2025 VT Envirothon: Current Issue Guide

Roots and Resiliency: Fostering Forest Stewardship in a Canopy of Change

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I. Introduction:

Global Context:

Forests play a vital role in maintaining ecological health, supporting biodiversity, and providing economic and cultural benefits. Forests create microclimates and species refugia, which mitigate the effects of climate change by providing stable habitats for flora and fauna, even as broader climatic conditions shift. However, climate change, invasive (non-native opportunistic) species, and human activity leading to deforestation have placed forests under extreme stress. Wildfires rage more intensely, insect outbreaks devastate tree populations, and human expansion into forested areas threaten ecosystems worldwide.

In the face of these challenges, fostering forest stewardship has become more critical than ever. Forests must be protected, managed, and restored using innovative and traditional practices that enhance their resilience. Traditional Indigenous stewardship methods, forestry techniques, and collaborative conservation efforts are pathways toward regenerative forest ecosystems.

This year's Current Issue will explore how forests can adapt to, and mitigate climate change impacts while balancing the needs of ecosystems, economies, and communities. You will be challenged to propose solutions for fostering forest stewardship in a rapidly changing world. How can forests remain strong, resilient, and productive for generations to come?

Local Context:

Vermont's forests have a long and dynamic history, shaped by both human activity and natural processes. Before European colonization, the region was predominantly forested, with diverse ecosystems featuring species such as beech, butternuts, chestnuts, hemlocks, hickories, oaks, spruce and more. Indigenous Abenaki people actively stewarded these landscapes, using practices like slashing and burning, propagation and selective breeding to enhance biodiversity. Their approach to forest management reflected a deep understanding of ecological balance and sustainability.

With the arrival of European settlers in the mid 15th - 16th Century. Vermont's forests were cleared for agriculture, timber, and fuel. By the 18th century colonial expansion accelerated and marked the beginning of widespread deforestation. By the early 19th century, the state entered the "Sheep Era," driven by high demand for wool during the Industrial Revolution. Sheep farming became the dominant land use, and nearly 80% of Vermont's forests were cleared to create pastures. This deforestation caused significant soil erosion, water quality degradation, and loss of wildlife habitat.

The decline of sheep farming in the mid-19th century, coupled with westward agricultural expansion, led to the abandonment of many farms. Forests began to naturally regenerate, starting the reforestation process that would eventually restore much of Vermont's tree cover. Today, Vermont's forests stand as a mix of young and mature woodlands, shaped by this complex history of human influence and natural resilience.

References:

Foster, D. R., & Aber, J. D. (2004). Forest Landscape Dynamics in the New England Region.

Vermont Natural Resources Council. History of Vermont Forests.

Cronon, W. (1983). Changes in the Land: Indians, Colonists, and the Ecology of New England.)

Current Issues Facing Vermont Forests

Vermont's forests are naturally resilient and capable of adapting to variations in temperature and precipitation. However, multiple stressors, including climate change, land use changes, and ecological threats, are reducing forest resilience. While shifts in forest composition may take decades to become fully evident, the long-term outlook underscores the need for proactive management to protect biodiversity, support sustainable industries, and promote the restoration of old-growth forests.

Forest productivity, a key indicator of forest health and carbon storage, may see short-term benefits from longer growing seasons and elevated atmospheric carbon dioxide levels.

However, these advantages are likely to be overshadowed by the long-term effects of extreme summer heat, drought, and soil nutrient depletion. Climate change is also exacerbating threats from invasive (non-native opportunistic) species, pests, and diseases, which weaken forest ecosystems, reduce biodiversity, and disrupt the delicate balance necessary for sustainable forest management.

Land use changes, including the conversion of forests for residential or commercial development, further compound these challenges. Parcelization and development fragment forest landscapes, diminishing ecological connectivity and reducing resilience. Proactive management strategies—such as enhancing forest structural complexity, increasing species diversity, and maintaining large intact forest tracts—are essential for improving adaptive capacity and preserving ecosystem function.

Impact on Vermont's Forest Industries

Climate change is also creating significant challenges for Vermont's forest-based industries, including sugaring and logging, which rely on healthy, predictable forest ecosystems. The maple sugaring industry, a cornerstone of Vermont's economy and cultural heritage, is particularly vulnerable. Rising temperatures are causing earlier sap flows and reducing sap sugar content, which affects both yield and syrup quality. Milder winters and shifting climate patterns may also lead to a northward migration of sugar maples over time, jeopardizing the long-term viability of Vermont's sugaring industry.

