative Extension Program, through a Renewable Resources formula grant. In fiscal year 2008, funding was \$46,525. This amount does not change much from year to year. The Storrs Agricultural Experiment Station receives \$67,542 in federal McIntire-Stennis funding. Combined, the University of Connecticut receives about \$114,000 annually for forestry related activities (Volin).

As of June 2010, the amount of active grants received by Yale forestry faculty for their work all over the world totals \$6.6 million dollars (Beznicki).

In addition, the Connecticut Agricultural Experiment Station receives grants for forest health, and other various forestry related research grants. The total dollar amount for the fiscal year 2009-2010 is \$466,522 (Stafford).

14.5 Capital expenditures by manufactures or wood-related products

According to the U.S. Economic Census 2007 Annual Survey of Manufactures, the capital expenditures for wood product manufacturing is listed as \$15.5 million dollars. This does not include paper, pulp, paperboard, or cardboard related materials. If added in, the total is \$181 million dollars (USCB EC).

Conclusions: Support from various federal funding opportunities provides the basis for much of the forestry programs that occur in state. State funding is sufficient to cover salaries, but does not extend much beyond that. Wood products manufacturing is significant within the state, and expected to grow as uses for wood as bioenergy increases.

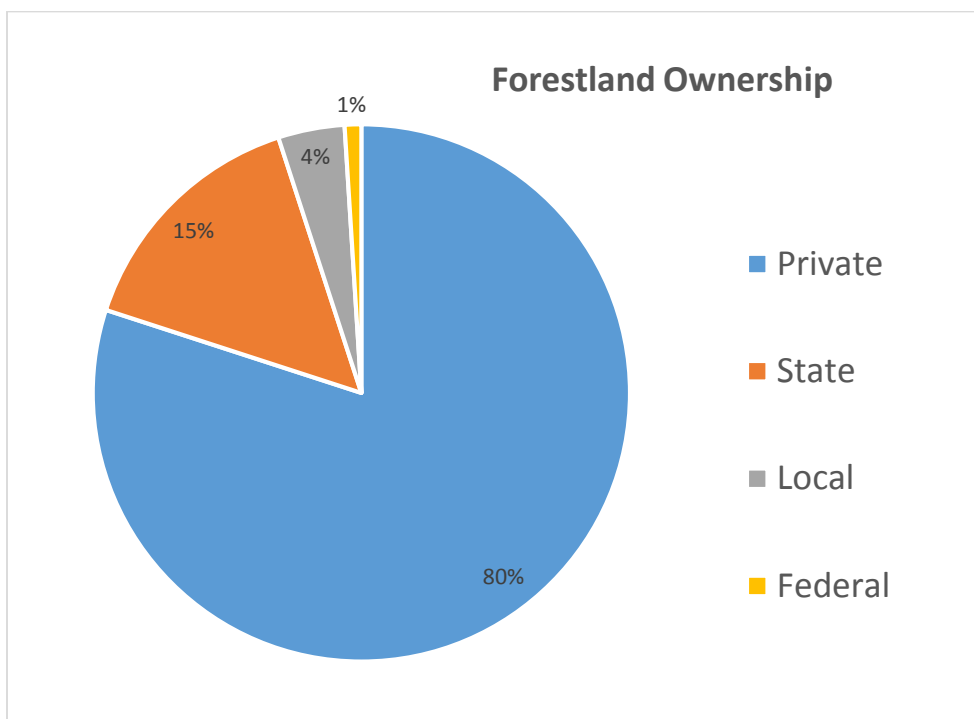
Indicator 15. Forest ownership, land use, and specially designated areas

Introduction: The percentages of public and private sector forestland ownership give an indication of the amount of forestland that is protected from conversion to other uses. Further analysis of private forests, such as the amounts under conservation easements and property tax reduction programs, provides a further understanding of the long-term sustainability of a state's forest resources.

15.1 Forestland Ownership

Forestland ownership in Connecticut is overwhelmingly by the non-industrial private sector. Figure 42 below illustrates the overall distribution of land ownership in the state.

Figure 42: Forest Land Ownership in Connecticut



With such an immense amount of forestland under private ownership, the future of Connecticut's forests are dependent on the goals and desires of these landowners. The DEEP Division of Forestry and the University of Connecticut Cooperative Extension Service are available to assist these landowners on a limited basis through technical support and advice regarding the present care and future management of their forests, as well as estate planning advice. As cost share opportunities arise, both agencies try to connect landowners with appropriate programs. Currently, most assistance is provided on a limited individual basis, or through small scale educational programs.

There is no statewide private organization whose sole mission is assisting these private landowners with decisions the care management of their land, although many local non-profit organizations include it as part of their mission.

The landowners themselves have organized an association to assist other landowners. The Eastern Connecticut Forest Landowners Association (ECFLA)/Wolf Den Land Trust (WDLT) is a nonprofit 501-(c)(3) organization formed in 1972 to:

- Promote the wise management of forest lands as a natural resource.
- Provide an ongoing source of any and all information that members may need to make informed decisions concerning their forest land.
- Work to make continuous professional forestry assistance more accessible to the small forest landowner.
- Work to make the ownership of forest land more attractive as an investment.
- Improve communications among landowners, foresters, mill owners, timber harvesters and other members of the forest products industry.
- protect open space and professionally manage demonstration forests through WDLT (ECFLA)

ECFLA represents “nearly 300 forest owners and their families who actively manage approximately 20,000 acres of woodlands and associated ponds, streams and wetlands.” (ECFLA). No counterpart to this association exists in western Connecticut.

15.2 State lands

The Department of Energy and Environmental Protection owns 251,000 acres in its series of parks, forests, and wildlife management areas. Of those 251,000 acres, approximately 170,000 of them are State Forests, 35,000 are in parks, and the rest are in wildlife, fisheries, and natural resource management areas. Staffing over the past decade has decreased significantly, and the Department is looking for ways to maintain and improve services with fewer resources.

One of 19 projects in the Agency to date, the Division of Forestry participated in the DEEP’s LEAN process for the first time in 2010. LEAN is a process improvement approach that identifies and minimizes wasted time and effort (DEEP LEAN). The Forest Management LEAN Team found cost savings with improved efficiencies and is adding value to the management planning process by implementing electronic data collection. Significant savings were found that reduced planning and review time, which utilizes existing staff more efficiently. The LEAN Team also recommended the use of electronic field data collectors to add value to the inventory process. DEEP is moving to create complementing GIS maps and access databases to accept and store forestry field data centrally, and share it with other divisions (Wildlife, Fisheries, and Parks). Division of Forestry personnel will lean heavily on the use of electronic field data collectors, advanced technology and other DEEP Division Support (Office Information Management) to fill the gap in personnel. Improved inventory methods and central data storage will reveal the vast assets of the forest resources and their corresponding values for both biomass and ecosystem services. The Division of Forestry’s ultimate goal is to complete management plans on all forests within 15 years.

15.3 Protected land

In 1997, the Connecticut General Assembly set a goal of preserving 21 percent of the land area of Connecticut for open space for public recreation and natural resource conservation and preservation (Green 2).

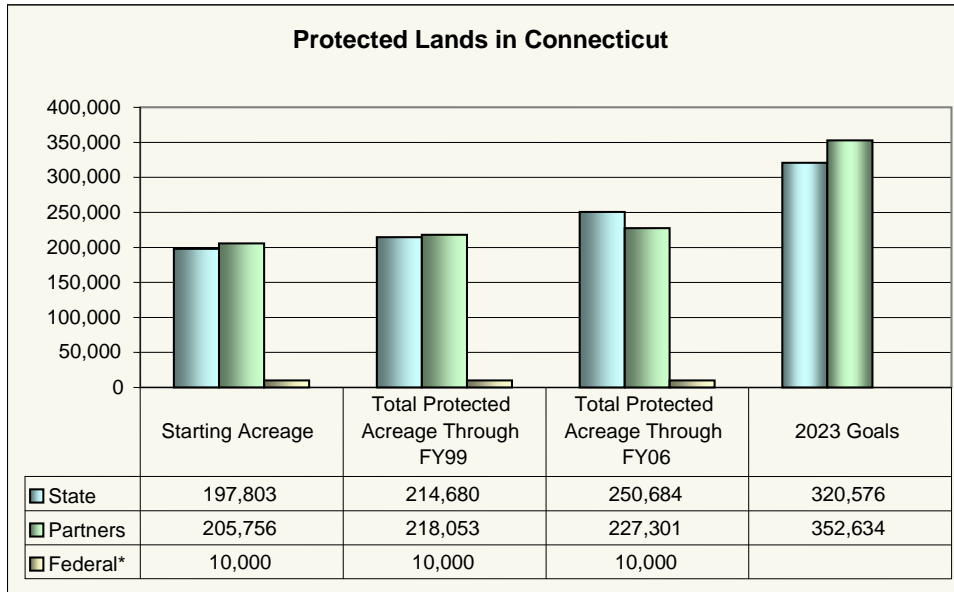
In 2001, the DEEP developed *The Green Plan* to guide its efforts to acquire and permanently protect open space. The updated plan (2007-2012): “1) identifies the State’s future open space goals; 2) summarizes land acquisition and protection efforts to date; 3) discusses threats and challenges to open space protection; 4) identifies priorities for acquisition and protection; 5) describes the programs and funding available; and 6) outlines the process. This document is a strategic plan for land acquisition and protection for the State of Connecticut through 2012. As such, it provides general guidance for program managers, is a tool for those who want to work with the State in preserving land, and offers a basic overview for the public of the State’s land acquisition and protection program” (Green 1).

The Green Plan’s lists total of 3,205,760 acres in Connecticut, of which 673,210 acres must be preserved to meet the goal mentioned above. In addition to the overall goal, CGS section 23-8 “sets targets for both the State and its land protection partners (municipalities, private non-profit land conservation organizations, and water utilities, whose Class I and II watershed lands count towards this goal). This statutory goal is ten percent (or 320,576 acres) be acquired and held by the State of Connecticut (as additions to the State’s system of parks, forests, wildlife, fisheries and natural resource management areas, and eleven percent (or 352,634 acres) be acquired and held by our partners. At the time, it was recognized that the threat of loss of open space to development was substantial and that preservation activities had to be pursued while there was still appropriate land available for open space so a time line was set with an end date of 2023” (Green 2).

As of 2007 totals, approximately 490,799 acres are protected in Connecticut. “Protected” means lands that are protected from development. These lands include federally owned lands; state owned lands (Department of Energy and Environmental Protection), municipalities, and non-governmental organizations (NGO) tracts, as well as areas protected by permanent conservation easements. As of January 1, 2007, the State has acquired a total of 251,001 acres for its system of parks, forests, and wildlife, fishery and natural resource management areas. This is 78 percent of the 320,576 acres of open space land targeted for State acquisition (Green 2).

Exact acreage of open space protected by DEEP’s partners has not yet been compiled. Our best estimate for our partners is that “municipalities (169 of them) own 74,971 acres of land; nonprofit land conservation organizations (116 of them) own 57,327 acres; and 85 water companies own 97,500 acres Class I and Class II lands. Together, open space acreage held by these partners is 229,798 acres, which is 65 percent of their statutory open space goal. There is no requirement that non-State partners report their land protection efforts and it is assumed that our partners actually hold significantly more acreage” (Green 3).

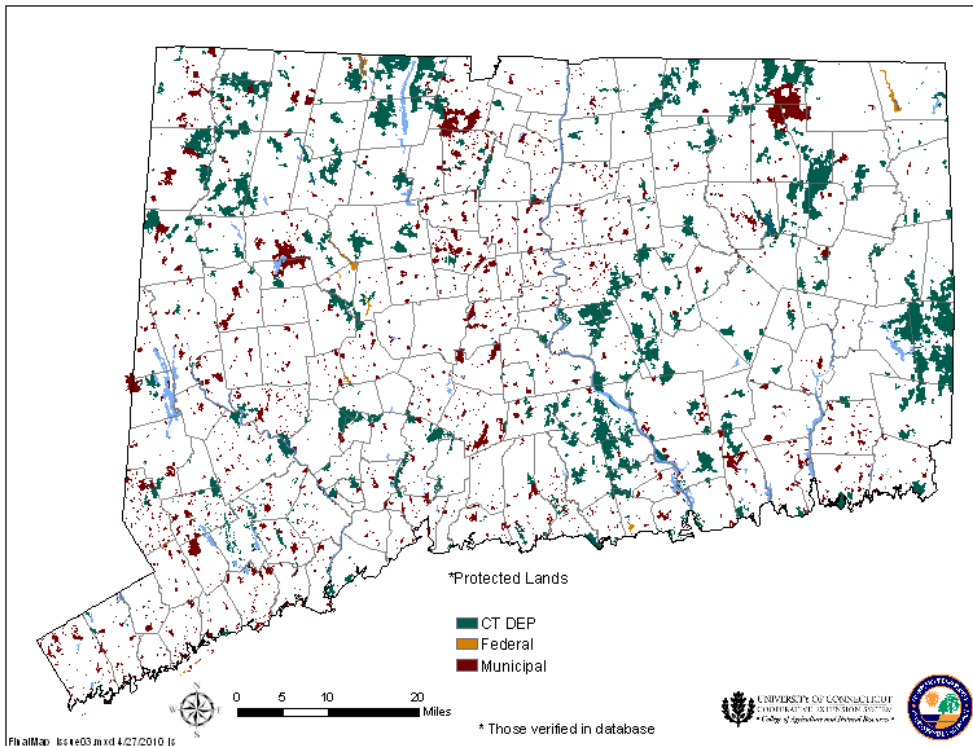
Figure 43. Protected Forestland over Time



*The acreage of Federal protected lands estimated here includes hiking trails, wildlife preserves, flood control projects and a national historic park. While these amenities are appreciated and enjoyed by the citizens of Connecticut, by statute the federally held acreage does not count towards the land protection goal set forth in the Green Plan. (Source; CT DEP Green Plan 2007-2012)

To visually depict what is known and mapped as protected lands in Connecticut, Figure 44 was created. This is not a complete or accurate representation of all protected properties in Connecticut, but it is the best available using existing information.

Figure 44. Protected Lands within Connecticut



To gain a better understanding of how much land is actually protected, the DEEP is currently undertaking a research project to inventory all open space parcels in the State, called the Protected Open Space Mapping (POSM) Project. Unfortunately, funding for the POSM project is intermittent, so the project has moved along sporadically.

Two programs exist within DEEP to assist in achieving *The Green Plan's* goal:

The Recreation and Natural Heritage Trust Program

“The Recreation and Natural Heritage Trust program was created by the Legislature in 1986 in order to help preserve Connecticut’s natural heritage. It is the Department of Energy and Environmental Protection’s (DEEP) primary program for acquiring land to expand the state’s system of parks, forests, wildlife, and other natural open spaces. Through it, the DEEP manages the acquisition of land of statewide significance that represents the ecological and cultural diversity of Connecticut, with a focus on unique features such as rivers, mountains, rare natural communities, scenic qualities, historic significance, connections to other protected land, and access to water (Green 10)”

The Open Space and Watershed Land Acquisition Grant Program (C.G.S. Section 7-131d to 7-131k)

“The Open Space and Watershed Land Acquisition Grant Program provides financial assistance to municipalities and nonprofit land conservation organizations to acquire land that will add to a community's open space, enhance recreational opportunities, protect unique geographical features or conserve habitat for living creatures” (Green 10).

There are also options available through state and federal partner programs for conserving forestlands.

Forest Legacy Program

Connecticut DEEP partners with the USDA Forest Service to implement the Forest Legacy Program. The Forest Legacy Program is used to identify and help conserve environmentally important forests from conversion to non-forest uses. The main tool used for protecting these important forests is conservation easements. The Federal government may fund up to 75% of program costs, with at least 25% coming from private, state or local sources. The Forest Legacy Program protects “working forests”, which is defined as those that protect water quality, provide habitat, forest products, opportunities for recreation and other public benefits (FLP). “The program encourages and supports acquisition of conservation easements, legally binding agreements transferring a negotiated set of property rights from one party to another, without removing the property from private ownership. Most FLP conservation easements restrict development, require sustainable forestry practices, and protect other values” (FLP). Since the start of the program in Connecticut, the Forest Legacy Program has helped to protect 7,347 acres in Connecticut for a value of \$9,049,000. (FLPA).

The Connecticut Forest Legacy Program will be implemented according to the Connecticut Forest Legacy Program (FLP) Assessment of Need (AON), which was approved by the Secretary of Agriculture on October 26, 1994 and amended and approved by the Chief of the Forest Service on July 6, 2001. The AON includes the approved Eligibility Criteria for the Forest

Legacy Areas (FLA); the Approved FLAs; specific goals and objectives to be accomplished by the Connecticut FLP; and the process by which the State Lead Agency will evaluate and prioritize projects to be considered for inclusion in the FLP. A copy of the State Lead Agency designation letter, the AON, and the AON approval letter can be obtained by contacting the Forest Legacy Program Manager at the Connecticut DEEP, Division of Forestry, 79 Elm Street, Hartford, CT 06106.

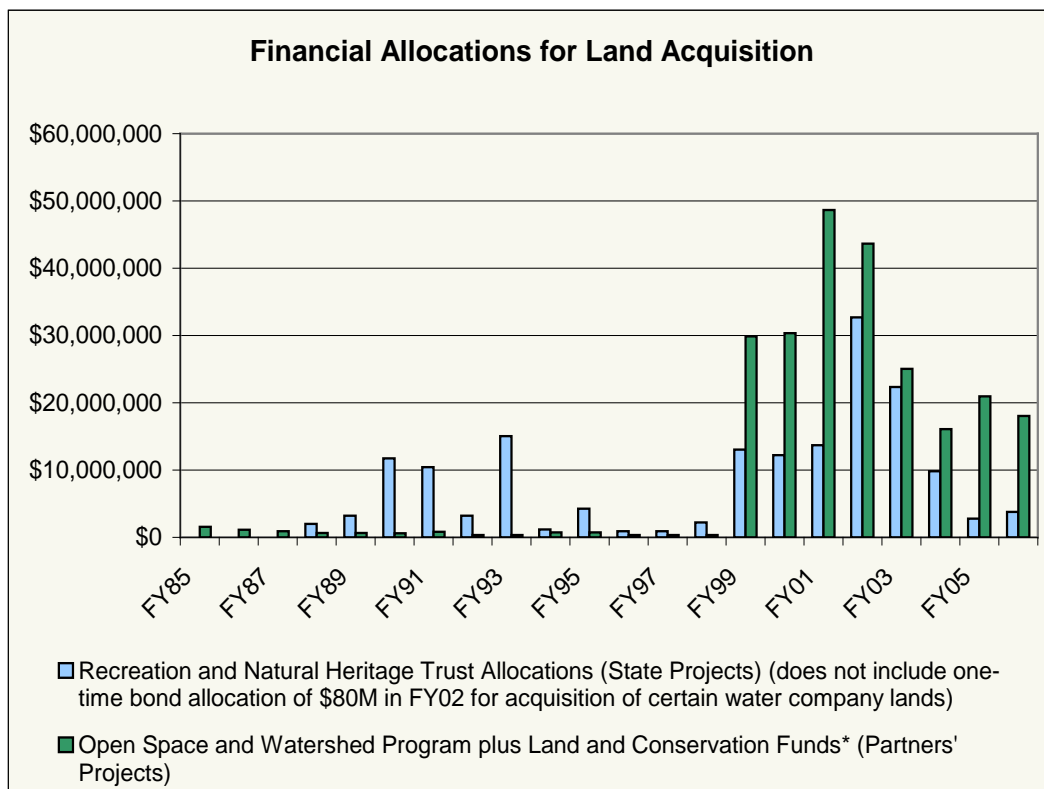
Connecticut Farmland Preservation Program

The Connecticut Farmland Preservation Program, run by the Department of Agriculture, preserves farmland by acquiring development rights to agricultural properties. Although the main objective of the farmland preservation program “is to secure a food and fiber producing land resource base, consisting primarily of prime and important farmland soils, for the future of agriculture in Connecticut, the program does allow forestland as part of the protected acreage, and therefore can be considered as a forestland protection agent” (DOAG).

To meet the goals set forth in statute and *The Green Plan*, the State of Connecticut must acquire nearly 70,000 additional acres by the end of 2023 and encourage the acquisition of approximately 125,000 additional acres by municipalities, private nonprofit land conservation organizations and water companies (Green 3).

Figure 45 below shows the trend of financial allocations for land acquisition between 1985 and 2006. Since this information was compiled, funding levels have significantly decreased, and may continue indefinitely due to the current economic situation within the state.

Figure 45. Financial Allocations for Land Acquisition



* The lands protected through the Land and Conservation Funds program have not been separated into State and Partners' lands. They are listed here under Partners' as the vast majority of this funding has been expended on local non-State protection efforts. Source: CT DEEP, *Green Plan*

15.4 Private Land with public conservation easements

The Department of Energy and Environmental Protection holds a variety of conservation easements. These include Forest Legacy Easements, flood control easements, fishing easements, access easements, and possibly some hunting easements. There is no complete listing or acreage estimate of DEEP's conservation easements.

There is also no comprehensive listing of easements held on private lands from other public entities. Hopefully this can be rectified through the completion of the POSM project listed above.

15.5 Forest land in tax reduction programs

Public Act 490, as described in Criterion 7, is the main tax reduction program in Connecticut. As of November 2015 there are approximately 10,223 parcels totaling about 521,689 acres in PA 490 for forest land. Other classes of PA 490 exist, including agriculture, and open space.

15.6 Forest certification

Currently, there are no state lands under Forest Certification within Connecticut. Certification has been considered in the past, but an implementation mechanism has not yet been developed.

Third party certification on private lands is delivered through at least two programs. There are 7,835 acres of certified forests under The Forest Stewardship Council in Connecticut. The American Tree Farm System, which is affiliated with the Sustainable Forestry Initiative, has 160 tree farms as participants in the certification process.

Conclusion: Currently, almost 60% of Connecticut is forested, highly impressive based on the dense population of residents in the state. Connecticut has a strong commitment to protecting open space, much of it forestland, as evidenced by the various programs available. In order to meet the goals set forth in Connecticut General Statutes section 23-8, and also to ensure that sufficient forestland is protected to maintain all of the functions and benefits that our forests provide, Connecticut will have to maintain an aggressive course of action in land conservation. This may involve increasing efforts to assist in private lands forestland protection, and advocating for more financial allocations for open space land acquisitions. It would also be beneficial to make the Protected Open Space Mapping project a priority.

Indicator 16. Employment and wages in forest-related sectors

Introduction: Sustainable forest management requires an economic infrastructure for the production of end-use products from timber.

16.1 Wood-related products manufacturing employees

According to 2007 Economic Census, Connecticut employs 1,789 wood product manufacturing employees (EC). Independent loggers are not included in this estimate.

16.2 State forestry employees

The Connecticut DEEP Division of Forestry includes 18 permanent employees as of the review of this report (November 18, 2015). This includes: one State Forester/Director, three Program Specialists (Program Leads for Forest Protection/Fire, State Lands, and Private & Municipal

Lands/Forest Practices Act), one Forest Planner/Federal Aid Coordinator, one Urban Forester, two Fire Control Officers, one Forest Protection Forester, one Enforcement Forester, five State Lands Foresters, two Service Foresters, and one Secretary. Seasonal employees can range from zero to 13 with State Lands and Forest Protection/Fire utilizing seasonals the most.

This number is significantly down from just over a decade ago when the total number of permanent employees totaled 31, and the Division had 13 seasonals to assist (NASF 1998, 12). Since that time, the closure of the State Nursery and numerous retirements without refills has led to a 42% reduction in full-time permanent staffing.

Although the Division is has taken measures to try and creatively make up staff deficiencies with more efficient program delivery, there have been programming/service cutbacks. Significant concern exists within the Division regarding the future of the Forestry Division. Several of the Division staff are at or within five years eligibility of retirement, including all of the service foresters. Concerted efforts need to continue by the Agency to seek higher legislative appropriations. In addition, a priority of developing and nurturing outside of the agency support has to be made so that constituency groups can provide support for staffing and programming improvements. Another priority has to be to improve interdivisional program cross training to prepare for future division staff reductions due to retirements.

The University of Connecticut also has two employees that work on forestry programs; both work under the Cooperative Extension System.

16.3 USDA Forest Service Employees

There are various regional USDA Forest Service Employees who work closely with the DEEP Division of Forestry and associated partners through federally run programs. These programs include, but are not limited to Fire Management, Cooperative Forestry, Conservation Education, Forest Health Protection, Forest Legacy, and Urban and Community Forestry. None of the associated USDA Forest Service employees are based in Connecticut.

16.4 Wood-related products manufacturing payroll and wages

According to the 2007 Economic Census information for Connecticut, the annual payroll was \$60.7 million dollars for wood product manufacturing, and \$242.5 million dollars for paper manufacturing. Due to the small number of establishments (5) related to wood office furniture manufacturing within the state, value could not be disclosed in the Economic Census for this category, and therefore this information is not being reported in the total value mentioned above. Also, as of 2002, the Census Bureau no longer collects value data for logging, so this information is not included above (US CB).

16.5 State Forestry salaries

According to the State Forestry Statistics put out by the National Association of State Foresters, in 2006, the last year that this information was reported, an estimated total of \$3,187,400.00 was spent on Connecticut Forestry Programs including implementation of the Fire Program, Cooperative Forestry/Landowner Assistance Programs, Forest Products Utilization and Marketing, Urban Forestry, Forest Health, and Watershed/Water Quality Protection/BMPs. (NASF 2006, 8).

Conclusion: Connecticut's working forests sustain a number of industries and employs almost 2,000 citizens. Support of these industries by DEEP Division of Forestry programs needs continued and increasing levels of funding to support Division infrastructure.

Summary: Wood materials play an important role in both providing substantial products and contributing to Connecticut's economy. The balance of production versus consumption that exists in the state could influence new wood related markets evolving in the state and the region. In addition, Connecticut's forests play a significant role in fulfilling the recreation needs of its citizens. A solid infrastructure of recreational facilities abounds in Connecticut, but as recreational pressures increase, multi-use concerns will become more prevalent and need to be monitored closely for impacts on the environment. Many of the forestry programs administered in the state are either fully funded by or supplemented by federal sources. Connecticut has a strong commitment to protecting open space, of which much is forestland, as evidenced by the various programs available. To ensure that sufficient forestland is protected to maintain all of the functions and benefits that our forests provide, Connecticut will have to maintain an aggressive course of action in land conservation. Connecticut's working forests sustain a number of industries and employ almost 2,000 citizens. Wood products manufacturing is significant within the state, and expected to grow as uses for wood such as bioenergy increase. The DEEP Division of Forestry will need continued and increasing levels of funding to support the growing infrastructure of these industries and ensure sustainable forestry practices.

Criterion 7: Legal, Institutional, and Economic Framework for Forest Conservation and Sustainable Management

Importance: Throughout history, the values of society and the social, legal, economic and environmental conditions of the day have all had a profound effect on the decisions made regarding forest conservation and sustainable management. Taken together, these decisions trace a course that has shown itself, time and again, to be positive and pro-active. These decisions have sought to reinforce professionalism and educated choices; and are reflective of the values that individuals and society at large place in the land and in the forest, as well as in those trees that grow outside of the forest but contribute to the quality of life in the state. Not all decisions have worked out well. For example, some communities, in an effort to slow growth, have enacted zoning ordinances to require larger lot sizes. This has the unintended effect of fragmenting more forest land than if lots were clustered closer together. However, the actions of the past have laid a firm foundation for the actions of today, and planning for the actions of the future.

Indicator 17. Forest management standards/guidelines

Introduction: The roots of forest conservation and management in Connecticut go back at least 115 years. A tradition of forest conservation, paired with an emphasis on training and ability, help define the current approach to forest management in the state today.

The following is a brief summary of the institutional and legal history of forestry in Connecticut:

- 1895 – The Connecticut Forest and Park Association is founded
- 1901 – The Connecticut General Assembly allocates funding for the first State Forest. Also, the first State Forester is appointed.
- 1901 – The original Tree Warden Law is passed. This law permitted towns to appoint a tree warden at the town's discretion.
- 1903 – The first State Forest is created.
- 1913 – Creation of the 10 Mill Law, the state's first law that provided tax benefits to those landowners who maintained their land as forest.
- 1919 – The original Arborist Law ("Tree Expert Law") is passed. This law requires those who advertise or contract themselves out as tree experts to be licensed by the state, and establishes the Tree Protection Examining Board to set standards and review the qualifications of those seeking this license.
- 1922 – The Connecticut Tree Protective Association is formed as an educational association to help prepare those seeking the "tree expert" license and also as a means of maintaining the qualifications of those licensed.
- 1929 – The Tree Warden Law is revised to require each municipality to appoint a tree warden, who would then have "care and control" of all public trees.
- 1963 – "PA 490", the state statute that established a current use tax policy to aid in the conservation of forest, farm and open space land. Owners of 25 acres or more of forested land could file for a greatly reduced property tax liability. This law replaced the previous 10 Mill Law.
- 1971 – The Connecticut Department of Energy and Environmental Protection is established. Responsibility for the State Forests is placed within DEEP Forestry.
- 1972 – Inland Wetland Statutes are passed.
- 1986 – The original Forest Practices Act is passed. This law established the voluntary certification of forest practitioners be certified by the State of Connecticut if they are to participate in a commercial forest practice. Three levels of certification are established: Forester, Supervising Forest Products Harvester and Forest Products Harvester. The law also allows for the establishment of regulations related to forest practices, and established the Forest Practices Advisory Board. This law was replaced by the current Statute in 1991.
- 1989 – The Connecticut Urban Forest Council is formed. This Council is charged with a leadership role in the developing urban forestry program in the state.
- 1991 – The Tree Wardens Association of Connecticut is formed. As one part of its mission, this educational association seeks to add a clear definition of the skills and qualifications of what a tree warden should be to the existing requirement that a tree warden be appointed by each municipality.
- 2004 – The current version of the Connecticut Statewide Forest Resource Plan is released. Among its particulars, this plan calls for the establishment of a Connecticut Forestlands Council. Also, the plan has led to the holding of an annual Forest Forum for all parties with an interest in forests, forest conservation and forestry.

17.1. Types of forest management standards/guidelines

There are four basic types of standards associated with forest management in Connecticut.

Legally mandated standards are those that are required by state statute, and include among them the licensing required for commercial arboriculture and the certification needed to legally

conduct commercial forest practices. *Professional standards* are associated with those who do forest management, and may or may not be legally mandated. *Performance standards* pertain to the quality of the work being done more so than to the qualifications of the individual doing the work. Finally, there are those *standards driven by public will* that are statements of the public's desire for policy positions relative to forest management. This last category would include the state's policy goal, stated in CGS 23-8, of holding 21% of the land area of the state as open space.

17.2. Voluntary and mandatory standards/guidelines

Unless the requirement is simply for the purpose of registering participants, the establishment of a licensing or certification requirement automatically brings about standards associated with those requirements. In Connecticut, there are two such requirements closely associated with forest management.

Certification of Forest Practitioners

The first of these is the certification required of all who would conduct commercial forest practices. If an individual in their activities will reach certain specific thresholds⁵, that individual must be certified. There are 3 separate levels of certification, each with its own distinct responsibilities and limitations. These three levels are:

- Forester
- Supervisory Forest Products Harvester
- Forest Products Harvester

In order to qualify in as a certified forest practitioner, an individual must pass a rigorous exam offered by the Department of Energy and Environmental Protection Division of Forestry. This examination is based on industry accepted standards regarding knowledge needed and practices acceptable in the field. Some of this is drawn from widely-used college texts and is considered common knowledge of those in professional practice. Other details are drawn from specific documents such as Best Management Practices (BMP's). All efforts are made to be clear to individuals what is required of them to qualify for certification.

In addition, all certified individuals are required to demonstrate that they are maintaining their knowledge of advances in the field through the submission of Continuing Education Credits (CEUs).

Arborist License

In a similar manner, those who wish to practice commercial arboriculture in Connecticut must be licensed by the state. To do so, a person must pass a written examination administered by the DEEP, and also pass an oral examination before the Tree Protection Examining Board. These

⁵ a commercial forest practice is defined as any forest practice performed by a person other than the property owner, either for remuneration or when such a practice will yield wood products in excess of 50 cords, 150 tons or 25,000 board feet in any twelve-month period.

examinations test the candidate's knowledge of trees and tree care, general arboricultural practices, the specifics of diseases, insects, tree conditions and their treatments, and also their knowledge of pesticides relevant to arboriculture.

For the most part, the arborist exam is based on general tree knowledge, the understanding of practices in general use in the field, and such specific standards as those adopted through the American National Standards Institute (ANSI) process. Continuing education credits are also required of those who wish to retain their arborist license.

Other certifications

Beyond what is specifically required to allow them to work legally in Connecticut, many professionals aspire to additional demonstrations of professional competence and qualification. For example, while the requirements of professional certification through the Society of American Foresters or the International Society of Arborists hold no legal sway in Connecticut, many individuals seek to augment their credentials through such programs. In turn, the existence of such programs do influence the professional standards associated with the legally mandated licensing and certification programs.

Professionals may also turn to independent associations in circumstances where there are no strict legal requirements, but in which there is a perceived need for established qualifications. A good example of this is the program of certification that is offered by the Tree Wardens Association of Connecticut. Through the Tree Wardens Association, individuals who wish to be certified as a tree warden may do so by demonstrating certain specific qualifications. In turn, the individual may show a municipality that is a potential employer this qualification. The expectation is that many cities and towns will realize the practical and legal benefits of having an individual qualified as tree warden in that city or town.

The Northeast Master Logger Certification (MLC) Program offers third-party independent certification of logging companies' harvesting practices. The certification system is built around standards that have been cross-referenced to all of the world's major green certification systems. The content of the master logger program is based on a common vision for the rural communities and forest resources of the Northeast. These eight goals guide Master Loggers in their work: Document Harvest Planning, Protect Water Quality, Maintain Soil Productivity, Sustain Forest Ecosystems, Manage Forest Aesthetics, Ensure Workplace Safety, Demonstrate Continuous Improvement, and Ensure Business Viability. There are detailed harvest responsibilities with explicit performance standards under each goal (www.masterloggercertification.com). Three companies that possess Master Logger Certification have staffs that are certified to operate in Connecticut.

DEEP encourages responsible and careful harvesting of wood, and the DOF has an employee that serves on the MLC Certification Board. The DOF expects to continue participation with this program. The DOF State Lands Program has directly benefited by having contracts with master loggers. Their work is above average and routinely requires less monitoring hence saving time and effort.

There are no legal requirements for landowners to manage their forestlands to any specific standards, or for property owners to care for their trees in accord with any specific requirements. Individual property owners who wish to enroll in such voluntary programs as the Forest Foundation's American Tree Farm System or any of the other various third-party certification programs are welcome to do so; however, they do not receive any specific benefits from such participation apart from what they gain from the program itself. Even under the "PA 490" current use tax program, landowners are only required to keep their land as forestland; there is no requirement that they undertake any forest management activities in order to receive the reduction in property taxes.

Associations such as the Connecticut Forest and Park Association play a key role in informing their members and the public at large about the status of forests and forest management in the state. CFPA's support of legislative initiatives is often critical. Organizations such as these help maintain an informed perspective regarding how forests are managed in the state and where additional resources or changes might be necessary.

Other Training Opportunities

The Land Use Academy, a program out of the University of Connecticut Center for Land Use Education and Research “provides practical education for local land use decision makers in Connecticut. The program focuses on the fundamental knowledge and skills needed to serve effectively on a local land use commission. In addition to core training, the Land Use Academy offers additional workshops on pertinent Land Use Planning Topics as part of the Municipal Initiative. The Land Use Academy is recognized as the state’s official certification program in basic land use education for local commissioners. The Connecticut Land Use Academy is supported by the Connecticut Office of Policy and Management (OPM) Office of Responsible Growth, with funds provided by the Connecticut General Assembly” (CLEAR).

The Coverts Project is a special educational program of the University of Connecticut Cooperative Extension System and the Ruffed Grouse Society. “Since 1983, The Coverts Project has been reaching out to Connecticut's individual woodland owners and teaching them how sound management practices can make wildlife healthier, more diverse, and more abundant” (UConn).

The Meskwaka Tree Project is a training and outreach program for urban and community forestry citizen volunteers. As a component of the University of Connecticut Cooperative Extension System Urban and Community Forestry program, the Meskwaka Tree Project “provides training, resource materials and support to selected volunteer community leaders, innovators and activists so they may develop new or enhance existing programs and organizations (UConn)”

Project Learning Tree (PLT) (www.plt.org) “is an award-winning environmental education program designed for teachers and other educators, parents, and community leaders working with youth from preschool through grade 12. The Connecticut Forest & Park Association (CFPA) offers hands-on professional development workshops for teachers and other educators on forests and related natural resources topics. The PLT curricula helps students learn how to

think, not what to think, about the environment. PLT materials are aligned with state and national education standards in science, social studies, language arts, math, and other subjects; and the curriculum is broad-based: topics cover the total environment and are local, national, and global in scope” (CFPA).

Many of Connecticut’s Environmental Partners outside of State Agencies also provide educational opportunities and demonstration forests modeling sound forest management activities. Two of the best known examples include the John R. Camp Outdoor Classroom and Demonstration Forest at the Connecticut Forest and Park Association Headquarters in Middlefield, as well as the Yale Myers Forest, of Yale University which is located in Ashford/Eastford/Union, and provides five unique demonstration areas that serve to illustrate forest management to groups of professionals, students and the public.

17.3. Monitoring of standards/guidelines

Poor performance by a professional in the field can lead to legal ramifications. However, in the case of forest practices, this is most likely to occur through civil action at the local level. Connecticut is a strong "home rule" state. Municipal Inland Wetland Commissions often have broad authority over practices that are deemed harmful to inland wetlands and other environmental features, and so these municipalities are often effective in advancing improved forest practices throughout the state.

The Forest Practices Act does give the state the ability to establish regulations governing standards for forest practices, but to date, the state has not established these specific field standards. At the state level, an individual who performs forest practices without proper certification may be subject severe penalties.

Conclusion: Connecticut has a solid base of standards and guidelines supporting urban and rural forest sustainability.

Indicator 18. Forest-related planning, assessment, policy, and law

Introduction: Laws addressing forest management place boundaries on permissible activities to protect soil and water quality as well as the forest itself. Forest-related planning and assessment are tools through which policy recommendations are made. Solid legal and planning frameworks are necessary to ensure sustainable forest management. In addition, site-specific planning is necessary to promote proper management at the stand and parcel levels.

18.1. State Forest planning

The State owns approximately 251,000 acres in its system of parks, forests, and wildlife management areas, which are all managed out of the Department of Energy and Environmental Protection. Of those 251,000 acres, approximately 170,000 of them are managed as state forests divided into 32 State Forests across the state. The Division of Forestry manages those State Forests.

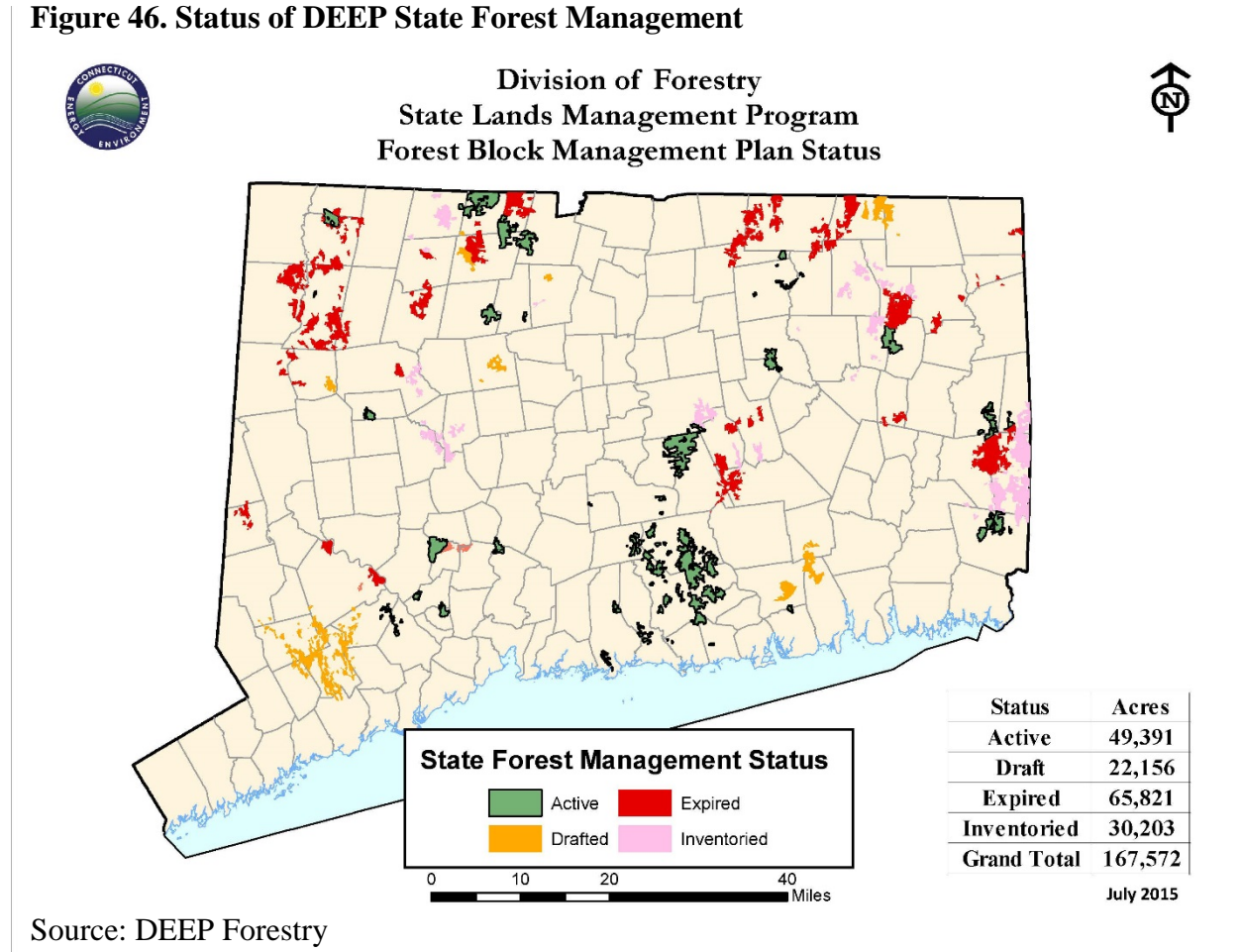
The DOF State Lands Standard Operating Procedure (SOP) guides the state lands program implementation, which includes the State Forests. Within the SOP are criteria for state lands

management plans. These management plans created for the State Forests address not only timber related activities, but wildlife, fisheries, and recreation, as well as site infrastructure, threatened and endangered species, and other relevant concerns. State Forest management plans contain input and are reviewed by the other natural resource divisions and programs within the agency including the Fisheries Division, the Wildlife Division, Inland Wetlands, Parks and Recreation, Law Enforcement, and the Natural Diversity Database. These plans are approved by the Commissioner of DEEP or their designee. In addition plans are submitted to municipalities and partners for review. The DOF State Lands SOP is currently being revised, and should be completed by the end of 2010.

Ideally, all 32 State Forests would have management plans, and be considered actively managed. Currently, 23 State Forests (or about two-thirds) have DOF foresters assigned to manage them. This is a total area of about 80,000 acres. Three of the largest forests are currently considered unmanaged, as there is no full time forester assigned to them. Within the last five years there have been harvests on about 50% of the State Forests, including on so-called unmanaged forests that have residual active management plans.

Figure 46 below shows the current status of DEEP State Forest Management. Note that while many of the areas in red do not have active management plans, there are expired plans on file, which just need to be updated.

Figure 46. Status of DEEP State Forest Management



Source: DEEP Forestry

In order to be an effective leader in providing forestland management and guidelines, all state owned forestlands should be under management plans.

Every harvest on state-owned lands has a forest operation plan associated with it. These plans are written by the Connecticut Certified Forester assigned to the area. These plans are reviewed by the other programs within DEEP, including, inland wetland, fisheries, wildlife, operations, parks, natural diversity database, and the state forester. Plans may be reviewed by other natural resource programs and by those involved in outdoor recreation such as CFPA. All harvests are monitored, with best management practices (BMP's) implemented. All harvest operations also have a follow up inventory done to verify the results of timber harvests. DEEP Foresters post educational signs during harvesting activities, as well as more permanent educational signs throughout the state forest system showcasing different forest management and timber harvesting activities.

There are other programs within DEEP that manage state owned forestlands, but they designated for other specific purposes, which may not include timber management. These include State Parks and Wildlife Management Areas, each of which have their own procedures associated with their management.

In order to showcase sound and sustainable forestry and habitat management techniques, educational facilities are located across the state. The Sessions Woods Wildlife Management Area, located in Burlington, introduces visitors to wildlife and natural resource management through various educational programs, demonstration sites, self-guided hiking trails, and displays. The Goodwin Conservation Center, located in the James L. Goodwin State Forest in Hampton, offers programs for the public, schools, educators, and those who use and impact Connecticut's forests, including landowners, foresters, loggers and municipal land use commissioners.

18.2. Private non-industry forest planning

There is no requirement for private or municipal forestland owners to undertake any type of active management of their lands, even under those circumstances where a landowner claims a break in their property taxes due to keeping it as forest. However, whenever an individual or organization voluntarily chooses to undertake a management activity on their lands, including the development of a management plan or the harvest of forest products (conversion of forestland to non-forestland is exempted), the forest practitioner hired to undertake this management activity must be certified by the DOF.

Currently, there are 126 certified foresters, 365 certified supervisory forest products harvesters and 58 certified forest products harvesters, including government employees. Estimates of the percentage of private forestland under active management, as indicated either by a viable forest management plan or recent harvest, vary.

The DEEP Division of Forestry supports the efforts of those who seek to use the services of a certified forest practitioner, as well as those who seek to manage and properly care for trees that are outside of what is commonly known as forestland. The DOF Private and Municipal Lands Program provides a variety of services to private owners of forestland, to those who manage non-state owned public forestland, and to those who seek to care for their trees, including those

individuals responsible for municipal tree programs. The Private and Municipal Lands Program consists of two parts. The service forestry program provides technical forestry assistance to private forest landowners. The urban forestry program provides outreach to municipalities, non-profits and private landowners on matters relating to trees not on forested land. Both programs provide support and assistance to those who manage publicly-owned forestland, such as that owned by municipalities.

Private Forestlands

The service forestry program provides landowners (private and public) with sufficient, accurate, unbiased and state-of-the-art forestry expertise, while respecting and balancing landowner goals with fiscally and environmentally sound management practices. Such expertise is provided in one-on-one consultations and site visits and through education and outreach programs.

Often, the service forester's efforts are to get the landowner engaged, and to direct them towards the appropriate private professionals, while also informing them of the steps they should anticipate taking on the way towards their goals.

In particular, the service foresters work with foresters and landowners in the preparation and implementation of Forest Stewardship Plans. They also are responsible for approving Forest Stewardship Plans written by private foresters, and for operating an annual monitoring program that tracks implementation and performance. The service foresters do this with the guidance and assistance of the State Forest Stewardship Committee, and in collaboration with partners and stakeholders, for the purpose of helping landowners achieve their resource objectives in a sustainable manner.

Forest Stewardship Plans

Forest Stewardship Plans are forest management guiding documents prepared for individual landowners for specific parcels of forest land. Generally, Forest Stewardship Plans embody several interrelated concepts and ideas, under a conceptual framework that:

- Identifies forest values, benefits and services to be sustained or enhanced in place(s) under consideration. (Ownership Goals)
- Specifies indicators and desired future status for forest values and benefits. (Management Objectives)
- Examines relationships between existing conditions, natural processes, and forest values. (Resource Inventory)
- Considers whether human intervention can enhance identified forest values/benefits. (Actions to achieve a Desired Future Condition)
- Manages forests and landscapes to maintain and enhance identified forest values and benefits. (Recommendations)
- Monitors and evaluates indicators.

Connecticut Tree Farm Program

The service foresters and private consulting foresters encourage participation in the Connecticut Tree Farm Program, a part of the American Forest Foundation Tree Farm Program. Foresters and forestland owners in Connecticut have participated in this program for more than 50 years, providing recognition to forest landowners who exemplify sustainable forest management on

their properties. Participation is voluntary, both by landowners and the professional forestry community. However, active participation is a way for landowners to have regular contact with peers, receive professional forestry advice and hear of the accomplishments of other Tree Farmers from around the region and the country. Recently the Tree Farm Program has focused on Family Forest owners and on providing a means for small private land ownerships to be certified as sustainably managed forests. Currently there are approximately 160 Certified Tree Farms in Connecticut. Properties participating as Tree Farms are inspected by a certified tree farm inspector who monitors the property to assure that it is being managed according to National Tree Farm Standards.

Urban Forestry

The urban forestry program in Connecticut is structured to emphasize administration, leadership, outreach, support, collaboration and goal-sharing among interested partners. At the center of this structure are the urban forestry coordinator in the DEEP Division of Forestry, the volunteer coordinator affiliated with the University of Connecticut Cooperative Extension Program, and the Connecticut Urban Forest Council (CUFC), composed of many members representative of several groups engaged in urban forestry.

The primary audience for the urban forestry effort includes municipalities, non-profit groups, individuals motivated to specific accomplishments in urban forestry, volunteer groups, professionals from a variety of backgrounds, and average citizens.

In recent years, the urban forestry program has tended to focus on building capacity within the state, upon which individual urban forestry efforts could be based. Towards that end, the CUFC in its current five year plan (2006-2010) has identified the following goals for the state program:

Goal 1: Public Awareness: Education and Communication

Continue developing public responsibility and government responsiveness by promoting an understanding of the social, economic and environmental values of trees, forests and related natural resources in communities.

Goal 2: Outreach and Environmental Equity

Expand program participation to better engage all community members in all aspects of urban forestry.

Goal 3: Organizational Capacity

Expand the capacity to address emerging issues and opportunities that support healthy, sustainable communities.

Goal 4: Natural Resource Management and Policy

Support research that monitors and integrates the biophysical, social and economic attributes of urban forestry.

Success according to these goals has been measured largely in terms of the number of activities initiated or continued that were in support of these goals. For example, inventories, local tree ordinances and volunteer hours have been considered as representative of progress towards achieving these goals, under the theory that these specific and measurable accomplishments would function towards the success of the more elusive and difficult to measure goals expressed by the Council.

Recently, there has been an increased interest in viewing urban forestry in terms of more measurable biological accomplishments, such as increased tree canopy cover or analyses of street tree inventories that show improvements in the health and condition of elements of the urban forest. Interest in viewing the urban forest in this fashion is sparked largely for two reasons. The first is because of the expanded use of tools, including those associated with remote sensing, have greatly increased the ability of managers to develop these sorts of analyses. The second is a steadily increasing archive of previous inventories, analyses, efforts and accomplishments now provides both a baseline and a track record by which to more intelligently measure current conditions.

The Connecticut program continues to both expand capacity at the local and the statewide levels by continuing to provide outreach and support and by getting more people involved with the goals and effort of the urban forestry program, and to provide measurable accomplishments in biological terms in ways that show advances with regards to the health, extent and condition of the urban forest. In consonance with this latter effort, the urban forestry program has sought out opportunities for increased involvement with other programs in the state that seek similar goals regarding the urban and built environment, including programs that focus on clean air, clean water and social involvement.

Community Accomplishments Reporting System (CARS)

Connecticut participates in the Community Accomplishments Reporting System (CARS) for the USFS Urban and Community Forestry Program. As used in Connecticut, CARS is a measure of the basic structural capacity of the municipalities throughout the state regarding urban forestry.

CARS considers four criteria:

- a management plan
- a professional urban forestry staff
- ordinances or established policies relative to urban forestry
- advocacy or advisory groups within the community

Connecticut uses these measurements as a measuring stick for progress within individual communities. It helps to identify and focus efforts in municipalities that are not active or that are early on in their progress.

America the Beautiful Small Grants Program

Among the key programs of the DOF regarding urban forestry is the small grants program generally known as the America the Beautiful grant program. This grant program invites applications from municipalities and non-profits, in five categories. The five categories are:

- Inner City Urban Forestry
- Municipal Urban Forest Planning and Maintenance
- Management of Urban Forest Woodlands
- Planting or Maintenance of Legacy Trees
- Other, General Urban Forestry Projects

For these grants, where tree planting is involved, specifications for planting must be included in the application, along with a detailed 5-year maintenance plan. The use of specialized publications such as University of Connecticut Cooperative Extension Publication “Tree

Planting” or the USDA Forest Service pamphlet “Planting Trees in Designed and Built Community Landscapes” are highly encouraged.

The Tree City USA Program

Connecticut also participates in The Tree City USA program. This program, sponsored by the Arbor Day Foundation in cooperation with the USDA Forest Service and the National Association of State Foresters, provides direction, technical assistance, public attention, and national recognition for urban and community forestry programs across the nation.

To qualify as a Tree City USA community, a town or city must meet four standards established by the National Arbor Day Foundation and the National Association of State Foresters. These standards are to ensure that each qualifying community has a viable tree management plan and an active program. Tree City USA is designed such that no community would be excluded because of size. The four standards for Tree City USA are:

1. A Tree Board or Department
2. A Tree Care Ordinance
3. A Community Forestry Program with an annual budget of at least \$2 per capita
4. An Arbor Day Observance and Proclamation

Currently in Connecticut there are seventeen communities that have been designated as Tree City USA's. These communities are: New Haven, Bridgeport, Danbury, East Hartford, Fairfield, Groton, Middletown, Southbury, Stamford, Wethersfield, Hartford, Ridgefield, Brookfield, Monroe, Norwalk, Wilton and West Haven.

Partner Efforts in Non-industry Forest Planning

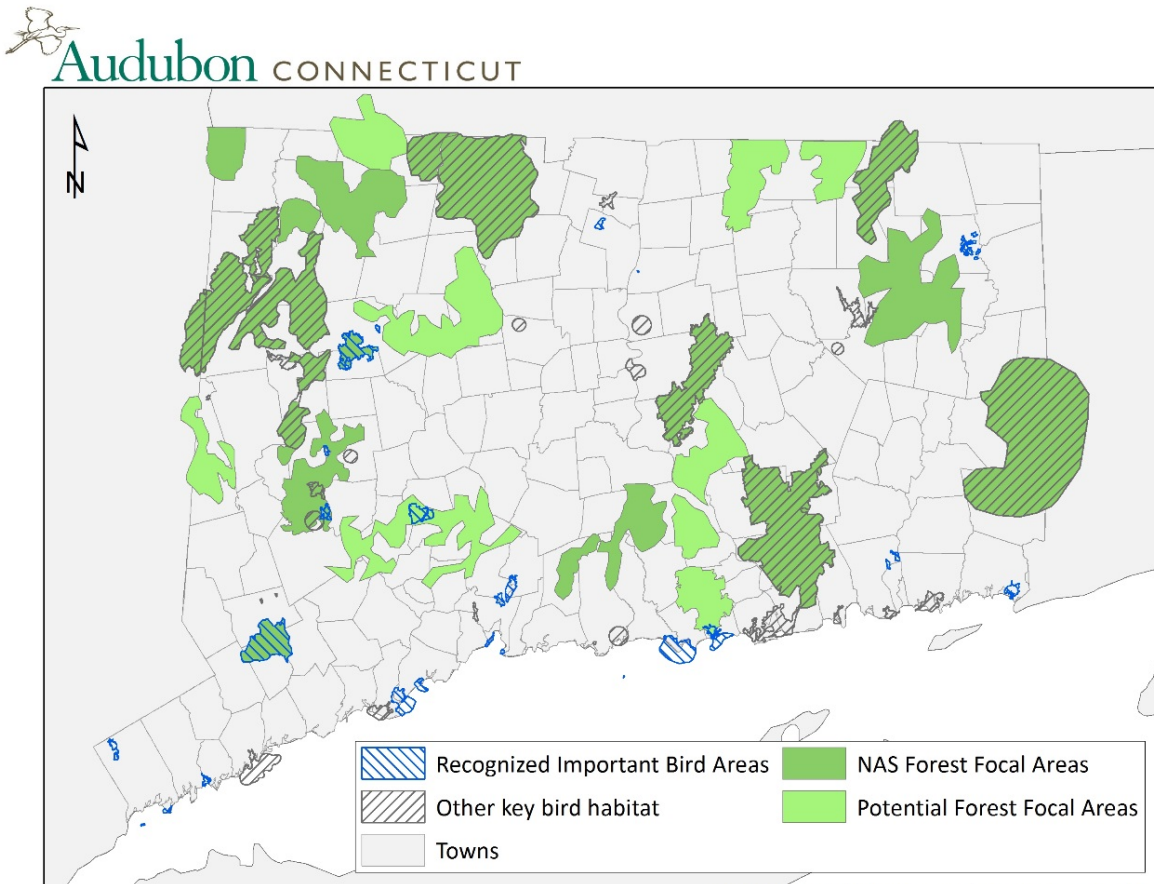
There are many private non-industry forest planning efforts on a regional and local scale in Connecticut. In addition to these local and regional efforts, two organizations that have targeted statewide forest protection priorities include the Connecticut Chapter of The Nature Conservancy and Audubon Connecticut. The Nature Conservancy has developed priority forest areas, across the state, some of which are listed under our Multi-state priority areas (i.e. The Borderlands Project, the Berkshire Taconic Landscape, and the Quinebaug Highlands Project). The Important Bird Areas under Audubon Connecticut are also a significant planning and assessment effort.

Audubon Connecticut

The Important Bird Areas Program (IBA) is a global effort to identify and conserve areas that are vital to birds and other biodiversity. IBAs are sites that provide essential habitat for one or more species of bird. IBAs include sites for breeding, wintering, and/or migrating birds. IBAs may be a few acres or thousands of acres, but usually they are discrete sites that stand out from the surrounding landscape. IBAs may include public or private lands, or both, and they may be protected or unprotected. Connecticut currently has 27 recognized IBAs which can be found at <http://ct.audubon.org/important-bird-areas-11> (Audubon Connecticut).

Since there are so few recognized forest IBAs, Audubon Connecticut has created a map noting the locations of Key Bird Habitats in Connecticut, which identifies primary forest blocks in Connecticut that are important to bird species. Additional data are needed on distribution and abundance of forest birds to refine the inventory of focal areas for bird conservation (Figure 47).

Figure 47. Audubon Key Bird Habitats in Connecticut (Source: Audubon Connecticut)



Map created by Corrie Folsom-O'Keefe, Nov. 13, 2015.

18.3. National forest planning

Not applicable in Connecticut.

18.4. State forest assessments

There are many ongoing forest-related planning and assessment efforts within Connecticut. Many revolve around conservation of forestland, as fragmentation and parcelization are major concerns.

Conservation of Forestland

Conservation and Development Policies Plan of Connecticut 2005–2010

At the highest statewide level is the *Conservation and Development Policies Plan of Connecticut 2005–2010* (State C&D Plan) which contains six growth principles including:

- Conserve and restore the natural environment, cultural and historical resources, and traditional rural lands and
- Protect and ensure the integrity of environmental assets critical to public health and safety.

The Green Plan: Guiding Land Acquisition and Protection in Connecticut 2007-2012

At the Department level, the DEEP has developed “*The Green Plan: Guiding Land Acquisition and Protection in Connecticut 2007-2012*,” which is an update of the original *Green Plan* (2001). The updated plan:

1. identifies the State’s future open space goals;
2. summarizes land acquisition and protection efforts to date;
3. discusses threats and challenges to open space protection;
4. identifies priorities for acquisition and protection;
5. describes the programs and funding available; and
6. outlines the process.

