



FACING OUR FUTURE: Forestry Adapting to Connecticut's Changing Climate

“The challenge for the future is how to sustain the delivery of goods and services people expect from Connecticut’s forest resource while addressing problems associated with increasing land development controlling introduced pests, diseases, and invasive exotic plants; and manage the lack of regeneration of desirable tree species such as oak.” *The Forests of Connecticut*, United States Department of Agriculture, 2004.

The Importance of Connecticut's Forest

With over 3.4 million citizens living on 3.2 million acres of land, Connecticut is one of the most densely populated states in the country. At the same time, with some 1.8 million acres covered by forests, the percentage of the state that is forested is also among the highest in the country. Connecticut is truly a state of forest-dwellers, and it is this forest that touches virtually every aspect of the quality of life in the state. Connecticut residents are becoming more aware that a sustainable forest provides not only wood but clean water, clean air, shading, cooling, critical habitat, recreational opportunities, and carbon sequestration.

Some of these benefits of the forest to the people of Connecticut are direct and tangible. The state’s forests are responsible for filtering and protecting the quality of Connecticut’s drinking water and for cleaning ambient air. The public and private forests provide innumerable state residents with opportunities to hike, hunt, camp, and fish. The forest products industry in Connecticut contributes 500 million dollars annually to the state’s economy. The beauty of the state’s forests, particularly in the fall, draw in enormous numbers of tourist dollars to the state.

Some of the benefits of this forest are less tangible. Trees, individually and collectively, provide a strong sense of place to people, and the extensive forest all around Connecticut are a part of what typifies the state to its people.

While the degree to which the forest cleans the air or the water can be quantified, the exhilaration felt by an individual in the woods breathing that air and crossing those streams cannot be, at least not readily.



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Carbon Sequestration - A well managed forest is a valuable carbon sequestration tool. A well-adapted, diverse, healthy forest will promote a growth rate per tree directly linked to maximizing mitigation of carbon dioxide, a greenhouse gas, through carbon sequestration.

A Brief Snapshot of Connecticut's Forest

Connecticut’s forests have always been in a process of change, ever since the first tree seeded following the retreat of the last glacier. To some extent, a forest is simply the sum output of the dynamic forces that shape it – including climate, soil, species, weather, and

human history. This is true of the forest of today and this will be true of the forest of tomorrow.

A brief snapshot of the forests currently in Connecticut would show a remarkable diversity in tree species including representatives of the more southerly oak-hickory forests (oaks, hickories, red maple, etc.) and of the northern hardwood forests (sugar maple, yellow birch and beech). Connecticut's forests also have a significant coniferous component, including eastern white pine and eastern hemlock. The great number of tree species that have their range overlap in Connecticut is indeed unusual.



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At the same time, the forests in Connecticut are old, in the sense that a majority of the individual forested acreages are filled with mature trees. While there is a diversity of species, there is not a diversity of age classes. As the health and the resiliency of the forest often depends upon both species diversity and a diversity of age classes, the ability of Connecticut's forest to respond to stress and changing conditions is mixed. This lack of diversity in age class may become more of a factor as climate change affects the overall condition of the state's forests.

Forests in Connecticut have long been under stress due to many factors. These stresses include a legacy of extensive land-clearing from the past three centuries, often followed by poor woodland management as the forest returned; a history of severe forest disruption due to the introduction of exotic pests such as the chestnut blight, the gypsy moth and the hemlock woolly adelgid; and, in more recent times, trends such as urban sprawl invading the forest, changing ownership patterns dividing the forest and exotic plant species moving into the forest and

displacing native species. Take these stressors and add climate changes, such as increasing temperatures and changing hydrology and it is reasonable to expect ecological and economic challenges for years to come.

Implications of a changing climate for the Forests of Connecticut

Climate change may affect Connecticut's forests in the following ways.

Species composition - As Connecticut gets warmer in terms of relative annual highs and lows of temperature, the competitive advantage that certain tree species have over other trees' species will likely increase – with those species in the more southerly oak-hickory mix likely gaining an advantage over those in the northern hardwood mix. Overall, there is likely to be a decrease in the diversity of tree species in Connecticut's forests. This change in tree composition will likely influence similar changes in the occurrence of plant and animal species dependent on forest type. Of course, the temperature changes will not occur in complete isolation; climate change will interact with these other factors, often in ways that are subtle and difficult to connect. (For more details related to habitats, phenology and wildlife see the Biodiversity and Wildlife fact sheets).