Logging and forest product industries face similar threats. Changes in forest composition and health can alter the availability and quality of marketable timber. Increased storm intensity and unpredictable weather patterns can lead to more frequent blowdowns and flooding, complicating sustainable harvesting practices. Additionally, invasive (non-native opportunistic) species, such as the emerald ash borer and hemlock woolly adelgid, threaten valuable tree species, potentially reducing the supply of high-quality wood products. As Vermont works to balance economic and environmental priorities, sustainable forest management will be critical to maintaining the long-term health of these industries.

The Role of Urban Forests

Urban forests in Vermont also play a crucial role in mitigating climate change and enhancing community resilience. Trees provide shade to reduce the urban heat island effect, help manage stormwater runoff, and improve air and water quality. However, urban trees already contend with stressors such as soil compaction, pollution, and limited root space. The challenges posed by warmer winters and wetter summers are expected to intensify, making urban forestry initiatives even more important for maintaining tree health and canopy cover.

With nearly 39% of Vermont's population living in urbanized areas, urban trees offer essential ecosystem services that often exceed those provided by rural forests on a per-tree basis. Preserving and expanding urban canopy cover through collaborative efforts between local governments, community organizations, and residents is vital for ensuring the continued benefits of urban forestry in a changing climate.

Looking Ahead

The intersection of climate change, ecological stressors, and economic pressures creates a complex challenge for Vermont's forests and forest-based industries. Proactive management, informed by the latest climate science, is essential to safeguarding biodiversity, supporting local industries, and ensuring that Vermont's forests remain resilient for future generations. By integrating sustainable forestry practices, protecting forested landscapes, and investing in urban and rural forestry initiatives, Vermont can navigate these challenges while maintaining the benefits that forests provide to both people and the economy.

References: Vermont Climate Assessment 2023, USDA Forest Service, UVM Extension

II. Setting the Stage

A. Forests in a Changing Climate

Forests are deeply affected by the following challenges:

- 1. Climate Change: Increased temperatures, shifting rainfall patterns, and prolonged droughts. Individually, a healthy functioning forest can cope with these changes, however, the cumulative and prolonged stress of these factors are detrimental to the forest and species they support.
- 2. Invasive (non-native opportunistic) Species: Globalization has spread pests, pathogens, and invasive plants at unprecedented rates causing widespread harm to native forested ecosystems. Entire tree species have been removed from the forest landscape by invasive pests and pathogens. The American chestnut was a dominant species along the entire eastern seaboard of the US until the 1940s when the chestnut blight all but eradicated them. Invasive, opportunistic plants, like Japanese knotweed, out-compete native vegetation, altering forest composition and ecosystem dynamics. Emerald Ash Borer now threatens to eliminate the ash tree from local forests, further highlighting the profound impacts of invasive species on forest landscapes.
- 3. Wildfires: Wildfires are becoming more severe, posing significant threats to forests and nearby communities. Climate change is a major driver, with rising temperatures,

prolonged droughts, and shifting precipitation patterns creating drier and more fire-prone conditions. Past fire suppression practices have also contributed by allowing the buildup of dense vegetation, which serves as fuel for larger and more intense fires. Additionally, pest outbreaks, often exacerbated by climate change, leave behind dead trees that further increase wildfire risk.

• Deforestation: Loss of forests threatens biodiversity, water quality, and removes the very trees that help us cope with climate change. Activities such as building roads and development, mining, poor logging practices, and industrial agriculture all remove trees that are not likely to grow back. Healthy forests remove carbon from the atmosphere and store it for centuries.

B. Research, Discussion, and Prompts

Research Questions:

- 1. How does climate change impact forest health?
- 2. What role do forests play in mitigating climate change?
- 3. How do Indigenous stewardship practices differ from modern forestry techniques?

Discussion Prompts:

- What are the greatest threats to forests in your region?
- How can local communities contribute to forest restoration and conservation?
- What innovations in forest management are already being implemented?

III. What Can We Do?

A. Narrative

Innovative solutions will ensure forests are sustainable and can continue to support biodiversity, provide ecosystem services, support local economies, and add unique cultural value to the region. Communities, forest managers, policymakers, and scientists must work together to develop and implement adaptive strategies to protect the evolving landscape of Vermont forests.