This document is a strategic plan for land acquisition and protection for the State of Connecticut through 2012. As such, it provides general guidance for program managers, is a tool for those who want to work with the State in preserving land, and offers a basic overview for the public of the State’s land acquisition and protection program.

Landscape Stewardship Initiative

In addition, the Department of Energy and Environmental Protection has a Landscape Stewardship Initiative. The goal of the Landscape Stewardship Initiative is to coordinate and focus the Department’s many programs that influence land development to ensure that they are not having unintentional adverse effects. This Initiative enhances DEEP’s ability to assist municipalities, land trusts, landowners and others in making better informed land use decisions, resulting in better stewardship of our shared landscape.

Other plans within DEEP which address forests in some capacity, and are not mentioned elsewhere in this document include the Connecticut Climate Change Action Plan (CCAP), the Connecticut Recreation Trails Plan, the Natural Hazard Mitigation Plan, and the Coastal and Estuarine Land Conservation Program Plan (CELCP). All of these plans can be found on the DEEP website at www.ct.gov/deep.

Forestland Protection

Other planning efforts revolve around forestland protection. Connecticut is a charter member of the Northeastern Forest Fire Protection Compact (NFFPC). The Northeastern Forest Fire Protection Compact (NFFPC) was formed after the disastrous fires in northern New England in 1947. Created in 1949, this became the first fire compact authorized by the US Congress. The purpose of the Compact was to promote effective prevention and control of forest fires in the northeastern region of the U.S. and adjacent areas of Canada. Presently the Compact membership is made up of the 6 New England States, New York, the National Forests of New England (Green, White Mountain, Finger Lakes), New Brunswick, Quebec, Nova Scotia and Labrador/Newfoundland. The Compact is administered by a Commission set up within the law.

State Forest Assessments

The Connecticut Statewide Forest Resource Plan (2004-2013)

The Connecticut Statewide Forest Resource Plan (2004-2013) (CTFRP) was the guiding forestlands document in Connecticut until it was replaced by the Forest Action Plan in 2010. It was designed to serve as an overview for planning future activities within the forest community

of Connecticut. The plan identifies issues as perceived by various stakeholders regarding the State's forestlands, and provides the basis for putting limited available state and federal funds, as well as participating groups' and individuals' time, to the best and most urgent uses through a series of action steps. The basis for this current Assessment and Strategy resides in the information originally gathered during the compilation of the CTFRP. The CTFRP is available online at http://www.ct.gov/deep/cwp/view.asp?A=2697&Q=322794&deepNav_GID=1631.

Connecticut Assessment of Need (AON)

Completed in 1994, the Connecticut Assessment of Need (AON) was developed to document the need for Connecticut to be included in the Forest Legacy Program, through an evaluation of existing forests, forest uses, and the trends and forces causing conversion to non-forest uses. The AON defined the Eligibility Criteria that was used in the identification of important forest areas that became the Western and Eastern Forest Legacy Areas (FLAs) in which Forest Legacy activities can occur; and determined through analysis what defines "threatened" and "environmentally important forests;" and outlined the State's project evaluation and prioritization procedures. The AON was developed in consultation with State Forest Stewardship Committee (SFSCC) and approved by the State lead agency. (FLG)

The Connecticut Forest Legacy Program will be implemented according to the Connecticut Forest Legacy Program (FLP) Assessment of Need (AON), which was approved by the Secretary of Agriculture on October 26, 1994 and amended and approved by the Chief of the Forest Service on July 6, 2001. The AON includes the approved Eligibility Criteria for the Forest Legacy Areas (FLA); the Approved FLAs; specific goals and objectives to be accomplished by the Connecticut FLP; and the process by which the State Lead Agency will evaluate and prioritize projects to be considered for inclusion in the FLP. A copy of the State Lead Agency designation letter, the AON, and the AON approval letter can be obtained by contacting the Forest Legacy Program Manager at the Connecticut DEEP, Division of Forestry, 79 Elm Street, Hartford, CT 06106.

Connecticut Wildlife Action Plan

Connecticut's Comprehensive Wildlife Conservation Strategy 2005-2015 (the State's Wildlife Action Plan) identifies species of greatest conservation need and their affiliated habitats as well as priority research needs and conservation actions necessary to address problems facing these species and habitats.

Statewide Comprehensive Outdoor Recreation Plan (SCORP)

The Statewide Comprehensive Outdoor Recreation Plan (SCORP) is a planning document which assesses both the demand for and the supply of outdoor recreational facilities statewide. Using the data and insights obtained through the preparation of the SCORP, both the state and its municipalities can more effectively provide and improve outdoor recreational opportunities for Connecticut's residents and visitors. (SCORP)

Forest Inventory and Analysis

Connecticut participates in the U.S Forest Service's Forest Inventory and Analysis (FIA) program. FIA utilizes a series of permanent plots located throughout the state to analyze and assess the forest resources. FIA reports on status and trends in forest area and location; in the

species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership. (fia.fs.fed.us)

Forest Health Surveys

Forest Health Monitoring Plots includes annual surveying of forest health at 51 permanent plots as well as ¼ mile roadside surveys near each of the 51 permanent plots.

Other current surveys conducted by the Connecticut Agricultural Experiment Station include performing gypsy moth egg mass surveys to delineate potential problem areas for the subsequent year, as well as conducting surveys for the presence of Asian longhorned beetle, Emerald ash borer, *Phytophthora ramorum* and Sirex woodwasp (*Sirex noctilio*) in Connecticut.

The Forest Health Monitoring (FHM) Off-Plot Program supplements plot data with landscape level data on forest stressors. Annual Aerial Detection Surveys are conducted statewide to evaluate tree health and identify stress problems across the landscape. The surveys are carried out on State and private lands through the USFS Cooperative Forest Health Program and State Partners. All areas with defoliation, discoloration, dieback and decline, breakage, and mortality above thresholds will be delineated. In addition, all other areas that are detected will be mapped and, where possible, identified by damaging agent. Canopy damage is photographed during aerial surveys. This information is used to predict next year's conditions. (Frament and Lilja)

18.5. Forest laws and policies

Forest Laws

There are several laws in Connecticut supporting forestland preservation, forest protection, sustainable forestry practices, and tree protection and care. Below is a summary of each.

Forestland Preservation

Public Act 490

In 1963 the Connecticut General Assembly enacted Public Act 63-490, "An Act Concerning the Taxation and Preservation of Farm, Forest, or Open Space". Commonly referred to as simply "PA-490," this act has become one of the most important laws in existence towards protecting an agricultural, forest and natural resource land base in Connecticut.

With its roots in the 1913 Law "An Act Concerning the Taxation of Woodland", Public Act 490 states "(1) that it is in the public interest to encourage the preservation of farm land, forest land and open space land, and (2) that it is in the public interest to prevent the forced conversion of farm land, forest land and open space land to more intensive uses as the result of economic pressures caused by the assessment thereof for purposes of property taxation at values incompatible with their preservation as such farm land, forest land and open space land." A landowner with twenty-five acres or more of forest land in Connecticut may file an application along with a "Qualified Foresters Report" with their Assessor for classification as "forest land". To receive the reduced property tax rates, the property must meet the standards for classification as forest land as defined in Section 12-107b of the Connecticut General Statutes. In 2014 an amendment was passed to clarify language on exempted transfers.

1913 Tax Law/10 Mill Law

This law concerning the taxation of forested land was first passed in 1913 (Connecticut General Statutes section 12-96 through 12-103) and subsequently amended several times to its present form (see **Public Act 490 above**). The law is a functioning anachronism in that there remain approximately 75 landowners in Connecticut (+/-14,050 acres) with active classifications of their land under this law, but it is no longer possible for new land to qualify for classification under this law. The law requires a minimum of 25 acres and that the land, exclusive of the timber thereon, has a value of not more than \$100 per acre. Since there is no longer any forested land in Connecticut having a value anywhere near \$100 per acre, the law remains valid, but no new land may be classified under it. Land classified under this law is taxed, based on 100 percent of the true valuation as established by the assessors at the time of classification. That the valuation is frozen for a 50-year period, providing the land use does not change. The Law then establishes a tax rate of no more than 10 mills. At the end of the 50-year period, a revaluation is made and the land is again taxed at a rate not to exceed 10 mills for another 50 years.

The 10 Mill classification does not terminate upon sale or transfer of the land. It is tied to the land and is not personal to the owner. The owner of the land must pay a yield tax to the town on any timber cut, with the exception that timber cut for domestic use is exempt from the yield tax. There is also a substantial penalty to be paid upon cancellation of the classification. Any use of forest land classified under the 10 Mill law is permissible as long as the use does not cause a change in the basic character of the land as forest land. Any conversion of the land from its growth, management and use as a forest is a change of use. It should be noted that the classification of land under the 10 Mill law is binding upon the entire tract of land and, when any portion of that tract must be removed from classification, the classification for the entire tract must be cancelled.

Public Act 11-198 “allows an owner of forest land enrolled in the state’s ‘10 Mill program’ to convert to the state’s forest preservation program (‘490 program’) without penalty, including penalties for the value of standing timber, if a sale or donation of the land to a nonprofit land preservation organization or a permanent conservation easement on the land occurs before the conversion. Alternatively, the act specifies that woodlands retaining a 10 mill classification on their 50th-year revaluation will be assessed at a tax rate not to exceed the similar properties classified as ‘forestland’ under the 490 program. Any landowner who elects to discontinue participation in the 10 mill program will be subject to applicable penalties.”

Forestland Protection

There are many fire statutes that govern the Department of Energy and Environmental Protection Division of Forestry, Forest Protection Unit. Many date back to the 1930’s and 1940’s. A number of them were updated in the mid-1990’s. Many of these statutes are common between states and deal with powers and duties of Fire Control Personnel, compensation to fire departments and Fire Wardens, open burning, etc. There are two overriding statutes that play a primary role in governing how and why the program functions.

Section 23-35 mandates the State Forest Fire Warden (DEEP Commissioner) to equip trained fire-fighting crews at major Department installations. These crews must be able to respond to

requests for assistance for wildfire suppression from Connecticut fire departments, other states, and the US Forest Service.

Section 23-36 defines the powers and duties of the State Forest Fire Warden. This statute allows the State to enter into agreements with the Federal Government, municipalities, fire departments, etc. It also allows for the creation of a fire warden system and payment (reimbursement) opportunities for individuals and fire departments for wildfire suppression.

Sustainable Forestry Practices

Forest Practices Act

In 1991, the Connecticut legislature overwhelmingly approved Connecticut's first Forest Practices legislation known as the Forest Practices Act (Connecticut General Statutes 2365f-o). Made up of three main sections, the goal of the legislation was to protect and conserve Connecticut's forest resources by encouraging their wise and careful use. Forest practices such as commercial timber harvesting for logs or firewood are key examples of operations that are covered by the law.

Forest Practitioner Certification

One important component of the Forest Practices Act is the requirement of forest practitioners to be certified by the Department of Energy and Environmental Protection prior to conducting any commercial forest practices in Connecticut. Forest Practitioners (people who design, supervise or participate in forest practices such as timber harvesting for logs or firewood) must now be certified to conduct commercial forest practices within the State of Connecticut. Certification is not required for harvesting trees for the purpose of converting forest land to another land use provided certain statutory requirements are achieved.

Since 1996 regulations have required anyone who advertises, solicits, contracts or engages in commercial forest practices within Connecticut at any time to have the appropriate certificate issued in accordance with the law. Essentially, this means that if an operator advertises, solicits, contracts or engages in an activity which is undertaken in connection with the harvest of timber from a tract of forest land in excess of 50 cords, 150 tons or 25,000 board feet in any twelve month period, and the operator receives remuneration (income or goods and services in some form, including timber) for that work, certification is necessary.

There are three levels of certification offered; Forester, Supervising Forest Products Harvester and Forest Products Harvester. Each level has a specific description of what activities they are permitted to do under the law. Additional information on those specific activities each level of certification may perform in accordance to the law may be found on the DOF website at: www.ct.gov/deep/forestry.

The regulations which govern Connecticut forest practitioner certification (Connecticut General Statutes 23-65i) require that all certified forest practitioners participate every two year (biennial) period for the life of their certification in a relevant program of professional education to improve or maintain professional forestry skills.

Forest Practices Advisory Board

The second main component of the Forest Practices Act established the Forest Practices Advisory Board (see description below under **Important Forest Boards, Councils, Committees, & Associations**).

Regulations

The third component of the Forest Practices Act allowed the Department to adopt regulations governing on the ground-forest-practices. Although proposals have reached the public hearing process and discussions on their merit presently continue, regulations governing forest practices have not been adopted.

Regulations were adopted in 2005 concerning the conduct of forest practitioners while conducting forest practices. These regulations resemble the Society of American Foresters ethical standards and those commonly found in other professional licensing standards.

Municipalities may be authorized to govern some or all aspects of a forest practice through one of several state statutes. The Forest Practices Act names twenty towns that may adopt regulations governing on the ground forest practices. Those twenty towns, who had forestry regulations prior to the adoption of the Forest Practices Act, must submit the regulations to the DEEP DOF for approval.

Inland Wetlands and Watercourses Act

In 1972, the state legislature enacted the Inland Wetlands and Watercourses Act which provides for the municipal regulation of activities affecting the wetlands and watercourses of our state. Many, but not all, activities associated with farming and forestry in wetland and watercourses are permitted as-of right under the Inland Wetlands and Watercourses Act, and therefore are not regulated activities. The interpretation of permitted as-of-right provision for forestry activities has been the subject of considerable educational efforts by the DOF and Division of Inland Water Resources to assist all stakeholders in reaching a uniform understanding.

Tree Protection and Care

Tree Warden Law - CGS 23:58 and 23:59 and 23-59a

The Tree Warden Law was first established in 1901. It requires each municipality to appoint a tree warden, who shall have "care and control" of all public trees, including authority over tree removals. Exceptions are trees alongside of state highways (these are the responsibility of the State Commissioner of Transportation) and, in municipalities where there is a Park Commission, public parks.

Up until 2013, the Tree Warden Law did not require any basic qualifications for tree wardens. However, the Tree Wardens Association of Connecticut established a certification program for tree wardens that gained recognition as a base-level qualification for municipalities to consider when they appoint a new tree warden. In 2013 CGS 23-59a was enacted requiring completion of coursework in tree biology, tree maintenance and pruning, urban forest management, and tree laws. A tree warden does not have to complete the coursework if they are a CT licensed arborist or if they appoint a deputy tree warden who is a CT licensed arborist or has passed the required coursework.

Arborist Law – CGS 23:65a-f

The Arborist Law was first established in 1919. It requires that anyone who practices commercial arboriculture in Connecticut be licensed by the State of Connecticut. Exceptions include tree removal and arboriculture done for an employer on the employer's property. Two Attorneys General have also issued opinions that tree work done for utility right of way also does not fall under the Arborist Law.

The most significant outcome of the Arborist Law is that it allows very definite standards to be set as to what constitutes proper tree work. The licensing process involves detailed testing of the individual applicants. The tests involved in licensing are widely held to be thorough and difficult, and requiring that the individuals have extensive field knowledge as well as a good understanding of insects, diseases, tree biology, diagnosis and treatment.

Currently, there are 940 licensed arborists in the state. Those who hold the arborist license are very protective of its standards and its privileges.

Other Tree Protection and Care Laws

In addition to the Arborist Law, various pesticide laws and regulations apply to arborists, as the arborist license is also a supervisory pesticide license.

In addition, CGS 23:65 protects public trees from certain specific damages, and gives the tree warden the authority to act against such actions as vandalism or damage to public trees, shrubs and other objects in the public right of way. This statute establishes the "Guide to Plant Appraisal" as a reference to tree value and damage appraisal.

A compilation of pertinent statutes and regulations for arborists, foresters, tree wardens, and others involved with Connecticut's trees entitled "Connecticut Tree Laws" was updated in February 2010, and is available from the Connecticut DEEP, Division of Forestry. This book has been widely distributed to appropriate audiences.

Forest Policies

Best Management Practices

In the spring of 2007, the CT DEEP published a field guide, *Best Management Practices for Water Quality While Harvesting Forest Products* (www.ct.gov/deep/lib/deep/forestry/best_management_practices/best_practicesmanual.pdf) that will assist certified forest practitioners, private landowners and municipal officials towards a better understanding of the best management practices (BMPs) associated with the harvest of forest products. BMPs for water quality are the minimum standards to be taken to ensure water quality. This field guide is intended for certified forest practitioners, private landowners, and municipal officials to use while planning, executing, or monitoring commercial forest practices. The focus of the publication is to promote sound timber harvesting practices in Connecticut woodlands by strengthening planning efforts and fostering better communications between municipal officials, landowners, foresters, and loggers.

CT DEEP brochure “Agriculture, Forestry and Wetlands Protection in Connecticut”

The *Agriculture, Forestry and Wetlands Protection in CT* brochure (www.ct.gov/deep/lib/deep/water_inland/wetlands/agriculture_forestry_and_wetlands_protection_in_ct.pdf) was devised by the CT DEEP Division of Inland Water Resources in collaboration with the Division of Forestry with the purpose of educating municipal regulatory bodies, agricultural entities which includes forest practitioners, and the general public on how state statutes and regulations impact agriculture and forest practices in and around wetlands and watercourses. Since state statutes authorize municipalities to adopt regulations governing certain activities in and around wetlands and watercourses this is a key guidance document for all stakeholders.

Invasive Species

Connecticut also has an active program geared towards reducing the impacts of invasive plants already found within the state and also working to prevent new invasions. It is the policy of the Connecticut Department of Energy and Environmental Protection to discourage the planting of species that are non-native and invasive, so that the spread of these aggressive plants can be better controlled. Consistent with this policy, the Division of Forestry is not able to provide funding for the planting of those tree and shrub species which the Department has determined to be non-native, invasive plants. Included on the list of nonnative, invasive tree species compiled by CT DEEP are the following:

Figure 48: CT Invasive Tree Species

Scientific Name	Common Name
<i>Acer ginnala</i>	Amur maple
<i>Acer platanoides</i>	Norway maple (including varieties)
<i>Acer pseudoplatanus</i>	Sycamore maple
<i>Ailanthus altissima</i>	Tree-of-heaven
<i>Frangula alnus</i>	European buckthorn
<i>Paulownia tomentosa</i>	Princess tree / empress tree
<i>Populus alba</i>	White poplar
<i>Rhamnus cathartica</i>	Buckthorn
<i>Robinia pseudoacacia</i>	Black locust

In addition, there are several commonly planted shrubs on the invasive species list. Among the shrubs listed are Japanese barberry and several of the honeysuckles. A complete copy of this list is found in Appendix 10.

Biomass Harvesting Guidelines

In the past few years, several biomass plant proposals were introduced within Connecticut communities following a 2003 Connecticut renewable energy bill. Reacting to the influx of proposals, the CT DEEP Division of Forestry drafted a proposal to develop State specific Biomass Harvesting Guidelines, but was unable to obtain state funding for this project. The urgency to pursue guidelines has subsided due to various factors including a delay in permit follow-through for several of the biomass plants proposed for Connecticut. Currently, the Forest Guild Northeast Region Program is working with the University of Maine and other stakeholders to establish a model set of state-based guidelines for forest biomass harvesting. Based on the outcome and evaluation of applicability to CT forest types Connecticut may utilize that data.

DEEP Municipal Inland Wetland Commissioners Training Program

Each year the Wetlands Management Section of the Connecticut DEEP provides extensive training, regulatory, and technical assistance to Connecticut's Municipal Inland Wetlands Agencies. Beginning in the mid 1990's the Division of Forestry has participated in this annual training with the purpose of educating municipal employees whose regulatory responsibility may expose them to forest practices. The level of training ranges from a one hour presentation on land use history, basic forest practices and an explanation of the Forest Practices Act, the law that governs forest practitioners, to an all-day field training on an active logging operation. www.ct.gov/dep/cwp/view.asp?a=2720&q=449872&depNav_GID=1907.

Wildland Fire Fighting

In relation to wildland firefighting activities, the National Wildfire Coordinating Group (NWCG) is the body that develops standards for training, equipment and experience for national response. Connecticut fire staff annually train DEEP employees in wildland fire suppression and tactics that are used both locally and nationally.

The DEEP Division of Forestry Fire Program (housed in the Forest Protection Program) has a written Standard Operating Procedures (SOP) document that provides policy on all aspects of programming, suppression, training, safety, air operations, prescribed burning, National Incident Management System (NIMS) compliance, incident management, etc. It is the goal to provide a document that maintains high standards but allows for flexibility for fire managers when appropriate. As is true for most states, full compliance with National Standards within the National Wildfire Coordinating Group (NWCG) is not fully attainable or desirable. Fire activities within Connecticut receive direction and standards through the Fire SOP. Any resources responding to a National mobilization are fully NWCG compliant.

Timber Harvest Notification Form

While not an official Connecticut DEEP form or endorsed by the DEEP, there is a relatively new voluntary "Notification of Timber Harvest Form" that forest landowners or their agents who are planning a commercial timber harvest can submit to their town's Inland Wetlands Commission. This form, which is hoped will be widely adopted for use by towns across Connecticut, was developed over many months by an Ad-Hoc Subcommittee of the State Forest Practices Advisory Board. It is hoped that this form will be widely accepted as the standard document municipalities rely on in reviewing proposed commercial forest practices activities. It does not replace nor contradict the guidance given in the authoritative CT DEEP brochure "Agriculture, Forestry and Wetlands Protection in Connecticut. For a copy of the form, please go to www.timproct.org.

18.6. State forest advisory committees

The Forest Practices Advisory Board

The Forest Practices Advisory Board was established by State Statute (Connecticut General Statutes 23-65g) in 1991. The board consists of the State Forester or his designee and nine public members. The Board is charged with three primary duties:

- To periodically review applicable regulations concerning forest practices and the certification of forest practitioners and, as needed, issue recommendations to the Commissioner of Environmental Protection for changes to such regulations;
- To periodically review the programs and policies of the department regarding forests, forest health and forest practices and issue recommendations to the commissioner for changes, as needed, to such programs and policies; and
- To provide advice and guidance to the commissioner regarding the certification of technically proficient forest practitioners and the revocation or suspension of such certifications.

State Forest Stewardship Committee

The Connecticut Statewide Forest Stewardship Committee provides advice and guidance to the State Forester's office to administer the Forest Stewardship Program and the Forest Legacy Program. The Statewide Forest Stewardship Committee is comprised of individuals, organizational and agency representatives (government, NGO and private) and other stakeholders who have an interest in private lands forest management and public assistance for private forest landowners to accomplish forest stewardship planning.

Rural Fire Council

The Connecticut Rural Fire council was organized in 2003 with four basic objectives:

- Identify Rural Fire Issues
- Look at and review DEEP Forestry/Fire programs and determine if those programs mesh with identified rural issues.
- Make suggestions on Fire program changes
- Provide for a more organized and direct conduit from the Fire program to the Fire Chiefs

The Council is made up of representatives of the County Chiefs Organizations and generally meets twice per year. The Council is active, interested in their function and have been very influential in their work. DEEP Fire programs are better and more responsive to the needs of the fire departments because of it.

The Connecticut Urban Forest Council

The Connecticut Urban Forest Council Inc. (CUFC), is a statewide organization composed of representatives from Connecticut environmental organizations, state agencies, universities, research institutions, corporations, professional communities and citizen tree groups. Its purpose is to provide advice, assistance, education, information and support to urban and community forestry professionals, associated professionals, municipal, state and corporate leaders, and volunteers.

The Council Seeks To:

- Increase the number and quality of urban and community forestry programs in Connecticut towns and cities.
- Inform community decisions makers, legislators, and the public about the essential benefits derived from urban and community forestry.

- Provide continuing education and make educational resources available to arborists, tree wardens, foresters, community tree volunteers, public work employees and others practicing urban and community forestry in Connecticut.
- Develop policies designed to promote progressive and appropriate urban and community forestry programs and practices throughout the state. (CUFC)

Connecticut Forestlands Council

In existence since 2004, the Connecticut Forestlands Council was formed to oversee implementation of the Connecticut Statewide Forest Resource Plan. The Council is comprised of 11 individuals and representatives from various forest stakeholder organizations focused around eight forest topic areas with associated committees. The Council is currently undergoing an organizational transformation to encourage more membership, and to refocus efforts.

Tree Wardens Association

The Tree Warden's Association of Connecticut, Inc. is a nonprofit organization dedicated to educating tree wardens and others about tree wardens roles and responsibilities (in the proper care and control of ornamental trees, shade trees, and shrubs for the purpose of assuring their continued preservation and natural beauty) through education and advocacy.

(www.cttreewardens.org)

Connecticut Tree Protective Association

CTPA is an educational association dedicated to advancing the care of Connecticut's trees. Currently, there are over 780 members, of whom approximately three-quarters are licensed arborists. About two-thirds of the licensed arborists in Connecticut are CTPA members.

(www.ctpa.org)

The Connecticut Professional Timber Producers Association, Incorporated

The Connecticut Professional Timber Producers Association, Inc., (TIMPRO), is a 501 c (6) non-profit trade organization representing the forest products industry in Connecticut. The Association represents all aspects of the forest products industry, including timber harvesters, truckers, foresters, sawmills, and associated businesses. TIMPRO's mission is to enhance the image and understanding of the forest products profession throughout the State of Connecticut through public outreach programs, education and a commitment to professionalism amongst its membership. (www.timproct.org)

The Connecticut Forest & Park Association

Formed in 1895, The Connecticut Forest & Park Association (CFPA) protects forests, parks, walking trails and open spaces for future generations by connecting people to the land. CFPA directly involves individuals and families, educators, community leaders and volunteers to enhance and defend Connecticut's rich natural heritage. CFPA is a private, non-profit organization that relies on members and supporters to carry out its mission.

(www.ctwoodlands.org)

OTHER IMPORTANT PARTNERS

The Yale School of Forestry & Environmental Studies and the Global Institute of Sustainable Forestry

Since its founding in 1901, the Yale School of Forestry & Environmental Studies has served as a locus for research into local, regional and global environmental issues, and has been in the forefront of developing a science-based approach to forest management, and in training leaders world-wide. The Global Institute of Sustainable Forestry established in 2000 continues this tradition. Its mission is to integrate, strengthen and direct the School's forestry research, education and outreach to address the challenges of sustaining forests in the 21st century and a globalized world. (environment.yale.edu)

The University of Connecticut (UConn), College of Agriculture and Natural Resources (CANR)

Established as the Storrs Agricultural School in 1881, the College of Agriculture and Natural Resources has been an important part of UConn since its inception. As the state's land-grant institution, it fulfills the land grant mission of teaching, developing new knowledge through research and delivering that knowledge to Connecticut citizens through formal and informal outreach and service programs. UConn contains several departments and units that play a large role in forestland topics including the Cooperative Extension System (CES), the Department of Natural Resources and the Environment, and the Center for Land Use and Education. (www.cag.uconn.edu/CANR/index.html)

Connecticut Agricultural Experiment Station (CAES)

The Experiment Station, founded in 1875 as the first agricultural experiment station in the country, is chartered by the State's General Assembly as an independent agency governed by a board of control. Station staffers are state employees. They are not part of the Connecticut Department of Agriculture, Connecticut Department of Energy and Environmental Protection, or the University of Connecticut, but they work with all three institutions, and the Cooperative Extension Service located at UConn. Station scientists make inquiries and conduct experiments regarding plant and their pests, insects, soil and water quality, food safety, and perform analyses for other State agencies (CAES).

Since 1993, the Connecticut Agricultural Experiment Station has implemented the State's Cooperative Forest Health Program. The Experiment Station is the plant pest regulatory agency for Connecticut. The Forest Health Program provides states with federal funds to detect, monitor, and evaluate forest health conditions on state and private lands. The funding enables states to collect forest health data in a standardized manner so it is compatible with other states for regional reporting. Additional support is provided by McIntire-Stennis forestry funds. The Experiment Station is in a unique position that combines forest research, pest survey, outreach, and regulatory response in one agency (CAES).

Conclusion: Forest-related planning in Connecticut began approximately 100 years ago. In that time, strong partnerships have formed between universities, non-profits and other state and federal agencies. It is through these partnerships that Connecticut has developed firm policy and regulations covering much of traditional and urban forestry programs working to protect the

resources of the state. Periodic assessments help to guide policy and will be critical as forest fragmentation continues to occur. There are opportunities to strengthen environmental regulations to better protect the resources that are crucial to healthy forest development.

Summary: Connecticut has a long history of forest planning. Policies and regulations that have evolved over the past hundred years provide a solid foundation for the traditional and urban forestry programs in the state. Partnerships between entities are strong, and there are many active and well respected forest associated organizations within the state.

SECTION 2. Identified Connecticut Forest Issues

Introduction to Connecticut's Forest Issues

The following issues were originally derived from stakeholder input during the planning and research phases of the 2004-2013 Connecticut Statewide Forest Resource Plan (CTFRP). A series of ten focus groups were held targeting different stakeholder groups to define issues and create action steps to combat those issues. The results were used in development of the CTFRP, and have been a guiding force during the implementation of the CTFRP. To fulfill this Statewide Forest Action Plan requirement, the original issues were put out to a targeted group of stakeholders to reaffirm that the issues were still relevant today. The results are as listed on the following page.

Issue 1. Maintaining Forest Ecosystem Health and Biodiversity⁶

A healthy and diverse forest resource will be able to provide a sustainable balance of benefits and services to residents of the state. In order to do so, forests must be sufficiently extensive, in a healthy and productive condition, and forest cover must be present in key locations, such as riparian zones and on steep slopes. Information provided in Criterion 1 indicates that despite the fairly high percentage age of forest cover recognized in Connecticut, the continuity, distribution and condition of the forest resource across the state is variable.

A. BIOTIC AND ABIOTIC CONCERNS

a. Invasive species (both native and exotic)

“Non-native invasive species pose a serious risk to North American forest ecosystems, threatening to change existing ecological trajectories, suppress rare and endangered native species, reduce productivity and biodiversity and damage wildlife habitat.” Chornesky et al 2005

⁶ Portions of this write up were taken directly from “Biological Integrity Issues in Connecticut’s Upland Forest” by Emery Gluck. The Habitat Newsletter, March 2010. Connecticut Association of Conservation and Inland Wetlands Commission, Inc. Other portions are from Kirby Stafford’s “Forest Health Program Integration” write up.

Connecticut has experienced many forest health problems in the last century. Chestnut blight, Dutch elm disease, gypsy moth, red pine scale, and butternut canker have all affected the structure and composition of Connecticut's forests. For example, chestnut accounted for 25% of Connecticut's growing stock before chestnut blight arrived. Now it forms only an understory shrub layer that is periodically killed back. (The Connecticut Agricultural Experiment Station is a leader in research to develop blight-resistant chestnut trees and reintroduce them to Connecticut's forests.)

Several exotic insects have had a recent effect on Connecticut's forests, or pose an imminent threat. One example is the hemlock woolly adelgid (HWA), a pest of Japanese origin that first appeared in Connecticut in 1985, and has since spread over the state. It has killed a large number of hemlocks, particularly in dense stands in the southern part of the state. Hemlock is an important conifer in the state. Remaining hemlock may survive as the initial infestation wave has passed and certain control mechanisms are at work within the environment. The adelgid causes branch tip dieback and tree mortality, often in combination with elongate hemlock scale (EHS) (another exotic species) and hemlock looper (a native defoliator). Alternatives for managing the adelgid, particularly in forests, are limited. The Connecticut Agricultural Experiment Station (CAES) and the USFS have been researching systemic insecticides and have released the adelgid predator *Sasajiscymnus tsugae*. There were over 176,000 *S. tsugae* released between 1995-2007 in Connecticut at 26 field release sites in state and private forests and parks. Hemlocks affected by HWA have shown recovery where the beetles have been released. Severe winters in 2014 and 2015 have also dramatically reduced overwintering HWA populations in all parts of the state. An Experiment Stations survey of northwestern Litchfield County in 2003-2004 revealed that 79% of hemlocks were either not infested or only lightly infested with EHS. Since then, there has been a buildup to extremely high density single pest infestations of EHS which have resulted in rapid tree decline from chlorosis, heavy needle loss and thin crowns. There are no current solutions to the scale problems in the forest by the Experiment Stations is investigating the potential of rearing and augmenting the native scale predator, the twice-stabbed ladybeetle, *Chilocorus stigma*.

Several other potential threats, such as Asian longhorned beetle (ALB) while not yet documented on forest trees in the state, have the potential to devastate oaks and other hardwoods if they become established. ALB, *Anoplophora glabripennis*, was first discovered in Brooklyn, NY in 1996, before spreading to other areas. It was also found in Worcester, MA. The USDA's Animal and Plant Health Inspection Service (USDA-APHIS), working with local and state partners, has quarantined infested areas in the Worcester area, and is attempting to eradicate the beetle by cutting and chipping infested and nearby maple and other host trees. The infestation is estimated to be 12-15 years old when detected, and to date, the quarantine area encompasses 110 square miles with over 24,395 infested trees found and a total of just over 35,027 trees removed (these statistics do not include host trees removed through acreage cuts within the regulated area). The risk of this beetle being in or introduced to Connecticut is considered high.

Another Asian insect, the Emerald Ash Borer (EAB), *Agrilus planipennis*, was detected in Connecticut in 2012 and will result in the death of most of Connecticut's ash trees. This beetle was first detected in southwestern Michigan in 2002 and has spread to New York and New England and as far south as Louisiana and Georgia. EAB has killed tens of millions of ash trees

in southeastern Michigan alone, with many tens of millions more lost in the other affected states and the provinces of Ontario and Quebec. The treatment to protect select ash trees or the removal of dead and dying trees by private homeowners, municipalities, and other entities will entail considerable expense. CAES is working in cooperation with the USDA-APHIS on the release of several EAB parasitoids.

Other organisms such as ALB and *P. ramorum* (which were mentioned in Criterion 3 will also have serious effects on Connecticut's forests if they became established, and the potential consequences to the forest products industry, nursery industry, tourism, and environmental quality are dramatic. At the current time, federal and state quarantine and eradication of ALB or *P. ramorum* is planned if they are detected in the state.

In addition to these forest pests, numerous exotic invasive plants have gained a well-established foothold and threaten to become pervasive in much of the forest. Many are characterized by "hypercompetitive behavior" that includes earlier leaf out than native competitors, the ability to re-sprout vigorously and production of large amounts of seeds spread by wind, birds and deer. Non-native invasive plants that can be ecologically disruptive in Connecticut's forest include winged euonymus (burning bush), tree-of-heaven, Japanese barberry, and Oriental bittersweet. In addition to the effect these species can have on forest condition and composition, some of these species present human health concerns. Tree-of-heaven has been documented to cause heart attack-like symptoms if a person's skin is exposed to an excessive amount of the plant's sap. The incidence of black-legged ticks, a major vector for Lyme disease, is greater in dense patches of Japanese barberry. The thickets provide an ideal refuge for the tick-carrying white-footed mouse. Bittersweet vines aggressively climb trees and monopolize forest understories. The vines can bend and break supple trees, while extensive mats in the understory smother tree seedlings and other native understory vegetation.

The foothold invasive plants have gained may turn into a stranglehold without considerable intervention. Complete control of exotic invasive plants is unlikely without a monumental statewide effort at an exorbitant financial cost. Herbicides provide the most definitive control but their use must be carefully monitored. Uprooting smaller invasives is possible but unlikely to cover extensive areas. The repeated cutting or burning immediately after leaf out can kill a significant proportion of some invasives if done in the same growing season.

b. Deer browse

In addition to aiding the spread of invasive plants by depositing their seeds throughout the forest, an abundance of deer can alter the composition of the forest. They have been known to browse the native understory plants so much that the reduction in native competition provides an opening for invasive plants to germinate, become established and thrive. Preferences of deer among native species can reduce native biodiversity even further. Deer often browse heavily on oak seedlings but avoid other native species such as black birch, which contains a chemical component disliked by deer. Nearly 100 threatened or endangered species are browsed by white-tailed deer. Where deer have been fenced out, the understory is often found to be lush with native plants.

Deer populations were historically controlled by predators. They were almost extirpated with the loss of mature forests and unrestricted hunting in the late 1800's. Citizens reported only 12 deer in Connecticut in 1893. With increased suburbanization creating significant edge habitat ideal for deer, maturing oak forests, and a decline in hunting, the deer population has grown exponentially. Their population is currently estimated at 65,000. (See Criterion 3 for more details). Significantly expanding responsible hunting and minimizing the conversion of forests to residential subdivisions could help stabilize an excessive deer population and revitalize the plants favored by deer.

c. Native insects and diseases

In a healthy, productive forest native insects and disease factors are usually present but are held in check and balance by other natural factors. When the forest is stressed by external factors, non-native components, overstocking or some other problem, native pests can get out of balance and impact forest composition and diversity. For example, in overstocked oak stands, particularly where shorter-lived oaks such as black oak and scarlet oak are reaching the end of their life-span, *Armillaria* (shoestring) fungus can cause the death of many trees. *Armillaria* is always present in the soil, and healthy trees can usually resist the fungus, but trees stressed by overstocking and competition can lose their resistance. There are many native tree diseases that can become problematic when trees and stands are under stress. Common tree diseases that affect the health, form and survivability of forest trees can often be controlled through proper management techniques that reduce stress and provide competitive advantage to desired trees.

Native insect pests have a similar type of impact, normally held in balance but becoming problematic when conditions are less than ideal for the trees in question. An example is white pine weevil. It kills the terminal leader on young white pine trees growing in full sunlight, causing tree deformation. Growing young white pines in partial shade with gradual release can reduce white pine weevil damage dramatically.

d. Age diversity

As described in Criterion 1, the forest resource in Connecticut is predominantly composed of sawtimber-size trees. Tree size is not necessarily a good indicator of stand age, but most Connecticut forest stands originated either from abandoned agricultural land during the last century or longer, or as the result of clearing for charcoal production during the late 1800s and early 1900s. Thus stand ages of 80 to 130 years are reflected quite closely in the sawtimber component of the forests in Connecticut. The high percentage of forest stands in maturing age classes is accompanied by a corresponding lack of balance of other stand age groups. Young seedling and sapling stands must be present in the landscape to develop into pole-sized, middle-aged stands, which in turn must be present on the landscape in sufficient quantity to develop into future maturing stands. Each age-class grouping supports its own unique mix of associated wildlife and herbaceous components, and delivers a unique balance of benefits and services within the environment. The key to biological diversity and forest health is a diversity and balance of age structure in the forest resource across the landscape.

e. Species diversity/composition and the role of disturbance

Some upland forest ecosystems can sustain themselves after disturbances such as fire, hurricanes and tornadoes. Such disturbances create temporary open environments where sun-dependent

plants perpetuate themselves, and their offspring are able to outgrow competing shade tolerant species. Native Americans frequently burned extensive areas of the forest to create an environment that attracted game animals, increased berry production, and enhanced numerous other benefits necessary for survival. Pre-settlement forests populated by Natives experienced low-intensity fires with much greater frequency than today's forests. Fires that sustained oak and pitch pine ecosystems for thousands of years are now controlled and extinguished as houses interface with the forest ecosystem to fill the woods. As mentioned above, today's maturing oak forest originated after extensive clearcuts, fires, chestnut blight and farm abandonment from over a century ago. The prolonged absence of similar events, in combination with excessive deer browse, is facilitating the slow transformation of much of Connecticut's oak forest into shade tolerant birch, beech and maple forests. Oak seedlings are found in the understory of an intact forest after an acorn crop but most die out, except on ridge-tops and droughty soils, within a few years due to inadequate sunlight. Survivors are severely hindered by overtopping competitors. The ability of a new generation of oak to graduate to the forest canopy is severely limited under the current conditions in much of Connecticut's forests.

The potential future displacement of oaks has enormous ecological consequences. Approximately 50 animal species depend upon acorns for their primary source of protein. Oak forests host more species and a higher abundance of birds than maple forests. Oaks cumulatively host over 500 species of Lepidoptera, an important food source for birds. Oaks also sequester more carbon than maple trees. While it is predicted that a warming climate will favor oak types over other species mixes, it is evident that oak forests are not sustaining themselves in southern climates similar to that which Connecticut is predicted to have in the future. It seems unlikely that a warmer and wet climate, by itself, would revive oak ecosystems here.

Pitch pine sand plain ecosystems have also been sustained by fire as well as abandoned plowed farmland. Pitch pine-scrub oak barrens have been identified as one of the thirteen most imperiled ecosystems in Connecticut. They have the potential to support a number of rare species, including the Karner blue butterfly (*Lycaeides melissa samuelis*), barrens buckmoth (*Hemileuca maia*), and sand-plain Gerardia (*Agalinis acuta*). Connecticut has lost an estimated 95% of its pitch pine sand plains to gravel pits and development. The remnant is succumbing to trees such as white pine, which are shading out the pitch pine. The absence of severe fire or other disturbances have led to the dearth of pitch pine seedlings and scrub oak. The detection of the southern pine beetle (*Dendroctonus frontalis*) in Connecticut in the spring of 2015 is of grave concern and a threat to Connecticut's pitch pines

Severe fire and other disturbances historically sustained a small part of the landscape in young forest habitat. Very young forests provide requisite dense shrubby habitat for 22 bird species and four mammal species in New England, including numerous declining species such as blue-winged warbler, chestnut-sided warbler, New England cottontail and bobcat. The unique assemblage of dense cover, herbaceous vegetation, and associated insects is short-lived as the habitat structure changes as the forest ages. Forests as young as eight years of age have already lost habitat value for some species. A frequent occurrence of relatively small but severe disturbances is necessary to sustain populations of animals dependent upon such habitat. The majority of the forest landscape should be made up of sawtimber-dominated forests in order to provide habitat for the bulk of the wildlife species, though perhaps not in the proportion currently

existing in Connecticut. Several species that utilize sawtimber forest for their primary habitat, such as the black and white warbler, also use young forest habitat.

The maintenance of disturbance-dependent ecosystems is a challenge in a mostly suburban state. Many residents are used to the forest resource they have seen around them for years, and are reluctant to see it changed or disturbed, particularly if they do not understand the value of that disturbance. Controlled burns can be an effective tool but there is very limited opportunity to implement them and they pose an element of risk. Mechanical grinders or masticators can create young forest habitat by grinding up a stand whose trees that are approaching 7" in diameter, though the immediate visual impact can be an issue, especially on private land. Mechanical treatments can mimic historic disturbances such as fire to a certain extent, but they are unlikely to capture the full ecological value of a natural disturbance.

Silvicultural systems that mimic natural disturbance, properly planned, implemented and managed, can accomplish young-forest habitat objectives and age structure diversity goals. Raw material for forest products extracted in the process can pay for or defray the expense of such treatments. The services of a Connecticut-Certified Forester are required for silvicultural prescriptions and recommendations.

f. Natural disturbance/extreme weather

As mentioned in the previous section, many forest resource and habitat management activities are designed to mimic natural disturbances, in order to take advantage of the characteristics and adaptations with which native species have evolved. It is worthwhile noting, however, that natural disturbances will still occur, including ice storms, fire, hurricanes, etc. While there may be habitat and forest diversity advantages to mimicking certain natural disturbances, there are some disturbances that do not need to be replicated on the landscape artificially, like large storm events, as they can be expected to occur anyway according to their natural cycle. The challenge for some types of natural disturbances is not in how or whether they occur, but rather the nature of human response. Certainly a degree of response is called for in many cases where storm or other disturbances damage trees, and perhaps create potential property damage or human health risk. On the other hand, not every natural disturbance requires a management response. There are times when the value of blown-down trees as coarse woody debris for wildlife habitat may outweigh their commercial value as forest products, or a natural low-intensity ground fire, when not otherwise risking private property damage, may be allowed to burn a small area. The forest resource in Connecticut has demonstrated numerous times to be resilient and vigorously responsive to disturbances both human-caused and natural, and as long as a disturbance is not one that converts the forest to some other land-use, then functions, benefits and services can be expected to continue from the forest ecosystem.

g. Erosion

Natural soil erosion is virtually non-existent on intact forest land. Soil movement in forested settings is generally the result of an activity that disturbs the organic layer of the forest floor on a slope, such as trail-building or log-skidding. Soil movement from exposed areas becomes a serious issue when mineral soil impacts streams and wetlands as sediment. Compared to non-forest land uses, erosion resulting from forest uses is minimal, most examples of this are related to illegal access or overuse?

B. SOCIAL AND LANDSCAPE-USE CONCERNS

a. Increasing forest fragmentation

Criterion 1 provides a synopsis of the parcelized and fragmented nature of the forest resource in Connecticut, resulting from patterns of land conversion and development. As development starts to devour a continuous forest, only fragments of forest cover remain. Fragmentation results in more edge, more perforations in the canopy, more disruption of forest floor structure and less contiguous or “core” forest area. These landscape changes affect forest health, biodiversity, forest benefits and services in a variety of ways.

Edge habitat occurring at the forest/development interface is inhospitable to many species of wildlife. The edge habitat is well suited for skunks, raccoons, dogs, cats and other animals that prey upon the eggs of ground nesting birds. Also, brown-headed cow birds, a brood parasite that lay their eggs in other birds’ nests, are more prevalent the closer to the edge. Brood parasitism and nest predation lead to the inability of smaller fragmented forests to sustain many interior bird species. Additionally, non-native invasive plants are usually more abundant in edge areas of fragmented forests. Generally, habitat quality declines as the size of the forest decreases.

b. Loss of connectivity between unfragmented forests

The processes that drive parcelization and fragmentation, as described in Criterion 1, also result in physically separating forested areas from each other, inhibiting natural processes, interrupting wildlife travel, and causing aesthetic discontinuity.

c. Landowner demographics, objectives, and perceptions

As described later in Issue 3, there are many factors influencing the decisions landowners make about the current and future status of their land. Proactive forest stewardship is complex and demanding and often involves knowledge, skills and information that landowners may not always possess. Landowner motivations and satisfactions may not always correspond with landscape-scale public biodiversity goals. While most landowners consider themselves good stewards and wish to have a healthy, productive forest, management decisions may be recreationally, aesthetically or economically driven as priorities over biodiversity. The transfer of land ownership contributes to problems associated with parcelization and fragmentation. Public forest benefits and services can be considered at risk in many ways due to the fact that most of the forest resource is in private hands and can be sold at any time.

d. Insufficient scientific knowledge regarding the suite of flora and fauna in the state

The quality of information regarding the distribution, abundance, and condition of species in Connecticut varies greatly. It is more difficult to make appropriate management decisions, and determine key habitats for protection without sufficient knowledge.

Issue 2. Promoting Stewardship of Public Forests

A. PROMOTING THE IMPORTANCE OF PUBLIC FORESTS

The Connecticut Department of Energy and Environmental Protection owns and manages over 251,000 acres of public land, the vast majority being forested. The State Forest system is the largest component at about 170,000 acres. The State Parks, State Park Scenic Reserves and Natural Area Preserves total about 36,000 acres. Wildlife Management Areas and Sanctuaries total the rest. All except the Wildlife Sanctuaries are open to the public.

In addition, thousands of acres of forestland across the state, in hundreds of separate parcels, are owned by towns, cities and publicly-owned potable water providers. These parcels may be identified as reserves, preserves, parks, subdivision open-space set-asides, town forests or some other category. They may be held solely by the town or jointly with some other entity, but all have some characteristics in common in that they are held for the benefit of the citizens of the community, they contribute to the character of the community, and quality of life there. Many of these parcels are open to the public and may be used regularly for recreational purposes.

Together, these publically owned lands provide important benefits to all citizens of Connecticut. These benefits come in the form of ecosystem services, social values, and educational opportunities.

a. Ecosystem services

According to the USFS, ecosystem services (ES) are defined as “goods and services that flow from ecological processes that have immediate or long-term benefit to human society. Ecosystem goods are generally tangible, material products that result from ecosystem processes, whereas ecosystem services are usually improvements in the condition of things of value. This distinction is useful as many ecosystem goods include traditional commodities, such as timber, are easily valued through current markets, while services such as the provision of clean water or biological diversity are not” (ES 6). In addition to providing a variety of ecosystem services, such as clean air and water, wildlife habitat and carbon sequestration, public forests can also be professionally managed to enhance these benefits.

b. Social values

Public forests provide a large range of social values to the residents of the state. Many use public forestland for some type of recreation (*e.g.* hunting, fishing, hiking, camping, hiking, biking, bird watching), some of which have a substantial economic effect, such as sales of gear and supplies. Public forests often provide the large scenic areas for the enjoyment of all. The commercial products harvested from Connecticut’s forests, including timber, firewood and maple syrup have an important economic effect. The production of sawlogs and veneer for mills in the Northeast and for export, provide a significant number of jobs in the forest products industry.

c. Outreach and education

The State Forests serve as demonstration areas to educate private landowners in forest management. A few towns in Connecticut have followed similar methods, conducting timber

harvests, and providing educational opportunities through interpretive trails, signage, and outdoor classrooms.

B. PUBLIC LAND MANAGEMENT CHALLENGES

Management challenges facing public lands, either municipal or state owned are similar. Many town-owned woodlands face similar problems as state and private lands at the interface of forest land use and residential land-use. Unwanted motorized vehicle access, dumping, invasive species infestations and boundary encroachment are common. Most town governments are ill equipped to manage these problems, and often the resources needed on a large scale for state owned lands is not available. While such forest lands are valuable assets for a town, few public resources are devoted to their stewardship and maintenance. Unlike long-term woodland owners who know their land, have an attachment to it and know how they enjoy it, local governments lack long-term continuity due to changes of board and commission members, elected officials, or others who may have authority over forested parcels. Although local governments find it difficult to keep up with maintenance, and struggle with the protection problem, it is even more challenging for them to engage in any kind of pro-active management of forest properties to enhance or optimize benefits.

a. Personnel limitations

The number of foresters managing State Forests has been reduced in recent years. A significant amount of State Forest land is unmanaged due to lack of personnel. Many of the State Forests do not have current forest management plans which also limits what active management is done in these forests.

In addition, few communities have the luxury to devote public funds or personnel time to managing “open space” unless an immediate public benefit can be identified and associated with the expenditure. Managing the town forest isn’t “anyone’s job.”

b. Constituency support

Although there are constituents out there, the constituent base for promoting forestry and the programs administered by the DEEP Division of Forestry needs to be strengthened. In order to accomplish proactive stewardship on community owned land a local group of interested residents must promote the idea within the community and to elected officials. While some good examples exist of “Friends of the Town Forest” type volunteer support groups, most town-owned woodlands do not have volunteer stewards, local support groups or vocal advocates for their management.

c. Lack of direction in developing local vision for local public forests

The stewardship of any forest land is a long-term commitment. There is a complex process that involves a balance of environmental, social, economic and legal factors that are often daunting and confusing even to interested residents who may have some background in such matters. Developing goals, visions and management objectives requires guidance and knowledge of options that may not be immediately available within a community. While strong interest may exist on the part of residents to manage town-owned lands, guidance; leadership and technical expertise must be available without requiring a big commitment of local public resources in

order to initiate the process. DEEP service foresters are available for such assistance but their time is limited.

d. Few good examples of towns practicing forest management

It has been demonstrated through projects in other parts of the region that local officials and citizen groups can learn about the stewardship of forest land by means of peer-to-peer education. Whether and where towns are actively managing their forest lands may not be known beyond town boundaries. A mechanism is needed for sharing information and fostering learning between communities and making good examples more visible.

e. Promoting “sufficient” sound forest stewardship

A local public may be interested in permanently protecting forest land and open space within their community. They may have the will and resources to accomplish that goal. Often however, once the land is acquired, a lack of understanding that management practices can enhance virtually any combination of public benefits prevails. It is this lack of understanding that presents a barrier to more active forest management in communities. Advocates for forest management who can clearly communicate positive stewardship outcomes are needed to be readily available to community groups and leaders.

f. Funding shortages for purchase and maintenance of public lands

Continuing state budget difficulties will keep this as a problem at the state level. A local public may be interested in permanently protecting forest land and open space within their community, for all the right reasons, and may have the will but not the resources to accomplish that goal. Local communities can apply for funding to acquire open space in a variety of ways. State matching fund programs often help, but regular, easy-to-use and reliable programs providing such assistance are needed. Local communities and citizens are often involved with these activities only on a part time basis so the process needs to be made easy.

g. Active opposition to management on public forests

In general, this has not been a major problem on State owned lands, due to the diligence of managing foresters or biologists to inform the public of any harvesting or other activities proposed, or ongoing. Regardless of how carefully a management plan for a community forest is prepared, or how many public benefits are being derived, there may always be some opposition to the plan or activity in question. Public input and public vetting will improve the odds of public acceptance, but guidance and assistance should be made available for community members who are involved to management planning or community outreach.

Issue 3. Protecting Private Forestlands: Challenges and Opportunities Facing Private Forest Landowners

a. Availability of technical and financial assistance

Technical and financial assistance for private landowners can be separated into two, categories:

- 1) ongoing management and
- 2) long term disposition and/or permanent protection (from development).

Technical assistance is available from a variety of sources: governmental, private and educational. As described under Criterion 7, the DEEP Private and Municipal Lands program offers, unbiased forestry expertise to private landowners, and cooperates with the USFS Forest Stewardship Program and the Connecticut Tree Farm Program, among others. Programs under the USDA Natural Resources Conservation Service are available to address conservation and management issues. Programs such as the Environmental Quality Incentive Program (EQIP) address specific conservation activities with technical expertise to design management practices and provide cost-share funds for implementation.

Educational programs such as the COVERTS Project, with a focus on wildlife habitat, and the Forest Stewardship Short Course, are hosted by UConn Cooperative Extension along with DEEP, CFPA, and other collaborators. These are available to private woodland owners every year and provide technical background and management training. Private Connecticut Certified Foresters who work as consultants are hired by private landowners for management assistance and/or technical service under NRCS programs.

Among the many challenges associated with providing management assistance is making landowners aware of the services and programs available. With more than 35,000 landowners holding ten or more acres of forestland in Connecticut, traditional advertising will only reach a small segment of this audience. In addition to initial contacts there is a challenge of keeping the landowner audience apprised of changes in programs and details. While good contact information exists for people who have taken advantage of a public program, informing and attracting new participants is a hurdle that needs to be addressed for public assistance programs. The use of modern communications, such as email list serves and social networks are not being fully utilized.

Permanently protecting or conserving private forestland is a complex process involving technical and legal assistance. Many landowners, while wanting to conserve their forest, can be intimidated by the legal complexities and costs involved. Under Criterion 1, several public programs are mentioned that provide funding assistance to landowners. However, funding varies from year to year, while the process of protecting a parcel by purchase or easement can often require several years. Guiding a landowner through such a complex once-in-a-lifetime experience is a task for someone with a rare combination of appropriate legal, technical and social skills. Some statewide organizations (CFPA, The Trust for Public Land.) have staff with the necessary expertise and some local land trusts also conduct creditable landowner guidance in land protection, but such individuals are rare, and an organized system for assisting landowners with land protection guidance does not exist.

b. Intergenerational transfer

Demographic statistics from the US Forest Service for family forest owners in the Northeast indicate that more than 75% of the non-industrial private forest land area and over 80% of owners are over 55 years old. It is logical to conclude that a large portion of the forest in our area will change hands during the next 25 years. Much of this land will transfer to heirs, but a large portion will be placed on the market. It is estimated that over 20% of forest landowners in Southern New England either already plan to sell some or all of their land, or have made no plans at all for its future disposition. Keeping private forestland intact means that families must

be provided with the best information available on options to transfer between generations. For land that comes up for sale, communities must be provided with resources and information to guide conservation decisions.

c. Incentives vs. disincentives

Private forest landowners derive a wide variety of benefits, find many sources of satisfaction and have many reasons for owning woodland. Such reasons range from recreational to family legacy to privacy to investment, and all are valid. The key to protecting the public benefits produced by private forests is enhancing the sources of satisfaction derived by landowners, especially for things like clean water or wildlife habitat or local rural economic enterprise where private and public benefits coincide. Local, state and federal public policy can be used to help landowners keep their woodlands in a healthy productive condition, or conversely, create an atmosphere of undue expense or hardship for landowners. The treatment of income from timber as a capital gain, NRCS cost-share programs, and PA 490 (see Criterion 7, Indicator 18) are all examples of federal and state policies that provide financial incentives on behalf of woodland owners. On the other hand, restrictive local regulations or a social, political and economic culture that favors development over forest conservation can have a disincentive effect for woodland owners, especially when the costs of land ownership are high, compared to income level or degree of personal ownership satisfaction.

d. Expenses vs. revenue sources

It is perhaps unrealistic in Southern New England to expect that forested acreage will “Pay its own way” given the variety of expenses associated with land ownership, versus the limited potential revenue sources available to the typical landowner. Taxes, insurance, and maintenance expenses (roads, trails, fences, gates, fuel, equipment and personal time) can amount to several thousand dollars each year. Occasional needs for survey, contracting work, or legal representation can make forestland ownership cost-prohibitive unless the parcel is also a homesite (for which some degree of such expenses could be anticipated) or unless some periodic revenue from the property can be derived.

Potential revenue sources are limited. Hunting or other sportsman leases are rare and income from them is likely offset by a need for additional liability coverage. Ecosystem service payments such as carbon markets are not yet a reality in our region, and cost-share payments under federal programs are only made after the expense associated with a particular product is undertaken. So virtually the only potential source of income from forests is that produced by the periodic harvest of trees or other material as forest products. Timber markets can be volatile and options for marketing wood limited at times. Harvesting is also a complex and somewhat disruptive transaction, but when managed correctly, conducted as part of a long-term management plan, and considered with the capabilities of the land in mind, forest products revenue can help defray the costs of land ownership dramatically.

Trees from Connecticut forests are highly valued and actively sought by the forest products industry. Many good reasons exist for landowners to consider selling trees (timber) for forest products. Ideally, harvesting is a management tool recommended within the context of a long-term Forest Management Plan prepared by a Certified Forester. Some reasons for timber harvesting:

- Habitat Management: Create or maintain special conditions needed by certain wildlife species.
- Species Composition: Enhance biodiversity with timber harvests to create desirable species mixes.
- Regeneration: Establish and grow new seedlings successfully by creating the optimal conditions.
- Forest Health: Remove potentially hazardous trees that are extensively damaged by insects and diseases.
- Income: Derive periodic or emergency income.
- Recreation: Create forest trails, paths, campsites and views.

e. Legal and regulatory considerations

In Connecticut, most land-use planning and regulation is conducted at the local level, therefore, some forest-based activities such as harvesting may be subject to local regulation. Certainly any activity that may impact inland forested wetlands or watercourses would be subject to local IWWC Agency scrutiny. Local regulations, even those intended to protect the forest from abuse, must carefully consider the degree of impact to landowner benefits and satisfactions to achieve a proper balance of public and private interests.

Forested parcels that are permanently protected by means of conservation easement generally are owned by one party while another holds the development rights, and as such present a stewardship and monitoring challenge for the easement holder. Each party must understand their rights under such arrangements.

Other legal and regulatory issues associated with private forestland ownership include:

- Boundary identification
- Trespass
- Poaching
- Harvesting regulations
- High property taxes

f. Unwanted access

The fragmented nature of the forested landscape in Connecticut, resulting primarily from residential development, creates situations in which a woodland ownership can be bordered by many different neighbors and separate parcels. Issues associated with boundary identification and maintenance and access control are common among landowners, many of whom experience problems associated with encroachment, dumping, all-terrain vehicles and other types of trespass.