Exotic Pests - A very strong case can be made that one major forest pest of current concern, the hemlock woolly adelgid, will thrive as the climate changes. This highly destructive insect, a recent introduction, is regularly held in check by cold winters. Warmer winters will likely allow the population of this insect to increase dramatically, although loss of the hemlock host or the emergence of predators on the insect could cause the opposite effect.

Climate change and changing forests will likely lead to new opportunities for exotic pests – insects, diseases, plants or animals. Climate change will likely accelerate the rate at which changes occur in the forest. Increased human commerce will expose these forests to increasing numbers of pests that can take advantage of the opportunities that change brings.

Weather - The trends in weather patterns projected as a result of a changing climate, if they occur as projected, will certainly have significant effects on Connecticut's forests.

The projections are for more intense storms, including seasons in which precipitation will be more intense followed by periods of extended drought. High winds generated from intense storms combined with heavy precipitation and flooding, such as occurred in the 1938 hurricane, can lead to the extensive destruction of large stands of trees. When these events are followed by extended drought the number and intensity of wildfires can be greatly increased. Fire releases carbon dioxide, causes increased health risks and damages property. Longer periods of drought make unhealthy forests especially vulnerable to fire. Subsequent flooding erodes nutrient rich soil and limits the types of tree species that can propagate in the area. (For more details on flooding see the Water Resources and Infrastructure fact sheets). Each of these types of weather-related events presents challenges to forest management.

The Forest Economy - For the forest products industry in Connecticut, changes in species composition might create new markets and could close out old ones. Longer growing seasons might mean that trees will grow faster and produce more wood, or that the exposure to the extremes of fire and weather will cause greater losses in the woods. An exotic pest might completely bring a promising opportunity to a halt, the way the chestnut blight ended the anticipated commercialization of chestnut in the early 1900's. The forest products industry will need to be adaptable and intelligent if it is to survive and thrive through change that will come to the region

Biomass - The forests contain a significant amount of biomass. This woody debris decays and slowly releases carbon dioxide. Yet, harvested biomass provides a relatively untapped and attractive financial opportunity as a local fuel. Active forest management that includes harvesting biomass using best management practices shows considerable promise as a strategy for forest managers to use in the reduction of invasives, forest pests and disease; to improve wildlife habitats and to restore high-graded areas. Overactive or

improper harvesting can deprive the soil of nutrients, spread invasives that propagate through cutting, destroy wildlife habitat, and reduce biodiversity. Biomass has a significantly lower carbon footprint than many other fuels. However, burning biomass can result in excess emissions of particulates and other air pollutants under certain conditions.

In order to maximize the utility of burning biofuel as an adaptive and mitigative approach to climate change it must be balanced with air quality and forest management concerns. Local outlets for biomass as a fuel need to be proactively managed as biomass harvesting becomes more attractive economically. The infrastructure that active biomass management creates will have the added benefit of providing an outlet for storm related debris, a need that may grow with projected increases in storm frequency.

As for other aspects of the forest economy, clean water, clean air, recreation and the value of real estate; it is quite likely that the relative value of each of these will increase as the climate changes and as the human population continues to make demands on the use of these resources. Enhanced forest management can increase this value. (For more on the relationship of land use management to water quality see the Water Resources fact sheet).

What does all of this mean? In the absence of change that is known, specific, and definable, it is important that Connecticut chooses options that maintain ongoing, close contact with the forest by qualified managers. For the forest to be sustained in a manner that maintains the health and sustains the benefits derived from the forest, those active in the forest will need to be observant and adaptive in their actions as the impacts of climate change reveal themselves.

What Connecticut is Doing

The Connecticut Department of Environmental Protection (CTDEP) Division of Forestry has an active program of forest management in place for the state's 170,000 acres of state-owned forestland. The purpose of this program is to enhance forest health, wildlife habitat and recreational opportunities on these lands, and to sustain those benefits for the generations to

come. This program is based on the insight and experience of more than a century of public forest management in Connecticut. Managing these lands not only provides a core of well-maintained forests for the state; this activity also serves as a model for proper forest land management for other land owners in Connecticut. Among the recent innovations in this program, the Division of Forestry along with the Wildlife Division is working with the University of Connecticut's Nonpoint Education for Municipal Officials (NEMO) program to map the state-owned forests and wildlife management areas, in an effort to enhance land use planning, wildlife research and forest management.