B. Adaptation and Innovative Solutions

Implementing Forest Management Strategies:

Utilizing strategies that protect water quality, improve forest health, and enhance wildlife habitat can increase forest resilience while meeting community needs. Past management practices have left Vermont with a forest that is roughly the same age and structure. The current forest may be nearly useless for species that require young dense stands of trees or those that depend on large cavity trees for nesting. It is essential to biodiversity for people to understand the natural evolution of a forest and the complex ecological relationships that exist between its various species.

to manage a forest for certain characteristics For example, <u>Structural Complexity</u> <u>Enhancement (SCE)</u>, a silvicultural treatment developed by Dr. Bill Keeton at the University of Vermont, focuses on managing forests for old-growth characteristics. While large openings in the forest create enough sunlight for species such as northern red oak to grow and young forests are often more resilient to ice and wind damage . Bear Island Forestry, led by Ethan Tapper, specializes in ecological forestry and managing for old-growth characteristics. This approach focuses on helping forests recover from past exploitation, navigating present threats and stressors, and building resilience and adaptability in the face of climate change. They emphasize that forest management can and must be restorative and regenerative, serving as a vital tool to create a more abundant and beautiful world. Through practices such as selective harvesting and enhancing structural diversity, Bear Island Forestry contributes to the restoration and long-term health of Vermont's forests. More information about their work can be found at <u>Bear Island Forestry</u>.

C. Incorporating Indigenous Knowledge

Indigenous practices in Vermont offer valuable insights into sustainable forest management. For instance, the Abenaki people's emphasis on forest stewardship and understanding ecological interconnectivity can guide practices that enhance ecosystem resilience. Methods such as controlled burns and selective harvesting are traditional techniques that align with modern adaptive management strategies.

D. Proactive Management: Assisted Migration of Tree Species

Many researchers are looking at how to help forests in the face of a warming climate. For example, in some cases management can promote species such as red oak or cherry that are present in the Vermont forest in small amounts but grow better to the south. In other cases it involves selecting seeds or seedlings grown in more southern regions and introducing them at the northern edge of their range. Research led by Dr. Tony D'Amato at UVM explores <u>assisted migration</u> as a proactive measure to address climate-driven changes in species distributions. Promoting southern-adapted species like northern red oak into Vermont's forests could help sustain forest productivity and ecological function as the climate warms.

E. Technological Innovations

The use of UAVs (unmanned aerial vehicles or drones) remote sensing technologies, LiDAR (Light Detection and Ranging) are all technological innovations that provide critical data on forest dynamics and health. These tools allow for detailed monitoring of changes in canopy

cover, biomass, or stress indicators. Forest managers are now able to identify and respond to emerging threats quickly and efficiently.

F. Enhancing Urban Forestry Initiatives

Expanding urban canopy cover, increasing tree species diversity, and improving planting practices can enhance the climate resilience of urban forests. Collaboration between municipal governments, local communities, and researchers is essential to maximize the benefits of urban trees.

G. Promoting Land Conservation

Preventing forest parcelization and encouraging conservation to protect large, contiguous forested blocks is a critical piece of creating resilient forests. These efforts maintain ecological connectivity, enhance habitat quality, and support carbon sequestration.

By embracing these strategies and fostering collaboration across disciplines and communities, Vermont can ensure that its forests remain resilient, productive, and integral to the state's ecological and economic well-being.

Case Study 1: Restoring Pre-Colonial Forest-Food Systems to Build Resilient Forest Stewardship

The Problem

Modern food systems and land-use practices have significantly contributed to deforestation, biodiversity loss, and climate change. The emphasis on monoculture crops and farming methodologies that require heavy fossil fuel inputs driving climate change has degraded forest ecosystems, reduced carbon storage, and left communities increasingly vulnerable to food insecurity. Climate change has further exacerbated these challenges, with extreme weather events like droughts, floods, and wildfires threatening both forests and food systems.

To foster resilient forests and ensure food security, sustainable and traditional approaches must be restored. Pre-colonial Indigenous food systems, which integrated forest stewardship with food production, offer critical lessons for modern forest management and ecological restoration.

The Solution: Forest-Based Agroecosystems Inspired by Indigenous Practices

Before colonization, Indigenous communities managed forests as food systems that provided sustenance while maintaining ecosystem health. This approach, rooted in Traditional

Ecological Knowledge (TEK), featured sustainable harvesting, plant diversity, and minimal disturbance to natural processes. Restoring these systems aligns with the 2025 Envirothon theme of "Roots and Resiliency: Fostering Forest Stewardship in a Canopy of Change."