Landowners throughout the region are concerned about damage and potential liability from trespass by motorized vehicles and the potential for lawsuits resulting from unauthorized access and use of their property.

Issue 4. Providing for Forest Based Recreational Opportunities

Connecticut is the third smallest state in the union, at 5,009 square miles stretching approximately 90 miles east to west, and 60 miles north to south with elevations ranging from sea level to 2,380 ft. The difference in climate, vegetation, and wildlife, as well as the three major river systems, 6,000 lakes and ponds, and Long Island Sound, has historically provided Connecticut's residents and visitors a wide diversity of recreational opportunities across its varied landscape (SCORP 7, 8).

In regards to available recreational areas, according to the Connecticut Statewide Comprehensive Outdoor Recreation Plan 2005-2010 (SCORP) supply inventory, a total of 328,000 acres of recreational land is designated as such, or 964 acres per 10,000 residents. This recreational land is not distributed uniformly across the state, and varies widely between urban and rural areas, with urban areas having many less acres per residents on average. (SCORP ii)

Connecticut's residents participate in a wide array of outdoor recreational activities. According to the Citizen Demand Survey created to gather information for the SCORP, the top ten activities in descending order of individual recreational activities are: walking/running/hiking, beach activities, visiting historic sites or museums, swimming in freshwater or saltwater, swimming in pools, biking, bird and wildlife watching, sledding, camping, and canoeing/kayaking/tubing (SCORP iv). As evidenced by the information, many of these activities utilize the natural resources of the state as the backdrop to their recreational pursuits.

"Outdoor recreational activities provide a range of benefits both to participating individuals and to the community. These benefits include physical, educational, psychological, community, and economic" (SCORP 1). The link between maintaining and protecting forestland and recreational activities is clear.

There are several limiting factors when considering for the provision of forest-based recreational activities, both in terms of recreation on public lands and private lands, the most limiting being availability.

a. Availability

"Currently, the State of Connecticut and its 169 municipalities are the dominant providers of outdoor recreational opportunities in Connecticut, with non-profit organizations, commercial entities, and the federal government playing important but lesser roles. The DEEP owns 66% of recreational areas, municipalities own 17%, and other entities own 17%. The DEEP provides major shares of the natural resource based supply of recreation, including 70.5% of hunting activity and 25-33% of boating access, camping, fishing, and winter sports facilities" (SCORP iii).

Unfortunately, "Connecticut's state park and forest system, as well as municipal open spaces, are experiencing greater use by the public as neighboring open spaces diminish. Open spaces such as state parks and forest are increasingly becoming islands of undeveloped land amongst subdivisions, whereas twenty years ago they were part of a fabric of contiguous open space.

State parks in urban areas often represent the only significant publically available open space in their regions” (SCORP 11).

This increasing dependency on publically owned lands being the primary and sometimes the sole provider puts an added pressure both environmentally, and economically on the organizations and agencies that care for these lands. This results in multiple use concerns, as more users compete for a smaller land base. Local land trusts, and other non-profits are often significant land holders, but may not allow recreational access open to the public.

There are multiple reasons why the availability of recreational activities may be diminishing on private lands. Many landowners might support the idea of recreational opportunities on their land, but are concerned with the potential for liability issues associated with allowing recreation on their land. Although there is a strong Recreational Use law that has provided liability protection for landowners since 1971, these perceptions linger. Other landowners may be concerned with the responsibilities of ongoing maintenance or the threat of illegal access by rogue users who do not respect the property. Having a solid partnership with an organization that provides maintenance and a physical presence is often critical to ease these concerns.

b. Lack of awareness of available resources

The Citizen Demand Survey compiled for the SCORP document found that “lack of knowledge regarding what is being offered and what is available at individual sites as the primary reasons residents do not take advantage of existing outdoor recreational facilities in Connecticut” (SCORP 159). Approximately 36.3% of respondents stated that they were unaware of activities that were taking place. The second highest ranking reason, at 27.3%, for lack of utilization was the public’s lack of knowledge on the locations of recreational facilities’. In an effort to raise public awareness to events and locations to visit, the commissioner has started the No Child Left Inside® campaign. This effort is in its fifth year of getting families back into the state parks and forests.

In addition, the DEEP’s website has been updated to include more detailed maps of forests and parks (see <http://www.ct.gov/deep/parkmaps>). DEEP is also supporting the Connecticut Forest & Park Association’s “WALKCT” initiative which promotes recreation on both state and private property (see www.walkct.org).

c. Funding and staffing

Another highly visible concern revolves around the availability of adequate funding and staffing for recreational facilities. According to 2004 data, Connecticut allocated 0.09% of its budget for operations of its state parks compared to an average of 0.20% by the other five New England states, and ranks 46th nationally (SCORP x). In tough economic times, this situation will continue to decline. Lower levels of funding and staffing contribute to less maintenance and services provided at facilities.

“In the Citizen Demand Survey, when asked to identify the factors which keep them from using state and local parks, or which prevent them from using these facilities more often, 15.5% of respondents stated that facilities are not well maintained” (SCORP VI). When asked what their top three actions could be to improve the supply and condition of recreational properties and

facilities, 59% stated that improving and maintaining existing outdoor facilities as on the of their top three actions” (SCORP).

A potential opportunity associated with this is the dedicated use of user/registration/permit fees to be returned to associated recreational facilities. In addition, part of the process for determining policies and budgets, and to better understand the needs of the public, there should be a continuing effort to engage recreational organizations for input.

d. Access

On state owned lands, one of the most apparent concerns brought forth by this increased pressure is the need for additional parking and road access. This need is for all types of parking, whether it is space for additional cars due to the increased usage, or increased parking access during the winter season, or parking for larger vehicles such as horse or snowmobile trailers. Access is not just a concern for users, as there are concerns regarding emergency medical and firefighting access. In addition, the Americans with Disabilities Act of 1990 has Universal Access requirements for outdoor recreational facilities that need to be addressed for newly constructed or altered public or commercial facilities, trails, picnic and camping facilities (ACCESS). Access to public land has been degraded by unauthorized off road ATV usage.

e. Unmet Trail Needs

Regardless of whether recreation is occurring on public or private land, there are still issues of unmet needs. Two of the largest unmet needs that have been discussed in terms of forest planning are the need for the creation of additional trails (including paved and unpaved multi-use trails, along with single use trails), and areas for off-road motorized biking and all-terrain vehicle use. The need for areas for off-road motorized biking and all-terrain vehicle use are discussed below (issue f). The trail concerns most likely stem from multiple use concerns at facilities, where competition between users exist, and it is felt that there are targeted user exclusions on some trails. A need for improved trail planning and maintenance directly ties in with this desire on the part of the public for more trails.

f. All-Terrain Vehicle/Off-Road Vehicle use (ATV/ORV)

Issues with ATV and ORV use are two sided. There are the issues of those who own these vehicles, and there are the issues of those who own and/or manage lands that are potential use sites (legal or illegal).

Though it is currently illegal to operate an ATV on state land and all roads in Connecticut, “in recent years, the dramatic increase in ATV sales has generated a significant demand for riding areas”. “According to SCORP Citizen Demand Survey, the activity with the greatest percentage of unmet needs is off-road motorized biking and all-terrain vehicle use. Fifty-two percent of those respondents expressing a need for this type of facility said their need is completely unmet, with another 20% finding their need to be only 25% met (SCORP v).

High levels of illegal use on both public and private lands, causes negative impacts on natural resources and other recreational users (ATV 2). “Off-road vehicle use on public lands is a complex issue that is not unique to Connecticut. The use of public lands, particularly DEEP managed properties, for off-road vehicles, presents significant and sometimes conflicting responsibilities for accommodating the varied philosophies and demands of divergent user groups” (ATV 2).

g. Recreational club member investments

Often times, recreational clubs invest volunteer time, equipment, and money towards maintaining and improving recreational facilities on both state and private lands. The full extent of their contributions towards facility maintenance is not always understood or appreciated. As an example, the trail volunteers of the Connecticut Forest and Park Association invested over 12,000 hours maintaining trails on public and private lands in 2009 alone.

h. Lack of umbrella organization to represent all recreation users in Connecticut

There is no one organization that is able to represent all recreation users in Connecticut. Different user groups don't often "talk" to one another, and are often unaware of the common bonds they share. An organization that could facilitate productive working relationships could lead on the ground collaborative recreation projects. In addition, an organization that had the ability to connect different, but compatible recreation opportunities could be an effective lobbying tool for recreation issues.

Issue 5. Supporting a Sustainable Forest-Based Economy

A. SUSTAINABILITY

a. Lack of age diversity within Connecticut's forests.

In Connecticut forests today, a beneficial mix of stand age and size classes does not exist. A disproportionate area – 79% of the timberland area – is in mature stands. There is an unusually small amount of regenerating stands, which comprise only 6% of timberland. The overall nature of tree growth, a decline in the abandonment of farmland, and reduced timber harvesting activities have contributed to produce a forest comprised predominantly of mature stands, with a deficit of regenerating stands.

This was not always so. In 1972, the different stand age and size classes were virtually balanced. During the intervening years, the area in mature stands steadily increased. Between 1972 and 1985 the area of intermediate stands remained essentially unchanged, declining only between 1985 and 1998. However, the area of regenerating stands has steadily declined.

These changes have been beneficial to some wildlife. The recovery and return of many woodland species has been remarkable during the last century. Black bear, wild turkey, white-tailed deer and beaver have increased in number. There is now a residential moose population along the Massachusetts border. Maturing forests have made this possible. But the lack of balance between stand age and size classes will eventually affect other species of wildlife, and may bring about population declines. Few deny the social and environmental value of maintaining mature forests. Yet a balance of stand size classes is necessary for health and diversity.

The forest products industry, researchers and managing foresters are acutely aware of the lack of diversity of age and size classes of Connecticut's forest. In the long run, a forest out of balance foretells a depletion of healthy, vigorous growing stock for future generations and will impede the sustainability of a vibrant forest-based industry.

b. Limited markets for low grade material

The market development for low grade timber products has always been an issue in Connecticut. End products that can maintain their wood integrity with common defects (knots) such as pallet lumber, guard rail posts, and timber bridges have low profit margins. The forest products industry carries a very high overhead (equipment, insurance) and cannot sustain high volume, low profit margins. The firewood market takes what could be low grade sawlogs and markets them for consumer firewood. Although this provides an outlet for some of this material, firewood does not produce the jobs that wood products manufacturing does. Low-grade logs that can be processed will produce work in sawmills, marketing, manufacturing and secondary outlets. This in turn provides competition for products, which helps the entire economy.

Connecticut has never had a local pulp market. While northern New England developed markets for chips, southern New England shipped chips for pulp, energy or oriented strand board. There are low grade markets that have potential, most notably the potential demand for wood chips in energy production.

For a decade or more, energy planners in the region have looked at woody biomass as a viable renewable energy source. Its development would re-establish local markets for low-value material, but the issue has sparked debate that initially surprised local planners. Resistance is primarily focused on four concerns: unsustainable harvesting; truck traffic to large facilities would be intolerable; large water demands and returning warm water to rivers would be detrimental; and air pollution would be unavoidable. Suspicion, or outright rejection, of the claim that biomass energy can be carbon-neutral or even low-carbon is also voiced.

These are valid concerns that need to be addressed. Vermont's success in designing efficiently-scaled models for systems that sustainably utilize a region's wood supply suggest that it is reasonable to continue looking at biomass energy potentials in southern New England where relatively dense populations are sited within large forests, and the history of producing heat from wood is well established. The Biomass Energy Resource Center (BERC) in Montpelier, VT is an excellent resource to aid development of small scale biomass facilities, and to help promote the *Fuels for Schools* program which has implemented biomass facilities at 40 schools in Vermont. In Connecticut, Rhode Island and Massachusetts, fewer than six such sites exist in total. The development of small biomass facilities could create well distributed markets for low-value woody material.

c. Gradual loss of historical economic species

The oak/hickory group has historically been the predominant forest type species group in Connecticut. However recent FIA data indicates that red maple has assumed the lead role in total growing stock. The predominant type of harvest on private land (removing valuable timber without taking anything else) results in small forest openings. Small openings in the forest canopy can promote the establishment of valuable northern hardwood timber species (sugar maple, yellow birch), but also can promote more vigorous red maple and black (sweet) birch. Normally, red maple is considered a low-grade timber species and in Eastern Connecticut canker problems put black birch in that category as well.

Red maple and black birch are adapted to a broad range of growing conditions and can be found in heavy concentrations across the state. Red maple, the leading species in terms of growing stock volume increased by nearly 65 percent between 1972 and 1985, and 9 percent between 1985 and 1998. Red maple is a volunteer species on abandoned farmland, especially on moist sites. Cutting practices that remove more valuable species and leave the less-valued red maple probably promoted its volume increase more than any other factor.

d. Outside influences affecting sustainability

Outside influences are affecting the forest products industry. Most are economic in nature and others are more social. Economic issues include increasing prices of fuel, and insurance costs (liability, worker's compensation). Society has induced its own influences, with many young people raised in a rural setting opting for a college degree and higher-paying jobs. Traditionally these folks were more apt to follow their family heritage into the sawmill or logging business.

The adoption of the Connecticut Forest Practices Act required forest harvesters, supervisors and foresters to be certified by the State of Connecticut. Examinations are required for every level, and enforcement for compliance has also limited some people who may have previously made their living in the woods. The industry which had been unregulated, now must follow a clear set of limitations and ethical standards. Some industry personnel have moved their operations elsewhere.

The industry has declined from an infrastructure standpoint. Fewer buyers mean fewer options in markets. Declining demand has also restricted market share.

B. REGULATORY CONCERNS

The regulation of forest practices has been the subject of much debate for more than 30 years. In 1985, a Resource Conservation & Development report identified municipal regulation of timber harvesting as one of the most critical, complex and controversial issues facing forestry. In 1991, the legislature adopted the Forest Practices Act in part to address the issue of municipal and statewide regulation of forest practices. While the DOF adopted and implement regulations governing the certification of forest practitioners in 1996, and the conduct of forest practitioners in 2005, efforts to adopt regulations governing the conduct of forest practices did not advance beyond a public hearing in 1999. The Act permits those twenty municipalities that possessed forestry regulations prior to the adoption of the Forest Practices Act to continue with their regulations. By design, the remaining 149 municipalities were to be covered by statewide forest practices regulations adopted by the Department. Adoption of such regulations, however, has not yet occurred. Since the inception of the Act there has been considerable debate on the exact content of statewide regulations and the lack of uniformity between town regulations. In 2007, an Ad Hoc committee of the Forest Practices Advisory Board reviewed the issue and made several recommendations. In 2010, another such committee will be established to continue to monitor the issue and once again make appropriate recommendations. While the debate over the role of forest practice regulations persists, anecdotal evidence and a 2001 study of municipal officials suggest that the need for statewide forest practices regulations has been tempered by the improved professionalism and performance of forest practitioners as a result of the implementation of certification regulations.

A second and closely related issue is the authorization by the State's Inland Water Resources Act allowing municipalities to regulate activities affecting wetlands and watercourses. Pursuant to this Act, many but not all activities associated with farming and forestry in wetland and watercourses enjoy permitted as-of-right status and therefore are not regulated activities. The permitted as-of-right provision for forestry activities has been the subject of confusion by both the industry and municipalities. Considerable educational and training efforts have been made by the Department's Division of Inland Water Resources and the Division of Forestry on the State's Inland Water Resources Act, and in particular the permitted as-of-right provision. It is essential that these efforts by the Department in collaboration with key stakeholders continue to assure that a uniform and legally correct interpretation of the statute and details of associated case law is conveyed to all stakeholders.

C. REVENUE SOURCES

a. Economy of Scale

As Connecticut becomes more fragmented, the wood products industry deals with smaller woodlots, more landowners who are more detached from a rural economy, and fewer landowners who are willing to practice and invest in forest management activities. Smaller woodlots drive up the cost of doing business because of the cost of moving equipment, dealing with multiple planning/conservation commissions, and the time involved with closing a deal with multiple owners and meeting a variety of management objectives. The lower economy of scale drives up the cost of doing business, which lowers stumpage value to landowners and creates difficulty in marketing products.

b. Decrease in the volume of timber being harvested from State property

The Division of Forestry has had a net loss of 10 professional forestry/fire positions, 3 clerical positions and 2 maintenance positions over the past 20 years. In the past 24 years, the Division of Forestry has seen a steady decline in employees working within the State Lands Program. One exception to this was for a brief period between 1996 and 2001, which saw a temporary increase with some new hires. The state lands management program has lost staff to retirement and to switches in program responsibility. This decrease in staff has directly affected timber sales production resulting in approximately a 50% reduction in revenue to the state. Some of this revenue loss is due to a decline in stumpage prices. This significant loss of the marketing of stumpage has impacted the industry as a once steady, reliable flow of products is no longer present in the same capacity.

c. Non-traditional revenue sources

Several opportunities exist to support a non-traditional income flow from forestlands. Income that may be derived from these opportunities may help to alleviate pressure to sell property, and also make additional private property available for recreational pursuits. Landowners especially may benefit from land/lease opportunities for recreation (hunting, fishing, skiing, biking), mushroom production, boughs, etc. Markets for biomass or carbon credits may also provide long term opportunities for forest landowners.

Issue 6. Fostering Public Awareness and Support of Forests

Forestry professionals have long known the value of a public informed about the forest, as well as supportive of forest management which helps satisfy the many demands and expectations of the forest resource base. American society is composed of the private landowners that hold the future of most of our forested acres in their hands, and citizens that use the forest.

The benefits of improving public awareness and support of forest conservation and management are clear: Without support, efforts to conserve, manage and foster healthier forests will be underfunded, dropped from legislative priorities, even opposed. Traditionally, when forestry efforts and programs are supported, more acres are conserved and managed as forest, programs are more likely to receive a higher profile, and private landowners are more likely to promote a healthier long-term forest on their land.

A healthy forest base depends on public awareness of the benefits of our forest resources, threats to our forest resources, measures needed to protect and enhance our forests, and overall support of the forestry community's efforts to conserve and manage our resources. Therefore, the forest community and its objectives largely depend on effective education and outreach to its many users. Success in forestry is not simply measured by the latest in scientific research, sound silvicultural prescriptions, balanced management and conservation efforts. Effective communication, education and outreach are critical to the future of the forest and all efforts of the forestry community.

While this is recognized and even inarguable to much of the forest community, there remain many obstacles to successful outreach and education that reflect a lack of unity, consistency, as well as availability and standardization of messages and materials.

a. Education material regarding Connecticut's forestlands (Lack of standardization and availability of educational material)

There are many forest user groups and environmental groups with special interest in the forest resources of Connecticut, in addition to the forest industry, water companies, private landowners and the Connecticut Department of Energy and Environmental Protection. Although these different groups predictably have some differing ideas of how forests should be conserved, managed and used, frequently there is a great deal of "common ground" on the central issue of promoting future forest health. However, there is a lack of standardization of the message, resulting in a clouding of facts and confusion of the meaning of "forest health" and how Connecticut should foster it. Some of this may result from distrust issues between various groups, such as between industry and some environmental groups. Most importantly is a simple lack of coordination between these various groups in processing, agreeing on, and disseminating a uniform message. Improved communication and coordination between groups in production and distribution of educational tools would more effectively foster a greater public awareness of Connecticut forest issues. A more accurate, consistent message would reach more people, and ultimately this increased awareness of forests and would garner more public support.

Similarly, a more unified and active constituency of forest users would make a more effective lobby in the state legislature. Few would argue that a larger, unified voice is more easily heard than smaller, separate and conflicting ones.

Another recognized impediment to greater awareness and support is a lack of availability of appropriate educational information. DEEP, as well as user groups and many other stakeholders in Connecticut's forests provide information in the forms of hikes, workshops and presentations, brochures/booklets, posters, websites, blogs, articles, etc. However, many of these separate entities provide materials on a limited basis that may not see widespread distribution, or are produced with inadequate and or inaccurate information. As a result, while many citizens may grasp that the forest provides some intangible benefits in all our daily lives, they may not understand the degree to which our forests directly affect our quality of life in many areas, including air and water quality, climate mitigation, and even property values.

b. Lack of funding for outreach programs

A challenge that is obvious in these difficult economic times is a lack of funding of outreach programs. Since the beginning of the recession, dwindling resources have resulted in cuts to programs not considered "essential". The National Environmental Education Fund Act, which in 1996 technically expired, has seen repeated dramatic cuts in the past five years, which has directly affected programs and funding availability for outreach in Connecticut.

c. Lack of environmental educators

Related to the above obstacle is a lack of time teachers have to implement environmental education programs and disseminate related materials. With the current "No Child Left Behind" federal act, school districts' funding is closely coupled with how well their students score on standardized tests. Many teachers and administrators share that this pressures them to teach the content that their students will find on these tests - environmental and conservation content has been left on the sidelines as its content is not tested. Many teachers have had to cancel outdoor and other field trips so their students have time to prepare and study for the test. Even professional development workshops for teachers must show a strong correlation to standardized test content, specifically reading, writing, and mathematics. With this focus on testing and preparing for testing, there is little time or even priority given to environmental education in the schools.

d. Getting youth outdoors

The changing "culture of childhood" is a distinct impediment to the current and future support of forest health objectives. It is widely reported in the media that America is experiencing a national epidemic of obesity, which includes childhood obesity. On average, children of today do not actively play in the outdoors as much as previous generations, a topic discussed at length in Richard Louv's book *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder*. In his book, Louv cites a 4th grader's reasoning: "I like to play indoors better 'cause that's where all the electrical outlets are." The apparent challenge in this electronic age is to encourage children to spend more time outdoors, a challenge that the DEEP No Child Left Inside[®] program is attempting to address. This objective is critically important to the future of forest management and forest health, as the children of today will become the recreationists,

policy-makers, professionals and citizens of the future. A disconnect from the forest environment has obvious negative connotations for the future of the forest.

e. Reaching Private Forest Landowners

Private landowners control 85% of Connecticut's forestlands. Many of the challenges that need to be addressed relate to information not being readily available or accessible. Today it is clear that many private landowners don't understand forestry principles and management techniques, the effects of fragmentation, and the important role that their forestlands can play on the quality of life for everyone in Connecticut. Positive incentives are needed to outweigh disincentives for retaining and managing private forests. Education and incentives require a combination of materials and programs made available, possible legislative changes, and greater assistance by Connecticut DEEP and its partners in facilitating greater private landowner awareness and participation in forestry.

In summary, promoting greater public awareness and support of forests will likely include making the message more standardized and coordinating all stakeholders more effectively through greater communications and partnerships. At the same time, making educational information more readily available, increasing outreach in the educational system and to private landowners, and promoting programs to get kids outdoors as much as possible, are all separate but related and essential for reaching more people and garnering more long-term support for forests. In a time when both financial limitations and pressure on the forest resource are both greater than ever, it is also more important than ever before to support a thorough and aggressive approach to promoting public awareness through greater coordination and partnership efforts, and adequate funding and staffing of appropriate outreach programs. This may become the most critical component of conserving forests for Connecticut's future and promoting long-term forest ecosystem health, as support of the public and forest landowners is essential.

Issue 7. Advocating and Implementing Effective Forest Planning and Policy

Forest planning and policy in Connecticut is dominated by one social-economic force. Per capita incomes outside the major cities is among the nation's highest, which means that rural and semi-rural land values for residential and commercial development are high and rise more rapidly than the economy. The state does have several incentives to maintain forests as working landscapes and open space, including reduced property taxes and reasonable outreach technical support. Timber investments and other reasons for owning forestland make sense as stand-alone economic activities; however, forest use cannot compete with development alternatives in terms of returns to ownership.

Overcoming this economic context is yet more difficult because of the structure of local governance and planning, regional threats from insects and diseases, a less than complete implementation of the state's Forest Practices Act, and inconsistent application of municipal inland wetland regulations that adversely impact forest practices. Sustainable forestry in Connecticut requires decoupling development rights from the bundle of property rights on larger forest tracts. Tax incentives, working closely with local land trusts and a coalition of non-profits, and other strategies will be required to accomplish this shift. Regional movements, like the New England state foresters' forest initiative, the *Wildlands and Woodlands* effort, and *Tree Farm*

participation as a means of sustainability certification, will provide new ideas and support to Connecticut efforts to move toward sustainable forests.

Some details on the issues and possible solutions follow in the next sections.

Lack of comprehensive land use plans

A common description of Connecticut is as the most bottom-up state in the union because of its strong legal and political traditions of home rule by the towns. The state eliminated the county layer of government many years ago, so there is no governmental layer between the 169 towns and the state. Some regional thinking, planning, and implementation exist and the legislature and Governor encourage more regional actions. However, regionalization of land-use and resources planning in the near future is highly unlikely. Consequently, several symptoms of poor planning and policy will persist.

a. Inconsistent planning, zoning, and building regulations

In Connecticut, town planning and zoning commissions generally are composed of volunteers. The Town Planner, where one exists, is a professional and often has responsibility for economic development. While considerable guidance and training are available, these volunteer boards tend to develop their own standards of what is acceptable land use and planning for future uses. The variations are amplified if inland wetlands, conservation, or other duties fall to the Planning & Zoning committee.

Building regulations are somewhat more uniform because of fire codes and other standards required for insurance and state support.

b. Ecosystem and habitat issues that cross town boundaries

While there is no necessary requirement to plan across town boundaries, many examples exist where the need was obvious, and local leaders on both sides of the boundary saw an opportunity. In eastern Connecticut, many town conservation and planning leaders receive training to look for connections that already promote corridors across two or more towns. Public forests, parks, and wildlife refuges are such connecting elements. The Blue Blazed Hiking Trails and the Appalachian Trail are obvious connectors. Rivers and streams, ridges and valleys, and road systems are other natural and infrastructural connectors that lead to cross-boundary thinking about ecosystems and habitats. In some cases, like the regional Highland Studies that connect western Connecticut to other states, research results can encourage thinking beyond local boundaries.

c. Use of open space lands designation within towns

Towns vary widely in their recognition of open space. Passage of Public Act (PA) 490 in 1962 was to encourage retaining farms and forests as open space. Property taxes are levied using values that reflect croplands, pastures, forests and other agricultural land uses as the “highest and best” use value. Several towns also take advantage of the PA 490 open space category, which allows a tax rate higher than agriculture but considerably less than development for residential or commercial purposes. The advantage of this optional category is to encourage smaller open spaces than those required for PA 490 categorization as forest (25 acres) or farmland (usually 10 acres).

Some towns have set open space goals and are actively acquiring land or conservation easements to meet their goal. The strategies vary among towns. Mansfield, where the University of Connecticut, Storrs, is located, acquires open space using funds from bonds. Granby, located just west of Bradley International Airport, works collaboratively with the Granby Land Trust to acquire lands or easements that protect open space in critical areas and corridors. In both cases, the town has permanent open-space goals in the neighborhood of 25%, but history and circumstances have led each to different ways of achieving results. This kind of successful experimentation, coupled with sharing of results by Town Planners, is one of the advantages of home rule and lack of rigid processes dictated by higher levels of government.

d. Interpretation and implementation of regulations

Several inconsistencies flow from the home rule approach to resource planning and regulation. The volunteer boards are often ill informed on facts or scientific knowledge about forests, water, and other natural resources. As is true in many states, water quality issues for domestic use, fish, inland wetlands, and coastal zones direct land use decisions. Coupled with ideological views on any forest harvesting, clearcutting in any case, or specific notions of “proper” silviculture, local boards can misinterpret their authority or simply make rulings with no basis in fact or science.

While forestry practices are permitted “as of right” agricultural practices, that determination is not self-executing. Local Inland Wetland Agencies are legally entitled to review any proposed activity which may affect a wetland or watercourse to determine whether such activity is regulated or qualifies as permitted “as of right”. An interesting inconsistency often is observed between proposals for clearing for cropland or pastureland and proposed timber harvesting. Many Wetland agencies fail to make the connection that timber harvesting is legally identified as an agricultural practice as is clearing for cropland and, often require the proposal for timber harvesting to include burdensome information and to go through the several week application and permit process, while the clearing proposal will receive the permitted “as of right” ruling quickly.

In some towns, the P&Z committee gets involved in forestry decisions. With the emergence of wetlands issues, however, this overlap of jurisdictions is less frequent. Conservation Commissions and Agricultural Commissions can express interest in forestlands, but in general their interests are in support of forest stewardship and protection of open space. In a few cases, towns have considered and, in at least one instance, passed town forest regulations. Twenty towns had some regulations before the Forest Practices Act passed in 1991, and they are “grandfathered” in the state legislation. The fact that the DEEP has not developed and implemented statewide regulations has prompted some local discussion to try to force the hand of the state legislature and DEEP.

One result of a town issuing regulations a few years ago was an ad hoc committee working under the State Forest Practices Advisory Committee to look at potential for agreement on a set of regulations. The committee included practicing foresters, timber harvesters, and a variety of research and other professional forestry interests. The committee did not reach consensus on specific regulations or on the roles of foresters and loggers in marking trees for harvest. However, it did develop a *Timber Harvest Notification* form for use by towns. Landowners would both notify the Inland Wetland Commission with the intent to harvest timber and provide

adequate information for the commission to establish whether its concerns justified it having jurisdiction to review a harvest plan before implementation. This is not an official Connecticut DEEP form but it has been endorsed for town usage by Connecticut Farm Bureau Association, Connecticut Forest & Park Association, the Connecticut Professional Timber Producers, the Society of American Foresters - Connecticut Chapter, and others. The form is currently circulating to towns in the state. Adaptation and use would be voluntary. For the foreseeable future, using the form would not be required by the state.

Forestland Protection

There are two broad dangers to Connecticut forestlands: 1) invasive species, and 2) parcelization and fragmentation. Like most states, we face invasives that might devastate major species or types in a short time – e.g., Asian longhorn beetle or emerald ash borer – or over long time periods – e.g., invasive plants like wild rose or Japanese barberry or climate change and slow northward shifts in natural ranges of forest species. These threats present technical and policy challenges, but the state can share its results and benefit from the experience of others.

The state is fortunate to have the oldest agricultural experiment station in the nation with the oldest state-funded forestry research program. The Connecticut Agricultural Experiment Station also has quality programs in invasive insect species, invasive plant species and diseases, and Chestnut breeding. The USDA Forest Service Laboratory in Hamden, focused on forest insects, amplifies this expertise.

Additional research resources are at the University of Connecticut and the Storrs Agricultural Experiment Station. The Department of Ecology and Evolutionary Biology is among the nation's top 10 programs, and the Department of Natural Resources and the Environment is a rapidly developing unit. Yale's School of Forestry and Environmental Studies has a research forest in Union, Connecticut, and several other private colleges have research on forest habitats, birds, and habitat ecology. All of these resources are concerned with ecological changes that increase the probability of threats.

The second danger is common throughout the Northeast, Mid-Atlantic, and Atlanta/Southeast and other areas where urbanization of rural lands is forcing land prices up relative to other resource values. Parcelization of ownerships, fragmentation of forest cover and development for residential or commercial land uses follows.

PA 490 was a pioneering effort to encourage forest and farm uses to continue and provide open space values through private land ownership. More recent uses of Forest Legacy, land trust, and other sources of funding to purchase lands and conservation easements are important responses to recognizing that timber values no longer can carry a working forest in the face of high land values for development.

Overall, however, Connecticut does not have adequate resources to protect working and preserved forestlands as open spaces. The annual Connecticut Forest Forum, the Connecticut Forestlands Council, and several emerging policy initiatives, like the Wildlands and Woodlands initiative for New England and the New England State Foresters Forest Initiative may coalesce into more effective policy vehicles for funding and acquiring development rights on private

forestlands. If these efforts prove effective, it will be because they shift the action balance from reactive to proactive approaches.

Forest Practices Act

Connecticut passed a Forest Practices Act in 1991, judged among the best in the Northeast. It authorized licensing of professional foresters and supervising harvesters, a forest practices advisory committee for the state forester, an ethics review process, and state forest practice regulations. The first two were in place shortly after passage of the law, but the ethics element took several years to gather consensus and put in place. To date, formal forest regulations have not developed with a consensus to implement. However, the *Notification of Harvest* form was promulgated by a coalition of non-profit organizations and shows some signs of becoming common practice in many towns.

Incentives for Sustainable Forestry

Connecticut has support services for private forest landowners and it has a professional cadre in charge of state forest, park, and wildlife lands. In both cases, the human resources are solid, but considerably less than two to three decades ago. Public funding of forestry and forestry support programs has declined dramatically over the years. Given the poverty, education, and other problems facing the state and the predicted budget shortfalls for the coming decade or more, it is highly unlikely that public forestry programs will increase in strength.

The state already has essentially eliminated the property tax on forestlands. An archaic 10-Mill tax law needs a resolution to preclude some 14,000 acres of larger ownerships being parcelized and fragmented, but hopefully this issue will be resolved this year or next.

The least expensive social mechanism to protect forests as open space is to encourage working forests. The current property tax policy is excellent, but some additional tax incentives would be helpful. A federal deduction for donating conservation easements on land called, the Enhanced Easement Incentive expired in 2009. It allowed the value donated to be deducted over a 16-year period, which is important where large values are involved. This tax benefit can be especially important in Connecticut where the difference between land values for development vs. working landscapes often is enormous. As of March 10, 2010 the House and Senate have both passed a one year extension until December 31, 2010 that would be retroactive to the beginning of this year. Opportunities to lower the acreage requirement for PA490 could encourage additional protection of forest lands, as long as the acreage requirements allow for economic feasibility for land management activities.

Another mechanism would be modifying the state tax code to favor donating lands and easements for conservation and open space purposes. Connecticut does not allow deductions for charitable gifts. This proposal would allow deduction of up to half the taxpayer's adjusted gross income for gifts and bargain sale prices on lands and easements over a 16-year period. This is an inexpensive way to capture open space without direct expenditure of public funds.

Some changes are less forest policy ideas than broader changes in social policy that would reduce the incentives to sell parcels and fragment large forest ownerships. These include Smart Growth initiatives, a revised transportation policy, improved city environments, especially

schools, and more comprehensive planning and zoning at the town and regional levels help. None of these are the conventional topics of forest policy, which reflects the realities of high rural land values. Forest landowners and professional foresters should look to town planners, regional collaboration, mass transit advocates, land trusts, and environmental organizations as potential allies in changing land use policies.

Payments for the public goods produced by private lands, like carbon sequestration, watershed protection, and wildlife habitat, would encourage working forests. A simple version would pay a set amount per acre annually to any forest owner who has a forest stewardship plan and agrees to a rolling 10-year restriction on development. The annual payment might be significantly higher for owners who place a conservation easement on their property. These payments probably cannot be high enough to compensate for the current low ratio of timber prices to land values in Connecticut, but they would help justify maintaining working forests as open spaces in the state. Habitat mitigation might develop for some rare or endangered species in Connecticut. In the South, for example, Cockaded Woodpecker habitats can be bought and sold through mitigation. If an owner wants to harvest a woodpecker habitat, she can purchase a habitat guarantee elsewhere to mitigate this loss.

Professor Chad Oliver at Yale suggested another incentive for forest owners. If the state or a town (or a private organization, such as The Nature Conservancy) wants more of a particular forest type, such as an early successional stage or a savannah, it could pay landowners to produce the desired result. The purchase agreements might be for 10, 15 or 20 years – depending on how long a landscape can easily be kept in the desired stage of stand development.

New policies will not be adopted without appreciation for the importance of forested landscapes by taxpayers. To this end, the state could use existing extension, outreach, and nongovernmental organizations to help Connecticut's residents understand and better support working forests. The capacity is in place for such an educational effort. What is needed is effective leadership of a broad coalition of interests.

Carbon Sequestration and Climate Change

Connecticut was a leader in establishment of RGGI (Regional Greenhouse Gas Initiative) that establishes a "Cap and Trade" system for several Northeastern and Mid-Atlantic States. While some carbon-offset credits are possible, the system is primarily concerned with reducing CO₂ emissions from large-scale electric power plants that serve the region. Although some evolutions of the system may give more favorable treatment to sequestration of carbon by local forests, this is unlikely to be a major source of incentives to practice forestry over the coming decade or two.

While moving toward maturity, Connecticut forests generally are still sequestering considerable carbon. In a growth curve sense, the biomass and carbon accumulation is around the inflection point of rapid accumulation, not in a stage of rapid decline. This trait suggests some alternative mechanisms to provide benefits to Connecticut forest landowners.

One might be shifting the policy attention from "Cap and Trade" systems to Carbon Taxes. Because taxes have become a dirty word in American policy discussions, we might call this a 'Carbon Tipping Fee,' like tipping fees at dumps and recycling centers. The critical element is

charging fees for the discharge of CO₂ and rebates would be given for sequestering carbon. As Connecticut is growing twice the volume it removes each year, collectively state forest owners would receive a 200% rebate on taxes paid for carbon removals. The measurement of the net and allocation of benefits provide some challenging details, to be sure, but moving to a carbon tax is more equitable and strongly favors forestry over many other carbon-sequestering activities.

Markets for carbon offsets might develop where a Connecticut forest owner could sell the right to harvest for 20 or 50 years. The net annual accumulation of carbon over that period would be sequestered carbon, and not harvesting precludes the immediate and slow flows of CO₂ as wood and fiber deteriorate.

State and Local Regulations

The DEEP Landscape Initiative summarizes the situation: “Land use decisions in Connecticut are, by custom and by law, primarily made at the local level by volunteer land use boards and commissions. There are many other stakeholders in these decisions, from the developer, to the municipal finance board, to the neighbors and the local voters. Encouraging, supporting and promoting informed land use and development conversations, choices and decisions is a complex but important challenge that is vital to address.”

Issue 8. The Importance of Ongoing Forest Research

The time frame associated with forest growth and development, forest influences and forest vegetation responses to disturbance and change demands long-term/multi-year commitments to the pursuit of forest biology and ecology research questions. Public funding for research efforts is often short-term, especially those funding sources that are competitively structured.

Developing and sustaining a comprehensive, collaborative (multi-partner) long term research initiative in Connecticut to address key forest resource questions demands the ability to recruit and retain talented researchers, supportive infrastructure, and a commitment to maintain experimental endeavors as needed.

a. Biological Research - The need for more within Connecticut

Forest biology and forest ecology research topics of importance in Connecticut forests include:

- Invasive species influences and control methods
- [Any number of] forest pests and diseases
- Impact of white-tailed deer on forest regeneration and native wildflowers
- “Micro-disturbance” responses related to small-scale management activities on smaller parcels
- Optimum species mix for growth and productivity by forest patch size
- Earthworm, non-native species and atmospheric soil chemistry influences
- Pollinator roles and habitat
- Predator/prey interactions between birds and insects
- Species responses to higher temperatures, higher precipitation and more intense storm events
- Stand-level responses to the above.
- Forest mitigating influences on the above.
- Carbon budgets at all forest growth stages and types.

b. Social Research - Need More Specific To Connecticut and How Social Behavior Impacts Land Management Actions

Social research topics of importance in Connecticut include:

- Demographics of forest landowner population
- Intergenerational transfer
- Local markets for locally grown forest products
- Effective public messages (see below)
- Landowner attitudes about [numerous topics that affect their land and the satisfactions they derive from owning it]
- How state and local regulations influence forest retention/perpetuation

c. Need for effective dissemination/extension of research information

Communications research can address:

- Audience segmentation
- Effective media use
- Message tailoring
- Metrics for gauging responses to outreach efforts (attitude or behavior change)
- Metrics for measuring engagement by individuals and/or groups
- Adaptive management for communication efforts
- Eliciting appropriate emotional responses

Issue 9. The Role of Urban Forestry in Connecticut

Since *urban forestry* concerns itself with the management of public trees outside of the forest, funding is the major limiting factor. It is apparent that many of the trees in our larger, older cities are the legacy of a time when a much larger proportion of the municipal budget was allocated to urban trees. In most Connecticut cities and towns today, those who manage the public trees are barely able to keep up with the problems that arise. Once common practice, proactive management is simply no longer in the budget. More funding would mean more staff, more equipment and, in the end, a healthier and more extensive urban tree canopy.

a. Liability

The benefits of trees in the urban setting are well-documented, as they improve the quality of life in numerous ways. An unhealthy urban forest, however, not only detracts from the quality of life in the community, but also creates great expense for the municipality in tree removals, clean-up, and other *reactive* forms of necessary maintenance due to a lack of proactive management. Even worse, this neglect can result in dramatic levels of liability and potential lawsuits, should significant property damage and injury be correlated to relative care of the trees. In the end, the municipality could pay far more than a properly-funded proactive urban forestry program as a result of the cutbacks. Therefore, increased funding is ultimately critical to the urban forest and its municipality, both in the area of education/outreach, and maintenance budgets.

b. Health Threats

One limitation of the urban forestry program is its tendency to inadequately focus on private trees and private tree owners. Again, increased outreach and communication could broaden the program to target private trees and their owners, which are also critical to a healthier urban forest environment.

Direct threats to the urban forest include several of bio-physical problems – from invasive plants and animals, including new insects and diseases, to storms and increasingly challenging urban environments. Indeed, decades of work can be lost from just one storm or one exotic insect. A single continual awareness of potential problems, a commitment to planning and steps taken for preparedness are all needed to be in a position to deal with these threats when they arise. Meanwhile, there are human-derived threats to the urban forest that need attention.

Humans can threaten the urban forest by neglecting it, by making poor decisions during an effort to manage it, or by setting the urban forest too low on the priority list when compared to other competing needs. Each form of threat brings its own set of problems.

Neglecting the urban forest often means not funding its growth and maintenance. As a result, trees can degrade to a point where they become a hazard to the public, leading to accident and injury, followed by calls to remove large parts of the urban forest. Poor decision-making can lead to poor tree choices, poor planting efforts, and the wrong tree in the wrong place. These, in turn, can lead to major wasting of money, time, and effort.

In addition, there is a lack of understanding and appreciation for the importance of soils, coupled with the steady depletion of the soil resource in both cities and suburbs. In particular, the stripping away of quality existing soils is often part of the construction process in new developments.

Similarly, there is a lack of recognition of what trees do, or can do, if properly planted and maintained. Trees are too often seen as simply an amenity and not as a working part of the urban ecosystem, making invaluable contributions to the lives of the people who live and work in proximity to those trees.

Following bad decisions or a bad storm, there is a tendency on the part of the public to move away from trees, due to a loss of confidence in them. Trees can also be an ongoing hazard in a city, especially when maintenance is lacking. Trees can be considered a nuisance, as a source of allergens and litter. Societal growth is also causing a rapid rate of change in the environment that often leads to compromised trees, early tree removal or the neglect and failure of trees not allowed the opportunity to adapt to changes.

c. Education

Access to increased funding would not solve all of the problems of today's urban forest. One consistent limitation to proper urban forestry in both the public and the private sectors is the state of knowledge regarding trees and tree care. Too many people know less than they think they do, and many bad practices are a result. These practices extend to where trees are planted, what trees are planted and their care and maintenance. Ongoing education, particularly of public tree managers, is needed to overcome these problems.

d. Volunteerism

Urban forestry depends upon people, and one of the best ways to advance urban forestry is to encourage more people to be involved with urban trees, in their appreciation, their planting and their care. Despite some progress, urban forestry is still limited in this area. Greater

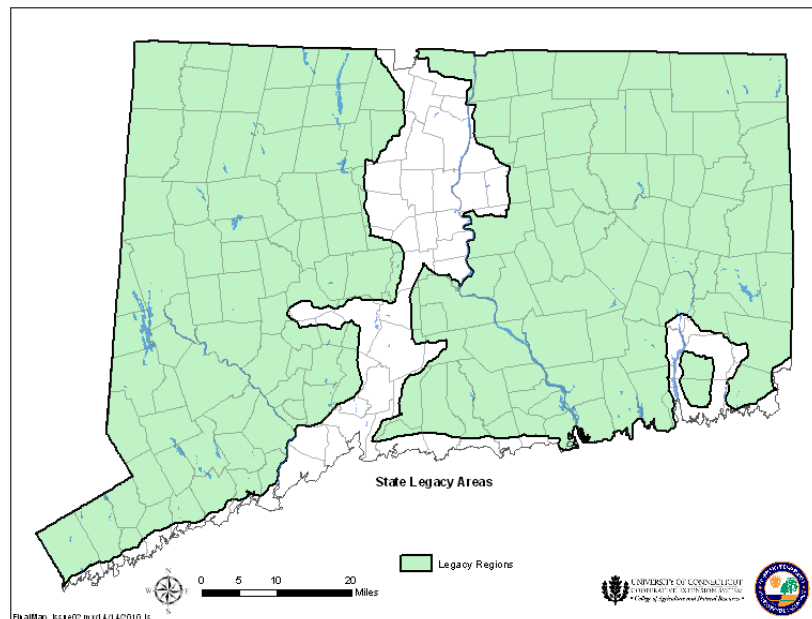
inclusiveness, particularly with regards to volunteer programs, would be very beneficial to any urban forest program. In turn, this highlights the need for better communication programs, at many levels. Indeed, the need for volunteer input is critical. Often, volunteer and volunteer groups serve to initiate and sustain urban forestry efforts in communities. The emphasis on volunteers brings its own difficulties, including that of keeping volunteer efforts ongoing, especially when the effort is dependent on one or a few people.

SECTION 3. Connecticut Forest Legacy Program Integration

The Connecticut Department of Energy and Environmental Protection partners with the USDA Forest Service to implement the Forest Legacy Program (FLP). The Forest Legacy Program is a program that helps identify and conserve environmentally important forests from conversion to non-forest uses. The main tool used for protecting these important forests is conservation easements. The Federal government may fund up to 75% of program costs, with at least 25% coming from private, state or local sources (USDA FLP). The Forest Legacy Program protects “working forests”, which are defined on the national Forest Legacy Program website as “those that protect water quality, provide habitat, forest products, opportunities for recreation and other public benefits”. The program “encourages and supports acquisition of conservation easements, legally binding agreements transferring a negotiated set of property rights from one party to another, without removing the property from private ownership. Most FLP conservation easements restrict development, require sustainable forestry practices, and protect other environmental values” (USDA FLP).

Approved by the Secretary of Agriculture in 1994, the Connecticut Assessment of Need (AON) was developed to document the need for Connecticut to be included in the Forest Legacy Program through an evaluation of existing forests, forest uses, and the trends and forces causing conversion to non-forest uses. The AON defined the Eligibility Criteria that was used in the identification of important forest areas that became the Western and Eastern Forest Legacy Areas (FLAs) in which Forest Legacy activities can occur (Figure 49); and determined through analysis what defines “threatened” and “environmentally important forests”; and outlined the State’s project evaluation and prioritization procedures. The AON was developed in consultation with SFSCC and approved by the State lead agency (USDA FLG).

Figure 49.
State Forest
Legacy Areas



To make the determination as to whether the AON needed to be updated for inclusion into the Statewide Forest Action Plan, or whether it could be “incorporated” as is, the Connecticut State Forest Stewardship Committee met and discussed the matter on March 23, 2010. It was determined at the meeting that it could be “incorporated” as is. Therefore, the Connecticut Forest Legacy Program will be implemented according to the Connecticut Forest Legacy Program (FLP) Assessment of Need (AON), which was approved by the Secretary of Agriculture on October 26, 1994 and again approved as needed on July 6, 2001 by the Chief of the Forest Service. The AON includes the approved Eligibility Criteria for the Forest Legacy Areas (FLA); the Approved FLAs; specific goals and objectives to be accomplished by the Connecticut FLP; and the process by which the State Lead Agency will evaluate and prioritize projects to be considered for inclusion in the FLP. A copy of the State Lead Agency designation letter, the AON, and the AON approval letter can be obtained by contacting the Forest Legacy Program Manager at the Connecticut DEEP, Division of Forestry, 79 Elm Street, Hartford, CT 06106.

As of November 2015, the Forest Legacy Program in Connecticut has protected 8,125 acres by acquiring parcels in fee or by holding conservation easements in perpetuity. This program has leveraged over \$8 million in federal funds (Figure 50). As of November 2015 another project was partially funded and work is continuing.

Figure 50. Table of completed Forest Legacy Projects through 2015

No.	Name	CE or Fee	Acres	Interests value	FLP payment
1	Maplewood Farm	CE	172	\$210,000	\$210,000
2–3	Great Mountain Forest 1–2	CE and Fee	5,528	5,453,000	4,089,000
4	Housatonic	Fee	204	410,000	0
5–10	Skiff Mountain 1–6	CE	705	8,445,000	1,733,000
11	Pootatuck	Fee	45	312,000	0
12	Nepaug	Fee	27	45,000	0
13	Mattatuck	Fee	55	170,000	0
14	Naugatuck	Fee	27	85,000	0
15	Shenipsit	Fee	311	597,000	0
16	Salmon River	Fee	158	315,000	0
17–19	Meshomasic 1–3	Fee	128	260,000	0
20	Peaceful Hill	CE	35	217,000	163,000
21	Pine Brook	CE	126	100,000	100,000
22–28	Stonehouse Brook 1–7	CE	478	795,000	596,000
29	Pogmore	CE	53	80,000	80,000
30	Tulmeadow Farm	CE	73	2,830,000	1,415,000
Completed Projects Total:			8,125	\$20,324,000	\$8,386,000

Source: USDA Forest Service Northeastern Area State and Private Forestry Forest Legacy Program Yearbook 2014

SECTION 4. Connecticut and Multi-State Priority Areas

Connecticut Priority Area Maps

Priority Map 1

Forest Ecosystem Health and Biodiversity

To identify areas with high potential or for current value as quality forest habitat, both for trees and animals. Timber production may coincide with similar areas, but the primary focus for this map set is increased biodiversity and overall health of the forest ecosystem.

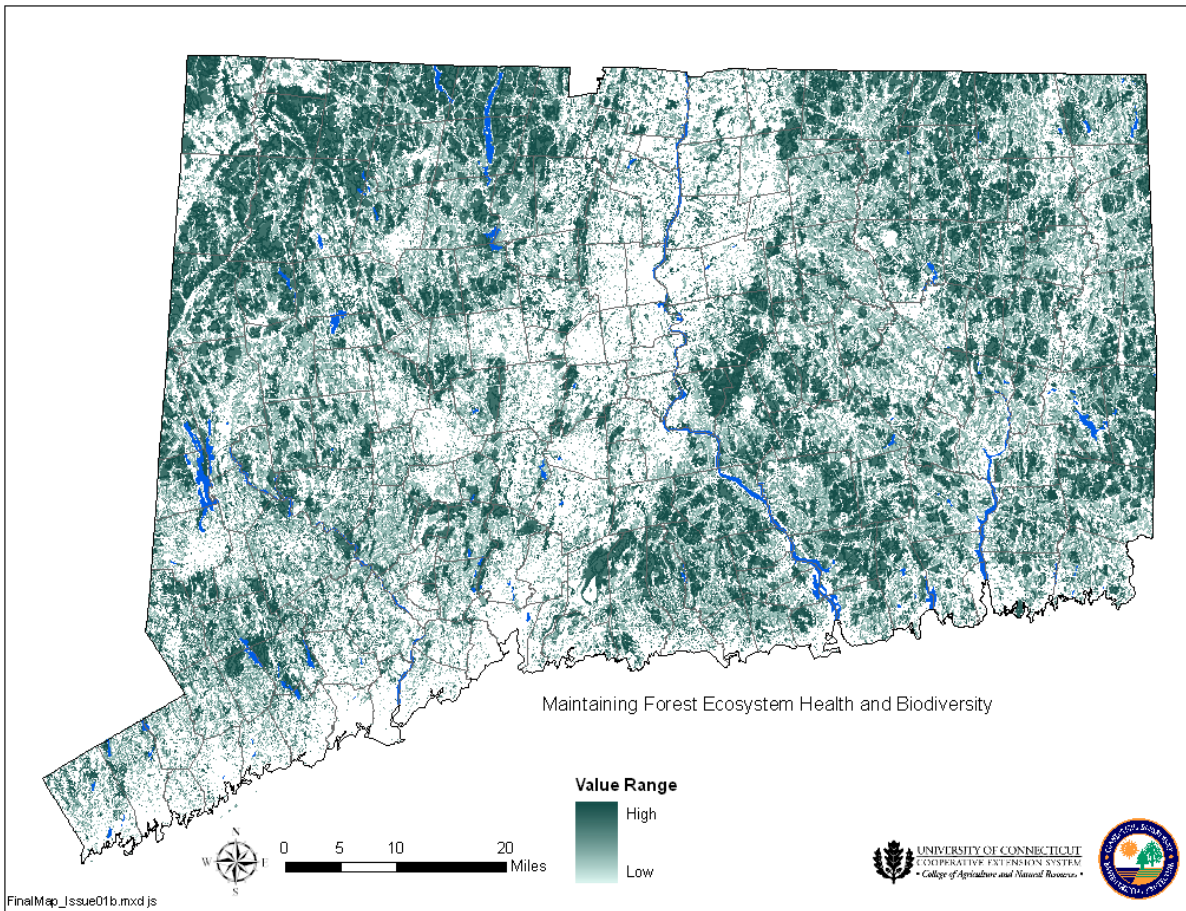


Figure 51. Priority Areas for Maintaining Forest Ecosystem Health and Biodiversity

Priority Map 2

Soil and Water Conservation

Overlay analysis to identify areas with the higher need for protection based on their value to water conservation and quality, the protection of hydric soils, and areas with the potential for higher erosion if vegetation cover is removed.

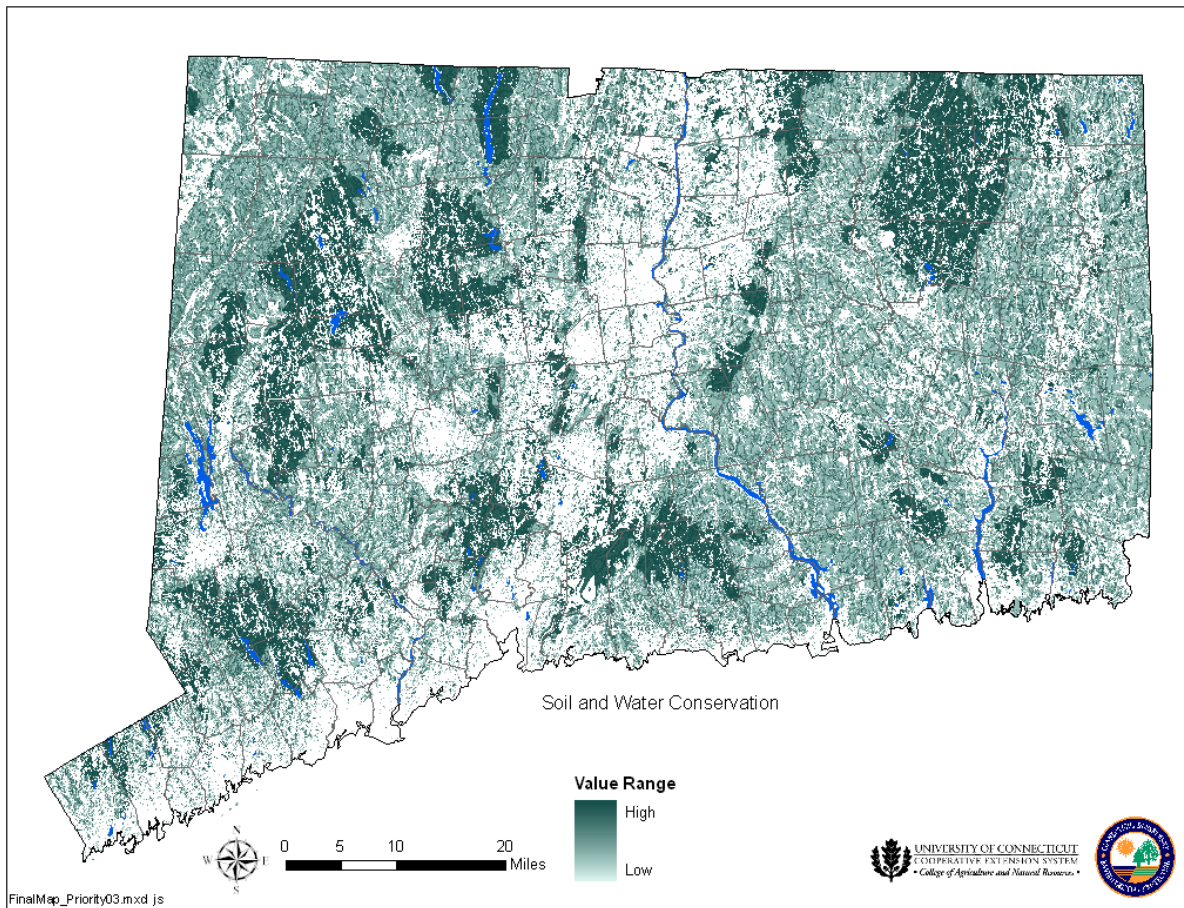


Figure 52. Priority Areas for Soil and Water Conservation

Priority Map 3

Providing For Forest Based Recreational Opportunities

To highlight and identify areas of forest based recreation within the State.