CTDEP Division of Forestry also regulates the community of forest practitioners who are engaged in carrying out forest management activities on private and public lands throughout the state. The forest practitioner certification program establishes standards for proper forestry and harvesting activities within the forests, and, through an enforcement program, takes steps to ensure that forestry activities are in accord with these standards. Foresters certified by the Division of Forestry regularly develop comprehensive forest management plans for more than 20,000 acres each year.

The outreach services of both the CTDEP Division of Forestry, through the Private and Municipal Land program, and the University of Connecticut Cooperative Extension Forestry Program provide a critical link between private forest land owners and the professional forestry community. After all, on private lands, it is the decision of the land owner that is pivotal in the long term outcome. Planning is not enough, Connecticut has to engage the land owners to be successful with large scale forest management. The scientific community within Connecticut is also key to maintaining this close, ongoing contact with the forest. The Connecticut Agricultural Experiment Station has long-term study plots to monitor forest growth and changes, and is in the lead in responding to the threats caused by forest pests and diseases. As home to a substantial Connecticut crop, the health of forests will continue to be monitored for adaptative strategies.

The Yale University School of Forestry and Environmental Studies is assisting CTDEP Division of Forestry with determining responsible forest harvest levels that will increase the Division's ability to manage the forest to generate a sustainable yield. The School of Forestry has indicated that revenues from state-owned forested lands can be tripled by improving potential product yield. Doing so will encourage biodiversity that improves the capability of Connecticut's forests to respond to the stresses brought about by climate change. More active management is better for the forest economy and is needed to be responsive to changes brought about by climate. If Connecticut doesn't rectify forest management practices undue stress will be put on the forests and the habitats they support. Active forest management will also enhance our forests' ability to act as carbon sinks, an important climate change mitigation strategy.

Other programs within the CTDEP Division of Forestry also have significant roles to play with respect to climate change. The fire and forest health programs monitor changes in the forest, such as those brought about by drought, fires, pests and invasive plants

The urban forestry program encourages healthy urban forests that help bring the benefits of trees to those who live in the more urbanized parts of the state, including the inner urban core, newly developed subdivisions and all points in-between. A recent study conducted by CTDEP Division of Forestry along with the City of Hartford, the Knox Parks Foundation and the US Forest Service found that the trees within the limits of Hartford remove about 2,440 tons of carbon a year from the atmosphere, and lock away that carbon for the life of the tree. These trees also provide localized protection from the heat of summer and the cold of winter to an extent that reduces residential energy use by the equivalent of about 2,400 barrels of oil annually. The study also showed that the trees of Hartford filter out about 37 tons of particulate matter a year, eight tons of carbon monoxide, seven tons of nitrogen dioxide and four tons of sulfur dioxide annually. By shading and cooling our streets, trees remove or help prevent the formation of about 15 tons of ozone each year. By improving life in our urban areas, the urban forest encourages reinvestment in existing urban

and suburban centers, and takes developmental pressure off of the more traditional woodlands of Connecticut.

In conclusion, it should be reemphasized that Connecticut's forests play an important mitigative role against the expected harmful effects of climate change. Trees shade homes and businesses during the summer, cleanse the air by intercepting airborne particles through respiration, and act as carbon sinks by storing carbon dioxide in the wood, roots and leaves. Connecticut can maximize these benefits by keeping forests as forests through proactive land conservation, land-use planning, and seeking professional forestry assistance to maintain vigorous and resilient forested conditions. Connecticut forests will be better able to adjust to the changing climate through the efforts of supporting agencies and organizations engaged in technical assistance and educational outreach activities where the latest in best management practices are shared with the forest land owners who, as a group, own over 1.5 million acres of Connecticut's open space woodlands.

This is one of eight documents in the series *Facing our Future* concerning Connecticut's changing climate, www.ct.gov/dep/climatechange

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IMPROVEMENTS AND CHALLENGES FOR TODAY

Individual, Corporate, Municipal and State Stewardship

- Support land acquisition containing critical habitat and head waters.
- Increase forest management activities to enhance age class diversity.
- Establish monitoring protocols.
- Preserve and manage as much traditional woodland, urban forest, shrub land and grassland as possible, including the significant holdings on privately owned lands.
- Encourage and maintain tree diversity.