Example: Forest Gardening and Food Sovereignty

Background: Indigenous communities across North America practiced forest gardening, a form of agroforestry where forests were intentionally managed to grow edible and medicinal plants alongside trees. These systems included:

- Nut Trees: Hickory, chestnut, and oak provided protein-rich nuts.
- Fruit Trees and Shrubs: Elderberry, pawpaw, and serviceberry offered nutritious fruit.
- Edible Understory Plants: Native plants like ramps, fiddlehead ferns, and wild leeks thrived under forest canopies.
- Medicinal Plants: Forest ecosystems included species like ginseng and goldenseal, used for medicine and trade.

Modern Revival: Forest gardening practices are being restored to support food security, enhance biodiversity, and strengthen forest resilience:

- 1. Food and Forest Integration: Programs led by Indigenous communities, such as the Menominee Forest in Wisconsin, focus on combining food systems with active forest management to protect tree health while harvesting forest foods sustainably.
- 2. Reintroducing Native Plants: Organizations like the Native Food Sovereignty Alliance are reviving traditional food plants, including forest-friendly crops like chestnut trees, hickory nuts, and edible ferns.
- 3. Carbon Sequestration and Forest Health: By incorporating food production into forests, these systems preserve old-growth trees, enhance carbon storage, and reduce the need for deforestation-driven agriculture.
- 4. Community-Based Forest Management: Community initiatives create forest food systems on public lands, integrating traditional stewardship practices with modern agroforestry techniques.

Benefits of Forest-Food Systems for Forest Stewardship

- 1. Resilience to Climate Change: Mixed forest food systems mimic natural ecosystems, improving resilience to drought, pests, and extreme weather.
- 2. Sustainable Food Security: Communities gain access to diverse, nutritious food sources while preserving forests.
- 3. Biodiversity Conservation: Forest gardens support native plants, pollinators, wildlife, and soil health.

- 4. Carbon Storage: Forest-based food systems maintain and enhance carbon sequestration, helping to mitigate climate change.
- 5. Cultural Revitalization: Restoring Indigenous food systems reconnects communities with their cultural heritage and traditional stewardship roles.

Applying Forest-Based Food Systems Locally

- 1. Community Forest Gardens: Local communities and schools can establish forest food gardens to grow native nut and fruit trees alongside edible understory plants.
- 2. Restoring Degraded Forests: Forest managers can integrate edible and medicinal plants into reforestation projects, enhancing ecological and economic value.
- 3. Educational Programs: Partner with Indigenous Knowledge Keepers to teach forest stewardship practices and promote sustainable harvesting of forest foods.
- 4. Policy Support: Advocate for policies that prioritize community-managed forests and forest food sovereignty initiatives.

Key Takeaways

- Pre-colonial forest-food systems offer a model for integrating forest stewardship with food production, enhancing both food security and forest resilience.
- By reviving Indigenous practices like forest gardening, we can restore degraded forests, conserve biodiversity, and build climate-resilient ecosystems.
- Combining traditional ecological knowledge with modern approaches fosters a future where forests provide for both people and the planet.

Case Study 2: Hickory Trees for Nut Oil Production – A Sustainable Forest-Based Resource

The Problem

Conventional oil production, such as palm and soybean oil, has led to widespread deforestation, habitat loss, and soil degradation globally. The clearing of forests for large-scale monoculture plantations not only threatens biodiversity but also contributes significantly to climate change through carbon emissions. There is a growing need for sustainable, forest-friendly oil alternatives that do not require deforestation or soil depletion.

The Solution: Hickory Trees as a Source of Nut Oil

Hickory trees (*Carya* spp.) are native to North America, particularly abundant in mixed hardwood forests. Their nuts are rich in oils that can be extracted for culinary, cosmetic, and

biofuel purposes. By sustainably managing hickory forests for oil production, communities can create an economic opportunity that promotes forest conservation rather than clearing.

Example: Sustainable Hickory Oil Production in Eastern United States

Background: In the Eastern U.S., hickory trees are a natural part of temperate forests. Historically, their nuts were used for food by Indigenous communities and early settlers, but commercial use has been limited compared to other nut-bearing species like walnuts. Recognizing the potential of hickory nut oil, farmers and forest managers have explored sustainable harvesting methods to produce high-quality oil while protecting the forest ecosystem.