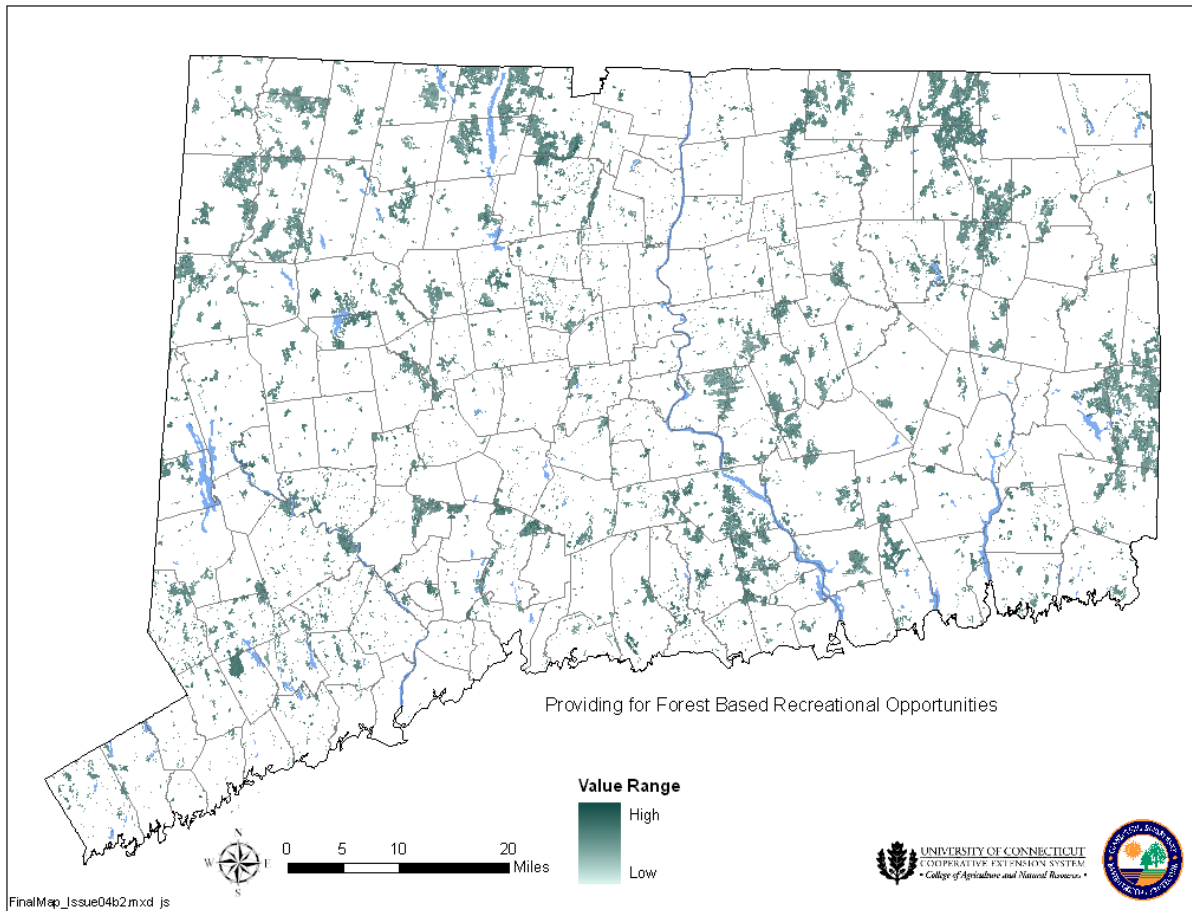


Figure 53. Practical Potential for Forest Based Opportunities

The estimated **MAXIMUM** potential for forest based recreation within the State.
**This map is strictly for comparative means. It is unrealistic to assume that this maximum potential can be reached and there is no avocation to do so.*

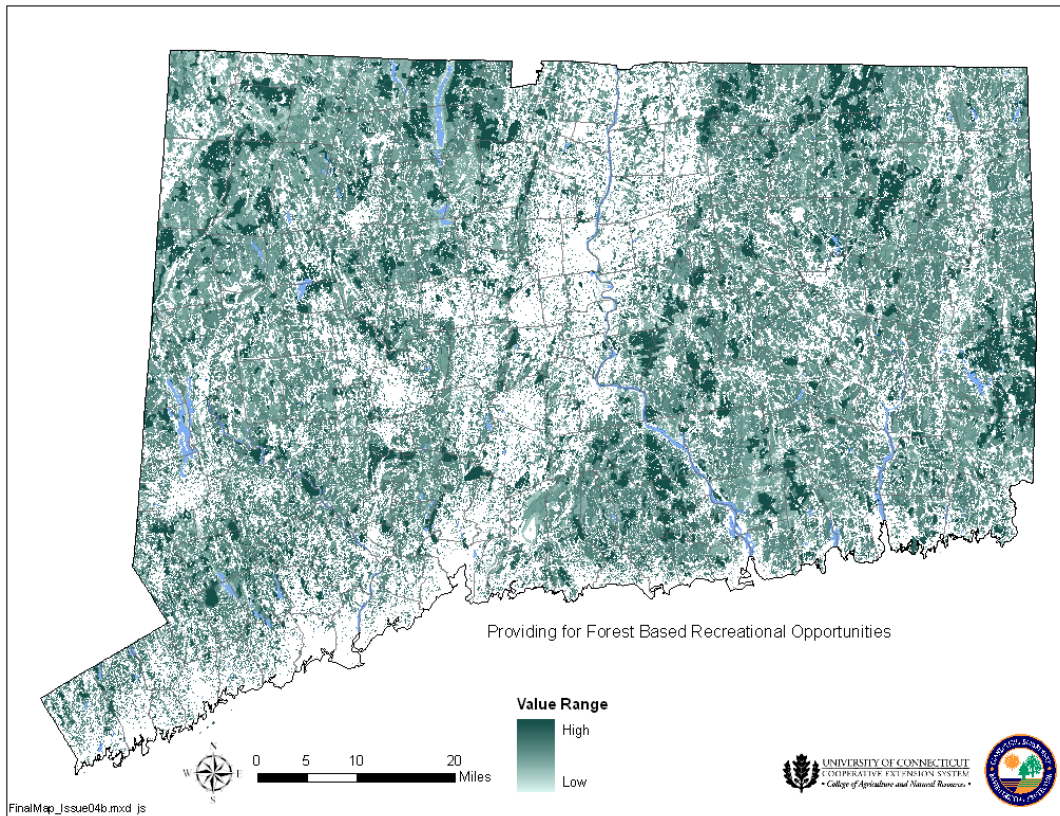
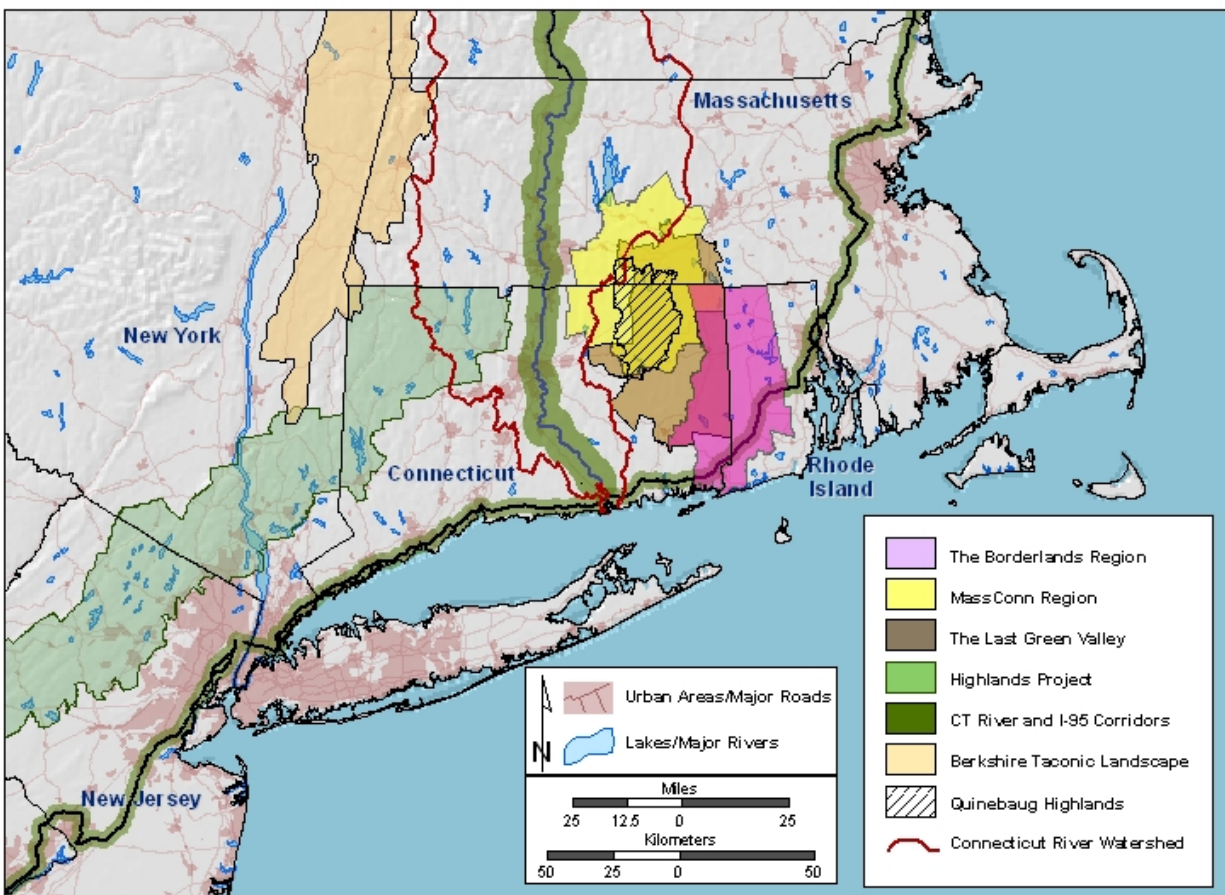


Figure 54. Maximum Potential for Forest Based Recreational Opportunities

Multi-State Priority Areas

There are several conservation efforts in Connecticut that cross state boundaries. Each effort may have one or many partners, and may have one or several on the ground conservation or habitat/ecosystem management projects ongoing, or recently completed. It is anticipated that work will continue in these pre-designated priority areas, but also that new attention will be focused on them as time and resources allow. A few of the larger and better known efforts are described below, and depicted in the Multi-state Priority Area Map. As evidenced in the map below (Figure 55) two distinct regions emerge as Priority Areas in terms of ongoing conservation efforts with our neighbors in Rhode Island, Massachusetts, and New York. Please note that this is not an attempt at creating an all-encompassing map of multi-state efforts, but it is meant to serve as a basis for determining existing priority landscape areas.

Figure 55. Multi-State Priority Area Map



Borderlands Project

“Launched in 2003, The Borderlands Project aims to build greater awareness for the unique assets of the rural area that spans the Connecticut-Rhode Island border. In the twenty town Borderlands region, the Project works to:

- To build a shared understanding for the unique assets of the region and the opportunities and threats facing it.
- Foster a culture of learning and collaboration across this bi-state, multi-town, multi-scale region.
- Explore innovative ways to balance growth and conservation.”

This project grew out of a regional collaborative sponsored by the Eastern Connecticut Chamber of Commerce and the Rhode Island Economic Policy Council, which recognized the need to address the economic concerns of their communities while still maintaining the rural character of the region. Source: Borderlands Project

Connecticut-New York-New Jersey-Pennsylvania Highlands Region

The Highlands Region, denoted as an area of national significance, is a critical watershed for an expanding nearby metropolitan area. The Highlands Conservation Act of 2004 directed the US Forest Service to expand the 2002 study to include Connecticut and Pennsylvania. This update included an analysis of the region’s natural resources, changes in land use, and economic pressures to alter land use. This report can be found at http://na.fs.fed.us/pubs/stewardship/highlands_regional_study_ct_pa_10_screen.pdf.

The Last Green Valley

“A culmination of years of grassroots initiative, The Last Green Valley, Inc. (TLGV, also known as the Quinebaug-Shetucket Heritage Corridor, Inc.) is a private, non-profit, 501(c)(3) corporation. It is designated by Congress as the management entity for the Quinebaug and Shetucket Rivers Valley National Heritage Corridor. It is the role of TLGV to:

- 1) Promote partnerships at the local, regional, state, and federal levels to accomplish the mission and maximize limited resources, and
- 2) Act as an educator/facilitator to motivate independent actions that will accomplish the mission and maximize limited resources, and
- 3) Take action through specific projects or programs when TLGV is the only or most appropriate entity to bring about initiation or successful completion of critical work.”

Past accomplishments include a successful grant program which distributed more than \$3.1 million to over 200 projects throughout the region; creation of the Green Valley Institute, a partnership with the University of Connecticut and the University of Massachusetts Cooperative Extension Services that provides continuing education for policy makers in the region; and publications on the significance of resources found within the region.

Source: <http://www.tlgv.org/>

Quinebaug Highlands Project

Within the Last Green Valley lies the Quinebaug Highlands Project. The Quinebaug Highlands region consists of a 34,000-acre forest block within the four towns of Ashford, Eastford, Union and Woodstock in Connecticut and the towns of Southbridge and Sturbridge in Massachusetts,

which face increased pressure from development. The project area includes the 114,000 acre Natchaug River Watershed which encompasses high quality streams and supports the largest drinking water supply watershed in Connecticut. The Quinebaug Highlands Project is “the result of partnership between The Nature Conservancy and the University of Connecticut Extension System’s Green Valley Institute. With the help of multiple partners in the region a landmark \$1,000,000 grant from the North American Wetlands Conservation Act (NAWCA), 1,100 acres of forest and freshwater resources in the Quinebaug Highlands’s Natchaug River Watershed have been protected. Source: The Nature Conservancy (<http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/connecticut/placesweprotect/quinebaug-highlands.xml>)

Berkshire Taconic Landscape

Three chapters of the Nature Conservancy have joined efforts to protect the forested landscape that “stretches across the mountains of Connecticut, Massachusetts and New York, and reaches down into the lowlands of the Housatonic and Hudson Valleys.” Conservation targets include Northern Hardwood Forest Matrix; Calcareous Seepage Wetland Mosaic; size one and two stream and river systems; hardwater lakes; floodplain forests; and timber rattlesnake and bog turtle critical habitat areas. Identified threats by the project include; habitat destruction and fragmentation, invasive species, stormwater run-off, global climate change, acid deposition from fossil fuels, and poaching or collection of rare and endangered species. The aim of the Nature Conservancy is to use “science-based conservation and collaborate with many different stakeholders” to accomplish these goals. Their conservation strategy includes land protection, ecological restoration, applied conservation science, collaborative land management, and collaboration with local communities. Source: The Nature Conservancy (<http://www.nature.org/ourinitiatives/regions/northamerica/areas/berkshire/>)

Connecticut River Watershed

“The Connecticut River Watershed is the largest river ecosystem in New England, encompassing approximately 11,000 square miles and spanning over four New England states, including Vermont, New Hampshire, Massachusetts, and Connecticut.” (MA EEA)

“The watershed was designated the Silvio O. Conte National Fish & Wildlife Refuge by an Act of Congress in 1991 and later became designated as a National Heritage River by President Clinton in 1998. It is the first of its kind that encompasses an entire watershed ecosystem.” (MA EEA) “The Nature Conservancy named it one of their "Last Great Places" in 1993. (MA EEA)

“The Connecticut River Watershed Council advocates for the entire, four-state Connecticut River watershed.” (<http://www.ctriver.org/>)

The watershed priorities are;

- “Continue to promote the protection and/or creation of riparian buffer zones along the waterways within the watershed.
- Work to eliminate the combined sewage overflow problems in the Springfield and Holyoke areas along the river.
- Restore the river community by removing barriers to fish and eel passages within the tributaries to the Connecticut River.
- Reduce the negative effects of non-point source pollution, primarily stormwater runoff.
- Improve upon the limited amount of water quality data available within the watershed” (MA EEA).

The MassConn Sustainable Forest Partnership

“The MassConn Sustainable Forest Partnership is a voluntary association of land trusts, conservation organizations, state agencies, and foresters serving a region of 35 towns spanning the border of South-Central Massachusetts and Northeastern Connecticut. Member groups identify key areas of the region for conservation, collaborate on land protection efforts, promote sustainable forestry practices, and organize public outreach and education efforts in order to increase the pace and efficacy of conservation in the MassConn area.”

Source: MassConn Sustainable Forestry Partnership (<http://www.opacumlt.org/massconn/>)

Interstate 95 Corridor

The remaining watersheds and forests along the I-95 corridor through Maine, New Hampshire, Massachusetts, Rhode Island and Connecticut face threats from expanding development, heavy use and poor planning. Degradation of watersheds, forest fragmentation, and a reduction of forested land along the corridor poses severe risk to water quality, forest diversity, and watershed health. Heavy use of the corridor increases the potential to spread non-native/invasive species and/or forest pests. Increasing land values enhance the pressure for private land owners to sell or subdivide forested land. (FTP)

It is important to note that several of these ongoing multi-state conservation efforts and areas are captured in, or correspond to, areas outlined in the DRAFT Concept Paper dated February 25, 2012 entitled New England/New York Forest Initiative developed by the seven state foresters (ME, NH, VT, MA, RI, CT, and NY). At the 2009 New England Governors’ Conference, the region’s State Foresters were tasked to develop, "...a New England Forest Initiative to Keep Forests as Forests that will constitute a new blueprint to protect the region's forest land-base and ensure the sustainability of these lands, as a public policy appropriate to all New England; and identify barriers to and opportunities for sustaining forestlands that are in private ownership and expanding forest products production and consumption" (NEFA 1).

Stated goals include: Strengthen Markets for Forest Products, Improve Forest Stewardship, and Minimize Forest Fragmentation, Parcelization, and Conversion (NEFA 4).

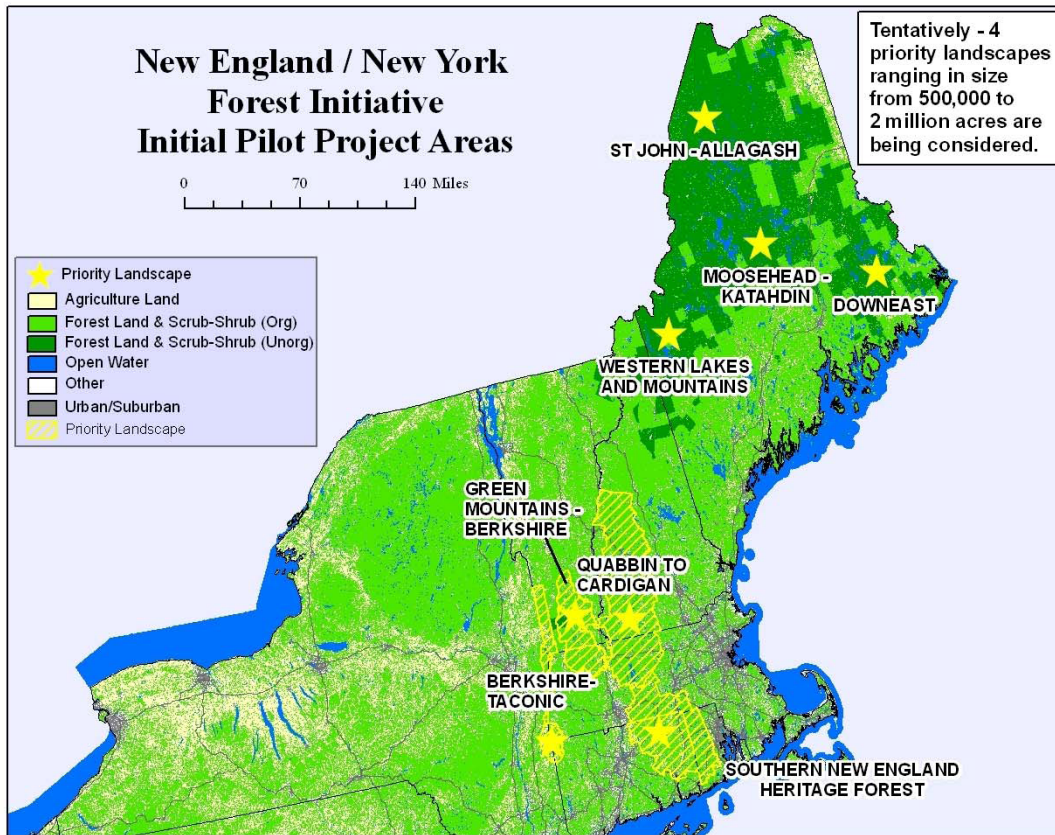
Expanding on the last goal includes ideas to “permanently conserve an additional 15 million acres of forest land in the region (reaching the goal of conserving half the forest land in the region); and have devised a variety of strategies and an initial set of pilot or demonstration projects to address them (NEFA 4).

As can be seen in Figure 56, two of the areas listed in the DRAFT New England/New York Forest Initiative as Initial Pilot Project Areas that include Connecticut:

The Berkshire/Taconic’s – “A 230,000 acre area containing an inordinate number of rare species threatened by development and climate change. Efforts will focus on restoring ecosystem functions. This will be accomplished through on-the-ground stewardship and preservation of large unfragmented forest blocks.”

Southern New England Heritage Forest – “A 1.4 million acre area that will receive focused land-use planning assistance with a variety of land conservation tools preserving the working heritage of the last remaining rural landscape in Southern New England” (NEFA 4).

Figure 56. New England/New York Forest Initiative Initial Pilot Project Areas



Source: DRAFT New England/New York Forest Initiative Concept Paper

As of the submission date of this Assessment and Strategy, this DRAFT New England/New York Forest Initiative is still a work in progress, and will be finalized after June 18, 2010 and will be presented to the New England Governors Council by July, 2010.

Multi-state Priority Issues

In addition to multi-state Priority Areas, there are also several priority issues that cross state boundaries and can be considered multi-state Priority Issues. These topics are mentioned in some capacity at various locations within in this Assessment and Strategy, a quick summary is listed below. Whenever opportunities arise, efforts will be coordinated with neighboring states to address these issues.*

* All issues write ups are summarized from information taken from the USFS FTP website based on consultations with regional forest planners in 2009. (USFS FTP) Actual quotes are cited.

Biomass Energy

This includes renewable energy and the accompanying markets for biomass. Issues involve availability/sustainability; impact on carbon balances on a regional and national level; air quality/emissions; incentives/efficient use; and state and federal regulations.

Habitat Diversity

Forests of New England and New York provide essential habitat for rare and endangered species. Concerns include change in forest diversity and structure as a result of climate change; forest fragmentation and loss of corridors; invasive species; loss of early successional habitat; and loss of forested riparian zones by increasing urban development leading to increase runoff.

Keeping Forest as Forest

Concerns include a reduction in forest acreage and increased forest fragmentation, due to increased development; uncertain forest product markets; and change in forest ownerships.

Watersheds

Protecting and managing forested watersheds is essential to provide clean water in the future. Watersheds that cross the I-95 corridor have been identified as having the greatest pressure from development. “The single most important issue facing watersheds in New England and New York is source protection” (USFS FTP).

Urban and Community Forestry – Green Infrastructure

“Green Infrastructure in an urban setting is the interconnected network of open spaces and natural areas, such as greenways, wetlands, parks, urban forests and native plant vegetation that naturally manages stormwater, reduces flooding risk and improves air and water quality” (USFS FTP). Benefits include energy efficiency, reduced costs, and community cohesiveness. Concerns involve the ambiguity in defined green and developed infrastructure areas.

Invasive Species

Invasive and non-native plant species are a threat to forest diversity, forest products, and niche habitats. Objectives are concerned with developing prevention and eradication strategies that are both time and cost effective. Since invasive populations are influenced by a plant/animal interaction, a systems based approach is essential. Invasive species also includes invasive forest pests.

Next Generation of Landowners

Concerns involve increased forest fragmentation and losing woodlands as a result of transfers of family owned land. “More than half of private woodland owners are 65 years-old or older” (USFS FTP). Increasing land values enhance the pressure for families to sell or subdivided forested land.

SECTION 5. Opportunities

Criterion 1. Conservation of Biological Diversity

Indicator 2: Forest type, size class, age class, and successional stage

Opportunities exist:

- To propagate more of an ecosystem balance within the forestlands of Connecticut by creating a better diversity of age and size classes.
- To maintain a better balance of forest types, tree sizes, and ages, by promoting size and age diversity within forests, especially in regards to maintaining early successional habitats.

Indicator 3: Extent of forestland conversion, fragmentation, and parcelization

Opportunities exist:

- To determine the exact size distribution and characteristics of these tracts.
- To education landowners in regards to this issue.

Indicator 4: Status of forest/woodland communities and associated species of concern

Opportunities exist:

- To improve the quality of information on distribution and abundance of various species.
- To create an all-inclusive forest associated species list.
- To further refine efforts to identify which species are forest-associated.

Criterion 2. Maintenance of Productive Capacity of Forest Ecosystems

Indicator 6. Annual removal of merchantable wood volume compared with net growth

Opportunities exist:

- To track other industries often associated with timber removals.
- To track sustainability through better growth and removal data regarding the timber resources of the state.

Criterion 3. Maintaining Forest Ecosystem Health and Vitality

Indicator 7. Area of forest land affected by potentially damaging agents

Opportunities exist:

- To expand responsible hunting and minimize additional conversion of forest to conventional subdivisions helping to stabilize and reduce an excessive deer population. This may have the effect of helping to regenerate tree species often heavily browsed.
- To combat invasive plant species through research, planning, and earmarked funding.

Criterion 4. Conservation and Maintenance of Soil and Water Resources

Indicator 8. Soil quality on forestland

Opportunities exist:

- To fill the research voids in data on soils and carbon. To date, the state has not studied total soil carbon and calcium-aluminum ratios for indicators of the overall soil health and its relationship with tree growth.

Indicator 10: Water quality in forested areas

Opportunities exist:

- To determine information regarding the value of forest and riparian areas and the benefits derived by the public sector not included in water quality reports.

Criterion 5. Maintenance of Forest Contribution to Global Carbon Cycles

Indicator 11: Forest ecosystem biomass and forest carbon pools

Opportunities exist:

- To educate and encourage landowners on the total values associated with forestland that, if successful, will maintain the major pools of forest carbon in the State.
- To encourage management of species and associated timber types that provides optimum carbon storage.

Criterion 6. Maintenance and Enhancement of Long-Term Multiple Socioeconomic Benefits to Meet the Needs of Societies

Indicator 13. Outdoor recreational participation and facilities

Opportunities exist:

- To list recreational opportunities in town plans such as the Blue-Blazed Hiking Trail system.
- To actively support planning and zoning regulations that provide protection for trails on private property.
- To pass ATV legislation.

Indicator 15. Forest ownership, land use, and specially designated areas

Opportunities exist:

- To increase pace of the inventory of all open space parcels in the State (Protected Open Space Mapping (POSM) Project.)
- To increase efforts to assist in private lands forestland protection, and advocating for more financial allocations for open space land acquisitions. It would also be beneficial to make the Protected Open Space Mapping project a priority.
- To catalogue all conservation easements.
- To complete the POSM project to garner comprehensive listing of easements on private lands.

Criterion 7. Legal, Institutional, and Economic Framework for Forest Conservation and Sustainable Management

Indicator 18. Forest-related planning, assessment, policy, and law

Opportunities exist:

- To complete individual plans for each State Forest management unit.
- To evaluate ways of determining urban forestry priority areas within the State.
- To increase funding for enhanced forest surveys to ensure long-term data input.
- To encourage Northeast Master Logger Certification.
- To create Biomass Harvesting Guidelines.

Issue 4. Providing for Forest Based Recreational Opportunities – Funding and staffing

Opportunities exist:

- To explore the dedicated use of user/registration/permit fees to be returned to associated recreational facilities. As part of the process for determining policies and budgets, and to better understand the needs of the public, there should be a continuing effort to engage recreational organizations for input.

Issue 6. Fostering Public Awareness and Support of Forests – Education Material Regarding Connecticut’s Forestlands (Lack of standardization and availability of educational material)

Opportunities exist:

- To create a manual on the basics of forestry that would be widely available to anyone who wants or needs it. New Hampshire’s new “Good Forestry in the Granite State” manual could serve as a template.
- To bring conservation groups together more often to ensure that the educational information they distribute provides a more clear and consistent message. [Create information dissemination process, i.e. local cable, CPTV, Web, List-serves, public service announcement announcing “Save the Forest” Campaign, mail a plan to each forest owner in the state of Connecticut.

Issue 7. Advocating and Implementing Effective Forest Planning and Policy Incentives for Sustainable Forestry

Opportunities exist:

- To lower the acreage requirement for PA490 to encourage additional protection of forest lands. Any acreage requirement needs to allow for economic feasibility for land management activities.

Issue 9. Limits and Threats to Urban Forestry in Connecticut - Volunteerism

Opportunities exist:

- To better utilize interested volunteers. Volunteer input is critical. Often, volunteer and volunteer groups serve to initiate and sustain urban forestry efforts in communities. The emphasis on volunteers brings its own difficulties, including that of keeping volunteer efforts ongoing, especially when the effort is dependent on one or a few people.

Throughout this Statewide Forest Action Plan the Connecticut Division of Forestry along with its numerous partners and constituents addressed the various needs and resources required to meet the many missions, goals and visions. There is a common theme among the public agencies and private conservation groups that emerges. In order to implement this assessment additional human resources are needed at the public agencies. Documentation is offered on the drastic reduction in the staffing levels of the Division. This can only change with a multi-faceted approach. Additional support and coordination for conservation programs needs to be garnered from many sectors of the state. This support and coordination needs to come from within the Department of Energy and Environmental Protection, from other state agencies (CAES, Agriculture, Extension), from NGOs (Audubon, TNC), TIMPRO, Farm Bureau, and the general public.

PART 2. STATEWIDE FOREST RESOURCE STRATEGY

SECTION 1. Visions for the Future

Connecticut Roundtable Process and Strategy Development

Connecticut held a series of seven Forest Roundtables between November 2009 and March 2010 to provide the necessary public input for this plan. Over 260 individuals participated in one or more of these events. The roundtable process developed visions, principles, and action steps with strong agreement among many kinds of stakeholders of forests of the state.

The tables of 6 to 8 people were the basic element of each roundtable. They began their dialogues with the vision statements from the previous roundtable. When their discussion developed a sense of agreement, they moved on. When they felt ambiguity or disagreement with a vision, they worked on modifications until the table was comfortable and in agreement. The tables interacted as a whole from time to time through the process, sharing progress and observations with one another. The largest participant group –168 people – was at the November 24, 2009, Forest Forum, which lasted one hour. The local and statewide roundtables were daylong processes. The groups varied from 26 to 42 participants at the local roundtables, and 75 people attended the statewide roundtable on March 16, 2010.

The visions are from 2003 results for the Statewide Forest Resource Plan and recent work by the Connecticut Urban Forestry Council. Several iterations and revisions led to the 10 visions presented in this report. Principles and action steps emerged to guide each vision toward the desired future. The results provide a base for the 2010 Connecticut Forest Assessment and Strategy, which the Connecticut DEEP Division of Forestry is developing with support from the USDA Forest Service's State and Private Forestry Program.

The results also will guide the Connecticut Forest Conservation and Research Forum, The Connecticut Forestlands Council, and several non-profit organizations concerned with the future of the state's forestlands and advocate for improved policies and practices.

Connecticut is one of the most heavily forested states in America. Our forests clean our air and water, shelter our wildlife, sequester carbon, contribute tens of millions of dollars to our economy, and add immeasurably to the quality of our everyday lives. Yet every day, our forests are under threat. Invasive insects and diseases and our dense and growing human population continue to stress our forests in unprecedented ways. Conserving a healthy forest for future generations will require creating public awareness, identifying solutions to our problems and taking action.

The Connecticut Forest Roundtable process began November 24, 2009, at the 5th Connecticut Forest Conservation and Research Forum. Building on 8 visions developed for the 2004-2013 Connecticut Statewide Forest Resource Plan and an urban forestry vision developed by the Connecticut Urban Forestry Council, participants began in small, interactive groups to:

- Create agreed-upon visions for the future of our forest resources;
- Identify new and innovative ways to make the visions into realities; and
- Develop new relationships and strengthen existing partnerships to get the job done.

Four local Forest Roundtables during December through February 2010 led to the Statewide Forest Roundtable on March 16, 2010. The results include strong agreement on 10 visions for the future of Connecticut’s forests. The principles and action steps for each vision will help guide management and policy actions toward the desired future.

The visions and principles will help achieve three broad purposes:

Conserve Working Forest Lands – Conserve and manage working forest landscapes for multiple values and uses, especially in legacy areas, some of which cross state lines with our neighbors – NY, MA, and RI.

Protect Forests from Harm –Protect forests from threats, including catastrophic storms, flooding, insect or disease outbreak, & invasive species.

Enhance Public Benefits from Trees and Forests – Enhance air and water quality, soil conservation, biological diversity, carbon storage, recreation, forest products, production of renewable energy, & wildlife. Public benefits drive many of the draft principles.

Essential public benefits from forests include:

- Climate moderation
- Water quality and quantity
- Air quality
- Biodiversity
- Forest products
- Aesthetics & scenic vistas
- Scientific research
- Education
- Recreation
- And other forest-based values

The products of the Forest Roundtables are visions, principles, and action steps. Visions are simple statements of our desired future forest in 5 to 20 years. They are a stretch but realistic goals for our forest policies and management activities. Principles are statements about how we think the world works; they are in a sense working hypotheses about the bigger world in which Connecticut forest problems exist. Principles guide our actions to reach our visions. As we learn from experience and others, our knowledge and understanding will lead to improved principles. Action steps are specific things identified organizations or groups can do now. Monitoring the implementation of action steps is an important way of really working toward the visions.

The visions, principles, and action steps are inputs to three policy efforts. First, they provide stakeholder input to the 2010 Connecticut Forest Assessment and Strategy. Second, they give direction to the 2010 Forest Forum and efforts to work with many partners in Connecticut, in our neighbor states of New York, Massachusetts, Rhode Island, and in the rest of New England to promote the three broad purposes. Third, the results will guide the Connecticut Forestlands Council as it reconsiders its role in state forestry for the coming five years.

Over 260 individuals participated in the seven Forest Roundtables and some people attended two or three events. Their involvement and their statements testify to their enthusiasm for Connecticut’s trees and forests, as well as their concerns about forces that lead to reduced area of working forests, increased harm from development and invasives, and decreased public benefits from forests.

The participants expressed their delight with Connecticut's forests, and their worries about the future. The visions and principles they developed are their current thoughts on how to address their concerns and continue to have the many benefits that forests provide.

The Roundtable Process

The Roundtable process used in Connecticut follows the broad patterns of the 1996 Seventh American Forest Congress. Dialogues at the tables lead to three possible kinds of agreements or disagreements:

- Green – I agree with the statement
- Yellow – I am not sure/I feel ambiguous about the statement
- Red – I disagree with the wording or the values in the vision

Each table discussed:

- *Visions and Principles: Where do we have high levels of agreement?*
- *Can we improve the statements where we have ambiguity or disagreement?*

The moderator interrupted table discussions periodically to share results and discussion points and to ascertain levels of agreement. Most of the assessment of consensus was verbal or by show of hands, but use of green, yellow and red dots on statewide roundtable tables made the levels of agreement quite vivid and helped focus on visions and principles where further dialogue had high payoffs.

The process led to consensus, and the results are not the outcomes of "votes" in the sense observed on town committees or state commissions. Because of repeated conversations and considerable careful listening by the participants and the moderators, we can be reasonably sure that the visions are statements upon which there is general agreement.

After the Forum Roundtable in November and after the statewide Roundtable, the moderator circulated draft results to facilitators and key leaders at the sessions to make sure interpretation of their notes were correct.

The over 260 individuals who participated in one or more of the Forest Roundtables came from all parts of the state. Many have work connected to forests or natural resources, but more often than not the participants came to a roundtable as part of their work and interests in one or more voluntary organizations. There are unavoidable biases in the roundtable process because some stakeholders simply cannot get the time to spend a day away from work or family. Members of the Connecticut Urban Forestry Council Urban represented urban perspectives well, but few participants live in one of Connecticut's major cities.

This report will be on the DEEP and CFPA web pages (with links from other organizations) and DEEP Forestry will invite further comment from the public. This process will continue beyond submission of the 2010 Connecticut Forest Assessment and Strategy in June. It is possible that DEEP Forestry, CFPA, CFC, and other partners will keep the process ongoing to pick up changes in perspective and value regarding forests in the state.

Connecticut's Forest Vision Statements

The state-level results include 10 visions with solid agreement at the end of the Statewide Forest Roundtable on March 16, 2010. All the vision statements are in the future tense with the implied time frame of 5 to 20 years – not tomorrow, but not an indefinite future either. Therefore, the common phrase for all visions is, *In the future....*

In the future,

1. The fact that all forests provide important public benefits will guide Connecticut's forest and land use policies.
2. Connecticut will increase the amount of forest protected from development following priority criteria based on core forest areas, forest legacy potential, and vulnerability.
3. Connecticut's forests will contain healthy and sustainable populations of native plants and animals.
4. Public agencies will manage Connecticut's public forestlands to enhance public benefits.
5. Policies will fully support and encourage private forest owners that have environmentally, socially, and economically balanced stewardship goals.
6. The people of Connecticut will understand and value the urban forests as essential parts of healthy urban ecosystems.
7. Connecticut's forests will support a broad spectrum of appropriate recreational activities that attract users to Connecticut's forests.
8. Connecticut will use its forests to stimulate learning about nature and ecology and to demonstrate various sustainable forest management strategies.
9. Connecticut's forests will support a viable forest products industry that provides marketable products from renewable and diverse forest resources.
10. Management of Connecticut's forests will use the best available scientific information and the best available data as the basis for sound conservation and management decisions.

Complete Set of Agreed-Upon Vision, Principles, and Action Steps

The vision statements evolved from the visions created in 2003-04 with stakeholder input to the Connecticut Statewide Forest Resource Plan 2004-2013 (which is still available on the DEEP Forestry Division web pages). This Report's Appendix provides the starting point and the evolution of visions over the seven Forest Roundtables from November 2009 to March 2010.

1. In the future, the fact that all forests provide important public benefits will guide Connecticut's forest and land use policies.

Principles:

- a) All forests – urban, suburban, and rural – provide some combination of important public benefits that have real value, but the benefits often do not pass through the marketplace or have prices.
- b) Connecticut policies affecting forests will use the best available scientific research and information in a collaborative manner.
- c) Citizen understanding of the important benefits provided by Connecticut's forests requires more education.
- d) Connecticut legislators will recognize that ensuring a future supply of these important benefits requires incentives for those who provide them (e.g., PA 490).

Action steps to accomplish this vision

- a) Connecticut policies and programs will promote active forest management to maintain a diversity of habitats.
- b) DEEP Forestry, CFPA, and other non-profit organizations will help coordinate and collaborate with public and private organizations and neighboring states.

2. Connecticut will increase the amount of forest protected from development, following priority criteria based on core forest areas, forest legacy potential, and vulnerability.

Principles:

- a) In the future, Connecticut forestlands will cover about 60% of the state's land area; as much as a third or more of the forest area will be more than 300 feet from non-forested areas (the purpose of such forest integrity needs CFC member review in 2010-2011 and a specific target set).
- b) Educational programs are necessary to develop public understanding and support for this vision.

Action steps to accomplish this vision:

- a) The Connecticut legislature will pass a law to insure conversion of the approximately 14,000 acres of forestland under the "10 Mill" law to property tax rates under PA 490, or write a new law that strongly encourages continuation as open space and working forests.

- b) DEEP will develop a Connecticut Forest Land Conservation program to aid in achieving this vision in cooperation with public and private programs such as local land trusts, the USDA Forest Service Forest Legacy Program, and The Nature Conservancy.
- c) All organizations concerned with forestlands will increase public awareness of opportunities to protect forestlands, emphasizing public benefits; the state may need a *Working Forests Initiative* (similar to Connecticut Farmland Preservation).
- d) CUFC will increase public awareness of opportunities to protect urban forestlands and urban trees, emphasizing public benefits.
- e) CFPA and land trusts will consider advocating for Connecticut income tax deductions for gifts of land or below-value sale of conservation easements that will preclude development of private forestlands.
- f) DEEP Forestry will try to use federal funds to support Forest Legacy Program meetings of collaborators who are working with state and federal agencies to advise and implement strategies.
- g) Reverse the fragmentation process through identification and protection of properties that will create core forests or expand existing core forests.

3. In the future, Connecticut's forests will contain healthy and sustainable populations of native plants and animals.

Principles:

- a) A diversity of habitats is necessary to maintain a diversity of wildlife and native plants, so Connecticut landowners should manage forests and other open spaces for a mix of land uses from grasslands to shrublands to mature forest stands.
- b) Prompt control of alien invasive species will require public and/or private funds, given that removal often is very expensive.

Action steps to accomplish this vision

- a) DEEP and non-profit organizations will encourage population reduction in locally over-abundant species that damage ecosystems, such as native white-tailed deer; this may require new legal frameworks to permit reduction of deer populations on lands that prohibit hunting; e.g., Goodwin State Forest.
- b) CFPA, UConn Cooperative Extension System, and other organizations will provide the education needed in schools and adult workshops so that Connecticut citizens understand the linkages between ecological diversity and plant and animal populations.
- c) CFC, UConn, Yale F&ES, and non-profits will encourage the natural resource professional and scientific communities to monitor species populations; where decline or disappearances occur, and they will promote efforts to restore habitats and return the species to its previous position in the overall environment.
- d) Use Garden Clubs and non-profit organizations with expertise to educate garden centers regarding sale of non-invasive plants.

4. In the future, public agencies will manage Connecticut’s public forestlands to enhance public benefits.

Principles:

- a) State-owned lands utilize the best, most current biological, physical, and social science information to make informed decisions.
- b) Municipally owned forestlands also will utilize the best science, but the forest management goals may be quite different from those for state forests and other forested state lands (e.g., parks, wildlife refuges).
- c) Coordination among DEEP, DOT, utilities, and towns will improve management of the forest strips and corridors.

Action steps to accomplish this vision:

- a) The State Legislature will create a funding mechanism to ensure that revenues generated from state-owned forests be used for sustainable management of those lands.
- b) Local education programs will enhance the ability of municipal and state agencies to manage public forestlands for public benefits.
- c) Municipal conservation planning efforts will identify key properties for conservation.

5. In the future, policies will fully support and encourage private forest owners that have environmentally, socially, and economically balanced stewardship goals.

Principles:

- a) Public and Private programs will maximize (1) the area (acres) and (2) the number of parcels on which landowner goals and conservation of public benefit are aligned.

Action steps to accomplish this vision:

- a) Create effective, appropriately funded public/private support systems addressing education, research, consultation/advice, compensation/incentives, and communications.
- b) Local land management regulators will promote, and extension foresters, service foresters, and forestry consultants will encourage, forest owners, foresters, and forest harvesters to use Best Management Practices in all field operations.

6. In the future, the people of Connecticut understand and value urban forests as essential parts of healthy urban ecosystems.

Principles:

- a) Urban forests are composed of the trees where we live and work—in public and private ownership—including all the trees: along our streets and highways; in parks and public spaces; around our schools; in our yards; on residential, commercial, industrial, institutional, retail; and recreational properties of all types; and in green and open spaces.

- b) Urban forests exist in all our communities—urban, suburban, and rural—and are not limited to a few large cities.
- c) Healthy forest ecosystems are necessary to the function of all landscapes.
- d) Urban forest management is a complex undertaking that involves knowledge of trees, the personal and spiritual needs of people, and the difficulties and opportunities within the urban environment; professionals who manage urban forests will also need to be versatile, with a skill set that draws upon a range of disciplines.

Action steps to accomplish this vision:

- a) CUFC will work to increase public involvement in local urban forestry projects because community support is critical to the future of the urban forest.
- b) Municipalities, designers, architects, engineers, and urban foresters will explore and further develop ways by which urban trees will have a direct role in improving the functioning of the built environment; examples include cleaning the air, reducing storm water runoff, and reducing energy consumption.

7. In the future, Connecticut’s forests will support a broad spectrum of appropriate recreational activities that attract users to Connecticut’s forests.

Principles:

- a) Outdoor recreation is the single most common reason why people are in the forest and develop an appreciation of its many values.
- b) Recreation activities and sites provide excellent opportunities for education about forest management
- c) Outdoor recreation in forests can benefit state tourism aspects and increase revenue from tourist activities.

Action steps to accomplish this vision:

- a) Educate users in the values and manners of multi-use recreation areas; where multi-use is not possible, there may be a need for dedicated areas that separate incompatible activities.
- b) Improve parking for cars and recreation trailers; improve trail signage, picnicking and camping areas, and other facilities that will encourage outdoor recreation.
- c) The Legislature should complete a review of proposed increases in fees using benefit/cost analysis that considers (1) impact on total revenues and use levels, (2) impact on users in lower income levels, and (3) impact of higher fees on other state policy goals, such as reducing damage to forest from high deer populations.
- d) Encourage more volunteer efforts to improve and maintain recreation facilities.
- e) CFPA, other trail organizations, land trusts, and towns will work together to protect Connecticut’s Blue-Blazed Hiking Trails and other trail systems in the state.
- f) State and local organizations will provide more and better internet links regarding trails and other forest recreation opportunities.

- g) Require licenses and control recreation activities that pose safety hazards and potential nuisance problems.
- h) Promote outdoor recreation as part of No Child Left Inside[®].
- i) Allocate funding for activities, such as off-road vehicle use, currently prohibited in many locations. Specific areas would be designated that alleviate reasons for prior prohibitions. Design, control, maintenance, and cost issues will need resolution.
- j) Improve opportunities for willing private landowners to provide areas for some or all forest-based recreation activities.
- k) Towns and State should appropriate adequate funds to enforce restrictions on activities, licenses, etc., because unenforced laws encourage disregard for laws and leave people unprotected.

8. In the future, Connecticut will use its forests to stimulate learning about nature and ecology and to demonstrate various sustainable forest management strategies.

Principles:

- a) Increase the emphasis on nature and ecology in schools because education is integral to the success and sustainability of healthy forest ecosystems.
- b) Adults learn more rapidly and thoroughly about forests through experiential education focused on areas of specific interest to them (e.g., forest management, recreation, urban environment, etc.)

Action steps to accomplish this vision:

- a) Extension forestry, service forestry, and local organizations will use existing programs, such as Coverts and Goodwin Forest Outreach, as excellent templates for statewide replication to address adult education needs for forest landowners.
- b) CFPA, DEEP, and other organizations will work with various stakeholders to write Connecticut's Environmental Literacy Plan (ELP) and insure that the Connecticut ELP addresses the public benefits of Connecticut forests as part of its content (Note – CT can receive up to \$1 million for No Child Left Inside[®] funding, but only if state ELP is in place).
- c) CFPA and partners will work with the Connecticut State Department of Education during the next revision of the state's frameworks (standards) to include ecology of forests, wildlife, and aquatic systems in various disciplines (science, social studies, math, and language arts).
- d) CUFC, CFPA, and others will help connect the tools, resources, and funding to teach about urban forestry and the tools to manage urban trees and forests.
- e) CFC and member organizations will develop a plan and strategy of education for the Media, including web-based outlets like Facebook.
- f) DEEP Forestry, CFC, CFPA, and educational organizations will collaborate with initiatives in education, communication, and efforts to realize the other nine forest visions. They will develop comprehensive information about Connecticut forests that is easy for the public to access and understand.

9. In the future, Connecticut's forests will support a viable forest products industry that provides marketable products from renewable and diverse forest resources.

Principles:

- a) A viable forest industry is essential to sustainable management of forests.
- b) Both timber and non-timber forest products comprise a viable forest economy.

Action steps to accomplish this vision:

- a) CFPA and its partners will distribute the *Notification of Timber Harvest* forms developed by the Ad Hoc Forest Regulation Committee to all Connecticut towns with a recommendation to use it instead of the odd mix of local application forms currently observed.
- b) TimPro, its partners, and individuals will develop stronger DEEP and legislative support for public policies favorable to the industry and promote general initiatives to make Connecticut laws and regulations both simpler and more efficient for the industry.
- c) TimPro and other associations will advertise and promote the markets for Connecticut grown wood and fiber. This will include expanding the branding of Connecticut Grown crops and products to include Connecticut's forest resources.
- d) CFC and member organizations will promote education to increase awareness and understanding of the economic values forests provide.
- e) State legislation will support Federal Fair Trade laws to eliminate illegally harvested forest products in imported materials and require chain of custody certification on processed goods.
- f) TimPro and other organizations will argue to bring Connecticut truck weight limits into conformance with PA, NY, MA, and RI.
- g) TimPro will promote a viable forest products industry that contributes to Connecticut's economy.
- h) Obtain State (and local) Economic Development Commission support for the Connecticut forest products industry.

10. Management of Connecticut's forests will use the best available scientific information and the best available data as the basis for sound conservation and management decisions.

Principles:

- a) Science enables our understanding of forests and their dynamics; it provides a basis for predicting responses of forests to management, and responses by people to changes in their forests.
- b) Adaptive management will be the standard practice with data-driven results providing feedback to improve ongoing management decisions.

- c) Research priorities will be the result of an ongoing dialogue among scientists, forest owners and managers, and outreach specialists.

Action steps to accomplish this vision:

- a) Increase state funding for forest research by the Connecticut Agricultural Experiment Station and University of Connecticut and other entities; advocate increased federal competitive grants for forestry research from USDA Forest Service, DOE, and NSF that are open to all state research organizations concerned with forests.
- b) Increase state funding for extension and service forestry programs and advocate for increased federal support. Working forests are the least expensive way to maintain open space and produce public benefits from forestlands (e.g., clean water, scenery, wildlife habitat, carbon sequestration, etc.)
- c) Outreach specialists will provide mechanisms to disseminate research findings to land managers and interested parties in ways that they can understand and use.
- d) Develop training programs to improve the collaborative dialogue among practicing foresters, forest landowners, and information service providers; hold regular meetings and field tours that bring these groups together for dialogue and planning.

Common Threads among Principles and Action Steps

Several principles are applicable across many visions and received strong levels of agreement. These principles both set the tone of common ground among several interests and pave the way toward improved policies and on-the-ground practices. Progress in both rural and urban areas will highlight the importance of forests and trees to Connecticut citizens and help gain support for improved policies and management in the future.

- All forests – urban, suburban, and rural – provide some combination of important public benefits that have real value; forest benefit values often do not have prices or appear in marketplace transactions.
- Urban forests are composed of the trees where we live and work—in public and private ownership—including all the trees: along our streets and highways; in parks and public spaces; around our schools; in our yards; on residential, commercial, industrial, institutional, retail; and recreational properties of all types; and in green and open spaces.
- Private forest owners provide the vast majority of public benefits without compensation, except for reduced property taxes for open space values (i.e., PA 490) and some support services (e.g., extension and service forestry programs).
- A diversity of habitats is necessary to maintain a diversity of wildlife and native plants, so Connecticut landowners are encouraged to manage forests and other open spaces for a mix of land uses from grasslands to shrublands to mature forest stands.
- Urban forests exist in all our communities—urban, suburban, and rural—and are not limited to a few large cities.
- Healthy forest ecosystems are necessary to the function of all landscapes.
- Connecticut’s State Forests will continue to serve as demonstration areas for sound forest management, as was one of the original purposes when Connecticut established State Forests in the early 1900s.

- K-12 and adult education will help Connecticut citizens understand the linkages between ecological diversity and plant and animal populations.

Progress comes from actions successfully implemented, not just encouraging words. Some steps that can be taken in the near term will set the stage for more creative and bold thinking over the coming few years. The following are steps that garnered strong agreement and would, if implemented quickly and with effective follow up, set the stage for statewide and regional actions to conserve working forests, protect forests from harm, and enhance the public benefits flowing from forestlands.

- CFPA and its partners will distribute the *Notification of Timber Harvest* forms developed by the Ad Hoc Forest Regulation Committee to all Connecticut towns with a recommendation to use it instead of the mix of local application forms currently in use.
- The Connecticut legislature will pass a law to insure conversion of the approximately 14,000 acres of forestland under the “10 Mill” law to property tax rates under PA 490 or write a new law that strongly encourages continuation as open space and working forests.
- Local land management regulators will promote and extension foresters, service foresters, and forestry consultants will encourage forest owners, foresters, and forest harvesters to use Best Management Practices in all field forestry operations.
- Connecticut’s public natural resource management agencies will coordinate and collaborate with neighboring states and private non-profit organizations to achieve common visions.
- All organizations concerned with forestlands will increase public awareness of opportunities to protect forestlands, emphasizing public benefits. Connecticut should consider a *Working Forests Initiative* that is similar to the state’s focus on farmland preservation.
- Connecticut public agencies will manage locally over-abundant species that damage ecosystems, such as native white-tailed deer, for population size and dynamics.

What is New and What is Not

Three purposes drive the Forest Assessment and Strategy in Connecticut and other states:

- *Conserve Working Forest Lands*
- *Protect Forests from Harm*
- *Enhance Public Benefits from Trees and Forests*

Table 1 demonstrates the solid connection between these purposes and the 2010 visions. Each vision contributes to all three purposes. Strong Contributions are denoted by a large, bold **X**, medium with a middle contribution **X**, and modest contributions with a normal size **X**.

Another way of looking at the linkage of vision to desired goals is reconsidering the public benefits noted at the beginning of this report. Some visions are more specific and some, like science and education, are universal.

<u><i>Essential public benefits from Forests:</i></u>	<u><i>Connecticut Forest Visions</i></u>
▪ Climate moderation	#1, 2, 3, 4, 5, 8,9, & 10
▪ Water quality and quantity	#1, 2, 3, 4, 5, 6, & 10
▪ Air quality	#1, 2, 3, 4, 5, 6, & 10
▪ Biodiversity	#1, 2, 3, & 10 (and likely 4 and 5)
▪ Forest products	#1, 3, 5 & 8
▪ Aesthetics & scenic vistas	#1, 2, 3, 4, 5, & 7
▪ Scientific research	#1, 2, 3, 4, 5, 6, 7, 8, 9, & 10*
▪ Education	#1, 2, 3, 4, 5, 6, 7, 8, 9, & 10*
▪ Recreation	#1, 2, 3, 4, 5, 6, 7, 8, 9, & 10*
▪ And other forest-based values	#4, 5, & 7
	It is hard to imagine a value not covered by one or more vision statements.

**Science and Education cut across all values and benefits from Connecticut's forests, and they are essential to sustaining and increasing these benefits in the future.*

The 2010 visions for Connecticut's forests are not dramatically different from the 2004 visions. In 2004, stakeholders produced 8 visions and CUFC added an urban forestry vision before the 2009 Forum Roundtable. We now have 10 visions, some of which are virtually the same (4 and 7). However, several are not the same (3, 5, 6, 8 and 9) and three are quite different (1, 2 and 10). The 2010 visions are more integrative and more focused on the quality characteristics of forest ecosystems than in 2004, and they point to improved social processes for continued dialogue about values and scientific priorities. See Table 2 for the comparison.

Table 1: Relationship of 2010 Vision Statements to Three Major Purposes of 2010 Connecticut Forest Assessment.

<p>In the future,</p>	<p>Conserve Working Forest Lands – Conserving and managing working forest landscapes for multiple values and uses, especially in legacy areas, some of which cross state lines with our neighbors – NY, MA, & RI.</p>	<p>Protect Forests from Harm – Protect forests from threats, including catastrophic storms, flooding, insect or disease outbreak, & invasive species.</p>	<p>Enhance Public Benefits from Trees and Forests – Air and water quality, soil conservation, biological diversity, carbon storage, recreation, forest products, production of renewable energy, & wildlife.</p>
<p>1. The fact that all forests provide important public benefits will guide Connecticut’s forest and land use policies.</p>	<p>Strong contributions</p>	<p>Strong contributions</p>	<p>Strong contributions</p>
<p>2. Connecticut will increase the amount of forest protected from development, following priority criteria based on core forest areas, forest legacy potential, and vulnerability.</p>	<p>X</p>	<p>X</p>	<p>X</p>
<p>3. Connecticut’s forests will contain healthy and sustainable populations of native plants and animals.</p>	<p>X</p>	<p>X</p>	<p>X</p>
<p>4. Public agencies will manage Connecticut’s public forestlands to enhance public benefits.</p>	<p>X</p>	<p>X</p>	<p>X</p>
<p>5. Policies will fully support and encourage private forest owners that have environmentally, socially, and economically balanced stewardship goals.</p>	<p>X</p>	<p>x</p>	<p>X</p>
<p>6. The people of Connecticut will understand and value the urban forests as essential parts of healthy urban ecosystems.</p>	<p>x</p>	<p>X</p>	<p>X</p>
<p>7. Connecticut’s forests will support a broad spectrum of appropriate recreational activities that attract users to Connecticut’s forests.</p>	<p>X</p>	<p>x</p>	<p>X</p>
<p>8. Connecticut will use its forests to stimulate learning about nature and ecology and to demonstrate various sustainable forest management strategies.</p>	<p>X</p>	<p>X</p>	<p>X</p>
<p>9. Connecticut’s forests will support a viable forest products industry that provides marketable products from renewable and diverse forest resources.</p>	<p>X</p>	<p>X</p>	<p>X</p>
<p>10. Management of Connecticut’s forests will use the best available scientific information and the best available data as the basis for sound conservation and management decisions.</p>	<p>X</p>	<p>X</p>	<p>X</p>

Table 2: Comparison of 2004 Vision Statements (top) with 2010 Vision Statements (side).

In the future,

1. The fact that all forests provide important public benefits will guide Connecticut's forest and land use policies.
2. Connecticut will increase the amount of forest protected from development, following priority criteria based on core forest areas, forest legacy potential, and vulnerability.
3. Connecticut's forests will contain healthy and sustainable populations of native plants and animals.
4. Public agencies will manage Connecticut's public forestlands to enhance public benefits.
5. Policies will fully support and encourage private forest owners that have environmentally, socially, and economically balanced stewardship goals.
6. The people of Connecticut will understand and value the urban forests as essential parts of healthy urban ecosystems.
7. Connecticut's forests will support a broad spectrum of appropriate recreational activities that attract users to Connecticut's forests.
8. Connecticut will use its forests to stimulate learning about nature and ecology and to demonstrate various sustainable forest management strategies.
9. Connecticut's forests will support a viable forest products industry that provides marketable products from renewable and diverse forest resources.
10. Management of Connecticut's forests will use the best available scientific information and the best available data as the basis for sound conservation and management decisions.

	1. Forest Ecosystem Health	2. Public Forest Stewardship	3. Private Forest Stewardship	4. Recreation	5. Sustainable Forest Based Economy	6. Education and Outreach	7. Planning and Policy	8. Research	9. Urban Forestry
							X		
	X								
	X								
		X							
			X						X
				X					
						X			
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SECTION 2. Statewide Forest Resource Strategies Program Area Integration

In addition to the Vision Statements, Principles and Action Steps developed during the Roundtable process, the DoF and the CAES, implementers of the forestry programs statewide, developed a series of visions, missions, critical success factors, and strategies and actions that could be integrated into the Statewide Strategy.

Connecticut Department of Energy and Environmental Protection – Division of Forestry

1) State Lands Management

a) Vision

- i)* The Division of Forestry (DoF) manages Connecticut’s State Forests, the largest single landholding in the state, to ensure that a viable and productive forest ecosystem provides clean air, water, carbon sequestration and climate moderation while unique, fragile, and threatened habitats are protected. This management model uses an ecological approach to resource sustainability in a functioning biological system with intrinsic ecosystem values to be held in the public trust for future generations.

b) Mission

- i)* It is the mission of the DoF to manage the resources of the State Forests in a professional manner, perpetuating a healthy forest ecosystem of native species and preserving significant habitat values while protecting the forest from fire, theft, exotic plants and insects, disease and illegal/abusive practices. The DoF uses scientific forest management methods to provide a variety of valuable ecosystem services to citizens and industry. This ensures that the State Forests serve as a resource management demonstration model and an example of silvicultural success while providing both traditional and non-traditional forest products to citizens and the forest based economy in a sustainable manner. This will ensure an array of resources, uses and values now and in the future. This mission of the DoF supports the comprehensive plans of the DEEP Bureaus of Natural Resources and Outdoor Recreation [Connecticut’s Wildlife Action Plan (WAP), Statewide Comprehensive Outdoor Recreation Plan (SCORP) and the Fisheries Habitat Conservation Enhancement Plan (HCEP)].

c) Critical Success Factors

- i)* Perpetuate a forest ecosystem that graduates native and natural regeneration to the over-story. Create a mosaic of different aged stands coordinated with the habitat needs of native wildlife populations. Designate and protect core old forest land.
- ii)* Stop the spread of exotic invasive plants and insects into the public forest ecosystem.
- iii)* Protect all boundaries and roads, especially in watersheds for public, recreational and agricultural water supplies.
- iv)* Upgrade information management.
- v)* Support utilization and marketing as a management tool.
- vi)* Incorporate recreation uses into ecosystem sustainability

vii) Continually improve public information.

viii) Harvesting sustainability.

d) Strategies and Actions

i) Maintaining a sustainable forest ecosystem:

(1) Establish, perpetuate and graduate desirable native regeneration (oak, hickory, sugar maple, white pine, hemlock, yellow birch, white ash, and tulip).

(2) Control over-browsing by deer (supports WAP).

(3) Increase the number of acres of hunted state land to reduce deer and turkey populations (supports SCORP & WAP).

(4) Revisit stands within 5 years of established regeneration with follow up silviculture treatment to ensure regeneration-release-graduation.

(5) Develop a comprehensive trail policy with trail design standards based on user needs to avoid interruption to the regeneration harvest sequence and protect core old forest land (supports SCORP & WAP).

ii) Stop the spread of non-native plants and insects.

(1) Control/eradicate invasive plants within stands and monitor/prevent invasive insect infestations. Monitor potential diseases. Use prescribed burning for ecosystem maintenance/restoration to control/eradicate invasive plants, improve wildlife habitat and prepare stands for regeneration (supports WAP, Fire Management Program, and Forest Health Program).

iii) Mark forest boundaries on a regular cycle to find encroachments, trespass, theft and infrastructure damage (supports SCORP).

(1) Purchase interior land parcels, inform public of open forest roads, post or gate DEEP owned roads closed, and close illegal trails (supports SCORP).

iv) Upgrade Information Management – create an integrated system of field data collection, compilation, storage and dissemination to include GIS maps in house and online for management planning.

(1) Create DEEP biological database and GIS map system. Collect, store and distribute field data in partnership with other DEEP Divisions with portions available online (LEAN – Jan 2010).

(2) Explore a management system based on eco-regions with common landscapes and forest communities (southeast, northeast, central, northwest and southwest). Preserve and protect old forestland sites, watersheds (supports Watershed Forestry & WAP).

v) Utilization and Marketing

(1) Convey to the public and policy makers the economic importance and social value of Connecticut's forest industry. This includes the value of traditional products such as timber and firewood and non-traditional, non-timber products and ecosystem services such as boughs, biomass, maple taps, hiking, camping, clean fresh water streams, healthy wildlife populations, carbon sequestration and climate moderation. State forests provide a reliable, renewable and sustainable variety of products to the State certified professional forest products industry and citizens. For over 100 years, state forests have contributed to economic conditions with jobs, equipment and fuel sales and business opportunities in rural areas (supports SCORP, WAP, Forest Utilization and Marketing, FPA Mission).

- (2) Prepare a biomass harvesting strategy that addresses early intervention in younger stands, graduation of advanced regeneration, nutritive replenishment and sustainability.
- vi) Cultivate alliances with user groups for cooperative trail management agreements, Institute paid recreational passes for horses and wheeled vehicles (supports SCORP).
- vii) Provide conservation education and demonstration
 - (1) Partner with the Private & Municipal Land Program (P&ML) landowner groups, conservation organizations and other DEEP Divisions to establish Conservation/Demonstration harvest schedules and tours. Motivate landowners to learn the importance and apply principles of sustainable forest management to their land using partners like the University of Connecticut, Connecticut College, The Nature Conservancy and The Connecticut Forest and Park Association (supports WAP, Forest Stewardship Program, Conservation Education).
 - (2) Assist with Envirothon and No Child Left Inside[®].
 - (3) Promote research and projects that allow better quantification of ecosystem services. For policy makers, landowners, land managers and the public to fully embrace ecosystem services they need a greater understanding of how these benefits matter at the local level.
 - (4) Disperse information to the public regarding the benefits of forest management integrated with improved wildlife habitat management, clean water and well planned recreation using municipal involvement in management planning review, response to citizen concerns, clearly marked boundaries and informational signs at harvest sites.
 - (5) Post harvest schedules online with maps.
- viii) The Yale University Sustainability Study, commissioned by DEEP, was completed in 2008. The study indicates that DEEP Forestry is currently harvesting approximately 30% of the available timber. The challenge is to meet the sustainable harvest goal of 9 million board feet of timber per year that the Yale Study references. This gap in sustainability reveals that only a portion of the ecosystem is being managed. The current State Lands Program is currently only 50% staffed. Four state forest units comprising about 60,000 acres are without forester coverage. This strains the remaining field staff and one supervisor to cover the unmanned areas for minimal management that will never approach a sustainable level without additional personnel. This will result in diminished ecosystem services, reduced economic importance and social value, increased invasive spread, and a degraded forest ecosystem in rural regions that will not be able to benefit equally with other areas of the state.

2) ***Forest Protection Unit***

a) **Background**

Connecticut Statutes require that the DEEP maintain personnel and equipment to be able to respond to requests for assistance in the suppression of wildfire. Consequently, DEEP Forestry staff and Parks and Recreation staff all have fire suppression as part of their job duties. Division of Forestry fire staff maintains wildland fire equipment and provides training to DEEP staff to meet the intent of the law.

Connecticut is a charter member of the Northeast Forest Fire Compact (NE Compact) that was formed after the disastrous fires in Maine in 1947. This is a mutual compact between the New England states, New York, the National Forest System in New England and four Canadian provinces. This is the oldest and most active fire compact in the country. Fire staff work on committees, train and coordinate all activities for compatibility.

The DEEP has an agreement in place to move federally qualified firefighters and equipment to respond to fires anywhere in the U.S. Fire crews made up of twenty highly trained persons have responded to fires all over the country and individuals meeting very high training standards with specialized experience have responded as well. These “national mobilizations” form the background of a very skilled workforce that makes the fire staff the best in Connecticut. The National Wildfire Coordinating Group (NWCG) is the body that develop standards for training, equipment and experience for national response.

Connecticut fire staff annually train DEEP employees in wildland fire suppression and tactics. In addition free training is provided to any fire department. Annually over 1000 local firefighters are trained. There is a close working relationship with local fire departments.

Five years ago the Connecticut Rural Fire Council was formed to provide an improved conduit to the DEEP fire staff and the local fire chiefs. The Council is made up of representatives from county chief’s organizations and reviews DEEP programs and identifies rural fire issues.

Wildland Urban Interface (WUI) is where the “wildlands” and people coexist. When people move into former wooded areas there are increased wildland fire issues that emergency responders must deal with. Although other areas of the country have very expansive WUI problems, Connecticut has its own set of concerns facing the fire departments and Emergency Responders. Nationally there are several programs that deal with WUI to help provide information, relevance and continuity to interested parties. Firewise is one such program that has gained national recognition.

b) Vision

i) Connecticut is a wealthy state that thrives on the home rule concept. Volunteer, paid and combination fire departments are independent yet are struggling to maintain membership, training requirements and high service to the public that they serve. The Division of Forestry has the skills necessary to meet the statutory requirements to assist fire departments with fire suppression through highly trained personnel and ready equipment. Fire departments depend on the Division of Forestry for the highest quality wildfire training, suppression assistance, knowledge of the Incident Management System (ICS), and the National Incident Management System (NIMS). The Division of Forestry has thorough knowledge of the rural fire needs and wildland urban interface concerns. A well-coordinated communications system and partnership between the state and the fire departments can help to achieve a safe wildfire working environment, an efficient suppression effort, reduce the number of acres burned and protect the lives of Connecticut’s citizens and reduce property damage.

c) Mission

- i)* Maintain NWCG safety standards for Connecticut wildland fire fighters.
- ii)* Maintain/improve annual wildland fire training for Connecticut wildland firefighters.
- iii)* Maintain/improve all equipment. Add equipment to improve efficiency and service.
- iv)* Maintain an active Connecticut Rural Fire Council.
- v)* Strive to get active Northeastern Compact Commissioner's appointed by the Governor's office.
- vi)* Continue with strong Northeastern Compact support and return to active participation at all levels.
- vii)* Maintain/improve wildland fire training to Fire Departments (FDs)
- viii)* Improve Wildland fire statistics.
- ix)* Continue with support of National Mobilization.
- x)* Improve capability of Wildland Fire Investigation.
- xi)* Improve in-state Incident Management Team (IMT) experience and capability.
- xii)* Improve our relationships/build coalition with partners and potential partners.
- xiii)* Improve our Prescribed fire program
- xiv)* Improve public/DEEP knowledge of the fire program.
- xv)* Improve efforts to meet the Rural Fire Issues identified by the Connecticut Rural Fire Council.
- xvi)* Improve ability to get precipitation data for fire weather predictions.

d) Critical Success Factors

- i)* Maintain funding from US Department of Agriculture Forest Service (USDA FS) for operational needs.
- ii)* Continue to receive the highest quality training for staff
- iii)* Get DEEP buy in for program. Develop stronger relationships with DEEP Law Enforcement & Air Bureau.
- iv)* Maintain an active Rural Fire Council.
- v)* Strengthen our involvement with Non-Governmental Agencies (NGOs) to foster close working relationships.
- vi)* Strengthen our relationship with Department of Homeland Security and Emergency Management (DHS & EM) to assist with ICS/NIMS, IMT development.
- vii)* Look to change the Connecticut Environmental Policy Act (CEPA) requirements to allow for larger prescribed burns on State Forests.
- viii)* Refill vacated fire position as Rural Fire Coordinator.
- ix)* Update State Fire Standard Operating Procedures (SOP).

e) Strategies & Actions

- i)* Maintain NWCG safety standards for Connecticut wildland fire fighters. Upgrade as necessary.
- ii)* Maintain/improve annual wildland fire training for Connecticut wildland fire fighters.
 - (1) Continue to create new training materials for in-state firefighters and bring appropriate NWCG training classes.
 - (2) Improve flexibility of personnel through training/experience.
 - (3) Strive to have 1 NWCG Engine Boss by 2010, 3 by 2011.
 - (4) Utilize NE Compact to provide training assistance as needed.
 - (5) Provide training assistance to Northeastern Compact as needed/requested.

- (6) Utilize Federal grant funds through the Northeastern Compact for training as necessary.
- (7) Provide Leadership classes as appropriate.
- iii) Maintain/improve all equipment. Maintain to NWCG specifications as much as possible and where appropriate.
 - (1) Make/upgrade equipment to achieve maximum flexibility.
 - (2) Maintain minimum NWCG standards for all engines.
 - (a) Strive to have 3 Type 6 engines available for National assignments by 2011.
 - (3) Replace laptops as needed with appropriate software.
 - (4) Replaced assigned vehicles as needed.
 - (5) Utilize Federal grant funds through NE Compact for equipment as necessary.
- iv) Maintain an active Connecticut Rural Fire Council
- v) Strive to get active Northeastern Compact Commissioner's appointed by Governor's office.
 - (1) Improve dialogue with Commissioners
 - (2) Gain active support
- vi) Maintain/improve wildland fire training to FDs
 - (1) Improve numbers of Fire Fighter 1 (FF1) Wildland Firefighter classes
 - (a) Open discussion with Fire Academy on DEEP being lead.
 - (b) Identify "other" wildland fire training cadre
 - (c) Develop training curriculum/monitor.
 - (2) Continue with Fire Academy Recruit training.
- vii) Improve Wildland fire statistics to be more accurate, increase number of FDs participation
 - (1) Better info from all-cause/size-work with dispatch areas.
 - (2) Develop better reporting program to support national needs (Texas).
 - (3) Get better handle on loss of structures and structures threatened due to wildland fire.
- viii) Continue with support of National Mobilization
 - (1) Provide minimum of two crews
 - (a) Upgrade all crews to Initial Attack (IA)
 - (2) Provide 12-15 different overhead positions.
- ix) Improve capability of Wildland Fire Investigation
- x) Improve in-state IMT experience and capability
 - (1) Partner with DEEP Law Enforcement for search & rescue.
 - (2) Build broader capabilities for all wildland fire positions.
- xi) Maintain and improve the Federal Excess Property Program (FEPP)
 - (1) Encourage FDs to get access to Federal purchasing contracts.
 - (2) Maintain current FEPP equipment and inventory
 - (a) Evaluate the current Fire Fighter Program.
- f) **Hazard Mitigation**
 - i) Develop workable plans to meet issues identified by the Connecticut Rural Fire Council Survey – (rural water supply, access issues, house numbering).
 - ii) Address issue of Rural Fire needs and WUI

- iii) Review Community Wildfire Protection Plans for their applicability and relevance to Rural Fire Issues
- iv) Review Firewise for relevance to Rural Fire Issues
- v) Review areas of State property where fuel reduction could be a concern and develop plans to mitigate situation.
- vi) Prescribed Fire
 - (1) Strengthen our involvement with NGOs to foster close working relationships.
 - (2) Prescribed burning can be a common link – Audubon, The Nature Conservancy.
 - (3) Strengthen our relationship within DEEP with air compliance (prescribed burning issues)
 - (4) Look to change the CEPA requirements to allow for larger prescribed burns on State forests.
 - (5) Increase the number of qualified burn bosses and safety officers.
 - (6) Look to improve large grassland habitats through burning coordinated with DEEP Division of Wildlife.
 - (7) Review prescribed fire policy and be sure there is enough flexibility to allow for assisting FDs, provide training and develop relationships with NGOs
- vii) Improve public knowledge and understanding of fire program
 - (1) Notify chief elected officials of funding awards
 - (a) Media notification
 - (2) Improved website.
- viii) Continued prevention and education activities
 - (1) Maintain strong Smokey Bear message
 - (2) Continue to have strong media ties to deliver prevention message during periods of high fire danger.
- ix) Continue to work with DEEP's Education programs to provide quality wildfire prevention information.

3) **Urban Forestry**

a) **Vision**

- i) Urban forestry is seen as an essential contributor to the quality of life throughout Connecticut. Governmental bodies, civic organizations, private property owners and citizens in general all know that each of them has a role in keeping the urban forest thriving and healthy. All of Connecticut's cities and towns have strong urban forestry programs that provide essential benefits to local residents.
- ii) Urban forests are managed with recognition of their critical role in the quality of life in Connecticut. The Connecticut Urban Forest Council, DEEP's Division of Forestry, UConn's Cooperative Extension system, and other organizations continue to inform community decisions makers, private property owners, legislators, concerned citizens and the public at large about the importance of trees, the contributions made by trees and their needs. All individuals and groups work to develop policies designed to promote progressive and appropriate urban forestry programs and practices throughout the state.

b) **Mission:**

- i) Build local capacity by providing leadership and support in the development of community management plans for urban forestry, local ordinances and policies

- relative to urban forestry, community advocacy and advisory groups and to encourage communities to have professional urban foresters on staff.
- ii)* Administer the small grant program to municipalities and non-profits.
 - iii)* Establish and maintain creative and productive collaborations with other groups throughout the state.
 - iv)* Support the two most important state laws with regards to urban forestry and quality tree care:
 - (1) The two laws are the Tree Wardens Law (Connecticut General Statute Section's 23-58, 59 and 65) and the Arborist Law (Connecticut General Statute Section's 23-61). This effort gibes with support for the Tree Wardens Association and Connecticut Tree Protection Association (CTPA).
 - v)* Establish and maintain creative and productive collaborations with other programs within the Department.
 - vi)* Support research and information gathering efforts regarding urban trees throughout the state.
 - vii)* Support publications that assist with information gathering and outreach efforts.
 - viii)* Support local non-profit and volunteer groups throughout the state
 - ix)* Provide basic leadership on issues of importance to urban forestry.
 - x)* Work directly with municipalities to help them bolster local urban forestry efforts.
 - xi)* Provide outreach and support to groups and individuals regarding basic tree care and the importance of trees outside of the forest.
 - xii)* Support urban forestry outreach and education efforts
- c) Critical Success Factors**
- i)* Maintain a well-trained and knowledgeable program staff that is apprised of current issues and of those techniques, programs or resources available to address those issues.
 - ii)* Continuing the practice of supporting existing collaborations and cultivating new ones.
 - iii)* Continued funding of small grants program to municipalities and non-profits. This is the program's key tool for providing outreach and direction to municipalities and non-profits throughout the state. It is the best way to cement gains, in terms of understanding and partnerships, all the while also getting good work done.
 - iv)* In David J Nowak and Jeffrey T Walton's report entitled Projected Urban Growth (2000 – 2050) and its Estimated Impact on the US Forest Resource, they project that more than half (61%) of the Connecticut's forestland will be subsumed by urban growth between 2000 and 2050. Regardless of the outcome of efforts to retain forests as forests, inevitably there will be increased need for communities to take a proactive approach to urban forestry and therefore an increased demand for our assistance. In order to adequately meet anticipated demands program capacity must increase resulting in more feet on the ground and additional financial support.
 - v)* Continue to coordinate with the Division's service foresters with respect to providing management advice and assistance on municipally owned forest lands.
- d) Strategies & Actions**

- i)* Administer the small grant program to municipalities and non-profits: As previously stated this is the urban program's key tool for providing outreach and direction to municipalities and non-profits throughout the state.
- ii)* Establish and maintain creative and productive collaborations with other groups throughout the state: These groups include the Connecticut Urban Forest Council, CTPA, Tree Wardens Association, UConn Cooperative Extension, UConn Technology Transfer Center, Connecticut Nursery and Landscape Association, and other organizations with a stake in urban forestry.
- iii)* Establish and maintain creative and productive collaborations with other programs within the Department: Urban forestry is a natural fit with the water quality and air quality groups, along with groups working on carbon management, climate change and, basically, all programs within forestry.
- iv)* Support research and information gathering efforts regarding urban trees throughout the state: These efforts include the Connecticut Agricultural Experiment Station's work on urban tree population studies, the urban tree canopy cover analyses being done for New Haven and Hartford by these cities in conjunction with the US Forest Service, the University of Vermont, UConn CLEAR and the Department, and also the many inventories and analyses going on throughout the state at the local level.
- v)* Support publications that assist with information gathering and outreach efforts: UConn Cooperative Extension has been in the lead in publishing useful urban forestry information, which has proven its value to the urban forestry programs throughout the state many times over. Other publications, such as those produced by non-profits and by the US Forest Service, are also of high value.
- vi)* Provide support to local non-profit and volunteer groups throughout the state: Local non-profit and volunteer groups have proven to be invaluable as bulwarks for the advance of urban forestry at the local – especially, the local municipal – level. In larger cities, these groups have tended to be well-established non-profits with paid staff, in smaller cities and in the towns, these are often volunteer groups that may or may not be incorporated 501(c)(3) non-profits, and in the smaller towns and villages, these are often individuals who have chosen to champion the cause. Each has different needs, including different financial needs. All require support.
- vii)* Provide outreach and support to groups and individuals regarding basic tree care and the importance of trees outside of the forest: There is an ongoing need for basic information regarding tree selection, tree planting and tree care. Similarly, there is a need to disseminate information regarding the importance and value of trees for people throughout the state. The urban forestry program can and should take a role in these outreach efforts. This is particularly important with respect to that part of the urban forest that is on private property.
- viii)* Place special focus on the larger cities and the urban core areas: The older and more densely populated areas of the state tend to present issues and challenges that are unique in the state. These issues and challenges should be recognized and provided support commensurate to their importance to the number of people affected.
- ix)* Place special focus on those parts of the state undergoing the most population growth and development: The issues raised in the suburbs and those in the more rural parts of

the state are often different from those in the urban core, but are nonetheless important to the state urban forestry program.

- x) Work directly with municipalities to help them bolster local urban forestry efforts:
- xi) Municipalities often ‘need a hand’ with respect to planning or implementing local urban forestry activities. In addition, programs such as Tree City USA provide opportunities to express public pride and commitment to municipal urban forestry efforts. Efforts in support of these activities help build local awareness and often lead to increased involvement in urban forestry efforts.
- xii) Attendance by program staff to critical training and informational meetings is essential. Beyond the technical aspect of such meetings they often provide the opportunity for peer to peer exchange of ideas, experiences and discussions on issues and potential resolutions that are of particular importance. It is also imperative that interested staff from other programs be given the opportunity to cross-train.

4) *Private and Municipal Lands*

a) Vision:

- i) Landowners (private and public) have all the resources (i.e., incentives, tools and guidance) at their disposal to completely understand and make intelligently informed decisions regarding the environmentally and fiscally sound management of their forest lands. The policymakers, forest landowners, public and certified forest practitioners understand the many benefits of forests and forestry and cooperatively and aggressively work together to implement policies and programs that help keep forests as forests. A sufficient pool of competent certified professional loggers and foresters exists to meet the needs of forest landowners, municipalities and the industry. In addition, a sufficiently strong local industry and markets exists for traditional and nontraditional forest products, non-timber products and ecosystem services to encourage and enable landowners to maintain their forests as forests.

b) Mission:

- i) Forest Land Taxation (Public Act 490, 10 Mill) – Provide training and assistance to certified foresters, landowners and municipal assessors on statutes and regulations pertaining to the classification of land as forest land.
- ii) Landowner incentive programs - In collaboration with other state and federal agencies, provide guidance and assistance in the design and implementation of programs that provide incentives to landowners including but not limited to cost share programs.
- iii) Forest landowner assistance – Provide landowners (private and public) with sufficient, accurate, unbiased and state-of-the-art forestry expertise respecting and balancing landowner goals with fiscally and environmentally sound management practices. Such expertise is provided in one-on-one consultations and site visits and through education and outreach programs.
- iv) Keeping forests as forests –Provide outreach, education and assistance to forest landowners, municipalities, policymakers, forest industry and citizens on the benefits and means by which landowners and communities may retain forests as forests.
- v) Assistance to other Division programs – One of the missions the service forestry program has traditionally engaged in is assistance in the form of manpower, support, outreach and education and technical expertise to the urban forestry program (e.g.,

- municipal tree worker workshops), the forest protection program (e.g., ALB and forest fires), the state lands management (e.g., boundaries and timber marking), the forest planner (e.g., Forest Legacy) and the forest practices act program (e.g., certification examinations).
- vi)* Public outreach and education – Provide or assist other programs and organizations in providing schools, organizations, municipalities and citizens with education and training on forests, forestry and the critical issues facing both.
 - vii)* Forest Stewardship – With the guidance and assistance of the Forest Stewardship Committee and in collaboration with our partners and stakeholders, work with foresters and landowners in the preparation and implementation of forest stewardship plans that help landowners achieve their resource objectives in a sustainable manner. In addition, the Division has the responsibility of approving stewardship plans written by private foresters and operating a monitoring program which tracks implementation performance.
 - viii)* Climate change – In collaboration with other programs, Division’s and partners support and assist with the design, implementation outreach and education of processes and programs designed to mitigate the impacts of climate change.
 - ix)* Provide leadership through our awareness of forestry related issues as they relate to forestland owners and through our knowledge of forestry and forest practices to a range of audiences, including the landowners themselves, policy makers and forest professionals.
- c) Critical Success Factors**
- i)* Maintain a well-trained and knowledgeable program staff that is apprised of current forestry issues and of those techniques, programs or resources available to address those issues.
 - ii)* Build and maintain partnerships – The key to future success will be built upon maintaining and cultivating new partnerships that support private forest lands, forest stewardship and sustainable forest management. Key programs and partnerships are the new forest landowner assistance program authorized under the Farm Bill and administered by the Natural Resources Conservation Service and the Biomass Crop Assistance Program administered by the Farm Services Agency.
 - iii)* Support additional research in critical areas such as best management practices, forest landowner dynamics and communications and social impacts on forests and forestry that will lead to improvements in environmental performance and provide greater understanding of the interactions between landowners, society and the environment. The outcomes of such research will help direct the Division as it focuses limited resources on key issues such as fragmentation, regressive harvesting and invasive species control.
 - iv)* There are 25,000 landowners owning ten acres of forests or more leaving each service forester to service more than 8,000 owners each. With these numbers in mind implementation and achievement of the Division’s vision, missions and strategies is already very challenging. Compounding this is the fact that all of the staff is currently eligible for retirement. The potential loss of such a significant level of expertise and institutional knowledge in such a short period of time would be a devastating setback to achieving the vision. Short-term success, i.e., maintaining the status quo, will be

very dependent upon working with our partners and cross-training and mentoring of staff from other Division programs in order to maintain the continuity and quality of service. Long-term success, i.e., implementing strategy and progression toward achieving the vision, will require a combination of an investment in and use of technology and placing more feet on the ground.

- v) Landowner incentives – Recent incentives programs (aka cost sharing) have been short-lived and underfunded resulting in lost confidence and interest of many forestry professionals. Interest and confidence need to be rebuilt through the careful long-term implementation of the new cost share program. Landowner incentives must go beyond traditional cost-sharing programs. Building strong and diverse local markets for traditional and nontraditional forest products, non-timber products and ecosystem services provide powerful incentives for landowners to keep their forests as forests. Creation of favorable state and federal taxes laws regarding estates and the sale of products are also critical. As favorable incentives are created, it is essential that disincentives such as liability, timber encroachments and theft and poorly written or inconsistently implemented laws governing forest practices be eliminated.
- vi) Renewal of the 10 Mill forest land taxation is on the horizon. The Division needs to provide strong leadership in crafting and advocating for a process that provides landowners the incentives necessary to keep forests as forests.

d) Strategies & Actions

- i) Outreach and education:
 - (1) Landowners (private and municipal) – In collaboration with our partners, provide assistance and guidance in forest management including but not limited to silviculture, invasive species, landowner incentives, forest land taxation and fragmentation. Efforts using traditional means such as one-on-one contacts, workshops, meetings, demonstrations, publications and the internet should continue but identifying and investing in additional effective and efficient means of outreach to traditional and nontraditional landowners is essential to long-term success.
 - (2) Public – In collaboration with our partners, provide or assist with outreach and education efforts with schools, private and municipal organizations and the public on understanding the many benefits of forests and forest stewardship. Continue collaboration with and support of the Bureau of Outdoor Recreation on their very successful No Child Left Inside[®] program and expand collaboration with the Department’s Air and Waste programs concerning the utilization of biomass. Continue support of other key efforts such as the Envirothon and Project Learning Tree.
- ii) Staff training: Attendance by program staff to critical training and informational meetings is essential. Beyond the technical aspect of such meetings they often provide the opportunity for peer to peer exchange of ideas, experiences and discussions on issues and potential resolutions that are of particular importance. It is also imperative that interested staff from other programs be given the opportunity to cross-train.

- iii) **Research:** Research concerning landowners is essential and must continue. Identifying who these landowners are and understanding their attitudes will greatly improve our ability to efficiently and effectively provide services.
- iv) **Landowner incentives:** Rebuild interest and confidence of forestry professionals and landowners in cost sharing programs. Assist other programs in advocating for policy and laws that build strong and diverse local industry and markets. Advocate for favorable state and federal taxes laws regarding estates and the sale of products. As favorable incentives are created, it is essential that the Division be a strong advocate of and actively work toward breaking down and eliminating disincentives such as liability, timber encroachments and theft and poorly written and implemented laws governing forest practices be eliminated.
- v) **Forest Stewardship:** Continue to support and assist landowners and forestry professionals writing and implementing forest stewardship plans.
- vi) **Partnerships:** The Division must continue to collaborate with and support the forest stewardship and forest land conservation related efforts of organizations such as Tree Farm, Coverts, Connecticut Forest and Park, Eastern Connecticut Forest Landowners, Conservation Districts, Connecticut Forestland Council, Nature Conservancy, Trust for the Public Lands the Goodwin Collaborative and other stakeholders.
- vii) **10 Mill forest land taxation:** In collaboration with our partners and municipalities craft those policies, statutes or regulations that are necessary to enable landowners to keep forests as forests.
- viii) Continue working with the Division's state land management program and the Goodwin Conservation Center in demonstrating forest land management and providing conservation education.

5) ***Forest Practices Act***

a) **Vision:**

- i) The implementation and enforcement of the certification and conduct regulations authorized by the Forest Practices Act has contributed significantly to the credibility of the profession and provided a firm footing for improving the public's perception of forestry and timber harvesting. The success of this program was and remains a critical factor in aiding private forest landowners in keeping forests as forests.
- ii) The future success of the program will be built on maintaining an environment whereby forest landowners are served by highly competent certified forestry and logging professionals. Understanding landowner's goals, certified forest practitioners use their expertise to guide landowners toward the implementation of safe and environmentally sound forest practices.

b) **Mission:**

- i) Establish, implement and maintain minimum standards for excellence that forest practitioners must demonstrate to achieve and maintain certification while promoting an environment that encourages certified forest practitioners to perform beyond such standards (Connecticut General Statutes Section 23-65h).
- ii) Establish, implement and maintain an outreach and education program targeting the forest industry, forest landowners and regulating government agencies on the provisions of the Forest Practices Act and other statutes and regulations that impact forest management and operations.

- iii*) Collaborate with other Division programs and partners to coordinate and implement a program of outreach and education with the forest industry, forest landowners, public and regulating government agencies on best management practices and matters relating to forest operations and forest management.
- iv*) Enforce the Forest Practices Act and all subsequent regulations and collaborate and support other local, state and federal agencies with compliance of all other environmental laws (civil and criminal) related to forestry practices.
- v*) Collaborate with other Division programs and partners to assure that forest landowners have the opportunity to consider, without bias, all available options to manage their lands.
- vi*) Encourage cooperation and understanding between the forest industry, forest landowners, the public and local and state agencies on issues surrounding forestry and related environmental policies and practices.
- vii*) Collect, observe, assess and report on the annual forest management and utilization activities of Connecticut's certified forestry professionals.
- viii*) Review and approve regulations to govern forest practices from those municipalities authorized to implement such regulations (Connecticut General Statutes Section 23-65k).

c) Critical Success Factors

- i*) Maintain a knowledgeable and experienced program staff at current levels – while the primary charge of the program requires regulatory skills, significant knowledge and experience in non-regulatory subjects such as utilization and marketing is often required to work with the industry and service forestry skills is often employed while working with landowners.
- ii*) Building and maintaining partnerships – while the Division stands alone during the conduct of its regulatory function, the key to success is built upon its partnerships and non-regulatory outreach and education of forest landowners, regulating government agencies, the forest industry and the public.
- iii*) Support additional research in areas such as best management practices and forest landowner dynamics and communications that will help maintain standards and better enable the program to focus its limited resources
- iv*) Municipalities, forest landowners, the general public and the forest industry have all benefitted from the increased professionalism and goodwill generated through the continuing education component of the Forest Practices Act required of all certified forest practitioners. For continued success, the program must build on this momentum and strive to improve the program by addressing several key issues such as the course cost and availability and course saturation.
- v*) Continue to seek the advice and guidance of the Forest Practices Advisory Board (Established pursuant to Connecticut General Statutes Section 23-65g) and other stakeholders concerning the Division's programs, regulations and policies regarding forests, forest health, forest practices and certification of technically proficient forest practitioners.
- vi*) Cross training and mentoring of staff in other Division programs

d) Strategies & Actions

- i*) Staff training:

- (1) Attendance to critical training and information meetings is essential. Beyond the technical aspect of such meetings they often provide the opportunity for peer to peer exchange of ideas, experiences and discussions on issues and potential resolutions that are of particular importance.
 - ii) Continuing education of certified practitioners:
 - (1) Working collaboratively with new and established government and nongovernment partners, continue seeking improvements in this very successful continuing education program addressing the need for new and innovative training methods and classes and assuring that a variety of quality educational opportunities are offered at the lowest cost possible, at sufficient intervals while avoiding course saturation.
 - iii) Landowner assistance, outreach and education:
 - (1) Working collaboratively with our partners and other Division programs, utilize established, new and innovative means and tools to provide landowners with critical information enabling them to make intelligent decisions concerning the management of their forest lands. Such information will include but not be limited to: Best Management Practices, programs governing the certification and conduct of forest practitioners, forest management and harvesting operations.
 - iv) Local and state agency assistance, outreach and education:
 - (1) Working collaboratively with new and established government and nongovernment partners, provide information and training opportunities for regulatory agencies whose responsibilities impact the conduct of forest practices.
 - (2) Provide technical assistance to municipalities, other agencies and programs with respect to the conduct of a particular forest practice(s).
 - (3) Review and approve regulations to govern forest practices submitted by those municipalities authorized to implement such regulations (Connecticut General Statutes Section 23-65k)
 - v) Annual reports:
 - (1) Collect, evaluate and report Connecticut's forestry activities through the collection of annual reports that are submitted to the Division of Forestry by certified forest practitioners.
 - vi) Communications:
 - (1) Utilize established, new and innovative ways to improve understanding and cooperation between forest landowners, the forest industry, the general public and regulating government agencies.
 - vii) Forest Practitioner Certification:
 - (1) Working collaboratively with partners, continue to provide comprehensive and current training materials to enable applicants to meet the minimum standards for excellence that forest practitioners must demonstrate to achieve and maintain certification.
 - (2) Maintain an active and effective program measuring and enforcing practitioner certification, practitioner conduct and best management practice compliance.
- 6) Utilization and Marketing**
- a) **Vision:**

- i)* Connecticut's forest landowners and industry are able to provide traditional and non-traditional forest products, non-timber products and ecosystem services to the state, nation and world from a sustainable and diverse forest resource. Success creates local jobs and provides landowners with the means to maintain their forests as forests and supports a robust and stable forest products industry.

b) Mission:

- i)* Encourage the development of sustainable markets for traditional and non-traditional forest products, non-timber products and ecosystem services from the state's rural and urban forests.
- ii)* Convey to the public and policy makers the economic importance and social value of Connecticut's forest industry and forest products, including the economic importance and social value of traditional and non-traditional forest products, non-timber products and ecosystem services.
- iii)* Encourage and support existing and future opportunities for third party green certification
- iv)* Observe, assess and report on the annual forest management and utilization activities of Connecticut's certified forestry professionals.
- v)* Collect, assess and convey information concerning new and innovative business and market opportunities.
- vi)* Promote the sustainable use of Connecticut's forest resource in a way that maintains or improves biodiversity.
- vii)* Encourage and support a strong forest industry and solid markets for Connecticut forest products so as to better enable forest landowners to maintain their forests as forests
- viii)* Provide outreach and education to the forest industry to improve safety, competitiveness and environmental performance
- ix)* Promote cooperation and understanding between local and state regulating entities and the forest industry and landowners

c) Critical Success Factors

- i)* Maintain a well-trained and knowledgeable program staff that is apprised of current industry issues and is aware of the techniques, programs or resources available to address those issues.
- ii)* Supporting existing partnerships and encourage the development of new partnerships.
- iii)* Collaborate with partners to provide educational opportunities for the forest industry, forest landowners, and government agencies on matters concerning and impacting forestry practices.
- iv)* Enhance cooperation and communications among the forest industry and local government and state regulatory agencies.
- v)* Promote research and projects that allow better quantification of ecosystem services. For policy makers, landowners, land managers and the public to fully embrace ecosystem services they need a greater understanding of how these benefits matter at the local level.
- vi)* Cross training and mentoring of staff in other Division programs.
- vii)* Expand collaboration with the Department's Air and Waste programs concerning the utilization of biomass.

d) Strategies & Actions

- i)* Engage the forest industry concerning evolving issues through the Forest Practices Advisory Board and through cooperation and partnerships with professional forestry organizations such as the Connecticut Professional Timber Producers Association, Inc., (TIMPRO) and the Society of American Foresters.
- ii)* Improve cooperation and communication among the forest industry, forest landowners and local government and state government.
- iii)* Collect, evaluate and report on Connecticut's forestry activities through the collection of annual reports that are submitted to the Division of Forestry by certified forest practitioners.
- iv)* Revise and update the "The Forests and the Connecticut Economy". This report, which describes the role of forest products industry in Connecticut's economy, is based on data that is nearly ten years old. The report should be expanded to include non-traditional forest products, non-timber products and especially ecosystem services.
- v)* Gather and analyze information on the impact of woody biomass harvesting. Utilize the outcome to establish a comprehensive set of best management practices for woody biomass harvesting.
- vi)* Collect and report data concerning the state's primary and secondary wood processors
- vii)* Collect, assess and report data pertaining to harvesting, the forest industry, forest landowners, public views and government regulations.
- viii)* Have staff and, where possible, key partners attend critical training and information meetings such as the Northeast Area Association of State Foresters Forest Utilization Committee. Such meetings provide the opportunity for peer to peer exchange of ideas, experiences and discussions on issues and potential resolutions that are of particular importance.
- ix)* Continue to provide support to the Master Logger and Tree Farm programs through which Connecticut's forest landowners are able to enter into the green certified wood market.
- x)* Create and encourage projects which demonstrate the best ways to utilize wood produced from urban forests.
- xi)* Collaborate with other Division programs and partners to provide continuing education opportunities to improve safety, competitiveness and environmental performance of the forest industry.
- xii)* Engage and support research and projects which quantify ecosystem services from both the rural and urban forests that will lead to greater understanding by the public and policy makers of the importance and potential value of those benefits.

Connecticut Agricultural Experiment Station – Forest Health Program

Vision

The vision of the Cooperative Forest Health Program in Connecticut is to protect the state's timberland, urban forest, and non-commercial forest resources from significant loss of economic, ecological, or aesthetic value due to insects, diseases, other stressors, and unknown causes and provide future generations with healthy, sustainable forests.

Mission Statement

The mission of the Connecticut Agricultural Experiment Station (CAES) is to develop, advance, and disseminate scientific knowledge, improve agricultural productivity and environmental quality, protect plants, and enhance human health and well-being through research for the benefit of Connecticut residents and the nation. Seeking solutions across a variety of disciplines for the benefit of urban, suburban, and rural communities, Station scientists remain committed to “Putting Science to Work for Society,” a motto as relevant today as it was at our founding in 1875.

Since 1993, CAES has implemented the State’s Cooperative Forest Health Program. The Experiment Station is the plant pest regulatory agency for Connecticut. The Forest Health Program provides states with federal funds to detect, monitor, and evaluate forest health conditions on state and private lands. The funding enables states to collect forest health data in a standardized manner so it is compatible with other states for regional reporting. Additional support is provided by McIntire-Stennis forestry funds. The Experiment Station is in a unique position that combines forest research, pest survey, outreach, and regulatory response in one agency.

The Experiment Station, founded in 1875 as the first agricultural experiment station in the country, is chartered by the State’s General Assembly as an independent agency governed by a board of control. Station staffers are state employees. They are not part of the Connecticut Department of Agriculture, Connecticut Department of Energy and Environmental Protection, or the University of Connecticut, but they work with all three institutions including the Cooperative Extension Service located at UConn. Station scientists make inquiries and conduct experiments regarding plant and their pests, insects, soil and water quality, food safety, and perform analyses for other State agencies. The Experiment Station’s main laboratories are located in New Haven with additional laboratories and farmland in Windsor; its Lockwood Farm is located in Hamden, and its Griswold Research Center is in Griswold and Voluntown.

Critical Success Factors

Connecticut has experienced many forest health problems in the last century. Chestnut blight, Dutch elm disease, gypsy moth, red pine scale, and butternut canker have all affected the structure and composition of Connecticut's forests. For example, chestnut accounted for 25% of Connecticut's growing stock before chestnut blight arrived. Now it forms only an understory shrub layer that is periodically killed back. The Experiment Station is a leader in research to develop blight-resistant Chestnut trees and reintroduce them to Connecticut's forests.

The hemlock woolly adelgid (HWA), an exotic insect from Asia, first appeared in south central Connecticut in 1985 and now occurs in all of the state's 169 towns, infesting eastern hemlock, *Tsuga canadensis*, which comprises 9% of Connecticut's forests. The adelgid causes tip branch dieback, needle loss, and tree mortality across the State, often in combination with other insects like elongate hemlock scale (EHS) (another exotic species) and hemlock looper (a native defoliator). Alternatives for managing the adelgid, particularly in forests, are limited. Suppression of HWA by the Experiment Station working with the USDA Forest Service has been provided by research on systemic insecticides and the mass rearing and release of the ladybeetle HWA predator *Sasajiscymnus tsugae* which is native to Japan. The earliest North American releases of *S. tsugae* were in Connecticut in all counties of the state between 1995-2007. Releases of over 176,000 adult beetles were made in 26 forest sites throughout the state. From 2005-2009, infested hemlocks in monitored beetle release sites which had been previously damaged recovered and showed healthy crowns. This recovery has persisted and in spring 2015 many former release sites showed healthy crowns. However, concurrent EHS infestations on stressed hemlocks have also increased significantly in the past 5-7 years, especially in northwest Connecticut. The rapid decline resulting from thinning crowns with heavy EGS infestations has since led to large areas of hemlock salvage on state and watershed lands. The HWA biological control strategy using *S. tsugae* will be assessed in detail over the next four years. Targeted chemical strategies developed by an Experiment Station scientist working with the USDA FS and others has protected hemlock trees throughout the range impacted by HWA until biological interventions can fully implemented.

Another insect native to Asia poses a significant threat to our forests and the nursery industry in Connecticut. The Asian longhorned beetle, (ALB), *Anoplophora glabripennis*, was first discovered in Brooklyn, NY in 1996, in other areas around New York City, and then in nearby areas in New Jersey. Other infestations have been found in Chicago, Toronto, Boston, and Worcester, MA, and most recently Clermont County, OH in 2011. The U.S. Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS), working with local and state partners, has quarantined infested areas and is attempting to eradicate the beetle by cutting and chipping infested and nearby host-associated trees. The Worcester infestation was estimated to be 12-15 years old when detected, and as of November 2015 the quarantine area encompasses 110 square miles with over 24,395 infested trees found and a total of just over 35,000 trees removed (these statistics do not include host trees removed through acreage cuts within the regulated area). The risk of this beetle being in or introduced to Connecticut is considered high.

An ALB management program relies on several approaches to eradicate the beetle. These are survey and detection to determine the limits of an infestation; eradication by cutting and chipping infested trees; chemical treatment of non-infested host trees; regulation to curtail movement of infested materials (firewood is considered to be a high-risk pathway for spread of the beetle); research on the beetle; education and outreach to citizens; and restoration efforts to both replace trees removed during eradication and to create a more diverse urban forest. Public outreach is a very important part of the program as all of the infestations have been detected by a citizen reporting the beetle to the proper authorities or bringing in a specimen for identification.

Unfortunately, a second Asian insect, the emerald ash borer (EAB), *Agrilus planipennis*, is killing many of Connecticut's ash trees. This beetle was first detected in the US in southwestern Michigan in 2002 and has spread to New York, New England, and as far south as Louisiana and Georgia. Although the beetle can fly and move several miles each year on its own, the rapid geographic spread of this pest has been primarily through the transport of infested firewood. Since its discovery, EAB has killed many tens of millions of ash trees in the many states where it has been found. As of the end of October 2015, EAB had been officially detected, primarily through a biosurveillance program using the native wasp, *Cerceris fumipennis*, in 76 towns in seven counties in Connecticut (Figure 57) and is likely distributed throughout much of the state. Connecticut dropped its internal EAB quarantine in December 2014 and as of November 2015, Connecticut, Massachusetts, much of New York, and parts of New Hampshire are part of the federal EAB quarantine. Working with USDA-APHIS, two small stingless parasitoid wasps, *Tetrastichus planipennisi* and *Oobius agrili*, were released by CAES for the biological control of EAB starting in 2013. A third parasitoid will be released in 2016. In 2015, *T. planipennisi* were recovered from EAB larvae at several initial release sites indicating that the parasitoid has become established. Firewood regulations were implemented to help reduce the risk of the importation of new exotic pests through infested firewood (CT Regulations Sec. 28-24-5g).

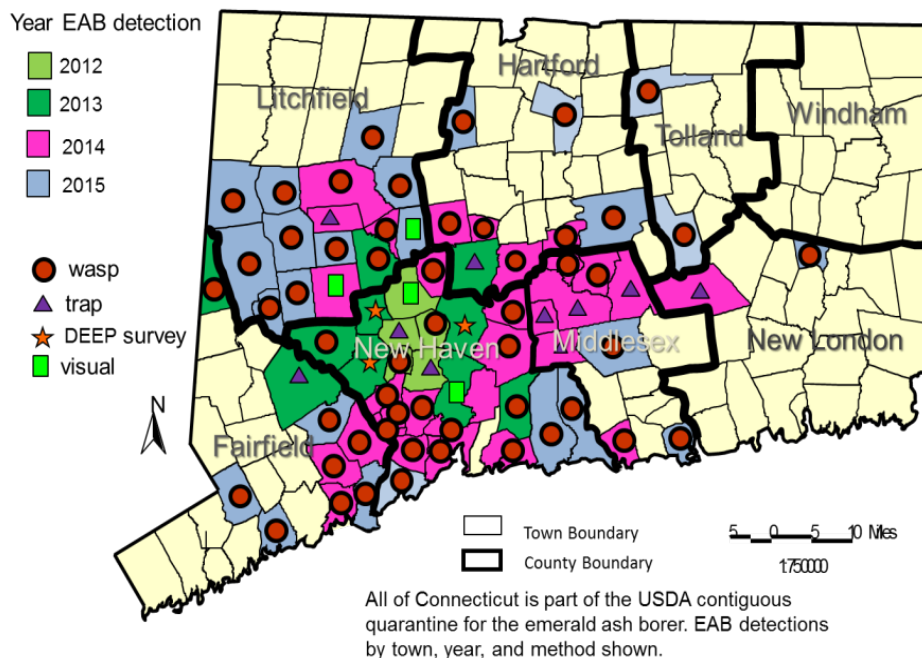


Figure 57.
Distribution of Emerald Ash Borer by Method of Detection and Town 2012-2015.

(Since the creation of this map EAB has been found in East Windsor, Simsbury, East Haddam, and Killingworth.)

Source: CAES

The question with all new exotic species is whether they will cause negative impacts like chestnut blight or hemlock woolly adelgid. We can only guess what overall impacts organisms like Asian longhorned beetle, emerald ash borer, southern pine beetle, winter moth, or *P. ramorum* will cause in Connecticut's forests if or as they become established, but the potential consequences to the nursery industry, forest products industries, tourism, and environmental quality are huge. For example, while high value ash trees and lightly infested trees can be treated with systemic insecticides to protect them against the emerald ash borer, Connecticut will lose most of its forest and urban ash tree resources to this destructive insect. However, the release and establishment of EAB parasitoids has the promise of providing long-term control of EAB. At the current time, federal and state quarantine and eradication of ALB would be the goal of the program if this insect is detected in the state. The program objective is to identify, manage, and reduce threats to forest and ecosystem health.

Specific Critical Success Factors include:

- Collaboration and communications with state (e.g., Connecticut Department of Energy and Environmental Protection; Cooperative Extension Service) and federal agencies (e.g., U.S. Forest Service; USDA/APHIS/Plant Protection and Quarantine), with forestry or forest pest responsibilities.
- Funding and infrastructure support from the State of Connecticut and agencies of the Federal government related to forest health monitoring, research, and response (e.g., U.S. Forest Service, USDA/APHIS/PPQ), particularly for pests of federal regulatory concern (i.e., Federal funding for an ALB eradication program). Infrastructure support includes availability of state vehicles, laboratories, and offices for research, survey, detection, and outreach activities.
- Input and communication with forest and plant health stakeholder groups such as Connecticut's Green Industry Coalition (CGIG), Connecticut Tree Protective Association, Connecticut Forest & Park Association, The Nature Conservancy, and Connecticut's garden clubs.
- Maintain survey and detection programs like the Cooperative Agricultural Pest Survey (CAPS) and National Plant Diagnostic Network (NPDN), and public access for pest reporting and identification. CAES is the lead agency for the CAPS program and a participant in the NPDN. Insect and plant pathogens are routinely identified for the green industry and the public through our insect inquiry and plant disease diagnostic laboratories. Many pests are detected through reports or specimens brought to diagnostic agencies and laboratories.
- Input from existing pest response and mitigation programs through after action reviews for U.S. quarantine pests such as ALB, for which the USDA-APHIS-PPQ still maintains an eradication program.
- Develop and maintain appropriate regulatory structure, regulations, and response related to plant pests. The Experiment Station Director has Connecticut statutory authority for the regulation of plant pests (CT Statute Sec. 22-84).

Forest Health Program Strategies & Actions for Objectives

Connecticut's Cooperative Forest Health Program will accomplish the second S&PF national themes and objectives to protect forests from harm by identifying, managing, and reducing threats to forest and ecosystem health. The program addresses, in whole or in part, all the following nine elements suggested for a State Strategy for Forest Health. Specific actions for each objective follow. Some activities will fit under more than one objective.

1. Address exotic invasive species and the impact they have on forest resources.

The Experiment Station conducts research to address exotic invasive species and the impact these species have on forest resources. Research on forest health and exotic species are long-term activities, though some specific projects may be short-term (1-5 years) or long-term (+5 years) in duration. Regulatory activities will also address the introduction of exotic species. These will include:

- Conduct HWA surveys to determine HWA suppression or resurgence throughout Connecticut in response to biological control efforts, concurrent pests such as elongate hemlock scale and hemlock borer, and abiotic factors such as winter mortality with extended low temperatures. See objective 4.
- Japanese barberry is listed as invasive in 20 states and is associated with enhanced densities of blacklegged ticks and detrimental impacts on Connecticut's native forested ecosystems and forest regeneration. Experiment Station research will continue on the effectiveness and relative costs of treatment combinations to control this plant, which will promote improved forest health throughout the state.
- The Experiment Station will breed chestnuts for orchard and timber trees and plant blight-resistant chestnut hybrids in forest clearcuts to further progress toward restoration of the American chestnut as a tree in our forests. This is a long-term project.
- Necessary regulations will be drafted and submitted for approval as needed for new pests or situations (e.g. regulation of firewood). See objective 9 on flexibility of response to emerging situations.

2. Detect, monitor, and evaluate forest pests and forest health conditions.

Monitor forest health at permanent plots – The Experiment Station will detect, identify, and evaluate population trends of pests known to cause serious forest damage using aerial surveys, permanent ground plots (51), and other ground surveys as needed to confirm aerial findings of damage and predict next year's conditions. Conduct ¼ mile roadside surveys near each of the 51 permanent plots. As a part of these surveys, CAES conducts an annual state-wide aerial survey for gypsy moth defoliation and defoliation caused by other insects, such as the orange-striped oakworm. CAES also performs gypsy moth egg mass surveys to delineate potential problem areas for the subsequent year. This is supported by the core forest health funding from the US Forest Service and it is a long-term strategy (+5 years).

Conduct Asian longhorned beetle and *Phytophthora ramorum* surveys, as well as surveys for newly detected pests. The Experiment Station will determine if these pests are present in Connecticut through survey and outreach and identification/diagnostic services to the public,

foresters, and other stakeholders. Surveillance is a long-term strategy depending upon detection/presence of the pests, which have not been found in Connecticut at this time (other than *P. ramorum* in a nursery, which was eradicated). However, some specific surveys are short term, 1-5 years, depending upon funding support. Detection of ALB, *P. ramorum*, and other potential pests of “regulatory concern” will initiate a regulatory response from USDA-APHIS-PPQ and the Experiment Station. Specifically;

- We will conduct visual surveys for ALB at warehouses, industrial areas, town parks, and other similar areas considered to be at high risk based on location or product import history, and examine trees reported by the public as possible ALB infestations. Trained state foresters will also conduct visual survey for ALB.
- We will conduct bio-surveillance for EAB with the native, solitary wasp *Cerceris fumipennis* (Hymenoptera: Crabronidae). Short-term, 1-5 years.
- We will conduct *Phytophthora ramorum* surveys in wholesale nursery perimeter sites, a woodland site, and garden center perimeters. These locations complement the CAPS survey in Connecticut. Short-term, 1-5 years.
- We will conduct Cooperative Agricultural Pest Surveys (CAPS) for pests of potential concern as determined by the state CAPS committee and national CAPS guidelines. Trapping is conducted from June to September. Short-term, 1-5 years.

Conduct plant pest diagnostics - The Experiment Station will perform diagnostic sample processing and identification of forest pests and pathogens using Station expertise. The Experiment Station is a member of the National Plant Diagnostic Network (NPDN). The diversity of arthropod pests and plant pathogens received for identification is large. The Kenneth A. Welch Insect Information Office in the Department of Entomology handled 5,610 inquiries in 2008 and 8,549 inquiries in 2014-2015. The gypsy moth was a leading pest of concern in 2015 because of an outbreak, due in part, to a spring drought. The Plant Disease Information Office (PDIO) in the Department of Plant Pathology and Ecology handled 4,895 inquiries in 2008 and 4,467 inquiries in 2014-2015 and the department processed two trace-forward and trace-back samples for *P. ramorum* for USDA-APHIS-PPQ. None were positive for *P. ramorum*. This is an ongoing, long-term strategy (+5 years).

3. Conduct activities to maintain and improve forest health conditions and sustainability.

The Experiment Station’s ongoing research is developing innovative methods of pest control and forest management that improve productivity while maintaining forest health. Other studies are examining the potential of prescribed fire to enhance oak regeneration, silviculture methods to increase tree crop production to help produce a sustainable economic return for private forest owners, tree populations in our cities and towns, barberry control impact on forest health, and forest dynamics over an 80-year period (the oldest such study in the United States). For example, carefully timed series of crop tree releases could increase regional forest productivity by 60%. The monitoring of forest dynamics is a very long-term program with assessments conducted every 10 years.

4. Reduce damage through effective pest management, including suppression and/or eradication. With US Forest Service, McIntire-Stennis, and Hatch fund support, research and suppression activities that will reduce damage or help improve pest management will include:

- Evaluation of biological control of HWA in Connecticut, focusing on *Sasajiscymnus tsugae* survival, impact and establishment, and assessment of hemlock health in stands where predators have been released. Long term, +5 years.
- Develop laboratory mass rearing methods for *Chilocorus stigma*, a native scale predator for augmentative releases to reduce elongate hemlock scale in hemlock forests.
- Determine factors that affect the catch of wood-boring beetles in Lindgren funnel traps to improve trap efficacy and performance. Short-term, 1-5 years.
- Determine the identity, seasonal activity period, succession, and hosts of Connecticut Cerambycidae. Short term, 1-5 years.
- Refine chemical control of HWA and EAB and evaluate bark applications of systemic insecticides on hemlock, ash, and maple. Short-term, 1-5 years.

5. Represent forest entomology and pathology expertise within Connecticut

As a research institution, The Connecticut Agricultural Experiment Station has five Departments and the Valley Laboratory; each is led by a chief scientist who still conducts research and reports to the Station Director. The Forest Health Unit at The Connecticut Agricultural Experiment Station currently consists of the State Entomologist, Deputy State Entomologist, four full-time plant inspectors (and a full time apiary inspector), and the State Survey Coordinator in the Department of Entomology. There are 13 scientists in the Departments of Entomology, Plant Pathology and Ecology, and Forestry and Horticulture who conduct research and survey on forest pests, diseases, or other forestry-related problems. Information gained from surveys and research is delivered to stakeholders by giving talks to civic groups; reports to town, state and federal officials; interviews with the media; scientific publications; and reports to the legislature, Eastern Plant Board, Forest Health Cooperators, and other relevant forestry meetings and workshops. In addition, the Experiment Station is a member of the National Plant Diagnostic Network.

6. Include education efforts where needed, such as the “do not move firewood” campaign and forest pest survey and outreach project to limit the spread of invasive insects and educate stakeholders on how to manage existing forest pests.

Experiment Station staff will continue to provide talks and interviews on research and other activities to state foresters, the public, stakeholder organizations, and the public media. In addition, The Experiment Station participated in an ALB survey and outreach program (i.e., the Northeast Forest Pest Survey and Outreach Program supported by USDA/APHIS and US Forest Service) in 2009. The “do not move firewood” campaign was part of this outreach. All ALB infestations to date have been detected and reported by the public. Activities include the transfer information through presentations at annual meetings like the Eastern Plant Board, Forest Health Workshop, Cooperators Meeting, Northeastern Forest Pest Council, and Plant Science Day Open House. CAES provides articles for the Tree Protective Association Newsletter, Frontiers of Plant Science, and the Connecticut Weekly Agricultural Report. Our annual Forest Health Monitoring workshop (February) fosters closer working relationships and transfers up-to-date information to

the State Forester and Division of Forestry staff. This meeting is highly anticipated and has had increasing attendance every year.

7. Involve lead agencies for Cooperative Forest Health.

The Experiment Station is the lead agency for Cooperative Forest Health and a partner to the State Forester and the Division of Forestry, Connecticut Department of Energy and Environmental Protection (DEEP) in the Statewide Forest Resource Strategy.

8. Collaborate regionally and nationally; collect forest health data compatible with other states.

The Connecticut Agricultural Experiment Station maintains excellent communication and working relationships with the State Forester and other foresters in the DEEP, USDA Forest Service, USDA APHIS, and forestry and plant health officials in the region.

The Forest Health Monitoring (FHM) Off-Plot Program supplements plot data with landscape level data on forest stressors. The program promotes survey standardization among states, enhanced surveys of specific health problems, and regional forest health mapping and reporting to promote healthy sustainable forests. Long-term, +5 years. Specific activities in Connecticut supported by the Forest Health Monitoring Off-Plot Program are:

Survey about 1.8 million acres of forested land using national aerial survey standards. Maps will be either 1:100,000 or 1:50,000 scale. All areas with defoliation, discoloration, dieback and decline, breakage, and mortality above thresholds will be delineated. In addition, all other areas that are detected will be mapped and, where possible, identified by damaging agent. Damage will be verified by ground surveys. No fly (survey) areas will be indicated. Hard copy and digital aerial survey maps and insect and disease narratives will be provided to the NA Durham, NH Field Office by December 15th of each year. A representative of the State's Forest Health Program will attend the National Forest Health Monitoring working group meeting to report Off-Plot survey results. Canopy damage will be photographed during aerial surveys.

9. Include flexibility to respond to emerging situations that threaten forest health.

The Experiment Station will continue to monitor and respond to emerging situations in a timely manner. For example, pursuant to Section 4-170 of the Connecticut General Statutes, new regulations were proposed and adopted to quarantine the Asian longhorned beetle and Emerald ash borer in Connecticut and implement regulations on the movement of firewood.

Prioritized Implementation Schedule

Many of the strategies planned for the Forest Health Program have been implemented or are part of ongoing survey, research, and outreach activities.

SECTION 3. National Priorities

As part of the required five-year review of the Forest Action Plan in 2015 was the addition of a new section titled “National Priorities”. This section aimed to describe actions and success stories contributing to each of the three national priorities identified by Congress in the 2008 Farm Bill. The three national priorities are:

- Conserve and Manage Working Forest Landscapes for Multiple Values and Uses
- Protect Forests from Threats
- Enhance Public Benefits from Trees and Forests

Conserve and Manage Working Forest Landscapes for Multiple Values and Uses

State Lands Management

Accomplishment: Purchased The Preserve State Forest

Protected in spring 2015 after many years of conservation efforts, The Preserve is a 963 acre forest located in the towns of Old Saybrook, Essex, and Westbrook. Many conservation organizations recognized this property as the largest remaining unprotected coastal forest between Boston and New York before its acquisition for conservation. Situated between Long Island Sound and the mouth of the Connecticut River, it is part of a relatively intact forest block of more than 6,000 acres and protects the drinking water supply for two towns.

Seventy acres in Essex are owned and managed by the Essex Land Trust (www.essexlandtrust.org), with the majority of the remaining acreage jointly owned by the state of Connecticut and the town of Old Saybrook. The property is managed as part of the State Forest system and open to the public for passive recreation.

Accomplishment: Purchased new state forest land

DEEP purchased an additional 1,019 acres of State Forest land, primarily inholdings, abutting properties, or lands adjacent to existing state forest land between fiscal years 2010-2015. Much of this land was purchased through the Recreation and Natural Heritage Trust Program which was established in 1986 to preserve Connecticut’s natural heritage and is DEEP’s primary program for acquiring land.

Accomplishment: Hired two durational foresters for the State Lands Management Program

Using funds from the Regional Greenhouse Gas Initiative (RGGI), two temporary “durational” foresters were hired by DEEP in 2011 to manage state forests. In less than two years they produced 10,000 acres worth of forest management plans and generated 530 acres of forest product sales projected to earn \$240,000 for the State. At the same time, these activities produce significant jobs and economic activity for Connecticut’s private sector industry while enhancing wildlife habitat and other ecological benefits these forests produce.

They have also assisted other foresters while training to prepare over 900 acres of harvests contributing to over \$400,000 in revenue. They have also marked 64 miles of boundary, suppressed several wildland fires covering 290 acres, classified 1,566 acres of state forest land under PA 490, and performed delimiting survey work for Emerald Ash Borer detection. They

have participated in Connecticut Envirothon training and No Child Left Inside events impacting approximately 1,000 people, many of them children. Both are Connecticut certified foresters, PA 490 qualified foresters, Interstate fire crew qualified, and technologically adept with GIS and GPS. Their hiring was the result of a DEEP LEAN event to improve state forest management planning.