The Hickory Oil Solution:

- 1. Harvesting Hickory Nuts: Hickory nuts are collected in the fall when they naturally drop, avoiding harm to the trees or surrounding ecosystem. This ensures continued forest health while providing an annual renewable resource.
- 2. Oil Extraction: Hickory nuts are cold-pressed to extract a rich, nutritious oil. This oil is suitable for culinary uses, cosmetics, and as an eco-friendly alternative for small-scale biofuels.
- 3. Forest Management: Managed hickory groves encourage natural regeneration and forest biodiversity. Practices include selective thinning, planting of young trees, and maintaining companion species (e.g., oaks and maples).
- 4. Economic Benefits: Hickory oil production creates income for landowners and local communities while maintaining the forest. Hickory nuts are also processed for value-added products like nut flour and snacks.

Results:

- Economic Opportunity: Hickory oil is marketed as a premium product due to its flavor, nutritional profile, and sustainable origin. It has attracted interest from chefs, cosmetics companies, and eco-conscious consumers.
- Forest Conservation: Instead of clearing forests for agriculture, landowners are incentivized to preserve and manage mixed hickory forests for nut production.
- Resilience to Climate Change: Hickory trees are hardy, drought-tolerant, and adaptable to shifting climatic conditions, making them ideal for sustainable forest-based agriculture.

Why Hickory Trees for Oil Production?

1. Sustainable Resource: Hickory trees naturally regenerate, requiring no replanting or soil disruption.

- 2. Low Input: Hickory trees thrive without chemical fertilizers or pesticides, reducing environmental impacts.
- 3. Carbon Sequestration: Maintaining hickory forests helps sequester carbon, mitigating climate change.
- 4. Biodiversity: Hickory forests support diverse wildlife, including squirrels, birds, and pollinators, maintaining a balanced ecosystem.

Applying Hickory Oil Production Locally

- 1. Community Forest Programs: Local communities can organize nut-harvesting cooperatives to share resources and profit.
- 2. Value-Added Products: Beyond oil, hickory nuts can be used for flour, animal feed, or natural food products.
- 3. Educational Opportunities: Schools and environmental organizations can promote hickory oil production as a model for sustainable forestry and forest-friendly agriculture.

Key Takeaways

- Hickory oil production represents a sustainable, forest-friendly alternative to conventional oil production.
- It promotes economic development while maintaining forest ecosystems, biodiversity, and carbon sequestration.
- By harnessing the natural resources of hickory forests without damaging them, communities can create a renewable, resilient food and oil system.

IV. Your Challenge

Create a 15-minute presentation that addresses the questions outlined in four areas of focus: The Problem, Adapting, Creative Solutions, and The Future. You can use PowerPoint or any other digital or physical materials for your presentation. In general, slides should be used for maps, diagrams, pictures and other graphics – they should enhance your presentation and make it interesting rather than including many slides of text for you to read from. Points will be deducted for slides with too much text or if you are frequently reading from the slides.

Following the presentation, the judges will have 10 minutes to ask you questions. Everyone on your team should help present your work and be able to answer questions.

Bring your work on a thumb drive and/or link it into an email and send it to: <u>Lucas@winooskinrcd.org</u> in advance. We will have a computer, projector and screen already set up. A month before the Envirothon, your team will receive a copy of the rubric the judges will use to assess your work. This will help ne-tune your efforts – but don't wait for it before you get started!

I. The Problem

Identify four major threats to forest health in VT due to climate change, globalization, and land-use.

1. Provide specific examples of these challenges affecting forests in Vermont.

II. Adapting

1. Provide two examples of adaptive forest management strategies that can be used in Vermont. Share one example of how your community or region is adapting to forest health challenges.

III. Creative Solutions

- 1. Propose two innovative strategies to address a forest health issue, combining technology, Indigenous knowledge, and stewardship practices.
- 2. Present one creative solution to increase forest resiliency in your local community.

IV. The Future

- 1. Describe how forests in 20 years will adapt to climate change and other threats.
- 2. Discuss how communities can ensure forests continue to provide ecological, economic, and cultural benefits.

Resources:

- Forest Health Highlights in VT 2023
- Current Forest Health Issues and Updates
- <u>Mighty Oaks of the Northeast</u>
- <u>Myco-Phytoremediation in Multi-Functional Riparian Forest Buffers</u>
 - Restoration, Education, Training and Rematriation at Shelburne Farms (2024-2026)
- Architects of Abundance: indigenous regenerative food and land management systems and the excavation of hidden history
 - Indigenous Food Systems The Kennedy Center
- <u>Transforming Food Systems with Trees and Forests</u>
- Big Timber: The Mast Trade

- Community Response to Logging in NH
- <u>Reading the Forested Landscape</u>: by Tom Wessels

Guide Created by: White River Natural Resources Conservation District

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