Accomplishment: Established the Timber Revolving Fund

The Timber Sale Revolving Account (PA 11-192) was established by the Connecticut Legislature on July 13, 2011. The fund allows the State Lands Program to address the mission of the State Lands Management Program (SLM) as described in the Forest Action Plan. These funds have been used to create access to support utilization and marketing as a management tool for locally grown traditional and non-traditional forest products, for invasive plant control to provide favorable conditions to regenerate forest stands and a healthy ecosystem of native plants, to support information management and increase field staff’s ability to collect, compile, store, and disseminate data for management planning and improving public information.

Revenues from timber harvesting on State Land have also been used fund 4-5 seasonal resource assistant positions per year to assist field foresters with associated work duties.

SLM Completed Treatments FY 2010 to 2015

1st shelterwood	561 acres
2nd shelterwood	212 acres
clear cut	71 acres
final shelterwood	624 acres
irregular shelterwood	1,476 acres
salvage	180 acres
selection harvest	856 acres
thin	739 acres
timber stand improvement	7 acres

Accomplishment: Completed silvicultural treatments on over 4,700 acres

Between 2010 and 2015 approximately 4,725 acres of state lands received some form of silvicultural treatment. Irregular shelterwood was completed on the most acres followed by selection harvest, thinning, final shelterwood, and first shelterwood.

Grand Total 4,725 acres

Urban Forestry

Accomplishment: Helped municipalities, professionals, and the public manage urban forests

While this theme is usually interpreted as being most applicable to working rural forests, no forests are harder working in terms of direct benefits to society than urban forests. A highly effective urban forestry program knits together the efforts of many actors and for many purposes. Connecticut has created a network of individuals from a variety of professional backgrounds and in a variety of roles that is highly influential in terms of promoting and helping implement urban forestry. As a result, Connecticut is highly aware of its urban forest, is pro-active in its management, and has sought to institutionalize the long-term recognition and care of this forest. The percentage of tree canopy cover in urban areas in this state leads the country.

Private and Municipal Lands

Accomplishment: Formed collaborative to increase impact on stewardship in Connecticut

A robust collaborative was formed between DEEP, NRCS, and UConn in 2010 with the goal of significantly increasing the group’s collective impact on forest stewardship in Connecticut. Efforts of the collaborative led to an unprecedented rise in financial assistance to landowners

(Connecticut NRCS EQIP budget spent on forest planning and practices rose from 0.25 to 14.6 percent annually), the active recruitment and training of private foresters as TSP's and the education and recruitment of landowners. In addition to a recent rise in forest stewardship plans recorded an additional 3,500 to 5,000 acres of NRCS Conservation Action Plan (CAP) 106 plans are now being written annually.

Accomplishment: Amended the 10 Mill current use forest tax program law

Forest and conservation advocates joined together to work toward successfully amending the law governing the 10 Mill program. Their efforts headed off a crisis that would have had a significant negative financial impact on the owners of 14,000 acres thereby placing the future of these lands as forest at risk. The 10 Mill program is the state's oldest current use forest land tax program.

Accomplishment: Amended the PA 490 current use forest tax program law

Forest and conservation advocates also joined together to work toward successfully amending PA 490, the state's most recent current use forest land tax program. The amendment served to clarify and improve language so its application by assessors, landowners, and forestry professionals is more uniform. Approximately 484,000 acres of all forest land (2015) in Connecticut is currently classified under PA490.

Accomplishment: Assisted forest landowners affected by Hurricane Sandy

The Division of Forestry, US Forest Service, and Farm Services Agency partnered to assist landowners whose forests were damaged by Hurricane Sandy. Restoration of damaged forests was made possible using financial assistance through the Emergency Forest Restoration Program.

Accomplishment: Refocused programmatic efforts to more closely align with landowner needs

The study Understanding Connecticut Woodland Owners by Mary Tyrell of Yale University School of Forestry and Environmental Studies was published. The results of this significant work have permitted DEEP Forestry and its partners to refocus their programmatic efforts to more closely align with the wants and desires of Connecticut's landowners.

Accomplishment: Provided training materials regarding forest practices and wetlands

DEEP and its partners have provided brochures, video, training, training materials and workshops to municipalities, professional loggers, landowners and the general public on statutes and regulations regarding forest practices and wetlands. The greater understanding allows for greater operational efficiency and better outcomes with regards to forest practices and environmental impacts.

Accomplishment: Provided assistance and educational materials and record stewardship plans

Each year from 2010 through 2015 the Division of Forestry averaged:

- 415 technical assists to forest landowners
- Provided educational materials to more than 1,560 forest landowners
- Recorded more than 10,000 acres in new or revised forest stewardship plans

Forest Legacy

Accomplishment: Protected working forests with the Forest Legacy Program

In 2011, the State of Connecticut, along with the Town of Simsbury, and the Simsbury Land Trust, Inc. used the Forest Legacy Program to acquire a conservation easement on 73 acres of working forest that was the last unprotected part of a 260 acre family farm in Simsbury, a Hartford suburb under significant development pressure.

Accomplishment: Completed surveys/baseline documents for previous Forest Legacy projects

In 2015, DEEP Division of Forestry completed three boundary surveys and three baseline documents for Forest Legacy Projects completed before 2009 that had used stewardship plans as the baseline documents. These documents were needed to comply with the Forest Legacy Program which has protected over 8,000 acres in Connecticut since the beginning of the program.

Accomplishment: Monitored more than 8,000 acres under conservation easements

Each year, DEEP service foresters and trained third-party personnel monitor more than 8,000 acres which are under conservation easements as part of the Forest Legacy Program. This annual monitoring ensures that the properties/landowners are complying with the terms of the conservation easements and the Forest Legacy Program.

Protect Forests from Threats

State Lands Management

Accomplishment: Developed an Emerald Ash Borer Management Guide

The State Lands Program has developed a guide, *Managing Connecticut's DEEP Lands Threatened by Emerald Ash Borer* as a resource for land managers working on DEEP-owned State Land. Three objectives were identified;

1. Conserve Economic Value
2. Maintain Ash as a component in our forests
3. Eliminate hazard trees from potential targets

Accomplishment: Assisted CAES with emerald ash borer and southern pine beetle detection

State Lands foresters and the Division of Forestry have worked closely with the Connecticut Agricultural Experiment Station during the EAB delimiting survey work and early southern pine beetle detection work.

Forest Protection

Accomplishment: Maintained a rigorous high quality wildland firefighter training program

Train an average of 21 new people a year and recertify another 65 people a year for our Connecticut Interstate Fire Crew under National Wildfire Coordinating Group standards. Train an average of 80 DEEP personnel for "in state" fire response. Specialty training given includes but is not limited to S-131 (Fire Fighting Training Type 1), S-211 (Portable Pumps and Water Use), S-212 (Wildland Fire Chain Saws), and L-280 (Followership to Leadership). For those specialty trainings that we do not provide, we send our wildland fire fighters to appropriate trainings nationwide. The Forest Protection Program trains an average of 45 Volunteer Fire Departments a year with an average of 25 firefighters per department. We also train an average

of 60 cadets a year. Over the last few years we have improved Volunteer Fire Department trainings by producing and distributing two DVD's on handline construction and dry hydrant installation. Staff has also organized two dry hydrant installation workshops and four International Standards Organizations (ISO) rural water supply workshops to assist towns in achieving lower fire related insurance premiums. We have worked to improve in-state Incident Management Team experience and capabilities through both simulations and real time incidents (3 total). Additionally, we both provide trainers, and participate as trainees, at various Northeastern Forest Fire Protection Compact trainings.

Accomplishment: Maintained/improved wildfire response equipment

Over the past few years, the program vehicle fleet has improved with the purchase of two new Type 6 engines, one Type 4 engine and two new Utility Task Vehicles (UTV's), with most vehicles replacing existing aging vehicles. In addition, we have purchased three new patrol trucks to replace aging fleet, and four small portable pumps. These improvements have allowed for more efficiency and better service from the program.

Accomplishment: Support national mobilizations for wildfire and other emergency response

Connecticut has provided ample support having mobilized 8 crews for national mobilizations over the past five years (to MN, VA, MT, CA, and ID), in addition to 2 mobilizations to Canada (QC). In addition, numerous single resources have been mobilized as well across the nation. Connecticut maintains one Type 2 Incident Commander that oversees the Northeastern Forest Fire Protection Compact Incident Management Team (IMT). This IMT has been on two national mobilizations since 2010.

Accomplishment: Improve relationships with partners and non-governmental organizations

New relationships were developed with Connecticut Audubon through collaborative work on a 17 acre prescribed burn at Stratford Point in Stratford. Relationships with Yale University expanded and improved through assistance on prescribed burns on University property. The University of Connecticut has become a more involved partner through various joint projects including a weather station project, a dry hydrant training project, and potential prescribed burn projects. The Forest Protection Program has also succeeded in creating a better working relationship with the Air Bureau in our own agency, to better inform and address compliance concerns associated with permitting for prescribed burning.

Accomplishment: Change the Connecticut Environmental Policy Act (CEPA) requirements to allow for larger prescribed burns on State Forests

Prescribed burns on state lands are no longer limited to 20 acres. A process is put in place for proposed burns over 20 acres to address any potential concerns.

Accomplishment: Improve ability to get precipitation data for fire weather predictions

We have been able to purchase two new weather stations for data collection. One is currently installed; the other is in the process of installation.

Accomplishment: Maintain an active Rural Fire Council to advise the Forest Protection Program

The Rural Fire Council continues to meet periodically, charged with identifying rural fire issues, reviewing DEEP Fire programs for relevance to current issues, making suggestions on program changes when necessary, and acting as a conduit from the Chiefs to DEEP Forestry.

Accomplishment: Assisted with creation of firewood regulations

DEEP assisted CAES, with help from APHIS, in developing firewood regulations in response to emerald ash borer. While CAES is the lead agency regarding quarantines, DEEP provides assistance with field personnel and development of quarantine areas restricting the movement of firewood and ash logs.

Urban Forestry

Accomplishment: Formation of the State Vegetation Management Task Force

In Connecticut, the threat of damage from storms, storm resilience, and the role of utilities have become major points of focus. In the 2010 Forest Action Plan, the regular occurrence of storms, including major storms such as ice storms and hurricanes, was only acknowledged tangentially and mostly in reference to the damage storms cause to the trees themselves, the maintenance response needed, and the havoc major storms can create for existing street tree inventories. This changed with the storms of 2011 (Tropical Storm Irene and the October snowstorm). Since those storms the impact of trees on infrastructure, including on roadways and electrical distribution hardware, has become a major issue. This led to the formation of the State Vegetation Management Task Force (SVMTF). The recommendations of the SVMTF are now entrenched in urban forestry discussions and have been the basis of significant changes in how roadside trees are managed.

Accomplishment: Provide outreach materials to towns regarding invasive species

The emerald ash borer (EAB) is probably the highest profile current threat to Connecticut's urban forests, and perhaps its forests overall. At this point, the charge is not so much to protect the forests from EAB but to mitigate the impact from this insect, while maintaining vigilance regarding other exotic pests such as the Asian longhorned beetle. As of July 2015, EAB information displays have been given to 31 towns.

Invasive exotic plants are also of concern, especially as so many enter into the more native environment through roadsides and urban plantings of a variety of sorts. The Urban Forestry Program encourages planting native species.

Enhance Public Benefits from Trees and Forests

State Lands Management

Accomplishment: Rectify boundary line issues and create boundary geo-database

Over the past 5 years, State Land Foresters have identified and reported 20 boundary line issues and 25 encroachments to the Division of Land Acquisition and Management which have been resolved. In 2014, The State Lands Program developed a boundary geo-database to manage and track boundary line maintenance, encroachments, and hazardous trees on state lands. The process has improved staffs abilities to identify maintenance needs and share site specific information to other Divisions to address public safety or encroachment issues.

Urban Forestry

Accomplishment: Encourage a more comprehensive view of urban ecosystems

Several key leaders in urban forestry, including within the USDA Forest Service, are actively encouraging the idea that urban forestry is much more than street trees and park trees and is, in fact, part of what is best described as the urban ecosystem. In a related manner, there has been a growing emphasis placed on recognizing the ecosystem benefits provided by urban trees. This way of thinking was incorporated in the urban forestry vision recorded in Connecticut's 2010 Forest Action Plan.

Accomplishment: Continue to use improving technologies, especially i-Tree

The prior emphasis on public trees was due in part to the sparseness of good information on urban trees prior to about 2005, outside of that which could be gathered from street tree inventories. That began to change with the adaption of forestry sampling methods to urban forestry (through i-Tree UFORE) and then got a huge boost with the introduction of UTC – urban tree canopy cover – analysis based on high resolution aerial photography. In Connecticut, we have a UFORE project from 2007 and several UTC projects, with the first ones initiated in 2008.

Accomplishment: Assist non-forestry professionals in understanding urban ecosystems

The role of trees and of the importance of urban ecosystem awareness is becoming important to managers with other primary interests, such as those in public health, those who manage storm water, air quality and “urban resilience”, and those in economic development who hope to attract people and money to a specific municipality or location. For a long while people, including many researchers, managers, tree professionals and lay observers, have felt that urban trees provide a unique value to cities and towns, but have only been able to state those impressions in qualitative and anecdotal terms – that is, until recently. The investigations of engineers, scientists, epidemiologists, and others are increasingly pointing out, in quantitative terms, the types of real environmental, social, and economic value that urban trees provide. As many of these researchers and practitioners are not urban foresters, their primary concerns are not the health or existence of the trees. Rather, their interest is in the significance of the benefit that comes from these trees, such as improved public health or reduced peak storm water flow. For them, trees are simply a means to an end. This makes their assessment of the role of trees that much more credible.

Accomplishment: Assisted municipalities in obtaining assessments and grants

Currently, the state has four Urban Tree Canopy Analyses, each of which is being used productively by the communities assessed. It has 18 Tree City USA's and has had two communities (Bridgeport and Hartford) recognized through the receipt of monetary awards from Green Streets program, jointly sponsored by TD Bank and the Arbor Day Foundation. Hartford has also received support from American Forests, while New Haven is regularly recognized for its leadership in urban forestry on a local and regional level. From 2010 through 2013 the Urban Forestry Program has awarded more than \$286,000 in America the Beautiful (ATB) grants to 47 different projects with funding from the USDA Forest Service and the Regional Greenhouse Gas Initiative (RGGI). Another \$98,000+ has been approved for current projects.

Accomplishment: Outreach to public

With respect to its Community Accomplishment Reporting System (CARS) reports, Connecticut has consistently shown itself able to reach over 98% of its population through its urban forestry program.

Accomplishment: Continue high standards for regulating tree wardens and arborists

The state's statutes regarding tree wardens and arborists places the state in a leadership role with respect to its standards regarding both public and private tree care. The state's tree warden program took a major step forward in 2013 with the requirement that all tree wardens need to be qualified being added to the already existing requirement that all municipalities must have a tree warden. There is now a standard for what it takes for an individual to be considered as qualified as a tree warden.

Private and Municipal Lands

Accomplishment: Provide educational outreach to forest landowners and the public

DEEP and all of its collaborators provided significant educational outreach to forest landowners and the public including, but not limited to, one on one site visits, meetings with groups, serving as advising forester to landowner groups or local environmentally oriented boards and the creation and distribution of publications, brochures, website and workshops. Examples include, but are not limited to, Coverts Project, Project Learning Tree forestry tour, Tree Farm, No Child Left Inside (Great Park Pursuit), Envirothon, sawmill workshops, and publications such as Thinking about Selling Timber, the Woodland Owner Packet and the Directory of Certified Forest Practitioners.

Forest Practices Act

Accomplishment: Continue to license and educate forest practitioners

More than 500 loggers and foresters are certified pursuant to the Forest Practices Act. Certification is primarily achieved through examination. The Division of Forestry approved more than 500 continuing education workshops over the past 5 years and certified practitioners logged in more than 19,000 hours of continuing education (3,800 hours annually) on subjects such as safety, harvesting techniques, best management practices, silviculture, business practices, forest health, and laws affecting forest practices.

Utilization and Marketing

Accomplishment: Develop publications on the economic importance of the forest industry

Several publications were developed and released that for the first time quantified the full impact the forest industry, including forestry based tourism, has on Connecticut's economy. The publications, *The Economic Impact of Connecticut's Agricultural Industry* and *The Economic Importance of Connecticut's Forest Based Economy* give forestry advocates the critical tools they previously lacked to advise policy makers and the public on important economic matters involving forestry.

Accomplishment: Expanded the Connecticut Grown Program to include forest products

The Division of Forestry partnered with the Connecticut Department of Agriculture to expand their Connecticut Grown program to include forest products. The program is a celebration of locally produced forest products that allows consumers to purchase knowing the wood was locally grown, harvested sustainably and produced locally. Approximately 50% of the state's primary timber production capacity has joined the Connecticut Grown forest products program. The Connecticut Grown Forest Products program has achieved significant media attention since its inception in 2010. An interactive map and primary processor directory helps connect wood producers with market prospects.

Accomplishment: Assist in connecting low-grade material suppliers and producers

Over the past five years the in-state demand for low-grade woody material has improved significantly. Several large scale biomass users have now become established such as the Plainfield Renewable Energy in Plainfield and Scotts Company in Lebanon and many established operations have grown in scale. Also gaining in strength are nearby out-of-state biomass markets. The current forest action plan noted that there never has been a pulpwood market in Connecticut. That has now changed with a successful pulpwood chipping facility being established in Enfield.

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APPENDICES

APPENDIX 1. NA/NAASF Base Indicators of Forest Sustainability and Associated Metrics

NA/NAASF Base Indicators of Forest Sustainability and Associated Metrics¹

These indicators and metrics span the Montreal Process criteria and are recommended for use in NA-wide and State forest sustainability assessments.

Criterion 1. Conservation of Biological Diversity

1. Area of total land, forest land, and reserved forest land

- 1.1 Forest and total land area
- 1.2 Forest density
- 1.3 Forest land and population
- 1.4 Reserved forest land
- 1.5 Urban forest

2. Forest type, size class, age class, and successional stage

- 2.1 Forest cover type groups
- 2.2 Size class
- 2.3 Age group
- Successional stage (*text document; no data/graphs*)

3. Extent of forest land conversion, fragmentation, and parcelization

- 3.1 Fragmentation (*text report with links; no data/graphs*)
- 3.2 Forest land developed
- 3.3 Net change in forest land
- 3.4 Additions to and conversions from forest land
- 3.5 Forest parcel sizes

4. Status of forest/woodland communities and associated species of concern

- 4.1 Forest and woodland communities
- 4.2 Forest-associated and all species
- 4.3 Forest-associated species of concern by taxonomic group
- 4.4 Bird populations

Criterion 2. Maintenance of Productive Capacity of Forest Ecosystems

5. Area of timberland

- 5.1 Amount of timberland

6. Annual removal of merchantable wood volume compared with net growth

- 6.1 Net growth and removals
- 6.2 Type of removals

Criterion 3. Maintenance of Forest Ecosystem Health and Vitality

7. Area of forest land affected by potentially damaging agents

- 7.1 Tree mortality and damage type
- 7.2 Wildfire
- 7.3 Drought
- 7.4 Insects, diseases, plants, and animals

Criterion 4. Conservation and Maintenance of Soil and Water Resources

8. Soil quality on forest land

- 8.1 Soil pH
- 8.2 Total soil carbon
- 8.3 Estimated bare soil
- 8.4 Bulk density
- 8.5 Calcium-aluminum ratio

9. Area of forest land adjacent to surface water, and forest land by watershed

- 9.1 Forested riparian area
- 9.2 Forest land by watershed

10. Water quality in forested areas

- 10.1 Water quality in forested areas (*text report with links, no data/graphs*)
- 10.2 Stream miles impaired by percentage of watershed forested

Criterion 5. Maintenance of Forest Contribution to Global Carbon Cycles

11. Forest ecosystem biomass and forest carbon pools

- 11.1 Forest ecosystem biomass
- 11.2 Forest carbon pools
- 11.3 Forest carbon by forest type
- 11.4 Change in forest carbon

Criterion 6. Maintenance and Enhancement of Long-Term Multiple Socioeconomic Benefits to Meet the Needs of Societies

12. Wood and wood products production, consumption, and trade

- 12.1 Value of wood-related products
- 12.2 Production of roundwood
- 12.3 Production and consumption of roundwood equivalent
- 12.4 Recovered paper
- 12.5 Bioenergy (*text report with links; no data/graphs*)
 - Trade or wood flow (*text document; no data/graphs*)
 - Non-timber forest products (*text document; no data/graphs*)

13. Outdoor recreational participation and facilities

- 13.1 Participation in outdoor recreation
- 13.2 Federal land open to recreation
- 13.3 Recreational facilities on State land
- 13.4 Trails
- 13.5 Campgrounds
- 13.6 Recreational facilities in national forests

14. Investments in forest health, management, research, and wood processing

- 14.1 USDA Forest Service Northeastern Area State and Private Forestry funding
- 14.2 State forestry agency funding
- 14.3 Funding for forestry research at universities
- 14.4 USDA Forest Service Research funding
- 14.5 Capital expenditures by manufacturers of wood-related products

15. Forest ownership, land use, and specially designated areas

- 15.1 Forest land ownership
- 15.2 State lands
- 15.3 Protected land
- 15.4 Private land with public conservation easements
- 15.5 Forest land in tax reduction programs
- 15.6 Forest certification

16. Employment and wages in forest-related sectors

- 16.1 Wood-related products manufacturing employees
- 16.2 State forestry employees
- 16.3 USDA Forest Service employees
- 16.4 Wood-related products manufacturing payroll and wages
- 16.5 State forestry salaries

Criterion 7. Legal, Institutional, and Economic Framework for Forest Conservation and Sustainable Management

17. Forest management standards/guidelines

- 17.1 Types of forest management standards/guidelines
- 17.2 Voluntary and mandatory standards/guidelines
- 17.3 Monitoring of standards/guidelines

18. Forest-related planning, assessment, policy, and law

- 18.1 State forest planning
- 18.2 Private non-industry forest planning
- 18.3 National forest planning
- 18.4 State forest assessments
- 18.5 Forest laws and policies
- 18.6 State forest advisory committees

¹ No priority is implied in the numeric listing of the criteria, indicators, and metrics.

APPENDIX 2. Forest Associated GNC Species by Habitat

Upland Forest (Habitat 1)

GCN Species by Taxon

Mammal

Most Important

Eastern Small-footed Bat
Hoary Bat
Indiana Bat
Red Bat
Silver-haired Bat

Very Important

Bobcat
Deer Mouse
Northern Flying Squirrel

Important

Black Bear
Hairy-Tailed Mole
Little Brown Bat
Long-tailed Weasel
Northern Long-eared Bat
Short-tailed Weasel
Southern Red-backed Vole
Tricolor Bat
Woodland Vole

Bird

Very Important

Acadian Flycatcher
Bald Eagle
Black-and-white Warbler
Black-throated Blue Warbler
Blue-headed Vireo
Cerulean Warbler
Golden-crowned Kinglet
Great Crested Flycatcher
Hermit Thrush
Long-eared Owl
Northern Saw-whet Owl
Rose-breasted Grosbeak
Ruffed Grouse
Sharp-shinned Hawk
Wood Thrush
Worm-eating Warbler

Bird cont.

Important

Barred Owl
Bay-breasted Warbler
Blackburnian Warbler
Black-throated Green Warbler
Broad-winged Hawk
Brown Creeper
Cape May Warbler
Cooper's Hawk
Dark-eyed Junco
Eastern Wood-pewee
Gray-cheeked Thrush
Great Horned Owl
Hooded Warbler
Louisiana Waterthrush
Magnolia Warbler
Northern Flicker
Northern Goshawk
Northern Parula
Olive-sided Flycatcher
Ovenbird
Pileated Woodpecker
Purple Finch
Red-breasted Nuthatch
Scarlet Tanager
Swainson's Thrush
Winter Wren
Yellow-rumped Warbler
Yellow-throated Vireo

Reptile/Amphibian

Most Important

Blue-spotted Salamander (diploid)
Eastern Spadefoot
Timber Rattlesnake

Very Important

Blue-spotted Salamander (complex)

Reptile/Amphibian cont.

Common Five-lined Skink
Eastern Box Turtle
Eastern Hog-nosed Snake
Eastern Ribbonsnake
Jefferson Salamander
Northern Leopard Frog
Northern Slimy Salamander
Northern Spring Salamander
Spotted Turtle
Wood Turtle

Important

Copperhead
Eastern Newt
Eastern Racer
Fowler's Toad
Gray Treefrog
Marbled Salamander
Northern Dusky Salamander
Spotted Salamander
Wood Frog

Invertebrate

Most Important

Columbine Duskywing

Very Important

Common Roadside Skipper

Important

American Burying Beetle
Atlantis Fritillary
Aureolaria Seed Borer
Black Lordithon Rove Beetle
Calosoma wilcoxi
Carabus sylvosus
Cicada
Columbine Borer
Gray Comma
Imperial Moth
Purse-web Spider
Regal Moth

Upland Woodland & Shrub (Habitat 2)
GCN Species by Taxon

Mammals	Mammal	Bird cont.	Wood Frog
Most Important		Important	Invertebrate
Eastern Small-footed Bat		Bank Swallow	Most Important
Hoary Bat		Black-crowned Night-heron	Buck Moth
Indiana Bat		Black-throated Green Warbler	Columbine Duskywing
Least Shrew		Cape May Warbler	Northern Metalmark
New England Cottontail		Eastern Kingbird	Persius Duskywing
Red Bat		Eastern Wood-pewee	Silvery Checkerspot
Silver-haired Bat		Gray-cheeked Thrush	Very Important
Very Important		Great Horned Owl	Barrens Itame
Bobcat		Northern Flicker	Coastal Heathland Cutworm
Meadow Jumping Mouse		Purple Martin	Frosted Elfin
Important		Snowy Owl	Herodias Underwing
Black Bear		White-eyed Vireo	Pink Sallow
Long-tailed Weasel		Yellow-rumped Warbler	Slender Clearwing
Short-tailed Weasel		Reptile/Amphibian	Violet Dart Moth
Southern Red-backed Vole		Most Important	<i>Zale submediana</i>
Tricolor Bat		Blue-spotted Salamander	Important
Woodland Vole		(diploid)	<i>Acronicta lanceolaria</i>
Bird		Eastern Spadefoot	Barrens Dagger Moth
Most Important		Timber Rattlesnake	Barrens Metarranthis Moth
Golden-winged Warbler		Very Important	<i>Chaetagnaea cerata</i>
Northern Harrier		Blue-spotted Salamander	<i>Eucloptocnemis fimbriaris</i>
Very Important		(complex)	Hoary Elfin
American Kestrel		Common Five-lined Skink	Horace's Duskywing
Brown Thrasher		Eastern Box Turtle	Lemmer's Noctuid Moth
Chestnut-sided Warbler		Eastern Hog-nosed Snake	Mottled Duskywing
Common Raven		Eastern Ribbonsnake	New Jersey Tea Inchworm
Eastern Towhee		Northern Leopard Frog	Pale Green Pinion Moth
Glossy Ibis		Spotted Turtle	Pine Barrens Zanclognatha
Great Crested Flycatcher		Important	Purse-web Spider
Ipswich Sparrow		Copperhead	<i>Schinia spinosae</i>
Northern Bobwhite		Eastern Newt	Scrub Euchlaena
Peregrine Falcon		Eastern Racer	Spotted Dart
Short-eared Owl		Fowler's Toad	Yellow-horned Beaded
Whip-poor-will		Marbled Salamander	Lacewing
Worm-eating Warbler		Smooth Greensnake	<i>Zale curema</i>
Yellow-crowned Night-heron		Spotted Salamander	<i>Zale oblique</i>

Forested Inland Wetland (Habitat 4)
GCN Species by Taxon

Mammal

- Most Important
 - Eastern Small-footed Bat
 - Hoary Bat
 - Indiana Bat
 - Red Bat
 - Silver-haired Bat
 - Southern Bog Lemming
- Very Important
 - Bobcat
 - Northern Water Shrew
- Important
 - Black Bear
 - Hairy-Tailed Mole
 - Little Brown Bat
 - Mink
 - Northern Long-eared Bat
 - Tricolor Bat

Mammal

Bird cont.

- Northern Saw-whet Owl
- Rose-breasted Grosbeak
- Yellow-billed Cuckoo
- Important
 - American Redstart
 - Baltimore Oriole
 - Barred Owl
 - Black-throated Green Warbler
 - Broad-winged Hawk
 - Eastern Kingbird
 - Eastern Screech-owl
 - Gray-cheeked Thrush
 - Great Blue Heron
 - Louisiana Waterthrush
 - Northern Flicker
 - Northern Parula
 - Northern Waterthrush
 - Purple Martin
 - Red-shouldered Hawk
 - Veery
 - Winter Wren
 - Yellow-throated Vireo

Reptile/Amphibian cont.

- Eastern Box Turtle
- Eastern Ribbonsnake
- Spotted Turtle
- Wood Turtle
- Important
 - Eastern Newt
 - Fowler's Toad
 - Marbled Salamander
 - Spotted Salamander
 - Wood Frog

Invertebrate

- Most Important
 - Hessel's Hairstreak
- Very Important
 - Pink Streak
 - Two-spotted Skipper
- Important
 - Annoited Sallow Moth
 - Bembidion semicinctum*
 - Brachinus cyanipennis*
 - Carabus vinctus*
 - Coastal Pond Amphipod
 - Goniops chrysocoma*
 - Gray Comma
 - Hybomitra trepida*
 - Hybomitra typhus*
 - Lemmer's Noctuid Moth
 - Loxandrus vitiosus*
 - Mystic Valley Amphipod

Bird

- Very Important
 - American Black Duck
 - American Woodcock
 - Black-billed Cuckoo
 - Black-throated Blue Warbler
 - Canada Warbler
 - Cerulean Warbler
 - Chestnut-sided Warbler
 - Green Heron
 - Hermit Thrush
 - Hooded Merganser
 - Least Flycatcher

Reptile/Amphibian

- Most Important
 - Blue-spotted Salamander
- (diploid)
 - Eastern Spadefoot
- Very Important
 - Blue-spotted Salamander
- (complex)

Intensively Managed Early Successional Shrublands and Forests (Habitat 12)
GCN Species by Taxon

Mammal

Most Important

Eastern Small-footed Bat
Hoary Bat
Indiana Bat
New England Cottontail
Red Bat
Silver-haired Bat

Important

Black Bear
Little Brown Bat
Northern Long-eared Bat
Tricolor Bat

Bird

Most Important

Barn Owl
Common Nighthawk
Golden-winged Warbler
Northern Harrier
Red-headed Woodpecker
Yellow-breasted Chat

Very Important

American Kestrel
American Woodcock
Blue-winged Warbler

Bird cont.

Brown Thrasher
Chestnut-sided Warbler
Eastern Towhee
Field Sparrow
Great Crested Flycatcher
Indigo Bunting
Northern Bobwhite
Prairie Warbler
Ruffed Grouse
Savannah Sparrow
Whip-poor-will
Yellow-billed Cuckoo

Important

American Redstart
Eastern Kingbird
Eastern Screech-owl
Eastern Wood-pewee
Gray Catbird
Great Horned Owl
Hooded Warbler
Magnolia Warbler
Orchard Oriole
Rough-legged Hawk
Ruby-throated Hummingbird

Bird cont.

Snowy Owl
Warbling Vireo
White-eyed Vireo
Willow Flycatcher

Reptile/Amphibian

Very Important

Eastern Hog-nosed Snake
Spotted Turtle
Wood Turtle

Important

Copperhead
Eastern Racer
Smooth Greensnake

Invertebrate

Very Important

Harris's Checkerspot

Important

Bronze Copper
Cicindela purpurea
Cuculia speyeri
Culvers Root Borer
Harpalus caliginosus
Hop Vine Borer Moth
Regal Fritillary

APPENDIX 3. Species Richness and Distribution in Southern New England Tables by Taxa

Figure 1.1 Mammal Species Richness and Distribution in Southern New England (Source: SNEGAP, Zuckerberg et al., 2004)

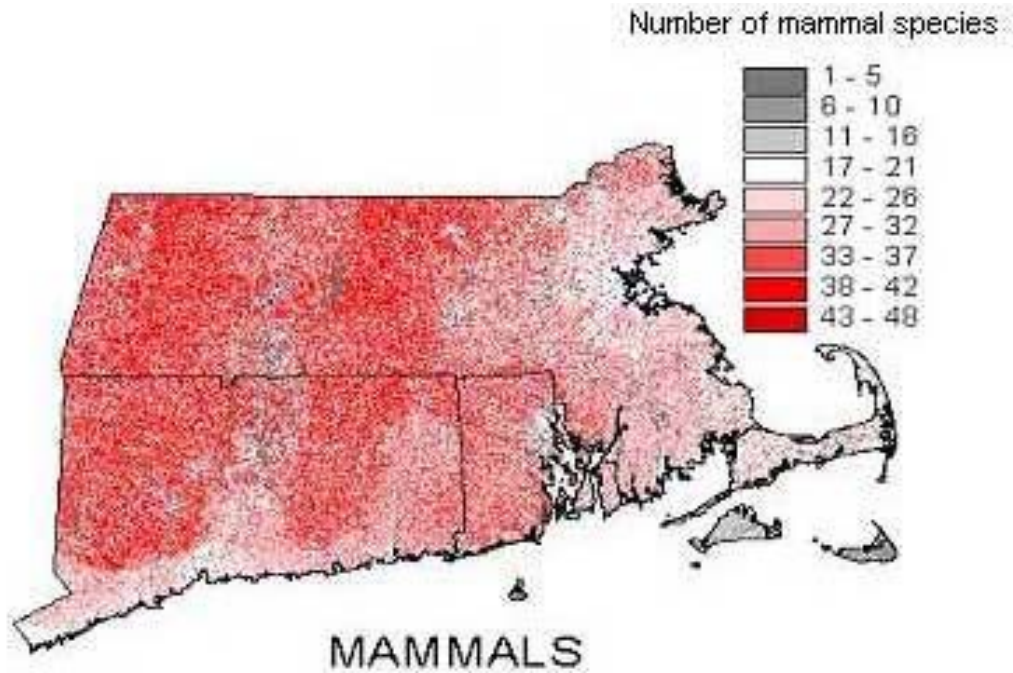


Figure 1.2 Bird Species Richness and Distribution in Southern New England (Source: SNEGAP, Zuckerberg et al., 2004)

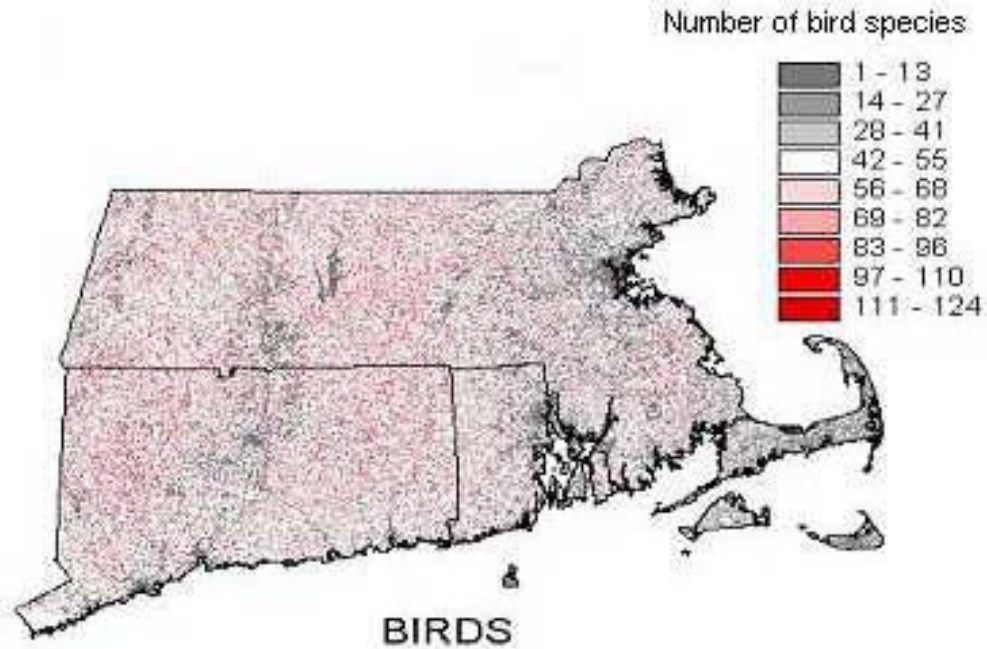


Figure 1.3 Species Richness for Common Bird Habitat Guilds (Source: SNE-GAP, Zuckerberg et al., 2004)

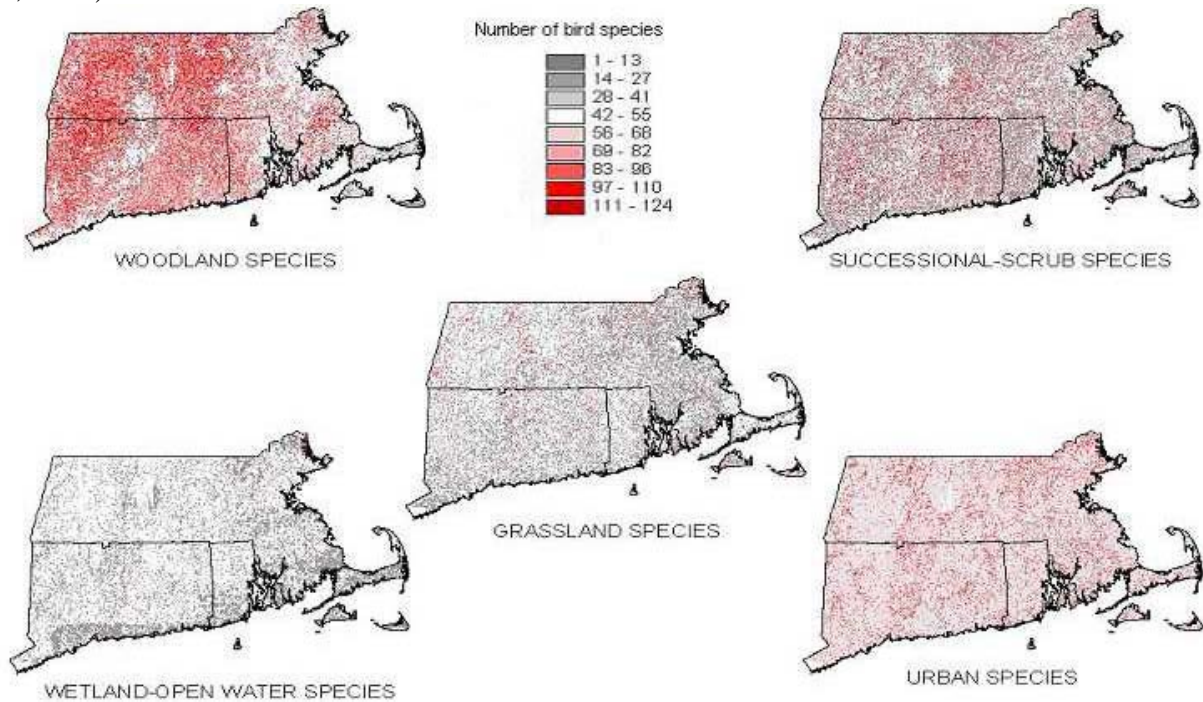


Figure 1.7 Predicted Distribution of Amphibians in Southern New England. (Source: SNE-GAP, Zuckerberg et al., 2004)

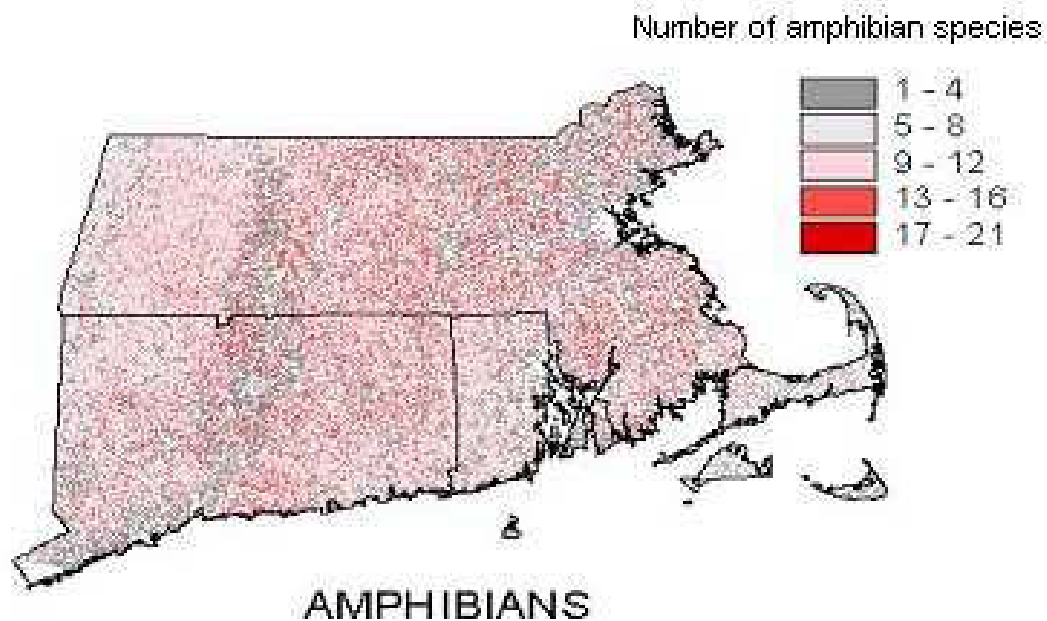


Figure 1.8 Predicted Distribution of Reptiles in Southern New England. (Source: SNE-GAP, Zuckerberg et al., 2004)

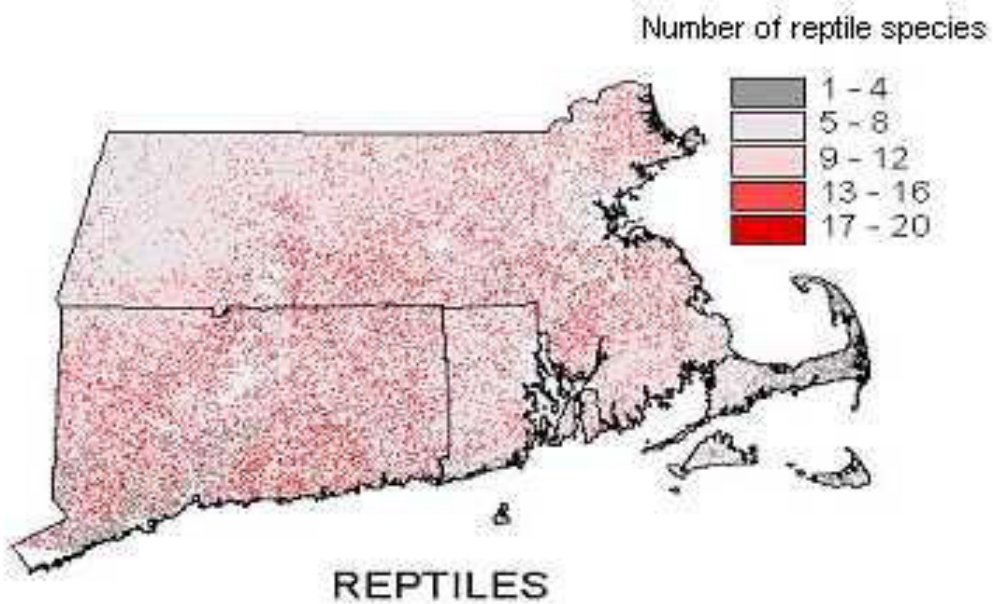


Figure 1.9 Total Number of Fish Species per Site (Source: CT DEP Stream Survey 1988-94)

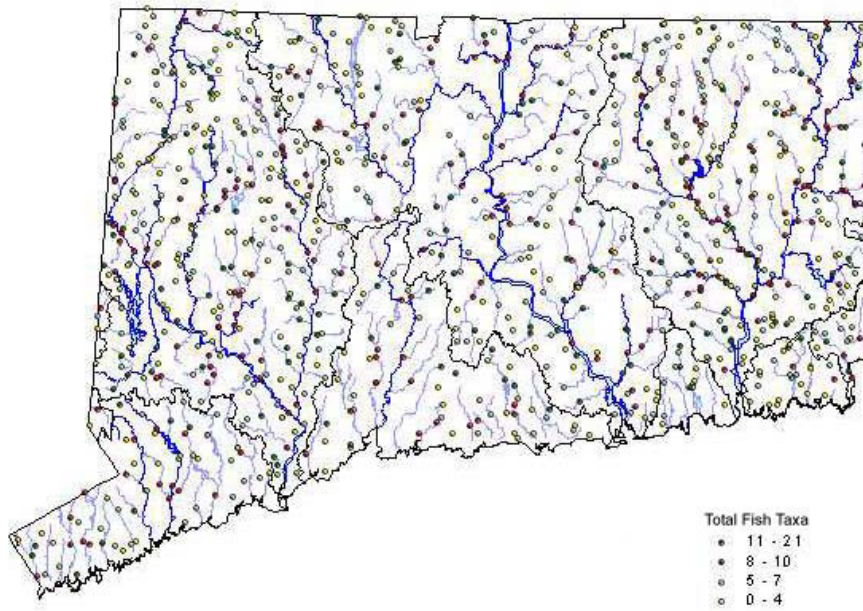
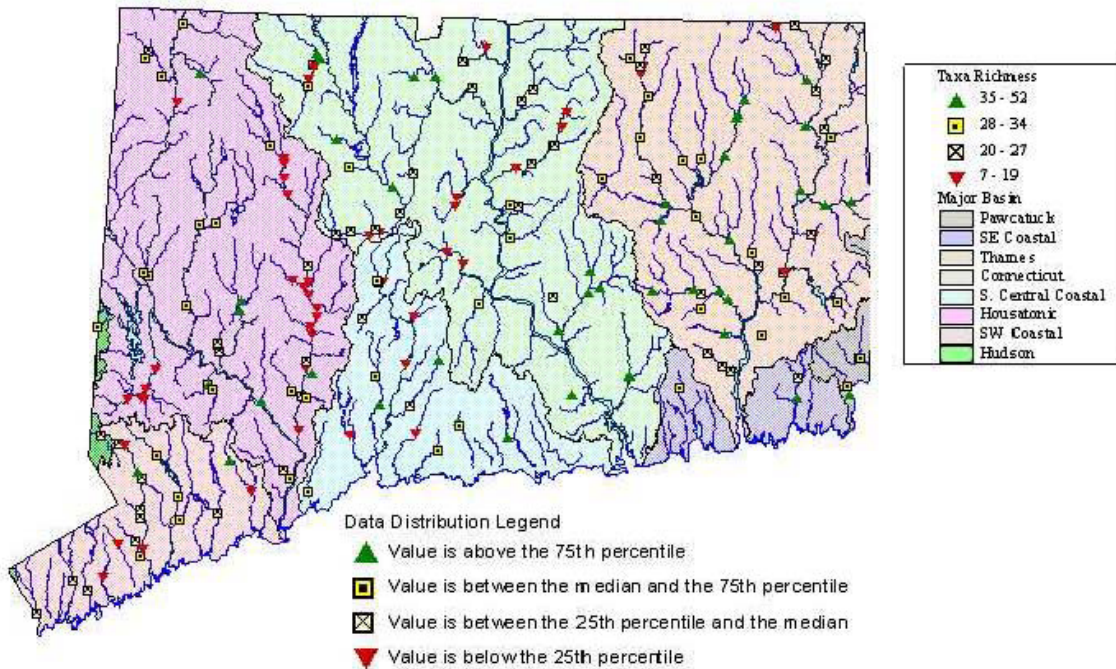


Figure 1.10. Distribution of Benthic Macroinvertebrates in Connecticut (Source: CT DEP BWM Rotating Basin Strategy)



APPENDIX 4. Forest Health Indicator Species (Birds)

(Compiled by the Connecticut Forestlands Council Forest Ecosystem Health Committee)

Deciduous Woodlands

- * Wood Thrush
- * Worm-eating Warbler
- * Scarlet Tanager
- * Louisiana Waterthrush
- * Cerulean Warbler
- * E Bald Eagle (?)
- * Hairy Woodpecker
- * Eastern Wood-Pewee
- * Least Flycatcher
- * Great Crested Flycatcher
- * Veery
- * Black-and-White Warbler
- * Ovenbird
- * Barred Owl
- * Blue-gray Gnatcatcher
- * Broad-winged Hawk
- * Cooper's Hawk
- * Northern Goshawk
- * Pileated Woodpecker
- * Red-shouldered Hawk
- * Red-eyed Vireo

Shrubland/young forest

- * Blue-winged Warbler
- * E Golden-winged Warbler
- * Prairie Warbler
- * American Woodcock
- * Chestnut-sided Warbler
- * E Yellow-breasted Chat
- * SC Northern Saw-whet Owl
- * SC Whip-poor-will
- * SC Brown Thrasher
- * Gray Catbird

Shrubland/young forest cont.

- * Eastern Towhee
- * Field Sparrow (?)
- * Ruffed Grouse
- * Eastern Screech Owl
- * White-eyed Vireo

Forest edge

- * Baltimore Oriole
- * Black-billed Cuckoo
- * Yellow-billed Cuckoo
- * E Red-headed Woodpecker
- * Orchard Oriole
- * Indigo Bunting
- * Rose-breasted Grosbeak
- * Northern Flicker
- * Ruby-throated Hummingbird
- * Warbling Vireo
- * Yellow-throated Vireo

Northern Forest

- * Canada Warbler
- * Black-throated Blue Warbler
- * Blackburnian Warbler
- * E Sharp-shinned Hawk
- * SC Common Raven
- * Purple Finch
- * Hermit Thrush
- * Blue-headed Vireo
- * Golden-crowned Kinglet
- * American Redstart
- * Black-throated Green Warbler
- * Brown Creeper
- * Dark-eyed Junco

Northern Forest cont.

- * Magnolia Warbler
- * Red-breasted Nuthatch
- * Swainson's Thrush
- * Winter Wren
- * Yellow-rumped Warbler
- * Northern Waterthrush

Southern Forest

- * Acadian Flycatcher
- * Hooded Warbler
- * Red-bellied Woodpecker

White Pine Forest

- * Pine Warbler

Special Categories

Air quality

- * SC Northern Parula

Shrubby wetlands

- * SC Alder Flycatcher
- * Willow Flycatcher

Questionable Category*

- * Great Blue Heron
- * Great Horned Owl
- * Black-capped Chickadee
- * Tufted Titmouse
- * White-breasted Nuthatch
- * Yellow-bell. Sapsucker
- * Wild Turkey

* Birds that use forests to a certain extent, but a determination hasn't been made as to what they can be used to indicate.

APPENDIX 5. Key Habitat Types and Associated Sub-Habitats

Key Habitat	Vegetative Community
1) Upland Forest	<ul style="list-style-type: none"> a) Oak Forests b) Calcareous Forests c) Coniferous Forests d) Old Growth Forests e) Northern Hardwood Forests f) Mixed Hardwood Forests g) Young Forests h) Maritime Forests
2) Upland Woodland and Shrub	<ul style="list-style-type: none"> a) Red Cedar Glades b) Pitch Pine-Scrub Oak Woodlands c) Maritime Shrublands d) Reverting Field and Early Successional Shrubland
3) Upland Herbaceous	<ul style="list-style-type: none"> a) Coastal Beaches and Dunes b) Grassy Glades and Balds c) Sand Barrens and Sparsely Vegetated Sand and Gravel d) Warm Season Grasslands e) Cool Season Grasslands
4) Forested Inland Wetland	<ul style="list-style-type: none"> a) Atlantic White Cedar Swamps b) Red/Black Spruce Swamps c) Northern White Cedar Swamps d) Floodplain Forests e) Red Maple Swamps
5) Shrub Inland Wetland	<ul style="list-style-type: none"> a) Bogs and Fens b) Shrub Swamps
6) Herbaceous Inland Wetland	<ul style="list-style-type: none"> a) Calcareous Spring Fens b) Freshwater Marshes c) Wet Meadows
7) Tidal Wetland	<ul style="list-style-type: none"> a) Salt and Brackish Marshes b) Intertidal Beaches, Flats, and Rocky Shores
8) Freshwater Aquatic	<ul style="list-style-type: none"> a) Large Rivers and Streams and their Associated Riparian Zones b) Unrestricted, Free-Flowing Streams c) Cold Water Streams d) Head-of-Tide and Coastal Streams e) Lakes and their Shorelines f) Coastal Plain Ponds

9) Estuarine Aquatic	<ul style="list-style-type: none"> a) Coastal Rivers, Coves, and Embayments b) Vegetation Beds c) Hard Bottoms d) Sponge Beds e) Shellfish Reefs/Beds f) Sedimentary Bottoms g) Open Water h) Algal Beds
10) Unique, Natural or Man-made	<ul style="list-style-type: none"> a) Traprock Ridges b) Offshore Islands c) Coastal Bluffs and Headlands d) Caves and Other Subterranean Habitats e) Urban and Man-made Features f) Cliffs and Talus Slopes g) Surface Springs and Seeps h) Vernal Pools i) Agricultural Lands j) Navigational Channels, Breakwaters, Jetties, and Piers k) Public Utility Transmission Corridors

APPENDIX 6. Connecticut Endangered, Threatened, and Special Concern Species 2010

(for a more up to date list see the 2015 CT Wildlife Action Plan)

Group	Subgroup	Scientific Name	Common Name	State Protection Status 2010	Comments	Federal Status
Amphibians	Salamanders	<i>Ambystoma laterale</i>	Blue-spotted salamander (diploid populations)	E	diploid populations	
Amphibians	Frogs and Toads	<i>Scaphiopus holbrookii</i>	Eastern spadefoot	E		
Amphibians	Salamanders	<i>Ambystoma jeffersonianum</i>	Jefferson salamander "complex"	SC		
Amphibians	Salamanders	<i>Ambystoma laterale</i>	Blue-spotted salamander "complex"	SC		
Amphibians	Frogs and Toads	<i>Rana pipiens</i>	Northern leopard frog	SC		
Amphibians	Salamanders	<i>Gyrinophilus porphyriticus</i>	Northern spring salamander	T		
Amphibians	Salamanders	<i>Plethodon glutinosus</i>	Northern slimy salamander	T		
Birds	Hawks and Others	<i>Accipiter striatus</i>	Sharp-shinned hawk	E		
Birds	Perching Birds	<i>Ammodramus savannarum</i>	Grasshopper sparrow	E		
Birds	Owls	<i>Asio otus</i>	Long-eared owl	E		
Birds	Shorebirds, Terns and Others	<i>Bartramia longicauda</i>	Upland sandpiper	E		
Birds	Wading Birds	<i>Botaurus lentiginosus</i>	American bittern	E		
Birds	Goatsuckers	<i>Chordeiles minor</i>	Common nighthawk	E		
Birds	Hawks and Others	<i>Circus cyaneus</i>	Northern harrier	E		
Birds	Perching Birds	<i>Cistothorus platensis</i>	Sedge wren	E		
Birds	Perching Birds	<i>Eremophila alpestris</i>	Horned lark	E		
Birds	Rails and Others	<i>Gallinula chloropus</i>	Common moorhen	E		
Birds	Perching Birds	<i>Icteria virens</i>	Yellow-breasted chat	E		
Birds	Rails and Others	<i>Laterallus jamaicensis</i>	Black rail	E	Nesting population only.	

Birds	Woodpeckers	<i>Melanerpes erythrocephalus</i>	Red-headed woodpecker	E	
Birds	Grebes	<i>Podilymbus podiceps</i>	Pied-billed grebe	E	
Birds	Perching Birds	<i>Pooecetes gramineus</i>	Vesper sparrow	E	
Birds	Rails and Others	<i>Rallus elegans</i>	King rail	E	Nesting population only.
Birds	Shorebirds, Terns and Others	<i>Sterna dougallii</i>	Roseate tern	E	Federally Endangered
Birds	Owls	<i>Tyto alba</i>	Barn owl	E	
Birds	Perching Birds	<i>Vermivora chrysoptera</i>	Golden-winged warbler	E	
Birds	Owls	<i>Aegolius acadicus</i>	Northern saw-whet owl	SC	
Birds	Perching Birds	<i>Ammodramus caudacutus</i>	Saltmarsh sharp-tailed sparrow	SC	
Birds	Hawks and Others	<i>Buteo platypterus</i>	Broad-winged hawk	SC	
Birds	Goatsuckers	<i>Caprimulgus vociferus</i>	Whip-poor-will	SC	
Birds	Perching Birds	<i>Dolichonyx oryzivorus</i>	Bobolink	SC	
Birds	Wading Birds	<i>Egretta caerulea</i>	Little blue heron	SC	
Birds	Perching Birds	<i>Empidonax alnorum</i>	Alder flycatcher	SC	
Birds	Loons	<i>Gavia immer</i>	Common loon	SC	
Birds	Wading Birds	<i>Nyctanassa violacea</i>	Yellow-crowned night-heron	SC	
Birds	Perching Birds	<i>Parula americana</i>	Northern parula	SC	
Birds	Perching Birds	<i>Passerculus sandwichensis</i>	Savannah sparrow	SC	
Birds	Perching Birds	<i>Passerculus sandwichensis ssp. princeps</i>	Ipswich sparrow	SC	(wintering populations)
Birds	Wading Birds	<i>Plegadis falcinellus</i>	Glossy ibis	SC	
Birds	Shorebirds, Terns and Others	<i>Sterna hirundo</i>	Common tern	SC	
Birds	Perching Birds	<i>Sturnella magna</i>	Eastern meadowlark	SC	
Birds	Perching Birds	<i>Toxostoma rufum</i>	Brown thrasher	SC	
Birds	Perching Birds	<i>Ammodramus henslowii</i>	Henslow's sparrow	SC*	
Birds	Shorebirds, Terns and Others	<i>Numenius borealis</i>	Eskimo curlew	SC*	Federally Endangered
Birds	Perching Birds	<i>Ammodramus maritimus</i>	Seaside sparrow	T	

Birds	Waterfowl	<i>Anas discors</i>	Blue-winged teal	T	Nesting population only.
Birds	Wading Birds	<i>Ardea alba</i>	Great egret	T	
Birds	Owls	<i>Asio flammeus</i>	Short-eared owl	T	Wintering populations.
Birds	Shorebirds, Terns and Others	<i>Charadrius melodus</i>	Piping plover	T	Federally Threatened
Birds	Wading Birds	<i>Egretta thula</i>	Snowy egret	T	
Birds	Hawks and Others	<i>Falco peregrinus</i>	Peregrine falcon	T	
Birds	Hawks and Others	<i>Falco sparverius</i>	American kestrel	T	
Birds	Shorebirds, Terns and Others	<i>Haematopus palliatus</i>	American oystercatcher	T	
Birds	Hawks and Others	<i>Haliaeetus leucocephalus</i>	Bald eagle	T	
Birds	Wading Birds	<i>Ixobrychus exilis</i>	Least bittern	T	
Birds	Perching Birds	<i>Progne subis</i>	Purple martin	T	
Birds	Shorebirds, Terns and Others	<i>Sternula antillarum</i>	Least tern	T	
Fish		<i>Acipenser brevirostrum</i>	Shortnose sturgeon	E	Federally Endangered
Fish		<i>Lampetra appendix</i>	American brook lamprey	E	
Fish		<i>Lota lota</i>	Burbot	E	
Fish		<i>Osmerus mordax</i>	Rainbow smelt	E	Anadromous populations only.
Fish		<i>Alosa aestivalis</i>	Blueback herring	SC	
Fish		<i>Catostomus catostomus</i>	Longnose sucker	SC	
Fish		<i>Enneacanthus obesus</i>	Banded sunfish	SC	
Fish		<i>Notropis bifrenatus</i>	Bridled shiner	SC	
Fish		<i>Acipenser oxyrinchus oxyrinchus</i>	Atlantic sturgeon	T	
Invertebrate Animal	Freshwater Mussels	<i>Alasmidonta heterodon</i>	Dwarf wedgemussel	E	Federally Endangered
Invertebrate Animal	Freshwater Mussels	<i>Alasmidonta varicosa</i>	Brook floater	E	

Invertebrate Animal	Skippers	<i>Amblyscirtes vialis</i>	Common roadside skipper	E	
Invertebrate Animal	Moths	<i>Anarta luteola</i>	Noctuid moth	E	
Invertebrate Animal	Butterflies	<i>Calephelis borealis</i>	Northern metalmark	E	
Invertebrate Animal	Butterflies	<i>Callophrys hesseli</i>	Hessel's hairstreak	E	
Invertebrate Animal	Moths	<i>Catocala herodias gerhardi</i>	Herodias underwing	E	
Invertebrate Animal	Beetles	<i>Cicindela lepida</i>	Dune ghost tiger beetle	E	
Invertebrate Animal	Beetles	<i>Cicindela puritana</i>	Puritan tiger beetle	E	Federally Threatened
Invertebrate Animal	Bees	<i>Epeoloides pilosula</i>	Macropis cuckoo	E	
Invertebrate Animal	Skippers	<i>Erynnis lucilius</i>	Columbine duskywing	E	
Invertebrate Animal	Skippers	<i>Erynnis persius persius</i>	Persius duskywing	E	
Invertebrate Animal	Crustacean	<i>Eubbranchipus holmanii</i>	Fairy shrimp	E	
Invertebrate Animal	Moths	<i>Grammia phyllira</i>	Phyllira tiger moth	E	
Invertebrate Animal	Moths	<i>Grammia speciosa</i>	Bog tiger moth	E	
Invertebrate Animal	Moths	<i>Hemileuca maia maia</i>	Buck moth	E	
Invertebrate Animal	Flies	<i>Hybomitra longiglossa</i>	Horse fly	E	
Invertebrate Animal	Freshwater Mussels	<i>Lampsilis cariosa</i>	Yellow lamp mussel	E	
Invertebrate Animal	Moths	<i>Metarranthis apiciaria</i>	Barrens metarranthis moth	E	
Invertebrate Animal	Moths	<i>Papaipema appassionata</i>	Pitcher plant borer	E	

Invertebrate Animal	Moths	<i>Phyllonorycter ledella</i>	Labrador tea tentiform leafminer	E
Invertebrate Animal	Dragonflies	<i>Williamsonia lintneri</i>	Banded bog skimmer	E
Invertebrate Animal	Beetles	<i>Agonum darlingtoni</i>	Ground beetle	SC
Invertebrate Animal	Beetles	<i>Agonum mutatum</i>	Ground beetle	SC
Invertebrate Animal	Moths	<i>Agrotis stigmosa</i>	Spotted dart moth	SC
Invertebrate Animal	Beetles	<i>Amara chalcea</i>	Ground beetle	SC
Invertebrate Animal	Mayflies	<i>Anthopotamus verticis</i>	Tusked sprawler	SC
Invertebrate Animal	Moths	<i>Apamea burgessi</i>	Apamea moth	SC
Invertebrate Animal	Moths	<i>Apamea inordinata</i>	Apamea moth	SC
Invertebrate Animal	Moths	<i>Apamea lintneri</i>	Apamea moth	SC
Invertebrate Animal	Moths	<i>Argyrostromis anilis</i>	Short-lined chocolate	SC
Invertebrate Animal	Flies	<i>Atylotus ohioensis</i>	Tabanid fly	SC
Invertebrate Animal	Beetles	<i>Badister transversus</i>	Ground beetle	SC
Invertebrate Animal	Beetles	<i>Bembidion carinula</i>	Ground beetle	SC
Invertebrate Animal	Beetles	<i>Bembidion lacunarium</i>	Ground beetle	SC
Invertebrate Animal	Beetles	<i>Bembidion planum</i>	Ground beetle	SC
Invertebrate Animal	Beetles	<i>Bembidion pseudocautum</i>	Ground beetle	SC
Invertebrate Animal	Beetles	<i>Bembidion quadratum</i>	Ground beetle	SC
Invertebrate Animal	Beetles	<i>Bembidion semicinctum</i>	Ground beetle	SC

Invertebrate Animal	Beetles	<i>Bembidion simplex</i>	Ground beetle	SC
Invertebrate Animal	Bees	<i>Bombus affinis</i>	Affable bumblebee	SC
Invertebrate Animal	Bees	<i>Bombus terricola</i>	Yellowbanded bumblebee	SC
Invertebrate Animal	Beetles	<i>Brachinus cyanipennis</i>	Bombardier beetle	SC
Invertebrate Animal	Beetles	<i>Brachinus fumans</i>	Bombardier beetle	SC
Invertebrate Animal	Beetles	<i>Brachinus medius</i>	Bombardier beetle	SC
Invertebrate Animal	Beetles	<i>Brachinus ovipennis</i>	Bombardier beetle	SC
Invertebrate Animal	Beetles	<i>Brachinus patruelis</i>	Bombardier beetle	SC
Invertebrate Animal	Butterflies	<i>Callophrys henrici</i>	Henry's elfin	SC
Invertebrate Animal	Beetles	<i>Carabus vinctus</i>	Ground beetle	SC
Invertebrate Animal	Moths	<i>Chaetagnaea cerata</i>	Noctuid moth	SC
Invertebrate Animal	Beetles	<i>Cicindela formosa generosa</i>	Pine barrens tiger beetle	SC
Invertebrate Animal	Beetles	<i>Cicindela hirticollis</i>	Tiger beetle	SC
Invertebrate Animal	Beetles	<i>Cicindela marginata</i>	Tiger beetle	SC
Invertebrate Animal	Beetles	<i>Cicindela tranquebarica</i>	Dark bellied tiger beetle	SC
Invertebrate Animal	Crustacean	<i>Crangonyx aberrans</i>	Mystic valley amphipod	SC
Invertebrate Animal	Damselflies	<i>Enallagma minusculum</i>	Little bluet	SC
Invertebrate Animal	Damselflies	<i>Enallagma pictum</i>	Scarlet bluet	SC
Invertebrate Animal	Skippers	<i>Erynnis horatius</i>	Horace's duskywing	SC

Invertebrate Animal	Moths	<i>Euchlaena madusaria</i>	Scrub euchlaena	SC
Invertebrate Animal	Moths	<i>Eucoptocnemis fimbriaris</i>	Noctuid moth	SC
Invertebrate Animal	Moths	<i>Eumacaria latiferrugata</i>	Brown-bordered geometer	SC
Invertebrate Animal	Skippers	<i>Euphyes dion</i>	Sedge skipper	SC
Invertebrate Animal	Moths	<i>Euxoa pleuritica</i>	Noctuid moth	SC
Invertebrate Animal	Moths	<i>Exyra fax</i>	Pitcher plant moth	SC
Invertebrate Animal	Snails	<i>Fossaria rustica</i>	Lymnaeid snail	SC
Invertebrate Animal	Beetles	<i>Geopinus incrassatus</i>	Ground beetle	SC
Invertebrate Animal	Dragonflies	<i>Gomphus vastus</i>	Cobra clubtail	SC
Invertebrate Animal	Dragonflies	<i>Gomphus ventricosus</i>	Skillet clubtail	SC
Invertebrate Animal	Flies	<i>Goniops chrysocoma</i>	Horse fly	SC
Invertebrate Animal	Snails	<i>Gyraulus circumstriatus</i>	Aquatic snail	SC
Invertebrate Animal	Beetles	<i>Harpalus caliginosus</i>	Ground beetle	SC
Invertebrate Animal	Beetles	<i>Harpalus eraticus</i>	Ground beetle	SC
Invertebrate Animal	Beetles	<i>Helluomorphoides praeustus bicolor</i>	Ground beetle	SC
Invertebrate Animal	Flies	<i>Hybomitra luridus</i>	Horse fly	SC
Invertebrate Animal	Flies	<i>Hybomitra trepida</i>	Horse fly	SC
Invertebrate Animal	Flies	<i>Hybomitra typhus</i>	Horse fly	SC
Invertebrate Animal	Dragonflies	<i>Ladona deplanata</i>	Blue corporal dragonfly	SC

Invertebrate Animal	Moths	<i>Lepipolys perscripta</i>	Scribbled sallow	SC
Invertebrate Animal	Freshwater Mussels	<i>Leptodea ochracea</i>	Tidewater mucket	SC
Invertebrate Animal	Freshwater Mussels	<i>Ligumia nasuta</i>	Eastern pond mussel	SC
Invertebrate Animal	Lacewings and Others	<i>Lomamyia flavicornis</i>	Yellow-horned beaded lacewing	SC
Invertebrate Animal	Beetles	<i>Loxandrus vulneratus</i>	Ground beetle	SC
Invertebrate Animal	Butterflies	<i>Lycaena epixanthe</i>	Bog copper	SC
Invertebrate Animal	Butterflies	<i>Lycaena hyllus</i>	Bronze copper	SC
Invertebrate Animal	Bees	<i>Macropis ciliata</i>	Fringed loosestrife oil- bee	SC
Invertebrate Animal	Freshwater Mussels	<i>Margaritifera margaritifera</i>	Eastern pearl shell	SC
Invertebrate Animal	Moths	<i>Melitara prodenialis</i>	Eastern cactus-boring moth	SC
Invertebrate Animal	Moths	<i>Meropleon ambifuscum</i>	Newman's brocade	SC
Invertebrate Animal	Flies	<i>Merycomyia whitneyi</i>	Tabanid fly	SC
Invertebrate Animal	Beetles	<i>Nebria lacustris lacustris</i>	Ground beetle	SC
Invertebrate Animal	Moths	<i>Oncocnemis riparia</i>	Dune oncocnemis	SC
Invertebrate Animal	Moths	<i>Papaipema duovata</i>	Seaside goldenrod stem borer	SC
Invertebrate Animal	Mayflies	<i>Paraleptophlebia assimilis</i>	A mayfly	SC
Invertebrate Animal	Snails	<i>Pomatiopsis lapidaria</i>	Slender walker	SC
Invertebrate Animal	Crustacean	<i>Procambarus acutus</i>	Whiteriver crayfish	SC

Invertebrate Animal	Moths	<i>Rhodoecia aurantiago</i>	Aureolaria seed borer	SC
Invertebrate Animal	Flies	<i>Sargus fasciatus</i>	Soldier fly	SC
Invertebrate Animal	Butterflies	<i>Satyroides eurydice</i>	Eyed brown	SC
Invertebrate Animal	Beetles	<i>Scaphinotus viduus</i>	Ground beetle	SC
Invertebrate Animal	Moths	<i>Schinia spinosae</i>	Noctuid moth	SC
Invertebrate Animal	Dragonflies	<i>Somatochlora elongata</i>	Ski-tailed emerald	SC
Invertebrate Animal	Moths	<i>Spartiniphaga inops</i>	Spartina borer moth	SC
Invertebrate Animal	Spiders	<i>Sphodros niger</i>	Purse web spider	SC
Invertebrate Animal	Snails	<i>Stagnicola catascopium</i>	Lymnaeid snail	SC
Invertebrate Animal	Flies	<i>Stonemyia isabellina</i>	Tabanid fly	SC
Invertebrate Animal	Crustacean	<i>Stygobromus tenuis tenuis</i>	Piedmont groundwater amphipod	SC
Invertebrate Animal	Crustacean	<i>Synurella chamberlaini</i>	Coastal pond amphipod	SC
Invertebrate Animal	Flies	<i>Tabanus fulvicallus</i>	Horse fly	SC
Invertebrate Animal	Beetles	<i>Tetragonoderus fasciatus</i>	Ground beetle	SC
Invertebrate Animal	Plant Bugs	<i>Tibicen auletes</i>	Cicada	SC
Invertebrate Animal	Snails	<i>Valvata sincera</i>	Boreal turret snail	SC
Invertebrate Animal	Snails	<i>Valvata tricarinata</i>	Turret snail	SC
Invertebrate Animal	Moths	<i>Zale obliqua</i>	Noctuid moth	SC
Invertebrate Animal	Moths	<i>Acronicta albarufa</i>	Barrens dagger moth	SC*

Invertebrate Animal	Moths	<i>Acrionicta lanceolaria</i>	Noctuid moth	SC*	
Invertebrate Animal	Bees	<i>Bombus ashtoni</i>	Ashton's bumblebee	SC*	
Invertebrate Animal	Butterflies	<i>Callophrys polios</i>	Hoary elfin	SC*	
Invertebrate Animal	Beetles	<i>Calosoma wilcoxi</i>	Ground beetle	SC*	
Invertebrate Animal	Beetles	<i>Carabus serratus</i>	Ground beetle	SC*	
Invertebrate Animal	Beetles	<i>Carabus sylvosus</i>	Ground beetle	SC*	
Invertebrate Animal	Moths	<i>Catocala pretiosa pretiosa</i>	Precious underwing moth	SC*	
Invertebrate Animal	Butterflies	<i>Chlosyne harrisii</i>	Harris' checkerspot	SC*	
Invertebrate Animal	Butterflies	<i>Chlosyne nycteis</i>	Silvery checkerspot	SC*	
Invertebrate Animal	Beetles	<i>Cicindela dorsalis dorsalis</i>	Northeastern beach tiger beetle	SC*	Federally Threatened
Invertebrate Animal	Beetles	<i>Cicindela purpurea</i>	Tiger beetle	SC*	
Invertebrate Animal	Moths	<i>Citheronia regalis</i>	Regal moth	SC*	
Invertebrate Animal	Beetles	<i>Coccinella novemnotata</i>	C9 lady beetle	SC*	
Invertebrate Animal	Moths	<i>Cucullia speyeri</i>	Noctuid moth	SC*	
Invertebrate Animal	Moths	<i>Eacles imperialis imperialis</i>	Imperial moth	SC*	
Invertebrate Animal	Skippers	<i>Erynnis martialis</i>	Mottled duskywing	SC*	
Invertebrate Animal	Crustacean	<i>Eulimnadia agassizii</i>	Clam shrimp	SC*	
Invertebrate Animal	Snails	<i>Fossaria galbana</i>	Lymnaeid snail	SC*	
Invertebrate Animal	Moths	<i>Hydraecia immanis</i>	Hop vine borer moth	SC*	

Invertebrate Animal	Moths	<i>Lithophane lemmeri</i>	Lemmer's noctuid moth	SC*	
Invertebrate Animal	Moths	<i>Lithophane viridipallens</i>	Pale green pinion moth	SC*	
Invertebrate Animal	Beetles	<i>Lordithon niger</i>	Black lordithon rove beetle	SC*	
Invertebrate Animal	Flies	<i>Mixogaster johnsoni</i>	Syrphid fly	SC*	
Invertebrate Animal	Beetles	<i>Nicrophorus americanus</i>	American burying beetle	SC*	Federally Endangered
Invertebrate Animal	Beetles	<i>Omophron tessellatum</i>	Ground beetle	SC*	
Invertebrate Animal	Beetles	<i>Panagaeus fasciatus</i>	Ground beetle	SC*	
Invertebrate Animal	Moths	<i>Papaipema circumlucens</i>	Hops-stalk borer moth	SC*	
Invertebrate Animal	Moths	<i>Papaipema maritima</i>	Maritime sunflower borer moth	SC*	
Invertebrate Animal	Moths	<i>Papaipema sciata</i>	Culvers root bore moth	SC*	
Invertebrate Animal	Butterflies	<i>Polygonia progne</i>	Gray comma	SC*	
Invertebrate Animal	Moths	<i>Pyreferra ceromatica</i>	Anointed sawfly	SC*	
Invertebrate Animal	Beetles	<i>Scaphinotus elevatus</i>	Ground beetle	SC*	
Invertebrate Animal	Butterflies	<i>Speyeria idalia</i>	Regal fritillary	SC*	
Invertebrate Animal	Moths	<i>Abagrotis nefascia benjamini</i>	Coastal heathland cutworm	T	
Invertebrate Animal	Moths	<i>Apodrepanulatrix liberaria</i>	New jersey tea inchworm	T	
Invertebrate Animal	Butterflies	<i>Callophrys irus</i>	Frosted elfin	T	
Invertebrate Animal	Damselflies	<i>Calopteryx dimidiata</i>	Sparkling jewelwing	T	

Invertebrate Animal	Butterflies	<i>Celastrina neglectamajor</i>	Appalachian blue	T
Invertebrate Animal	Dragonflies	<i>Cordulegaster erronea</i>	Tiger spiketail	T
Invertebrate Animal	Moths	<i>Drasteria graphica atlantica</i>	False heather underwing	T
Invertebrate Animal	Damselflies	<i>Enallagma doubledayi</i>	Atlantic bluet	T
Invertebrate Animal	Skippers	<i>Erynnis brizo</i>	Sleepy duskywing	T
Invertebrate Animal	Moths	<i>Eucosma morrisoni</i>	Morrison's mosaic	T
Invertebrate Animal	Skippers	<i>Euphyes bimacula</i>	Two-spotted skipper	T
Invertebrate Animal	Moths	<i>Euxoa violaris</i>	Violet dart moth	T
Invertebrate Animal	Moths	<i>Faronta rubripennis</i>	Pink streak	T
Invertebrate Animal	Dragonflies	<i>Gomphus adelphus</i>	Mustached clubtail	T
Invertebrate Animal	Dragonflies	<i>Gomphus descriptus</i>	Harpoon clubtail	T
Invertebrate Animal	Dragonflies	<i>Gomphus fraternus</i>	Midland clubtail	T
Invertebrate Animal	Dragonflies	<i>Gomphus quadricolor</i>	Rapids clubtail	T
Invertebrate Animal	Moths	<i>Hemaris gracilis</i>	Slender clearwing	T
Invertebrate Animal	Damselflies	<i>Hetaerina americana</i>	American rubyspot	T
Invertebrate Animal	Flies	<i>Hybomitra frosti</i>	Horse fly	T
Invertebrate Animal	Dragonflies	<i>Leucorrhinia glacialis</i>	Crimson-ringed whiteface	T
Invertebrate Animal	Moths	<i>Papaipema leucostigma</i>	Columbine borer	T
Invertebrate Animal	Moths	<i>Phaneta clavana</i>	Lanced phaneta	T

Invertebrate Animal	Dragonflies	<i>Progomphus obscurus</i>	Common sanddragon	T	
Invertebrate Animal	Moths	<i>Psectraglaea carnosa</i>	Pink sallow	T	
Invertebrate Animal	Moths	<i>Speranza exornata</i>	Barrens itame	T	
Invertebrate Animal	Butterflies	<i>Speyeria atlantis</i>	Atlantis fritillary butterfly	T	
Invertebrate Animal	Dragonflies	<i>Stylurus amnicola</i>	Riverine clubtail	T	
Invertebrate Animal	Moths	<i>Thaumatoopsis edonis</i>	Grassland thaumatopsis	T	
Invertebrate Animal	Moths	<i>Zale curema</i>	Noctuid moth	T	
Invertebrate Animal	Moths	<i>Zale submediana</i>	Noctuid moth	T	
Invertebrate Animal	Moths	<i>Zanclognatha martha</i>	Noctuid moth	T	
Mammals	Small Mammals	<i>Cryptotis parva</i>	Least shrew	E	
Mammals	Bats	<i>Myotis sodalis</i>	Indiana bat	E	Federally Endangered
Mammals	Bats	<i>Lasionycteris noctivagans</i>	Silver-haired bat	SC	
Mammals	Bats	<i>Lasiurus borealis</i>	Red bat	SC	
Mammals	Bats	<i>Lasiurus cinereus</i>	Hoary bat	SC	
Mammals	Porpoises	<i>Phocoena phocoena</i>	Harbor porpoise	SC	
Mammals	Small Mammals	<i>Synaptomys cooperi</i>	Southern bog lemming	SC	
Mammals	Carnivores	<i>Canis lupus</i>	Gray wolf	SC*	Federally Endangered
Mammals	Bats	<i>Myotis leibii</i>	Eastern small-footed bat	SC*	
Mammals	Small Mammals	<i>Neotoma magister</i>	Eastern woodrat	SC*	
Mammals	Carnivores	<i>Puma concolor cougar</i>	Eastern cougar	SC*	Federally Endangered
Reptiles	Lizards and Snakes	<i>Crotalus horridus</i>	Timber rattlesnake	E	
Reptiles	Turtles	<i>Dermochelys coriacea</i>	Leatherback	E	Federally Endangered

Reptiles	Turtles	<i>Glyptemys muhlenbergii</i>	Bog turtle	E	Federally Threatened
Reptiles	Turtles	<i>Lepidochelys kempii</i>	Atlantic ridley	E	Federally Endangered
Reptiles	Turtles	<i>Glyptemys insculpta</i>	Wood turtle	SC	
Reptiles	Lizards and Snakes	<i>Heterodon platirhinos</i>	Eastern hognose snake	SC	
Reptiles	Lizards and Snakes	<i>Liochlorophis vernalis</i>	Smooth green snake	SC	
Reptiles	Turtles	<i>Terrapene carolina carolina</i>	Eastern box turtle	SC	
Reptiles	Lizards and Snakes	<i>Thamnophis sauritus</i>	Eastern ribbon snake	SC	
Reptiles	Turtles	<i>Caretta caretta</i>	Loggerhead	T	Federally Threatened
Reptiles	Turtles	<i>Chelonia mydas</i>	Atlantic green turtle	T	Federally Threatened
Reptiles	Lizards and Snakes	<i>Eumeces fasciatus</i>	Five-lined skink	T	
Vascular Plant		<i>Abies balsamea</i>	Balsam fir	E	Native populations only.
Vascular Plant		<i>Agalinis acuta</i>	Sandplain gerardia	E	Federally Endangered
Vascular Plant		<i>Agastache nepetoides</i>	Yellow giant hyssop	E	
Vascular Plant		<i>Agastache scrophulariifolia</i>	Purple giant hyssop	E	
Vascular Plant		<i>Ageratina aromatica</i>	Small white snakeroot	E	
Vascular Plant		<i>Angelica lucida</i>	Sea-coast angelica	E	
Vascular Plant		<i>Arceuthobium pusillum</i>	Dwarf mistletoe	E	
Vascular Plant		<i>Aristida tuberculosa</i>	Beach needle grass	E	
Vascular Plant		<i>Asclepias viridiflora</i>	Green milkweed	E	
Vascular Plant		<i>Bouteloua curtipendula</i>	Side-oats grama-grass	E	
Vascular Plant		<i>Carex alata</i>	Broadwing sedge	E	
Vascular Plant		<i>Carex backii</i>	Sedge	E	
Vascular Plant		<i>Carex barrattii</i>	Barratt's sedge	E	
Vascular Plant		<i>Carex buxbaumii</i>	Brown bog sedge	E	
Vascular Plant		<i>Carex castanea</i>	Chestnut-colored sedge	E	
Vascular Plant		<i>Carex exilis</i>	Sedge	E	

Vascular Plant	<i>Carex magellanica</i>	Sedge	E
Vascular Plant	<i>Carex polymorpha</i>	Variable sedge	E
Vascular Plant	<i>Carex pseudocyperus</i>	Cyperus-like sedge	E
Vascular Plant	<i>Carex schweinitzii</i>	Schweinitz's sedge	E
Vascular Plant	<i>Carex viridula</i>	Little green sedge	E
Vascular Plant	<i>Carex willdenowii</i>	Willdenow's sedge	E
Vascular Plant	<i>Chamaelirium luteum</i>	Devil's-bit	E
Vascular Plant	<i>Cheilanthes lanosa</i>	Hairy lip-fern	E
Vascular Plant	<i>Cirsium horridulum</i>	Yellow thistle	E
Vascular Plant	<i>Coeloglossum viride</i>	Long-bracted green orchid	E
Vascular Plant	<i>Crassula aquatica</i>	Pygmyweed	E
Vascular Plant	<i>Cryptogramma stelleri</i>	Slender cliff-brake	E
Vascular Plant	<i>Cypripedium reginae</i>	Showy lady's-slipper	E
Vascular Plant	<i>Dalibarda repens</i>	Dew-drop	E
Vascular Plant	<i>Desmodium cuspidatum</i>	Large-bracted tick-trefoil	E
Vascular Plant	<i>Desmodium humifusum</i>	Trailing tick-trefoil	E
Vascular Plant	<i>Dichantherium scabriusculum</i>	Panic grass	E
Vascular Plant	<i>Diplazium pycnocarpon</i>	Narrow-leaved glade fern	E
Vascular Plant	<i>Dryopteris campyloptera</i>	Mountain wood-fern	E
Vascular Plant	<i>Echinodorus tenellus</i>	Bur-head	E
Vascular Plant	<i>Eleocharis equisetoides</i>	Horse-tail spike-rush	E
Vascular Plant	<i>Eleocharis quadrangulata</i> var. <i>crassior</i>	Spike-rush	E
Vascular Plant	<i>Equisetum pratense</i>	Meadow horsetail	E
Vascular Plant	<i>Equisetum scirpoides</i>	Dwarf scouring rush	E
Vascular Plant	<i>Eriocaulon parkeri</i>	Parker's pipewort	E
Vascular Plant	<i>Eupatorium album</i>	White thoroughwort	E
Vascular Plant	<i>Eurybia radula</i>	Rough aster	E
Vascular Plant	<i>Floerkea proserpinacoides</i>	False mermaid-weed	E
Vascular Plant	<i>Galium labradoricum</i>	Bog bedstraw	E

Vascular Plant	<i>Gentianella quinquefolia</i>	Stiff gentian	E	
Vascular Plant	<i>Hasteola suaveolens</i>	Sweet-scented indian-plantain	E	
Vascular Plant	<i>Hudsonia ericoides</i>	Golden-heather	E	
Vascular Plant	<i>Hydrastis canadensis</i>	Goldenseal	E	
Vascular Plant	<i>Hydrocotyle umbellata</i>	Water pennywort	E	
Vascular Plant	<i>Hydrocotyle verticillata</i>	Whorled pennywort	E	
Vascular Plant	<i>Isotria medeoloides</i>	Small whorled pogonia	E	
Vascular Plant	<i>Lachnanthes carolina</i>	Carolina redroot	E	Native populations only.
Vascular Plant	<i>Leptochloa fusca ssp. fascicularis</i>	Saltpond grass	E	
Vascular Plant	<i>Ligusticum scoticum</i>	Scotch lovage	E	
Vascular Plant	<i>Linnaea borealis ssp. americana</i>	Twinflower	E	
Vascular Plant	<i>Linum sulcatum</i>	Yellow flax	E	
Vascular Plant	<i>Liparis liliifolia</i>	Lily-leaved twayblade	E	
Vascular Plant	<i>Ludwigia sphaerocarpa</i>	Globe-fruited false-loosestrife	E	
Vascular Plant	<i>Lycopodiella alopecuroides</i>	Foxtail clubmoss	E	
Vascular Plant	<i>Lythrum alatum</i>	Winged loosestrife	E	
Vascular Plant	<i>Malaxis bayardii</i>	Bayard's white adder's mouth	E	
Vascular Plant	<i>Malaxis brachypoda</i>	White adder's-mouth	E	
Vascular Plant	<i>Malaxis unifolia</i>	Green adder's-mouth	E	
Vascular Plant	<i>Milium effusum</i>	Tall millet-grass	E	
Vascular Plant	<i>Moehringia macrophylla</i>	Large-leaved sandwort	E	
Vascular Plant	<i>Moneses uniflora</i>	One-flower wintergreen	E	
Vascular Plant	<i>Morus rubra</i>	Red mulberry	E	
Vascular Plant	<i>Muhlenbergia capillaris</i>	Long-awn hairgrass	E	
Vascular Plant	<i>Myriophyllum alterniflorum</i>	Slender water-milfoil	E	
Vascular Plant	<i>Myriophyllum pinnatum</i>	Cutleaf water-milfoil	E	

Vascular Plant	<i>Oclemena nemoralis</i>	Bog aster	E	
Vascular Plant	<i>Oclemena X blakei</i>	Blake's aster	E	
Vascular Plant	<i>Oligoneuron album</i>	Prairie goldenrod	E	
Vascular Plant	<i>Oligoneuron rigidum</i>	Stiff goldenrod	E	
Vascular Plant	<i>Onosmodium virginianum</i>	Gravel-weed	E	
Vascular Plant	<i>Paspalum laeve</i>	Field paspalum	E	
Vascular Plant	<i>Pellaea glabella</i>	Smooth cliff-brake	E	
				Native populations only.
Vascular Plant	<i>Pinus resinosa</i>	Red pine	E	
Vascular Plant	<i>Piptatherum pungens</i>	Slender mountain ricegrass	E	
Vascular Plant	<i>Pityopsis falcata</i>	Sickle-leaved golden aster	E	
Vascular Plant	<i>Platanthera blephariglottis</i>	White-fringed orchid	E	
Vascular Plant	<i>Polygala cruciata</i>	Field milkwort	E	
Vascular Plant	<i>Polygala nuttallii</i>	Nuttall's milkwort	E	
Vascular Plant	<i>Polygala senega</i>	Seneca snakeroot	E	
Vascular Plant	<i>Polymnia canadensis</i>	Small-flowered leafcup	E	
Vascular Plant	<i>Potamogeton confervoides</i>	Pondweed	E	
Vascular Plant	<i>Potamogeton friesii</i>	Fries' pondweed	E	
Vascular Plant	<i>Potamogeton hillii</i>	Hill's pondweed	E	
Vascular Plant	<i>Potamogeton ogdenii</i>	Ogden's pondweed	E	
Vascular Plant	<i>Potamogeton strictifolius</i>	Straight-leaved pondweed	E	
Vascular Plant	<i>Pycnanthemum clinopodioides</i>	Basil mountain-mint	E	
Vascular Plant	<i>Pycnanthemum torrei</i>	Torrey mountain-mint	E	
Vascular Plant	<i>Ranunculus ambigens</i>	Water-plantain spearwort	E	
Vascular Plant	<i>Ranunculus cymbalaria</i>	Seaside crowfoot	E	
Vascular Plant	<i>Rhynchospora capillacea</i>	Capillary beak-rush	E	
Vascular Plant	<i>Rhynchospora scirpoides</i>	Long-beaked bald rush	E	
Vascular Plant	<i>Ribes triste</i>	Swamp red currant	E	

Vascular Plant	<i>Sabatia stellaris</i>	Marsh pink	E
Vascular Plant	<i>Sagittaria cuneata</i>	Waputo	E
Vascular Plant	<i>Salix pedicellaris</i>	Bog willow	E
Vascular Plant	<i>Saururus cernuus</i>	Lizard's tail	E
Vascular Plant	<i>Scheuchzeria palustris</i> ssp. <i>americana</i>	Pod grass	E
Vascular Plant	<i>Scleria pauciflora</i> var. <i>caroliniana</i>	Few-flowered nutrush	E
Vascular Plant	<i>Scleria reticularis</i>	Reticulated nutrush	E
Vascular Plant	<i>Scleria triglomerata</i>	Nutrush	E
Vascular Plant	<i>Scutellaria integrifolia</i>	Hyssop skullcap	E
Vascular Plant	<i>Scutellaria parvula</i> var. <i>missouriensis</i>	Small skullcap	E
Vascular Plant	<i>Sparganium fluctuans</i>	Floating bur-reed	E
Vascular Plant	<i>Sparganium natans</i>	Small bur-reed	E
Vascular Plant	<i>Sporobolus clandestinus</i>	Rough dropseed	E
Vascular Plant	<i>Sporobolus heterolepis</i>	Northern dropseed	E
Vascular Plant	<i>Sporobolus neglectus</i>	Small dropseed	E
Vascular Plant	<i>Stachys hyssopifolia</i>	Hyssop-leaf hedge- nettle	E
Vascular Plant	<i>Taenidia integerrima</i>	Yellow pimpernel	E
Vascular Plant	<i>Trichostema brachiatum</i>	False pennyroyal	E
Vascular Plant	<i>Triosteum angustifolium</i>	Narrow-leaved horse gentian	E
Vascular Plant	<i>Triphora trianthophora</i>	Nodding pogonia	E
Vascular Plant	<i>Utricularia resupinata</i>	Bladderwort	E
Vascular Plant	<i>Uvularia grandiflora</i>	Large-flowered bellwort	E
Vascular Plant	<i>Vaccinium myrtilloides</i>	Velvetleaf blueberry	E
Vascular Plant	<i>Viola brittoniana</i>	Coast violet	E
Vascular Plant	<i>Waldsteinia fragarioides</i>	Barren strawberry	E
Vascular Plant	<i>Xyris smalliana</i>	Small's yellow-eyed grass	E
Vascular Plant	<i>Zizia aptera</i>	Golden alexanders	E

Vascular Plant	<i>Acalypha virginica</i>	Virginia copperleaf	SC
Vascular Plant	<i>Aristida longespica</i>	Needlegrass	SC
Vascular Plant	<i>Aristida purpurascens</i>	Arrowfeather	SC
Vascular Plant	<i>Aristolochia serpentaria</i>	Virginia snakeroot	SC
Vascular Plant	<i>Asclepias purpurascens</i>	Purple milkweed	SC
Vascular Plant	<i>Asplenium montanum</i>	Mountain spleenwort	SC
Vascular Plant	<i>Atriplex glabriuscula</i>	Orache	SC
Vascular Plant	<i>Betula pumila</i>	Swamp birch	SC
Vascular Plant	<i>Bolboschoenus maritimus</i> <i>ssp. paludosus</i>	Bayonet grass	SC
Vascular Plant	<i>Bolboschoenus novae-</i> <i>angliae</i>	Salt marsh bulrush	SC
Vascular Plant	<i>Calamagrostis stricta</i> <i>ssp.</i> <i>inexpansa</i>	Reed bentgrass	SC
Vascular Plant	<i>Cardamine douglassii</i>	Purple cress	SC
Vascular Plant	<i>Carex aestivalis</i>	Summer sedge	SC
Vascular Plant	<i>Carex aquatilis</i> <i>var.</i> <i>aquatilis</i>	Sedge	SC
Vascular Plant	<i>Carex bushii</i>	Sedge	SC
Vascular Plant	<i>Carex formosa</i>	Handsome sedge	SC
Vascular Plant	<i>Carex hitchcockiana</i>	Hitchcock's sedge	SC
Vascular Plant	<i>Carex molesta</i>	Troublesome sedge	SC
Vascular Plant	<i>Carex novae-angliae</i>	New England sedge	SC
Vascular Plant	<i>Carex oligocarpa</i>	Eastern few-fruit sedge	SC
Vascular Plant	<i>Carex prairea</i>	Prairie sedge	SC
Vascular Plant	<i>Carex squarrosa</i>	Sedge	SC
Vascular Plant	<i>Carex sterilis</i>	Dioecious sedge	SC
Vascular Plant	<i>Carex trichocarpa</i>	Sedge	SC
Vascular Plant	<i>Carex tuckermanii</i>	Tuckerman's sedge	SC
Vascular Plant	<i>Carex typhina</i>	Sedge	SC
Vascular Plant	<i>Corallorhiza trifida</i>	Early coral root	SC
Vascular Plant	<i>Cypripedium parviflorum</i>	Yellow lady's-slipper	SC
Vascular Plant	<i>Deschampsia caespitosa</i>	Tufted hairgrass	SC
Vascular Plant	<i>Desmodium glabellum</i>	Dillenius' tick-trefoil	SC

Vascular Plant	<i>Dicentra canadensis</i>	Squirrel corn	SC	
Vascular Plant	<i>Dichantheium ovale</i> var. <i>addisonii</i>	Panic grass	SC	
Vascular Plant	<i>Diospyros virginiana</i>	Persimmon	SC	
Vascular Plant	<i>Draba reptans</i>	Whitlow-grass	SC	
Vascular Plant	<i>Dryopteris goldiana</i>	Goldie's fern	SC	
Vascular Plant	<i>Elymus wiegandii</i>	Wiegand's wild rye	SC	
Vascular Plant	<i>Eurybia X herveyi</i>	Hervey's aster	SC	
Vascular Plant	<i>Gaultheria hispidula</i>	Creeping snowberry	SC	
Vascular Plant	<i>Hepatica nobilis</i> var. <i>acuta</i>	Sharp-lobed hepatica	SC	
Vascular Plant	<i>Honckenya peploides</i>	Seabeach sandwort	SC	
Vascular Plant	<i>Hottonia inflata</i>	Featherfoil	SC	
Vascular Plant	<i>Hydrophyllum virginianum</i>	Virginia waterleaf	SC	
Vascular Plant	<i>Hypericum ascyron</i>	Great St. John's-wort	SC	
Vascular Plant	<i>Krigia biflora</i>	Two-flowered cynthia	SC	
Vascular Plant	<i>Lespedeza repens</i>	Creeping bush-clover	SC	
Vascular Plant	<i>Liatris scariosa</i> var. <i>novae-</i> <i>angliae</i>	Blazing-star	SC	
Vascular Plant	<i>Lilaeopsis chinensis</i>	Lilaeopsis	SC	
Vascular Plant	<i>Limosella australis</i>	Mudwort	SC	
Vascular Plant	<i>Liquidambar styraciflua</i>	Sweet gum	SC	Native populations only.
Vascular Plant	<i>Lycopus amplexans</i>	Clasping-leaved water- horehound	SC	
Vascular Plant	<i>Lygodium palmatum</i>	Climbing fern	SC	
Vascular Plant	<i>Mitella nuda</i>	Naked miterwort	SC	
Vascular Plant	<i>Nuphar microphylla</i>	Small yellow pond lily	SC	
Vascular Plant	<i>Opuntia humifusa</i>	Eastern prickly pear	SC	
Vascular Plant	<i>Orontium aquaticum</i>	Golden club	SC	
Vascular Plant	<i>Oxalis violacea</i>	Violet wood-sorrel	SC	
Vascular Plant	<i>Panax quinquefolius</i>	American ginseng	SC	
Vascular Plant	<i>Plantago virginica</i>	Hoary plantain	SC	

Vascular Plant	<i>Platanthera flava</i> var. <i>herbiola</i>	Pale green orchid	SC	
Vascular Plant	<i>Podostemum ceratophyllum</i>	Threadfoot	SC	
Vascular Plant	<i>Potentilla arguta</i>	Tall cinquefoil	SC	
Vascular Plant	<i>Quercus macrocarpa</i>	Bur oak	SC	
Vascular Plant	<i>Ranunculus longirostris</i>	White water-crowfoot	SC	
Vascular Plant	<i>Ribes glandulosum</i>	Skunk currant	SC	
Vascular Plant	<i>Ribes rotundifolium</i>	Wild currant	SC	
Vascular Plant	<i>Rosa nitida</i>	Shining rose	SC	
Vascular Plant	<i>Rubus cuneifolius</i>	Sand bramble	SC	
Vascular Plant	<i>Sagittaria subulata</i>	Arrowleaf	SC	
Vascular Plant	<i>Salix petiolaris</i>	Slender willow	SC	
Vascular Plant	<i>Salix serissima</i>	Autumn willow	SC	
Vascular Plant	<i>Schizachne purpurascens</i>	Purple oat	SC	
Vascular Plant	<i>Scirpus georgianus</i>	Georgia bulrush	SC	
Vascular Plant	<i>Senna hebecarpa</i>	Wild senna	SC	
Vascular Plant	<i>Solidago latissimifolia</i>	Elliott's goldenrod	SC	
Vascular Plant	<i>Spiranthes tuberosa</i> var. <i>grayi</i>	Little ladies'-tresses	SC	
Vascular Plant	<i>Stachys tenuifolia</i>	Smooth hedge-nettle	SC	
Vascular Plant	<i>Stellaria borealis</i>	Northern stitchwort	SC	
Vascular Plant	<i>Trichomanes intricatum</i>	Appalachian gametophyte	SC	
Vascular Plant	<i>Trisetum spicatum</i>	Spiked false oats	SC	
Vascular Plant	<i>Viburnum prunifolium</i>	Smooth black-haw	SC	
Vascular Plant	<i>Viola adunca</i>	Hook-spurred violet	SC	
Vascular Plant	<i>Viola canadensis</i>	Canada violet	SC	
Vascular Plant	<i>Viola nephrophylla</i>	Northern bog violet	SC	
Vascular Plant	<i>Viola renifolia</i>	Kidney-leaf white violet	SC*	
Vascular Plant	<i>Viola selkirkii</i>	Great-spurred violet	SC	
Vascular Plant	<i>Vitis X novae-angliae</i>	New England grape	SC	
Vascular Plant	<i>Amaranthus pumilus</i>	Sea-beach amaranth	SC*	Federally Threatened

Vascular Plant	<i>Angelica venenosa</i>	Hairy angelica	SC*	
Vascular Plant	<i>Antennaria howellii</i> ssp. <i>petaloidea</i>	Field pussytoes	SC*	
Vascular Plant	<i>Aplectrum hyemale</i>	Puttyroot	SC*	
Vascular Plant	<i>Arethusa bulbosa</i>	Arethusa	SC*	
Vascular Plant	<i>Asclepias variegata</i>	White milkweed	SC*	
Vascular Plant	<i>Blephilia ciliata</i>	Downy wood-mint	SC*	
Vascular Plant	<i>Blephilia hirsuta</i>	Hairy woodmint	SC*	
Vascular Plant	<i>Botrychium simplex</i>	Little grape fern	SC*	
Vascular Plant	<i>Calystegia spithamea</i>	Low bindweed	SC*	
Vascular Plant	<i>Carex collinsii</i>	Collins sedge	SC*	
Vascular Plant	<i>Carex crawfordii</i>	Crawford sedge	SC*	
Vascular Plant	<i>Carex foenea</i>	Bronze sedge	SC*	
Vascular Plant	<i>Carex nigromarginata</i>	Black-edge sedge	SC*	
Vascular Plant	<i>Carex oligosperma</i>	Few-seeded sedge	SC*	
Vascular Plant	<i>Carex pauciflora</i>	Few-flowered sedge	SC*	
				Native populations only.
Vascular Plant	<i>Cercis canadensis</i>	Eastern redbud	SC*	
Vascular Plant	<i>Chenopodium rubrum</i>	Coast blite	SC*	
Vascular Plant	<i>Croton willdenowii</i>	Elliptical rushfoil	SC*	
Vascular Plant	<i>Cuphea viscosissima</i>	Blue waxweed	SC*	
Vascular Plant	<i>Cuscuta coryli</i>	Hazel dodder	SC*	
Vascular Plant	<i>Cynoglossum virginianum</i>	Wild comfrey	SC*	
Vascular Plant	<i>Cypripedium arietinum</i>	Ram's-head lady's-slipper	SC*	
Vascular Plant	<i>Desmodium sessilifolium</i>	Sessile-leaf tick-trefoil	SC*	
Vascular Plant	<i>Dichanthelium sphaerocarpon</i> var. <i>isophyllum</i>	Panic grass	SC*	
Vascular Plant	<i>Dichanthelium xanthophysum</i>	Panic grass	SC*	
Vascular Plant	<i>Drosera filiformis</i>	Thread-leaf sundew	SC*	

Vascular Plant	<i>Eleocharis microcarpa</i> var. <i>filiculmis</i>	Spike-rush	SC*
Vascular Plant	<i>Equisetum palustre</i>	Marsh horsetail	SC*
Vascular Plant	<i>Gamochaeta purpurea</i>	Purple cudweed	SC*
Vascular Plant	<i>Geranium bicknellii</i>	Bicknell's northern crane's-bill	SC*
Vascular Plant	<i>Goodyera repens</i> var. <i>ophioides</i>	Dwarf rattlesnake plantain	SC*
Vascular Plant	<i>Helianthemum dumosum</i>	Bush rockrose	SC*
Vascular Plant	<i>Heteranthera reniformis</i>	Kidneyleaf mud- plantain	SC*
Vascular Plant	<i>Huperzia selago</i>	Fir clubmoss	SC*
Vascular Plant	<i>Hybanthus concolor</i>	Green violet	SC*
Vascular Plant	<i>Hypericum adpressum</i>	Creeping St. John's- wort	SC*
Vascular Plant	<i>Juncus debilis</i>	Weak rush	SC*
Vascular Plant	<i>Linum intercursum</i>	Sandplain flax	SC*
Vascular Plant	<i>Ludwigia polycarpa</i>	Many-fruit false- loosestrife	SC*
Vascular Plant	<i>Lyonia mariana</i>	Stagger-bush	SC*
Vascular Plant	<i>Nuphar advena</i>	Large yellow pond lily	SC*
Vascular Plant	<i>Oenothera fruticosa</i>	Sundrops	SC*
Vascular Plant	<i>Orthilia secunda</i>	One-sided pyrola	SC*
Vascular Plant	<i>Panicum rigidulum</i> var. <i>elongatum</i>	Tall flat panic-grass	SC*
Vascular Plant	<i>Panicum verrucosum</i>	Warty panic grass	SC*
Vascular Plant	<i>Paronychia fastigiata</i>	Hairy forked chickweed	SC*
Vascular Plant	<i>Paspalum setaceum</i>	Bead grass	SC*
Vascular Plant	<i>Phaseolus polystachios</i> var. <i>polystachios</i>	Wild kidney bean	SC*
Vascular Plant	<i>Platanthera dilatata</i>	Tall white bog orchid	SC*
Vascular Plant	<i>Platanthera hookeri</i>	Hooker's orchid	SC*
Vascular Plant	<i>Platanthera orbiculata</i>	Large round-leaf orchid	SC*
Vascular Plant	<i>Polanisia dodecandra</i>	Clammy-weed	SC*

Vascular Plant	<i>Polygonum glaucum</i>	Seabeach knotweed	SC*	
Vascular Plant	<i>Prunus alleghaniensis</i>	Alleghany plum	SC*	
Vascular Plant	<i>Prunus maritima</i> var. <i>gravesii</i>	Graves beach plum	SC*	
Vascular Plant	<i>Puccinellia tenella</i> ssp. <i>alaskana</i>	Goose grass	SC*	
Vascular Plant	<i>Ranunculus flammula</i> var. <i>filiformis</i>	Creeping spearwort	SC*	
Vascular Plant	<i>Ranunculus pensylvanicus</i>	Bristly buttercup	SC*	
Vascular Plant	<i>Rhus aromatica</i>	Fragrant sumac	SC*	
Vascular Plant	<i>Ribes lacustre</i>	Swamp black currant	SC*	
Vascular Plant	<i>Rumex maritimus</i>	Sea-side dock	SC*	
Vascular Plant	<i>Sabatia dodecandra</i>	Large marsh pink	SC*	
Vascular Plant	<i>Schwalbea americana</i>	Chaffseed	SC*	Federally Endangered
Vascular Plant	<i>Scirpus longii</i>	Long's bulrush	SC*	
Vascular Plant	<i>Scleria verticillata</i>	Low nutrush	SC*	
Vascular Plant	<i>Smilax hispida</i>	Bristly greenbriar	SC*	
Vascular Plant	<i>Solidago rugosa</i> var. <i>sphagnophila</i>	Early wrinkle-leaved goldenrod	SC*	
Vascular Plant	<i>Symphyotrichum</i> <i>prenanthoides</i>	Crooked-stem aster	SC*	
Vascular Plant	<i>Trichophorum alpinum</i>	Cotton bulrush	SC*	
Vascular Plant	<i>Vaccinium vitis-idaea</i> ssp. <i>minus</i>	Mountain cranberry	SC*	
Vascular Plant	<i>Valerianella radiata</i>	Beaked corn-salad	SC*	
Vascular Plant	<i>Veratrum latifolium</i>	Hybrid bunchflower	SC*	
Vascular Plant	<i>Verbena simplex</i>	Narrow-leaved vervain	SC*	
Vascular Plant	<i>Viburnum nudum</i>	Possum haw	SC*	
Vascular Plant	<i>Viola hirsutula</i>	Southern wood violet	SC*	
Vascular Plant	<i>Viola striata</i>	Striped violet	SC*	
Vascular Plant	<i>Alopecurus aequalis</i>	Orange foxtail	T	
Vascular Plant	<i>Andromeda polifolia</i> var. <i>glaucophylla</i>	Bog rosemary	T	

Vascular Plant	<i>Anemone canadensis</i>	Canada anemone	T	
Vascular Plant	<i>Asplenium ruta-muraria</i>	Wallrue spleenwort	T	
Vascular Plant	<i>Bidens beckii</i>	Water-marigold	T	
Vascular Plant	<i>Bidens eatonii</i>	Eaton's beggars-tick	T	
Vascular Plant	<i>Carex alopecoidea</i>	Foxtail sedge	T	
Vascular Plant	<i>Carex crawei</i>	Crawe's sedge	T	
Vascular Plant	<i>Carex cumulata</i>	Clustered sedge	T	
Vascular Plant	<i>Carex davisii</i>	Davis' sedge	T	
Vascular Plant	<i>Carex limosa</i>	Sedge	T	
Vascular Plant	<i>Castilleja coccinea</i>	Indian paintbrush	T	
Vascular Plant	<i>Corydalis flavula</i>	Yellow corydalis	T	
Vascular Plant	<i>Eriophorum vaginatum</i> var. <i>spissum</i>	Hare's tail	T	
Vascular Plant	<i>Eurybia spectabilis</i>	Showy aster	T	
Vascular Plant	<i>Gaylussacia dumosa</i> var. <i>bigeloviana</i>	Dwarf huckleberry	T	
Vascular Plant	<i>Helianthemum propinquum</i>	Low frostweed	T	
Vascular Plant	<i>Houstonia longifolia</i>	Longleaf bluet	T	
Vascular Plant	<i>Hudsonia tomentosa</i>	False beach-heather	T	
Vascular Plant	<i>Ilex glabra</i>	Inkberry	T	native populations only
Vascular Plant	<i>Lipocarpha micrantha</i>	Dwarf bulrush	T	
Vascular Plant	<i>Maianthemum trifolium</i>	Three-leaved false Solomon's-seal	T	
Vascular Plant	<i>Minuartia glabra</i>	Mountain sandwort	T	
Vascular Plant	<i>Myriophyllum sibiricum</i>	Northern water-milfoil	T	
Vascular Plant	<i>Ophioglossum pusillum</i>	Adder's-tongue	T	
Vascular Plant	<i>Packera paupercula</i>	Ragwort	T	
Vascular Plant	<i>Panicum amarum</i>	Panic grass	T	
Vascular Plant	<i>Pedicularis lanceolata</i>	Swamp lousewort	T	
Vascular Plant	<i>Petasites frigidus</i> var. <i>palmatius</i>	Sweet coltsfoot	T	
Vascular Plant	<i>Platanthera ciliaris</i>	Yellow-fringed orchid	T	

Vascular Plant	<i>Populus heterophylla</i>	Swamp cottonwood	T	
Vascular Plant	<i>Potamogeton pusillus ssp. gemmiparus</i>	Capillary pondweed	T	
Vascular Plant	<i>Potamogeton vaseyi</i>	Vasey's pondweed	T	
Vascular Plant	<i>Rhododendron groenlandicum</i>	Labrador tea	T	
Vascular Plant	<i>Rhynchospora macrostachya</i>	Beaked rush	T	
Vascular Plant	<i>Rotala ramosior</i>	Toothcup	T	
Vascular Plant	<i>Salix exigua</i>	Sandbar willow	T	
Vascular Plant	<i>Schoenoplectus acutus</i>	Hard-stemmed bulrush	T	
Vascular Plant	<i>Schoenoplectus torreyi</i>	Torrey bulrush	T	
Vascular Plant	<i>Sibbaldiopsis tridentata</i>	Three-toothed cinquefoil	T	
Vascular Plant	<i>Silene stellata</i>	Starry champion	T	
Vascular Plant	<i>Spergularia canadensis</i>	Canada sand-spurry	T	
Vascular Plant	<i>Sporobolus cryptandrus</i>	Sand dropseed	T	
Vascular Plant	<i>Streptopus amplexifolius</i>	White mandarin	T	
Vascular Plant	<i>Thuja occidentalis</i>	Northern white cedar	T	Native populations only.
Vascular Plant	<i>Trollius laxus</i>	Spreading globe flower	T	
Vascular Plant	<i>Xyris montana</i>	Northern yellow-eyed grass	T	

APPENDIX 7. Connecticut Forest Resource Assessment - Technical Report

This section provides additional details on the development of maps used within the report. Most of the maps within the report are described here, others may be detailed in a later web based report. **Some maps described within this report did not get included in the final Assessment and Strategy.** For questions contact Joel Stocker of the University of Connecticut, Cooperative Extension System.

Introduction

Two types of Geographic Information System (GIS) map sets were created for this project. Standard maps with individual layers for displaying features available within the GIS and an overlay assessment involving the process of identifying data layers associated with a specific issue or priority and combining those layers to create a final map. The detailed overlay process involves multiple links between raw datasets, the layers produced, and the various steps required to fit those layers together into a final weighted analysis. With the State assessment a template of recommended layers and output maps was formulated from work with other states throughout the country. The Connecticut plan started with these recommendations as a base and adjusted the final process to reflect available datasets and the preferences of various stakeholders.

This technical report describes the procedures used to create the Geographic Information System (GIS) datasets for the project and how these datasets are used to create the map sets within the primary report. Each map is identified with a descriptive process, a list of layers, and a listing of the raw data required to create the layers or directly produce the map. Many of the layers and raw datasets were used in more than one map. Different outcomes can occur by selecting unique attributes from the same dataset for a given map.

Descriptive items

Raw GIS data vs. analysis layers. Base (raw) GIS data should not be confused with the weighted analysis layers. Many of the analysis layers have their origin as a combination of several base “raw” GIS files or as a selection from one or more datasets. For example, wetland features are actually a sub selection from the NRCS Soils shape file (hydric soils). The process identifying what constitutes a wetlands soil was pre-determined by NRCS independent of this project. Others, such as steep slopes greater than 25%, were created using several GIS operations applied to one or more base layers. The LIDAR 10 meter Digital Elevation Model (DEM) was provided as a Grid file by CLEAR, this was analyzed to produce slope then reclassified to select slopes greater than 25%. Most of the model operations within the project start with the base GIS layers to create the parameters for the overlay analysis, weights are assigned, and then the parameters combined to make the final map.

Label numbering scheme. To assist with data tracking during and after the analysis each of the layers was assigned a unique identifier code (layerID). See the Layer Definitions and Numbering section for a listing of the layerIDs, layer names, and descriptions. Providing a unique LayerID code helps to avoid problems caused by spelling errors and helps when managing the data sets using a database program. Actual datasets may change if the study is repeated depending on the

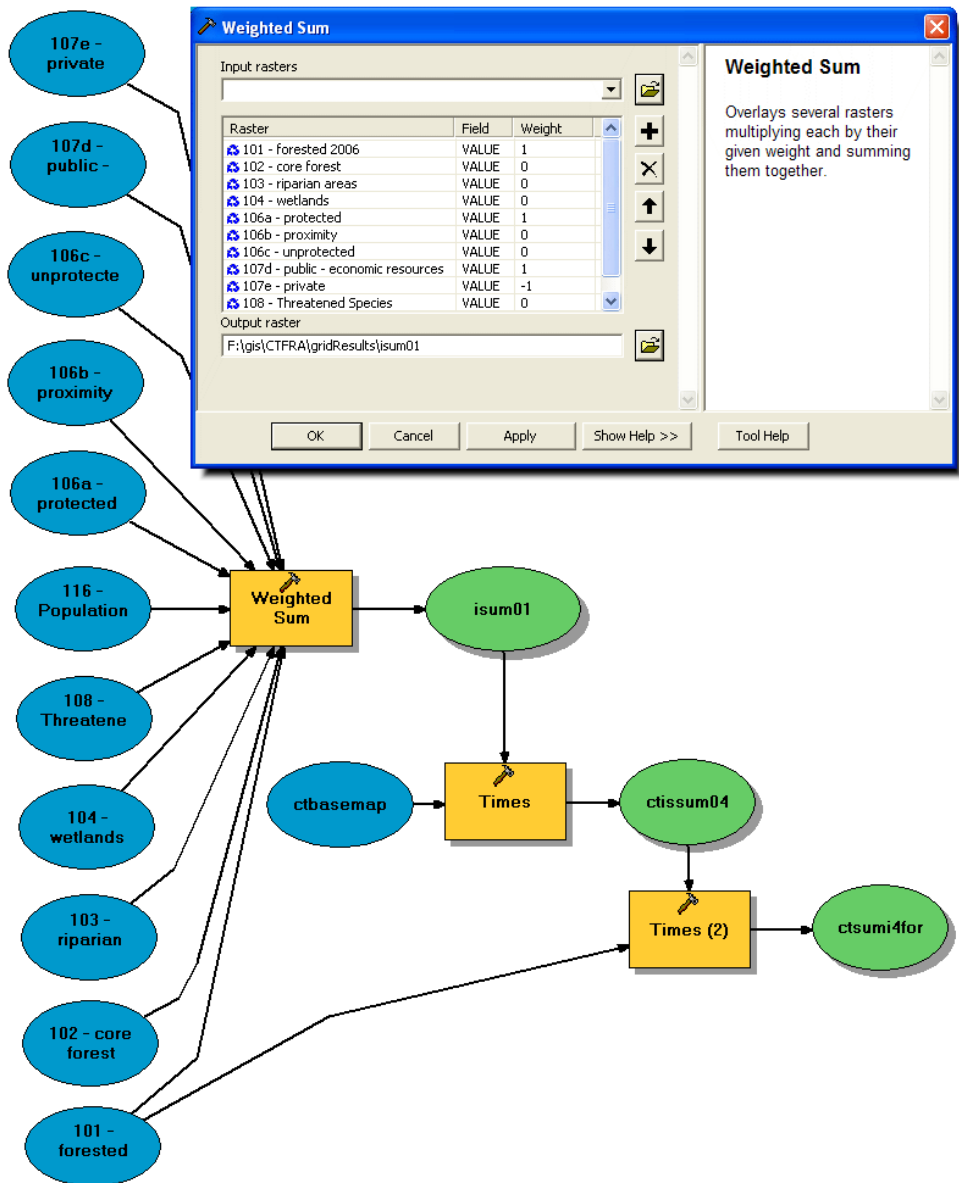
availability of new layers or changes in the model designs. The details are provided to help with understanding the process rather than repeat the analysis verbatim.

The use of Model Builder. Throughout this report there may be terms relating to use of a model. ArcGIS ArcView 9.3 was the primary software used for the study. Within the software is a Model Builder tool. This tool provides the option to create a “toolbox” for storing repetitive tasks and complex spatial routines. The user works in a graphics interface, adding items to a type of flow chart. The items contain procedures and spatial operations that can be applied in a set order. The ‘raw’ GIS data is added to the model on one side as base data, manipulated to create parameters, then weighted and combined to create the final output dataset (or maps). Models were used to create some of the base layers. A hybrid model/visual basic script was created to provide flexibility when assigning weights to the various overlay procedures.

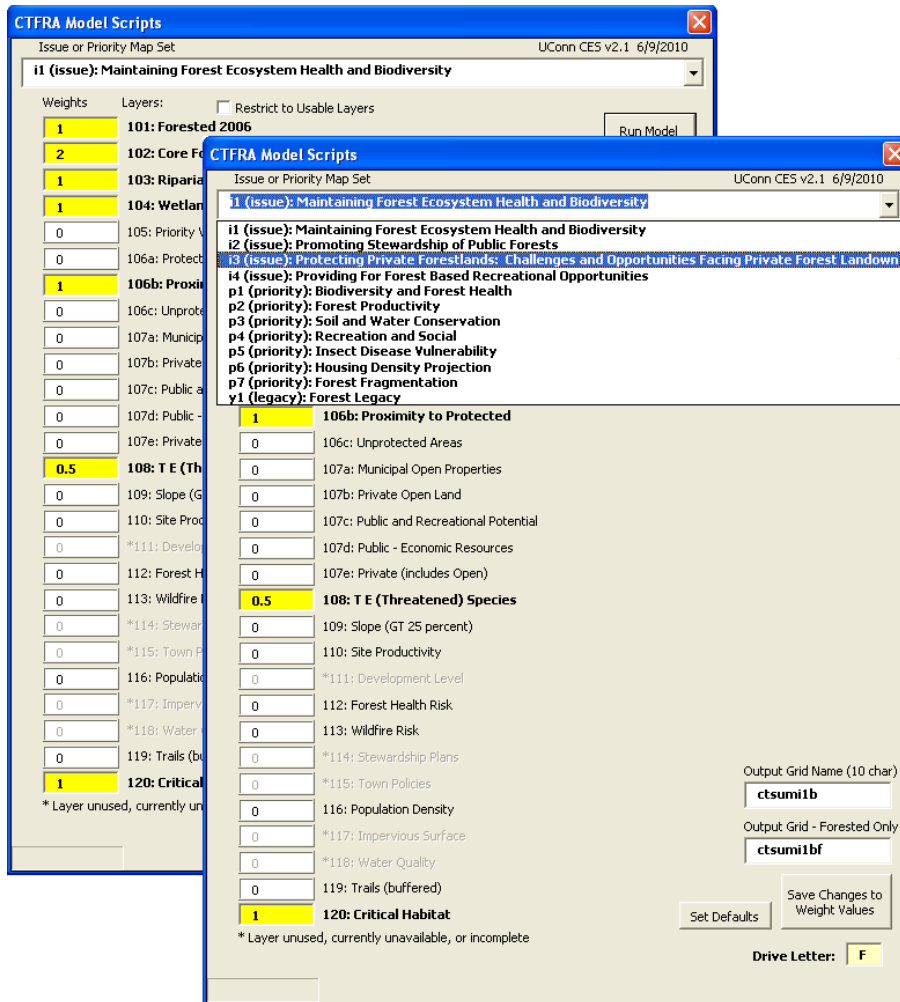
The use of vector and raster data formats. Vector datasets define features on the ground using polygons, lines, or point coordinate systems. With vector data a lake would be represented by a line enclosing an area and attributes would be assigned to the enclosed polygon. Raster datasets are represented by a spatial grid system with evenly distributed pixels, each with an associated value, using a concept is similar to that of a digital photograph. With raster data a lake would be identified as a cluster of pixels, each assigned the same ‘lake’ value. For GIS applications there are advantages and disadvantages of vector and raster formats depending on the application or analysis being applied. Vector operations are more flexible with map scale, providing more precision for detailed operations such as buffering, clipping, and line work. Raster files may have limited resolution, but the grid operations can be much faster than vector operations when working with overlay calculations.

For this project raster files were used because speed was essential to provide close to real-time updates during planning meetings and to maximize flexibility. Loss of precision was minimal, however, to maintain resolution for as long as possible all vector datasets retained their vector characteristics until the steps for statistical overlay were required. At that point they were converted to the resolution specified for the project. For alignment purposes, all grid features were ‘snapped’ to a base grid for Connecticut originally created from a 2006 Landsat image as provided by CLEAR and modified for the 30 by 30 meter format (98.423364 feet on a side).

Procedures for weighted overlay analysis. The overlay analysis involved the stacking of layers associated with each map theme into one grid. Each layer was assigned a weight using the ArcGIS Spatial Analyst weighted overlay tool. Before weighted, all layers used in the overlay analysis were first converted to a standardized statewide grid format and assigned values of 1 or 0, with the value “1” applying to the layer feature. Exceptions to this included the housing density layer, this retained a range of low to high (1, 2, and 3) for any given pixel. ArcGIS Model Builder was used to create a base layout for adjusting weighted values and providing standard output.



To maximize flexibility the model was converted to a script and modified to work within a Visual Basic interface. This Visual Basic tool allowed the selection of a specified issue or priority map set and the option to change weight values for selected layers before running the model. Because the layers were in raster format the overlay analysis for any given map was relatively fast, less than five minutes for a map set. With fast analysis several scenarios could be tested during planning meetings.



Report Format. Multiple maps were produced for the final report. The descriptions for these maps are provided here, grouped into the Issues and Priority map sets. Those maps involving overlay analysis are described first, followed by basic information for the standard display maps. Each is broken out by its purpose, the map identifying features and description (for record keeping), the GIS procedures, the layers used, and layer weights if an overlay analysis was used. A few of the maps described here may not be in the final report, the maps may have been removed as the report was finalized or are reserved for future revisions.

I. Overlay analysis maps for the Issues and Priority datasets

Maintaining Forest Ecosystem Health and Biodiversity

MapID: i1b

Project: FinalMap_Issue01b.mxd

Purpose: To identify areas with high potential or for current value as quality forest habitat, both for trees and animals. Timber production may coincide with similar areas, but the primary focus for this map set is increased biodiversity and overall health of the forest ecosystem.

Description: Issue Number 1.

Procedure: Weighted Overlay.

Layers and layer purpose for this map:

- Forested pixels. Assumes forested pixels have value to forest ecosystem.
- Core Forest. Forest pixels a set distance from fragmenting features (roads, urban areas). Assumes “core” forest have additional value away from edge features
- Riparian Areas - within 300 feet of water features. Assumes pixels near water features provide for more biodiversity.
- Wetland Soils. Assumes pixels within wetlands provide for more biodiversity
- Proximity to Protected areas (1000 and 2000 feet). Assumes a better chance of having and maintaining ecosystem value when near protected land.
- Threatened Species. Assumes the State species map reflects zones already supporting species of concern. Weight reduced because of spatial generalization.
- Critical Habitat Areas. Assumes areas already designated as critical have been evaluated as having an ecosystem value.

Layer weights:

<u>LayerCode</u>	<u>LayerName</u>	<u>LayerWeight</u>
101	Forested	1
102	Core Forest	2
103	Riparian Areas	1
104	Wetland Soils	1
106b	Proximity to Protected	1
108	Threatened Species	0.5
120	Critical Habitat Areas	1

Additional Notes: None

Providing For Forest Based Recreational Opportunities

MapID: i4b

Project: FinalMap_Issue04b.mxd

Purpose: To highlight and identify areas with potential for passive forest based recreation within the State.

Description: Issue Number 4. Overlay analysis to identify areas within the state providing increased value for forest based recreation.

Procedure: Weighted Overlay. Used vector trail maps as provided by the CT DEEP and the CT Forest and Parks association. Buffered them by (***)100 feet to make sure the trail system was properly included when converted to Grid format. Overlaid additional layers with associated weight values.

Layers and layer use or purpose for this map:

- Forested pixels. Areas currently forested provide a base for passive recreation.
- Riparian Areas. Water bodies and rivers have high recreation value. How the areas bordering these features are treated can improve the recreation experience and help provide access.
- Protected Areas. Made up of Federal, State, and Municipal lands considered as protected from future development or significant change. These have value directly as recreation areas and as sites contributing to nearby recreation.
- Private Open Land. Semi-protected properties in private ownership. Some do not allow public access directly but do contribute to nearby recreation and may be part of local hunting clubs.
- Public and Recreation Potential. Federal, State, and Municipal lands considered as publicly accessible. Some may fall under the protected category. These have a direct public use, including trails, camping, or hunting.
- Threatened Species Areas. A rough overlay of areas with potential or existing threatened or endangered plants or animals. This layer was considered to have a negative influence on recreation. There is positive “feel good” value knowing an area has unique species living within it, but direct human activity on or near these locations should be discouraged
- Population Density. A 2000 census block layer with a density range applied to each pixel. An older model (2010 data was not available as of this writing), this layer still provides a relative spatial representation higher and lower population levels. Areas within or near higher population areas were considered of higher value because of the potential for increased use.
- Trails (buffered). Trails were identified from available sources then buffered to include the value of surrounding pixels and as means to model a linear feature. These areas have a direct recreation value.

Layer weights: No layer weighting.

LayerCode	LayerName	LayerWeight
101	Forested	1
103	Riparian Areas	0.5
106a	Protected Areas	1
107b	Private Open Land	1
107c	Public and Recreation Potential	2
108	Threatened Species Polygons	-1
116	Population Density	0.5
119	Trails (buffered)	2

Additional Notes: The population density layer was the one layer where the grid pixel values retained a range during the analysis (0, 1, 2 – zero to medium and high density, versus 0, 1 for the others). To compensate for the potential to over-emphasize the layer the weight was cut in half. An alternative is to preselect the density range and give it a value of 1.

Soil and Water Conservation

MapID: p3

Project: FinalMap_Priority03.mxd

Purpose: To identify areas with direct or indirect value to soil and water conservation within the State.

Description: Priority Number 3. Overlay analysis to identify areas with the higher need for protection based on their value to water conservation and quality, the protection of hydric soils, and areas with the potential for higher erosion if vegetation cover is removed.

Procedure: Weighted Overlay. Uses a combination of layers associated with the need for good water quality, wetlands protection, proximity to water systems, and concerns about slope.

Layers and layer use or purpose for this map:

- Forested pixels. Areas currently forested provide the best land cover for water resource protection and soil retention.
- Riparian Areas. Areas closest to streams and water bodies have the potential for the most direct influence on water quality and soil retention.

- Wetland Soils. Wetland areas have a direct impact on water systems and are often important within themselves.
- Priority Watersheds. Watersheds identified as important for contributing to human related water systems like municipal wells and reservoirs. Protecting them protects the resource.
- Steep Slopes. Slopes identified as greater than 25 percent are considered at higher risk for erosion issues if altered or the vegetation is removed.

Layer weights: No layer weighting.

<u>LayerCode</u>	<u>LayerName</u>	<u>LayerWeight</u>
101	Forested	1
103	Riparian Areas	1
104	Wetland Soils	1
105	Priority Watersheds	2
109	Steep Slopes (> 25%)	1

Additional Notes:

II. Display maps (no overlay analysis) for the Issues and Priority datasets

Critical Habitat Data

MapID: i1a

Project: FinalMap_Issue01a.mxd

Purpose: To identify areas with high potential or for current value as quality forest habitat, both for trees and animals. Timber production may coincide with similar areas, but the primary focus for this map set is increased biodiversity and overall health of the forest ecosystem.

Description: Issue Number 1. A simple display map of previously identified critical habitat areas relating to forests. No overlay analysis was required. Part of Maintaining Forest Ecosystem Health and Biodiversity.

Procedure: The critical habitat polygon layer was downloaded from the CT DEEP GIS web site. Only feature attributes with references to forest habitat were selected for display. Selections using the statewide forest layer were not used to create a forest overlay because some of the critical habitat polygons related to forest habitat did not actually have trees on them. Selecting by direct overlap with the satellite forest cover data would have omitted portions of these polygons.

Promoting Stewardship of Public Forests

MapID: i2

Project: FinalMap_Issue02.mxd

Purpose: To highlight public forests within the State.

Description: Issue Number 2. Display of State, municipal, and federal that overlay the forest 2006 dataset (only forested pixels remain).

Procedure: Display map only. Converted each layer to Grid format. Multiplied public lands by forest 2006 to remove non-forested.

Layers and layer purpose for this map:

- Federal properties - selected for public use only
- DEEP properties
- Municipal properties selected for municipal, private removed.
- Forested 2006

Layer weights: No layer weighting. Did use forested for selection.

Additional Notes: None

Private Forested Lands

MapID: i3a

Project: FinalMap_Issue03.mxd

Purpose: To highlight the challenges and opportunities facing private forest.

Description: Issue Number 3. Selection of private forested lands. Public lands have been removed. Part of Protecting Private Forestlands.

Procedure: Display map only. Converted each layer to Grid format. Multiplied private lands by forest 2006 to remove non-forested.

Layers and layer use for this map:

- Federal properties - removed
- DEEP properties - removed
- Municipal properties - municipal removed, private remains
- Forested 2006

Layer weights: No layer weighting. Did use forested for selection.

Additional Notes: Includes private protected lands.

Private Forested Lands with Protected as Overlay

MapID: i3b

Project: FinalMap_Issue03.mxd

Purpose: To highlight the challenges and opportunities facing private forest.

Description: Issue Number 3. Selection of private forested lands. Public lands have been removed. Protected lands added as an overlay, included private protected lands if known.

Procedure: Display map only. Converted each layer to Grid format. Multiplied private lands by forest 2006 to remove non-forested. Included protected lands layer as overlay.

Layers and layer use for this map:

- Federal properties - removed
- DEEP properties - removed
- Municipal properties - municipal removed, private remains
- Protected lands - All available protected lands
- Forested 2006

Layer weights: No layer weighting. Did use forested for selection.

Additional Notes: Private protected lands combined with overall protected layer.

Trails and Public Lands

MapID: i4a

Project: FinalMap_Issue04a.mxd

Purpose: To highlight and identify areas with potential for passive forest based recreation within the State. Part of Providing For Forest Based Recreational Opportunities.

Description: Issue Number 4. Trail systems and public lands to highlight the trail network and their links to public lands within the State.

Procedure: Display map only. Used vector trail maps as provided by the CT DEEP and the CT Forest and Parks association. Overlaid for display on top of public properties (DEEP, Town, and Federal).

Layers and layer use for this map:

- Federal properties - public
- DEEP properties - public
- Municipal properties - municipal (not private open space)

- CFPA Trail data (vector) - Includes unverified layer
- CT DEEP Trail data (vector) - Includes all trail features (no attributes selected)

Layer weights: No layer weighting.

Additional Notes:

Supporting a Sustainable Forest Based Economy

MapID: i5

Project: FinalMap_Issue05.mxd

Purpose: To identify active sawmill locations within the State as a means to highlight the economic use and value of nearby forests.

Description: Issue Number 5. Point map of mill locations overlaid on the 2006 forested land cover data.

Procedure: Display map only. DEEP Forestry provided an excel list of active mills and the street addresses for the owners (some coincide with the mill locations). These were converted to an ArcGIS point file using address matching then exported as a Google Earth KML file. The forester responsible reviewed the KML file points in Google Earth and edited the properties to move misaligned points to the active mill locations on the Google Earth imagery. The revised KML file was converted back to ArcGIS shape format and used in this map.

Layers and layer use for this map:

- Forested 2006 - Base of forested lands within the State.
- Mill Locations - Point locations for active sawmills within the State.

Layer weights: No layer weighting.

Additional Notes: Locations are approximate.

The Role of Urban Forestry in Connecticut Communities

- Urban Tree Canopy

MapID: i9a

Project: FinalMap_Issue09.mxd

Purpose: To display the results of an assessment of tree canopy cover over municipalities within the State.

Description: Issue Number 9.

Procedure: Display map only. Data for canopy cover assessment by town was provided in an Excel spread sheet. The table was imported into an Access database and joined to the DEEP Towns dataset using the Town number ID, then displayed in color using the ranked assessment field as the range (Highest to Very Low).

Layers and layer use for this map:

- Table - Canopy Assessment.xls, Urban and community forestry assessment by county subdivisions.
- State Towns - Simple town polygon outlines

Layer weights: No layer weighting.

Additional Notes: Excel table provided by Chris Donnelly of the Connecticut Experiment Station.

The Role of Urban Forestry in Connecticut Communities

- Population Density by Municipality

MapID: i9b

Project: FinalMap_Issue09.mxd

Purpose: To display the population density for the towns within the State.

Description: Issue Number 9.

Procedure: Display map only. Data for population density in people per square mile for each town was provided in an Excel spread sheet. The table was imported into an Access database and joined to the DEEP Towns dataset using the Town number ID, then displayed in color using the people per square mile field.

Layers and layer use for this map:

- Table - Population Density.xls, year 2000 population characteristics by town.
- State Towns - Simple town polygon outlines

Layer weights: No layer weighting.

Additional Notes: Excel table provided by Chris Donnelly of the Connecticut Experiment Station.

The Role of Urban Forestry in Connecticut Communities

- Impervious Surface Cover by Municipality

MapID: i9c

Project: FinalMap_Issue09.mxd

Purpose: To display relative impervious surface levels for the towns within the State.

Description: Issue Number 9.

Procedure: Display map only. Percent impervious surface values for each town were provided in an Excel spread sheet. The table was imported into an Access database and joined to the DEEP Towns dataset using the Town number ID, then displayed in color using a range divided by natural breaks.

Layers and layer use for this map:

- Table - Impervious surface.xls. Tree canopy and impervious surface cover characteristics by county subdivision.
- State Towns - Simple town polygon outlines

Layer weights: No layer weighting.

Additional Notes: Excel table provided by Chris Donnelly of the Connecticut Experiment Station.

The Role of Urban Forestry in Connecticut Communities

- Urban Forestry Activity by Municipality

MapID: i9d

Project: FinalMap_Issue09.mxd

Purpose: To display the results of the FY2010 Community Accomplishment Detail Report for Connecticut. The values are a relative measure of the forestry activity and understanding of forestry issues by the towns within the State.

Description: Issue Number 9.

Procedure: Display map only. Field values for various factors related to UCF Type, Management Plans, Staff, Ordinances, Advisory, Tree City USA, and Grants were provided for each town in an Excel spread sheet. These fields (1,0 values) were summarized to represent a total based on which factors were represented for each town. The table was imported into an Access database and joined to the DEEP Towns dataset using the Town number ID, then displayed in color using the total values as an indicator of town forestry accomplishments and planning.

Layers and layer use for this map:

- Table - communitySocialList.xls. FY2010 Community Accomplishment Detail Report for Connecticut.
- State Towns - Simple town polygon outlines

Layer weights: No layer weighting.

Additional Notes: Excel table provided by Chris Donnelly of the Connecticut Experiment Station.

The Role of Urban Forestry in Connecticut Communities

- Certified Tree Wardens by Municipality

MapID: i9e

Project: FinalMap_Issue09.mxd

Purpose: To display the number of individuals who may be active or assisting with tree warden responsibilities for the towns. This can be an indicator of urban forestry activity and interest.

Description: Issue Number 9.

Procedure: Display map only. Tree warden information was listed by type (tree warden, deputy) for each town within an Excel spread sheet. The table and imported into an Access database and simplified to provide a count per town. This value was joined to the DEEP Towns dataset using the Town number ID, then displayed in color using a range. The results were not normalized by population.

Layers and layer use for this map:

- Table - CertTreeWardens10_7_09woDOT.xls. Tree warden listing by town.
- State Towns - Simple town polygon outlines

Layer weights: No layer weighting.

Additional Notes: Excel table provided by Chris Donnelly of the Connecticut Experiment Station.

Insect and Disease Vulnerability

- Risk of Basal Area Loss from Gypsy Moth

MapID: p5a

Project: FinalMap_Priority05.mxd

Purpose: To highlight the potential impacts of insect and diseases on the forests within the State.

Description: Priority Number 5. Relative spatial interpretation of forest areas where Gypsy Moth infestations would most likely occur.

Procedure: Display map only. Downloaded data grid files of total basal area losses for the 11 most significant mortality agents from the Forest Service Forest Health Technology Enterprise Team (FHTET) web site <http://www.fs.fed.us/foresthealth/technology/nidrm.shtml> . Of the top 11, Gypsy Moth is one of the agents found within Connecticut. File was subset to Connecticut. Data resolution is one kilometer per pixel.

Layers and layer use for this map:

- gm_baloss - Risk of basal area loss from Gypsy Moth.

Layer weights: No layer weighting.

Additional Notes:

Housing Density Projection

- Urban Growth 1985 to 2006

MapID: p6

Project: FinalMap_Priority06.mxd

Purpose: To display historic increases in urban cover as an indicator of potential change in the future.

Description: Priority Number 6. Land cover pixels classified as urban in the 2006 land cover dataset and as non-urban features in the 1985 dataset. The result shows increased urban cover. Any potential change from urban back to a vegetation cover is rare. If identified in the land cover analysis it would likely be increased tree canopy above urban features.

Procedure: A series of land cover maps are available for Connecticut through the College of Agriculture's Center for Landuse Education and Research (CLEAR). The remote sensing group within this center created cover maps for the years 1985, 1990, 1995, 2002, and 2006. For this map set urban cover types were selected from the 2006 and 1985 datasets, resampled to 1 and 0 values, then the 1985 data was subtracted from the 2006 data using ArcGIS Spatial Analyst. Remaining pixels with a positive value represent an increase in urban cover between the two periods. Pixel resolution is 100 feet per side.

Layers and layer use for this map:

- Land Cover 2006 - CLEAR Land Cover dataset, selected for urban cover.
- Land Cover 1985 - CLEAR Land Cover dataset, selected for urban cover.

Layer weights: No layer weighting.

Additional Notes:

Forest Fragmentation

- Forest Loss 1985 to 2006

MapID: p7a

Project: FinalMap_Priority7a.mxd

Purpose: To display historic decreases in forest cover as an indicator of potential change in the future.

Description: Priority Number 7. Land cover pixels classified as non-forested in the 2006 land cover dataset and as forested in the 1985 dataset. The result is forest loss. Measuring change back to forest cover requires longer time frames and rarely includes features previously converted to developed or urban.

Procedure: A series of land cover maps are available for Connecticut through the College of Agriculture's Center for Landuse Education and Research (CLEAR). The remote sensing group within this center created cover maps for the years 1985, 1990, 1995, 2002, and 2006. For this map forest cover types were selected from the 2006 and 1985 datasets, resampled to 1 and 0 values, then the 1985 data was subtracted from the 2006 data using ArcGIS Spatial Analyst. Remaining pixels with a negative value represent a decrease in forest cover between the two periods. Pixel resolution is 100 feet per side.

Layers and layer use for this map:

- Land Cover 2006 - CLEAR Land Cover dataset, selected for forest cover.
- Land Cover 1985 - CLEAR Land Cover dataset, selected for forest cover.

Layer weights: No layer weighting.

Additional Notes: Detailed analysis summarizing landscape changes over time can be found at the CLEAR website <http://clear.uconn.edu/projects/landscape/>

Forest Fragmentation

- Fragmentation Analysis 1985

MapID: p7b1

Project: FinalMap_Priority7b.mxd

Purpose: To display the resulting map from the CLEAR statewide forest fragmentation analysis.

Description: Priority Number 7. Statewide forest fragmentation analysis results for 1985. Categories include Core forests of various size levels, and patch, edge, and perforated forest areas. To provide focus, core areas greater than 100 hectares are likely to be of more value and quality for forest species.

Procedure: A series of forest fragmentation maps are available for Connecticut through the College of Agriculture's Center for Landuse Education and Research (CLEAR). The remote sensing group within this center created fragmentation maps for the years 1985, 1990, 1995, 2002, and 2006. The 1985 map was used for this display. The features extend beyond Connecticut to the boundaries of local watersheds.

Layers and layer use for this map:

- Forest Fragmentation 1985 - CLEAR forest fragmentation analysis.

Layer weights: No layer weighting.

Additional Notes: Detailed analysis summarizing changes in fragmentation over time can be found at the CLEAR website <http://clear.uconn.edu/projects/landscape/forestfrag/>

Forest Fragmentation

- Fragmentation Analysis 2006

MapID: p7b2

Project: FinalMap_Priority7b.mxd

Purpose: To display the resulting map from the CLEAR statewide forest fragmentation analysis.

Description: Priority Number 7. Statewide forest fragmentation analysis results for 2006. Categories include Core forests of various size levels, and patch, edge, and perforated forest areas. To provide focus, core areas greater than 100 hectares are likely to be of more value and quality for forest species.

Procedure: A series of forest fragmentation maps are available for Connecticut through the College of Agriculture's Center for Landuse Education and Research (CLEAR). The remote sensing group within this center created fragmentation maps for the years 1985, 1990, 1995, 2002, and 2006. The 2006 map was used for this display. The features extend beyond Connecticut to the boundaries of local watersheds.

Layers and layer use for this map:

- Forest Fragmentation 2006 - CLEAR forest fragmentation analysis.

Layer weights: No layer weighting.

Additional Notes: Detailed analysis summarizing changes in fragmentation over time can be found at the CLEAR website <http://clear.uconn.edu/projects/landscape/forestfrag/>

III. Layer Definitions and Numbering System

The following is a listing of each of the layers available for the analysis process. Not all of them were used, at times because of quality concerns brought up during review meetings. Some layers are used more than once. Sections like protected areas and public lands have individual selections from the same spatial dataset – broken out by the attribute field values appropriate for the given use.

LayerID - Layer Title:

101 - Forested

Existing forest cover. In this case derived from satellite analysis in 2006. This is a base layer for the analysis of existing forest (vs. potential growing sites). This layer will have a minimum value of one (1), to make sure it is counted, but could be ranked higher if the reviewer feels the mere existence of forest cover is a primary factor over other types of values (such as slope, core, etc.).

102 - Core Forest

Regions of core forest derived from the forested cover. Defined as areas unbroken by major roads or other man made features, then subset a specific distance in from those fragmenting features. This falls under the assumption there are benefits to large unbroken forest blocks at a distance away from fragmenting features.

103 - Riparian Areas

Areas extending a set distance upland from streams and other water features - including wetlands and marshes. In this analysis 300 feet was chosen as the buffer distance. An assumption is this zone would better protect water quality and habitat if in a forested state.

104 - Wetlands

Wetlands as defined by hydric types and other wetland categories within the soils spatial database. Some of the wetland features may be forested. For the analysis the uplands surrounding the wetland may be of importance.

105 - Priority Watersheds

Watersheds identified as having significant value for drinking water supplies within the State. Features falling within these boundaries can be considered important toward the protection of resources the watersheds provide.

106 - Protected Areas

This is a mix of lands that should remain in a natural or semi-natural state. Not all are public, such as private easements if available. The features are selections from the same datasets, the letters identify the separate categories from those selections. Only layers available within the statewide datasets were used.

106a - ospropprot Protected lands. Assumes these lands will not be converted from a natural resource use.

106b - proximity Proximity to protected lands. Used to address the natural resource value of lands near protected areas - either a set distance (i.e. 500 or 1000 feet) or a range of values.

106c - unprotected Opposite of protected lands. These areas have no protection status given the data available on a statewide level.

107 - Public Lands

Public lands as identified by Municipal, State, and Federal lands GIS datasets. Not all are protected, some areas are identified as regulated or as areas of significance like heritage zones. Public use can influence recreational values as well as have natural resource implications. Variable selections and combinations were made to identify only those land areas applicable to the map overlays they will be used in. The features are selections from the same datasets. The letters identify the separate categories from those selections. Individual towns or organizations may have more detailed records than these statewide datasets:

107a - ospropMuni (Municipal Open Properties) - Open or protected lands owned by towns other municipal agencies.

107b - ospropPriv (Private Open Land) - Open or protected lands owned by individuals, land trusts, or private groups.

107c - ospropRec (Public and Recreational Potential) - All public open or protected lands providing value for recreation

107d - ospropEcon (Economic Resources) - Open or protected lands with potential for forest resource use.

107e - osPrivate (Private Land) - Opposite of ospropRec (107c). All land falling outside the known public areas. Includes private open space (107b).

108 - Threatened and Endangered Species

Locations for known threatened or endangered species. Features covered by these areas may be considered of value on the assumption the species have already made their selection based on habitat quality. The locations for these areas are generalized, but the layer can provide notice of where protection or habitat value is important.

109 - Slope

Steep slopes. Slopes above a specified percentage or angle of grade can increase the likelihood of erosion if the soils on those slopes are not protected by vegetation. In

addition, steep slopes may be considered as areas needing special attention when considering site work for harvesting operations. For this project a value greater than or equal to 25 percent is provided as a layer.

110 - Site Productivity

Productive (farm) soils are identified within the statewide Soils database. Not all are in production as agriculture, some fall under existing forested areas or may be considered as prime growing sites for forest if agriculture is not a planned use. Protecting these areas may have a unique value.

111 - Development Level/Change

Change/Increase in development for given census blocks. Those sections of greatest change could be considered as requiring a need for increased protection, as areas at risk of conversion to a developed use, or as areas where the primary interest is development.

112 - Forest Health Risks

Risks to the forest from insects or disease. This layer is based on several factors linking the potential for insect damage or forest stress within the identified areas. These data were created for a nationwide dataset at a larger scale than the 30 meter datasets, hence the large block appearance on the maps.

113 - Wildfire Risk

Areas identified as having increase potential for fire risk, primarily as potential to burn (south facing aspect, dryer soils, and other factors).

114 - Stewardship Plans

Existing Stewardship projects on town, land trust, and private properties.

115 - Towns (Town Policies)

Spatial database of town boundaries. Several database tables were linked to a basic GIS town dataset. Attributes within the joined dataset allow for the display of a ranking system representing the town regulations and other policy issues related to forests and forestry. How the town policies effect these may influence how forests are managed within those boundaries.

116 - Population Density

This layer represents population density by census blocks. One intent is to highlight areas (pixels) of a specific density or density range to help classify and rank areas for urban forestry.

117 - Impervious Surface

This is a somewhat experimental layer representing relative imperviousness over a given 30 meter pixel. Highlighting areas with high or low impervious cover this may direct where forest cover could mitigate the effects. The current plan is to summarize the values over a given area, possibly a town. The weight would be attached to that feature.

118 - Water Quality

This is a surface water quality layer provided by the State. Highlighting rivers or lakes with impaired waters may direct which upland areas or towns need forest planning. The current plan is to summarize the values over a given area, possibly a town or watershed. The weight would be attached to that feature. Codes provided within the map layer are values assigned by CT DEEP. Details can be found within the metadata at the DEEP web site. The plan was to summarize those values into a range we can use for the project.

119 - Trails

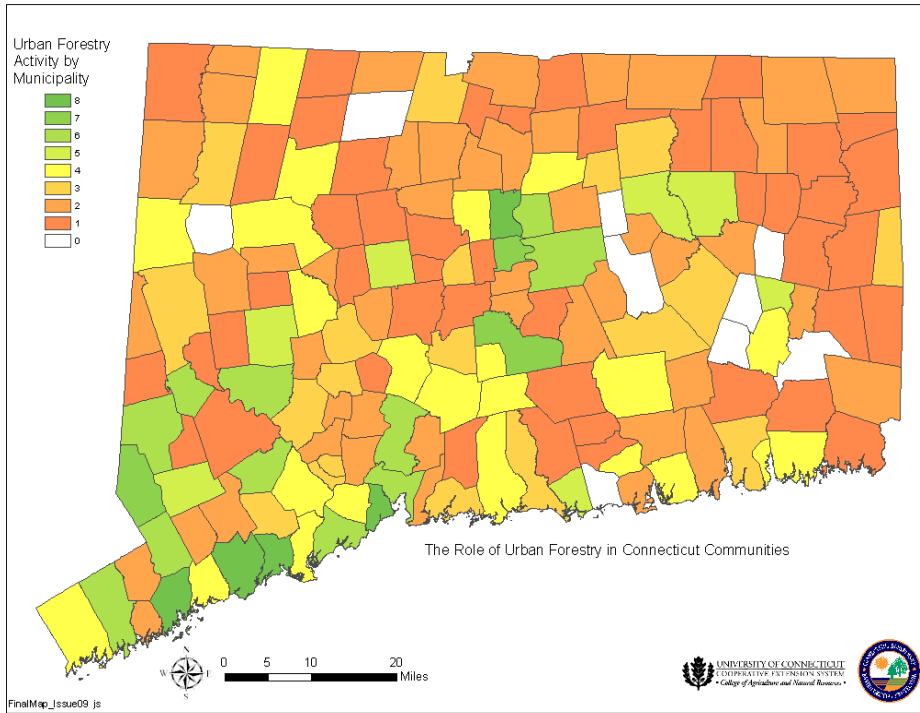
This is a compilation of trail line features from the State, CT Forest and Parks Association, (CFPA) and the Appalachian Trail. For the grid overlay analysis the centerlines were buffered by 100 feet on a side then converted to 30 meter pixels.

120 – Critical Habitat

This dataset was derived by Ken Metzler's and provided on the CT DEEP web site. For the project the areas associated with forest were selected from the attribute table. This layer is used in addition to the Natural Diversity Database layer to provide a better picture of areas sensitive from a wildlife habitat perspective.

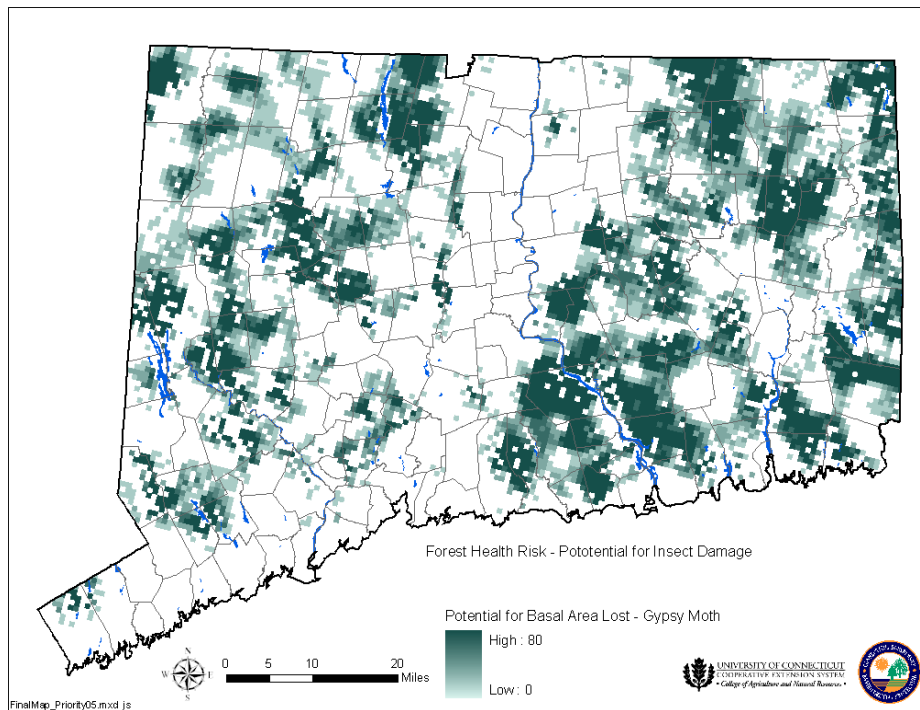
APPENDIX 8. Map Appendices

UConn CLEAR generated the following maps in addition to those included throughout this report. All GIS mapping was created by CLEAR unless otherwise stated.



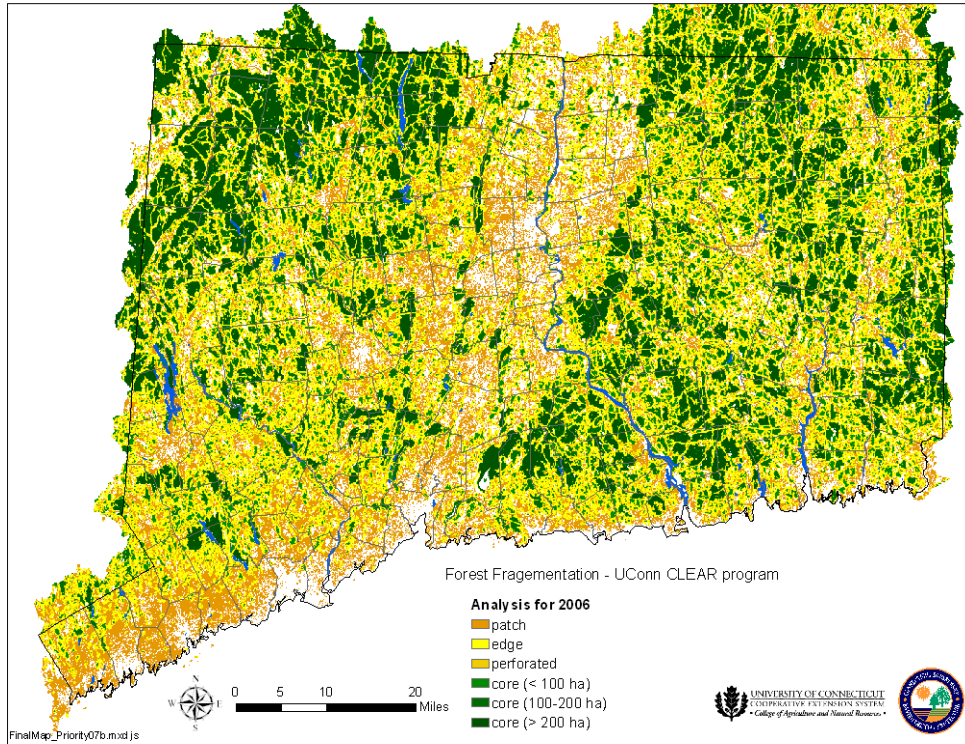
Map A. Forestry Activity and Understanding of Forestry Issues by Municipality

Purpose: To display the results of the FY10 Community Accomplishment Detail Report for Connecticut. The values are a relative measure of the forestry activity and understanding of forestry issues by the towns within the State.

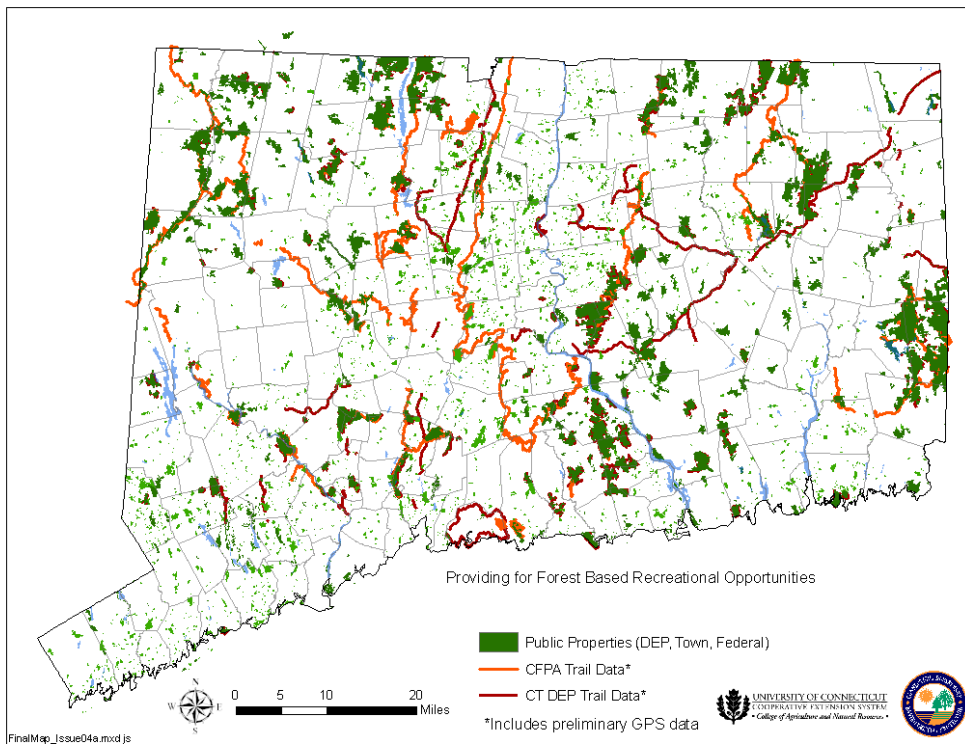


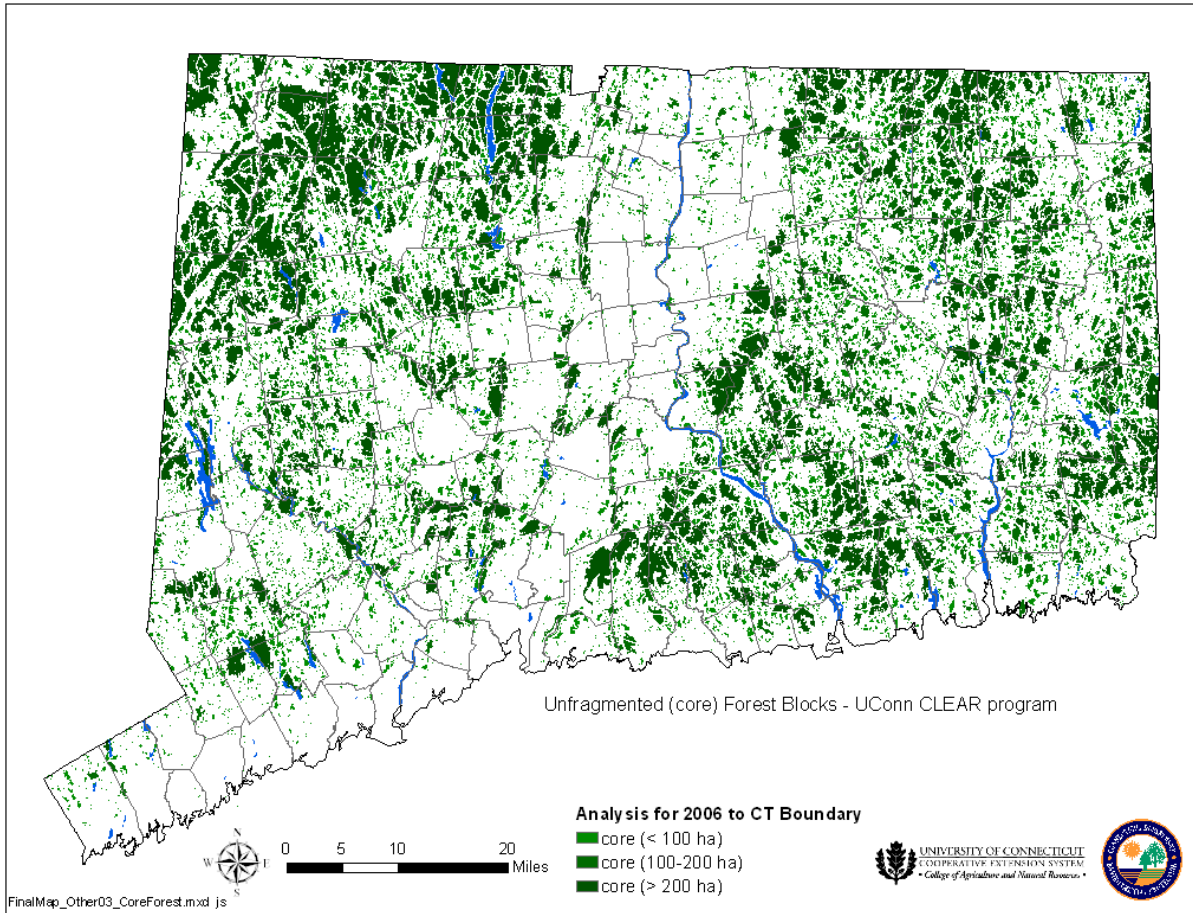
Map B. Forest Health Risk for Gypsy Moth Damage

**Map C.
Connecticut
Forest
Fragmentation
2006**



**Map D.
Statewide
Recreational
Opportunities**





Map E. Core Forest Blocks in Connecticut in 2006

APPENDIX 9. Comments on Roundtable Process

Comment 1.

Chris:

I left a phone message that I would mail you this thought. I haven't personally been able to participate in the Statewide Forest Plan - primarily because I work outside of forestry - and in New York City. However, I do spend a fair amount of time thinking about, and acting on forestry related issues - specifically restoration of the American chestnut as a forest species. More general information can be found on our web-site at <http://ctaaf.org>.

We have been very successful in CT bridging the public\private space by working with Government agencies and other funding sources such as Northeast Utilities, Norcross Foundation, and other Foundations to support our work with private landowners (especially Land Trusts, Audubon, White Memorial, and private owners) as well as Town Conservation organizations. We now have [seven back-cross research orchards in CT](#) with over [2200 trees planted](#) ... we'll be planting another 700 this spring in new orchards in Middletown and Litchfield. These trees planted are all progeny of local CT trees we've been able to successfully pollinate with controlled pollination. We use a scientifically peer reviewed and accepted back-cross method of breeding in blight resistance to native CT American chestnut. We have a strategic plan with metrics that we've been successfully achieving. We have a volunteer [Board of Directors](#) in CT with five PhDs and a wealth of imaginative ideas and devoted members. We try to work smart. We bring top researchers from across the country to present at our annual meeting held at locations such as Yale University, and recently Trinity College. Dr. Tom Kubisiak from the USFS came to Trinity two weeks ago and addressed a crowd of about a hundred people on molecular genetics and specifically what the [Fagaceae Genome Project](#) is doing to decode the genomes of both American and Chinese chestnut, as well as the chestnut fungus *Cryphonectria parasitica*.

Ok so enough of trying to establish our credentials. Hopefully I've been successful. Here is the idea I would like to see built into the plan.

Can a statement be built into the plan where the "plan" recognizes the activity of forest species restoration through breeding and other programs focused on restoring species that have been impacted by foreign pathogens. It would benefit all if the plan recognized and suggested supporting the research and then restoration efforts of such groups.

Specifically I'm thinking of efforts by groups like ours, or Sandy Anagnostakis at CAES, or other groups that may need to work in the future on problems like *Phytophthora cinnimomi* or the Emerald Ash borer or goodness knows what pathogens and pests that might be unleashed in the future. The statement need do no more than recognize that there are pests and pathogens, and that groups are working to combat their effects, and that the public and private sectors should - where feasible - support such efforts.

I'm just hoping that since I can't participate, that such a statement isn't somehow left out.

Thanks for reading this.

Bill Adamsen
Director, The American Chestnut Foundation
President, CT Chapter

Comment 2.

I'm unable to attend the roundtables, but wish to plead for preservation of our forests in CT. The United Nations has asked that we plant a tree for each of the world's population to address climate change and air pollution. That would be 2 million trees to preserve for the future of the planet. The program that DEP Commissioner Gina Murphy [sic] brought to us – Leave No Child Inside – and the book by Louv, *The Last Child in the Forest* – details how valuable the world of trees and nature is to the healthy development of children. Our world cannot be defined by money interests alone, for the dollar bills cannot challenge the imagination and wonder of the world where birds, squirrels and other creatures invoke the peace and linkage of our human world with the world of nature. We have seen the devastation of clear cutting by powerful logging interests and inadequate planning for reforestation and habitat for the creatures that live there. The erosion of Haiti's arable land, the desertification of large areas of Africa and the growing desert in our Pacific northwest should be evidence enough that the decisions you make are vital to the future of our state and planet. The beauty of Connecticut and attraction for tourists can be cataloged as impetus to preserve these priceless wild places. My days on this earth are limited, but I want the children of the future to have the joy of climbing a tree and looking at the sky through unfolding green leaves as the flash of color of migrating warblers excites the creativity and imagination to express this beauty in art and music. Children need to know the songs of this earth and the colors of the heights that trees provide. I look forward to a report of your deliberations and thank you for your stewardship of our trees.

Mary Keane
Trumbull

APPENDIX 10. CT INVASIVE PLANT LIST – November 2014 Ordered by Scientific Name

Connecticut Invasive Plants Council (This list is updated annually by the CT Invasive Plants Council)

Statement to accompany list -- January 2004: This is a list of species that have been determined by floristic analysis to be invasive or potentially invasive in the state of Connecticut, in accordance with PA 03-136. The Invasive Plants Council will generate a second list recommending restrictions on some of these plants. In developing the second list and particular restrictions, the Council will recognize the need to balance the detrimental effects of invasive plants with the agricultural and horticultural value of some of these plants, while still protecting the state's minimally managed habitats.

In May 2004, Public Act 04-203 restricted a subset of the January 2004 list making it illegal to move, sell, purchase, transplant, cultivate or distribute prohibited plants. Effective July 1, 2009, Public Act 09-52 removed the prohibition on *Pistia stratiotes*.

@ column indicates growth form or habitat: A = Aquatic & Wetland; G = Grass & Grass-like; H = Herbaceous; S = Shrub; T = Tree; V = Woody Vine

Explanation of symbols after Common Name:

(P) indicates Potentially Invasive (all other plants listed are considered Invasive in Connecticut)

* denotes that the species, although shown by scientific evaluation to be invasive, has cultivars that have not been evaluated for invasive characteristics. Further research may determine whether or not individual cultivars are potentially invasive. Cultivars are commercially available selections of a plant species that have been bred or selected for predictable, desirable attributes of horticultural value such as form (dwarf or weeping forms), foliage (variegated or colorful leaves), or flowering attributes (enhanced flower color or size).

"PROHIBITED BY STATUTE?" column indicates prohibited status: Y= prohibited from importation, movement, sale, purchase, transplanting, cultivation and distribution under CT Gen. Stat. §22a-381d; N/A= not prohibited

^ indicates species that are not currently known to be naturalized in Connecticut but would likely become invasive here if they are found to persist in the state without cultivation

The taxonomic names used by the Connecticut Invasive Plants Council on the Invasive Plant List are consistent with the names used by the United States Department of Agriculture PLANTS database, accessible online at www.plants.usda.gov. The Council also maintains a list of scientific name synonyms for reference purposes.

COMMON NAME	@	SCIENTIFIC NAME	SYNONYM	PROHIBITED BY STATUTE?
Amur maple (P)	T	<i>Acer ginnala</i> Maxim.		N/A
Norway maple*	T	<i>Acer platanoides</i> L.		N/A
Sycamore maple (P)	T	<i>Acer pseudoplatanus</i> L.		Y
Goutweed	H	<i>Aegopodium podagraria</i> L.	Bishop's weed	Y
Tree of heaven	T	<i>Ailanthus altissima</i> (Mill.) Swingle		Y
Garlic mustard	H	<i>Alliaria petiolata</i> (M. Bieb.) Cavara & Grande		Y
False indigo (P)	S	<i>Amorpha fruticosa</i> L.		Y
Porcelainberry*	V	<i>Ampelopsis brevipedunculata</i> (Maxim.) Trautv.	Amur peppervine	N/A
Mugwort	H	<i>Artemisia vulgaris</i> L.	Common wormwood	N/A
Hairy jointgrass (P)	G	<i>Arthraxon hispidus</i> (Thunb.) Makino	Small carpgrass	Y
Common kochia (P)	H	<i>Bassia scoparia</i> (L.) A.J. Scott	<i>Kochia scoparia</i> ; Fireweed; Summer cypress	Y
Japanese barberry*	S	<i>Berberis thunbergii</i> DC.		N/A
Common barberry	S	<i>Berberis vulgaris</i> L.		Y
Drooping brome-grass (P)	G	<i>Bromus tectorum</i> L.	Cheatgrass	Y
Flowering rush (P)	A	<i>Butomus umbellatus</i> L.		Y
Fanwort	A	<i>Cabomba caroliniana</i> A. Gray	Carolina fanwort	Y
Pond water-starwort (P)	A	<i>Callitriche stagnalis</i> Scop.		Y
Narrowleaf bittercress	H	<i>Cardamine impatiens</i> L.		Y
Japanese sedge^ (P)	G	<i>Carex kobomugi</i> Ohwi		Y
Oriental bittersweet	V	<i>Celastrus orbiculatus</i> Thunb.	Asiatic bittersweet	Y
Spotted knapweed	H	<i>Centaurea stoebe</i> L.	<i>Centaurea biebersteinii</i> ; <i>Centaurea maculosa</i>	Y
Canada thistle (P)	H	<i>Cirsium arvense</i> (L.) Scop.		Y

Black swallow-wort	H	<i>Cynanchum louiseae</i> Kartesz & Gandhi	<i>Cynanchum nigrum</i> ; <i>Vincetoxicum nigrum</i>	Y
Pale swallow-wort	H	<i>Cynanchum rossicum</i> (Kleoe.) Borhidi	<i>Vincetoxicum rossicum</i>	Y
Jimsonweed (P)	H	<i>Datura stramonium</i> L.		Y
Brazilian water-weed (P)	A	<i>Egeria densa</i> Planchon	Anacharis; Egeria	Y
Common water-hyacinth^ (P)	A	<i>Eichhornia crassipes</i> (Mart.) Solms		N/A
Russian olive (P)	S	<i>Elaeagnus angustifolia</i> L.		Y
Autumn olive	S	<i>Elaeagnus umbellata</i> Thunb.		Y
Crested late-summer mint (P)	H	<i>Elsholtzia ciliata</i> (Thunb.) Hylander	Elsholtzia	Y
Winged euonymus*	S	<i>Euonymus alatus</i> (Thunb.) Sieb.	Burning bush	N/A
Cypress spurge (P)	H	<i>Euphorbia cyparissias</i> L.		Y
Leafy spurge	H	<i>Euphorbia esula</i> L.		Y
Glossy buckthorn	S	<i>Frangula alnus</i> Mill.	<i>Rhamnus frangula</i> ; European buckthorn	N/A
Slender snake cotton	H	<i>Froelichia gracilis</i> (Hook.) Moq.	Cottonweed	Y
Ground ivy (P)	H	<i>Glechoma hederacea</i> L.	Gill-over-the-ground; Run-away robin	Y
Reed mannagrass^ (P)	G	<i>Glyceria maxima</i> (Hartm.) Holmb.	Tall mannagrass	Y
Giant hogweed (P)	H	<i>Heracleum mantegazzianum</i> (Sommier & Levier)		Y
Dame's rocket	H	<i>Hesperis matronalis</i> L.		Y
Japanese hops (P)	H	<i>Humulus japonicus</i> Sieb. & Zucc.	Japanese hop	Y
Hydrilla	A	<i>Hydrilla verticillata</i> (L.f.) Royle	Water thyme	Y
Ornamental jewelweed (P)	H	<i>Impatiens glandulifera</i> Royle	Tall impatiens	Y
Yellow iris	A	<i>Iris pseudacorus</i> L.	Yellow flag iris; Pale yellow iris	Y
Perennial pepperweed	H	<i>Lepidium latifolium</i> L.	Tall pepperwort	Y
Border privet (P)	S	<i>Ligustrum obtusifolium</i> Sieb. & Zucc.		Y
California privet (P)	S	<i>Ligustrum ovalifolium</i> Hassk.		N/A
European privet (P)	S	<i>Ligustrum vulgare</i> L.		N/A
Japanese honeysuckle*	V	<i>Lonicera japonica</i> Thunb.		Y
Amur honeysuckle	S	<i>Lonicera maackii</i> (Rupr.) Herder		Y
Morrow's honeysuckle	S	<i>Lonicera morrowii</i> A. Gray		Y
Tatarian honeysuckle (P)	S	<i>Lonicera tatarica</i> L.		Y
Belle honeysuckle	S	<i>Lonicera x bella</i> Zabel	Bell's honeysuckle (<i>misapplied</i>)	Y
Dwarf honeysuckle^ (P)	S	<i>Lonicera xylosteum</i> L.	European fly-honeysuckle	Y
Ragged robin (P)	H	<i>Lychnis flos-cuculi</i> L.		Y
Moneywort* (P)	H	<i>Lysimachia nummularia</i> L.	Creeping jenny	N/A
Garden loosestrife* (P)	H	<i>Lysimachia vulgaris</i> L.	Garden yellow loosestrife	Y
Purple loosestrife	A	<i>Lythrum salicaria</i> L.		Y
European waterclover (P)	A	<i>Marsilea quadrifolia</i> L.	Water shamrock	Y
Japanese stilt grass	G	<i>Microstegium vimineum</i> (Trin.) A. Camus		Y
Eulalia* (P)	G	<i>Miscanthus sinensis</i> Andersson	Chinese or Japanese silvergrass	N/A
Forget-me-not	A	<i>Myosotis scorpioides</i> L.	True forget-me-not; Water scorpion-grass	Y
Parrotfeather (P)	A	<i>Myriophyllum aquaticum</i> (Vell.) Verdc.		Y
Variable-leaf watermilfoil	A	<i>Myriophyllum heterophyllum</i> Michx.		Y
Eurasian watermilfoil	A	<i>Myriophyllum spicatum</i> L.		Y
Brittle water-nymph (P)	A	<i>Najas minor</i> All.	Eutrophic water-nymph	Y
Onerow yellowcress (P)	A	<i>Nasturtium microphyllum</i> Boenn. ex. Rchb.	<i>Rorippa microphylla</i>	Y
Watercress (P)	A	<i>Nasturtium officinale</i> W.T. Aiton	<i>Rorippa nasturtium-aquaticum</i>	Y
American water lotus (P)	A	<i>Nelumbo lutea</i> Willd.	American water lotus	Y
Yellow floating heart (P)	A	<i>Nymphoides peltata</i> (S.G. Gmel.) Kuntze		Y
Scotch thistle (P)	H	<i>Onopordum acanthium</i> L.		Y
Star-of-Bethlehem (P)	H	<i>Ornithogalum umbellatum</i> L.		N/A
Princess tree (P)	T	<i>Paulownia tomentosa</i> (Thunb.) Siebold & Zucc. ex Steud.	Empress-tree	Y
Reed canary grass	G	<i>Phalaris arundinacea</i> L.		N/A
Common reed	G	<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	Phragmites	Y

Water lettuce^ (P)	A	<i>Pistia stratiotes</i> L.		N/A
Canada bluegrass (P)	G	<i>Poa compressa</i> L.		Y
Bristled knotweed	H	<i>Polygonum caespitosum</i> Blume	<i>Persicaria longiseta</i> ; Oriental lady's thumb	Y
Japanese knotweed	H	<i>Polygonum cuspidatum</i> Siebold & Zucc.	<i>Fallopia japonica</i>	Y
Mile-a-minute vine	H	<i>Polygonum perfoliatum</i> L.	<i>Persicaria perfoliata</i>	Y
Giant knotweed (P)	H	<i>Polygonum sachalinense</i> F. Schmidt ex. Maxim.	<i>Fallopia sachalinense</i>	Y
White poplar (P)	T	<i>Populus alba</i> L.		Y
Crispy-leaved pondweed	A	<i>Potamogeton crispus</i> L.	Curly pondweed or Curly-leaved pondweed	Y
Kudzu (P)	V	<i>Pueraria montana</i> (Lour.) Merr.	<i>Pueraria lobata</i>	Y
Fig buttercup	H	<i>Ranunculus ficaria</i> L.	Lesser celandine; <i>Ficaria verna</i>	Y
Common buckthorn	S	<i>Rhamnus cathartica</i> L.		Y
Black locust*	T	<i>Robinia pseudoacacia</i> L.		N/A
Multiflora rose	S	<i>Rosa multiflora</i> Thunb.		Y
Rugosa rose* (P)	S	<i>Rosa rugosa</i> Thunb.*	Beach, Salt spray, Japanese, or Ramanas Rose	N/A
		<i>*Note: This plant is especially aggressive in coastal areas</i>		
Wineberry	S	<i>Rubus phoenicolasius</i> Maxim.		Y
Sheep sorrel (P)	H	<i>Rumex acetosella</i> L.		Y
Giant salvinia^ (P)	A	<i>Salvinia molesta</i> Mitchell		Y
Tansy ragwort^ (P)	H	<i>Senecio jacobaea</i> L.	Stinking Willie	Y
Cup plant (P)	H	<i>Silphium perfoliatum</i> L.		Y
Bittersweet nightshade (P)	H	<i>Solanum dulcamara</i> L.	Climbing nightshade	Y
Water chestnut	A	<i>Trapa natans</i> L.		Y
Coltsfoot	H	<i>Tussilago farfara</i> L.		Y
Garden heliotrope (P)	H	<i>Valeriana officinalis</i> L.	Garden Valerian	Y