The Future Forests Geo-visualization and Decision Support Tool

Linking science and management in a geospatial, mutli-criteria decision support framework

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FForGeoVDS Tool

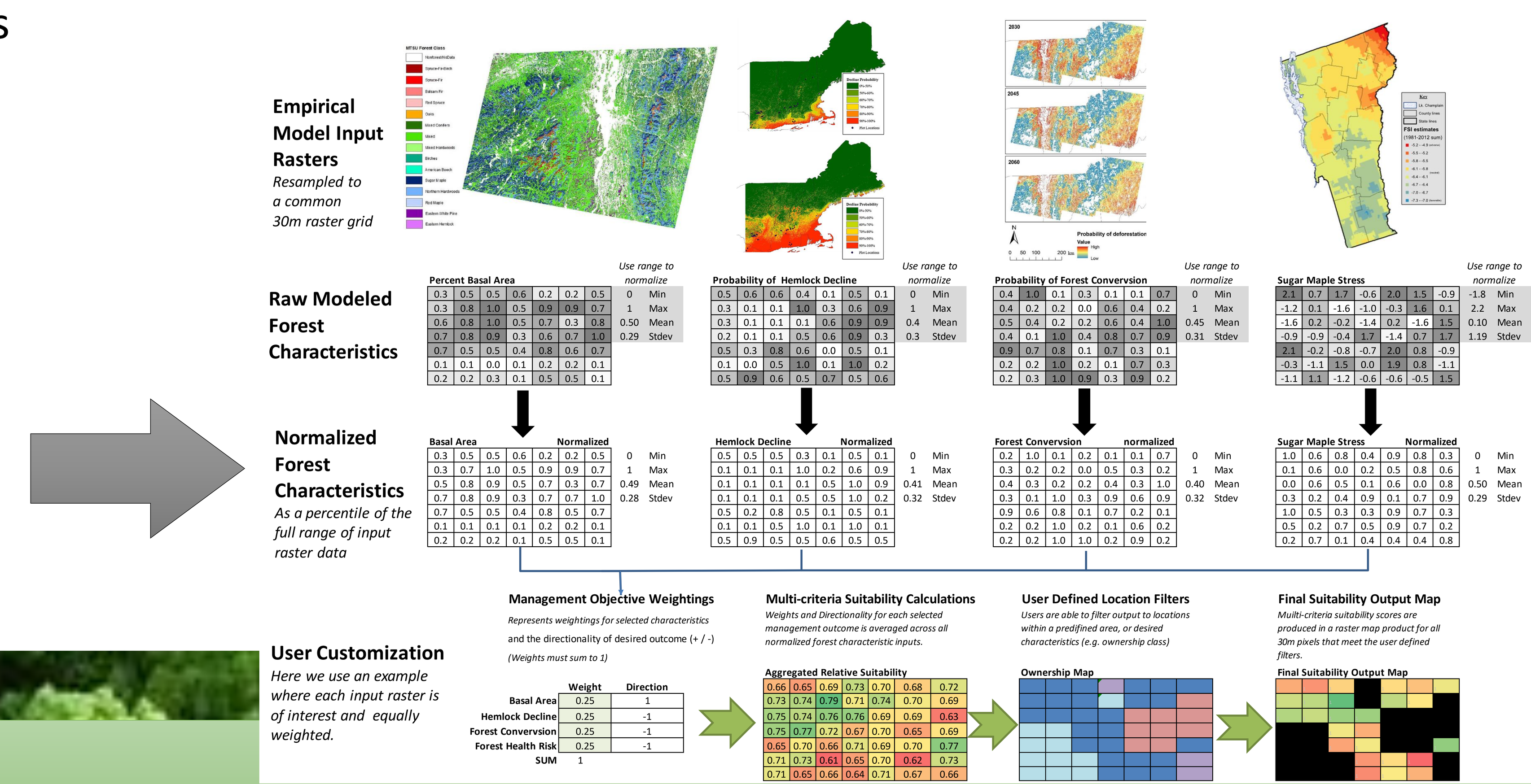
Project Overview:

Land managers are often faced with planning management activities to balance a diversity of management objectives. Advances in ecosystem modeling provide a rich source of information to inform management. Coupled with advances in decision support techniques and computing capabilities, interactive tools are now accessible for a broad range of stakeholders. Here we present one such tool, the Future Forests Geo-visualization and Decision Support Tool designed to capture information on how climate change may impact forested ecosystems, and how that impact varies spatially across the landscape.

This tool highlights the value of flexible models that can be easily run with customized weightings in a dynamic, integrated assessment that allows users to hone in on their potentially complex management objectives, and to visualize patterns and prioritize locations across the landscape. It also demonstrates the importance of including climate considerations for long-term management. This merging of complex scientific findings with the wide ranges of stakeholder needs for managing forests is an important step towards using science to inform management and policy.

Approach:

The **Future Forests Geo-visualization and Decision Support Tool** integrates empirical models of current and future forest structure and function in a structured decision framework that allows users to customize weights for multiple management objectives and visualize suitability outcomes across the landscape. Combined with climate projections, the resulting products allow stakeholders to compare the relative success of various management objectives on a pixel by pixel basis and identify locations where multiple management outcomes are most likely to be met.



Use Case Studies

Objectives:

Here we demonstrate this approach with the integration of several of the preliminary models developed to map **species distributions**, **sugar maple health as a function of climate**, **forest fragmentation risk** and **hemlock vulnerability to hemlock woolly adelgid** under current and future climate scenarios.   We compare three use cases with objective weightings designed to:

Identify key parcels for sugarbush conservation and adaptive management in response to climate change

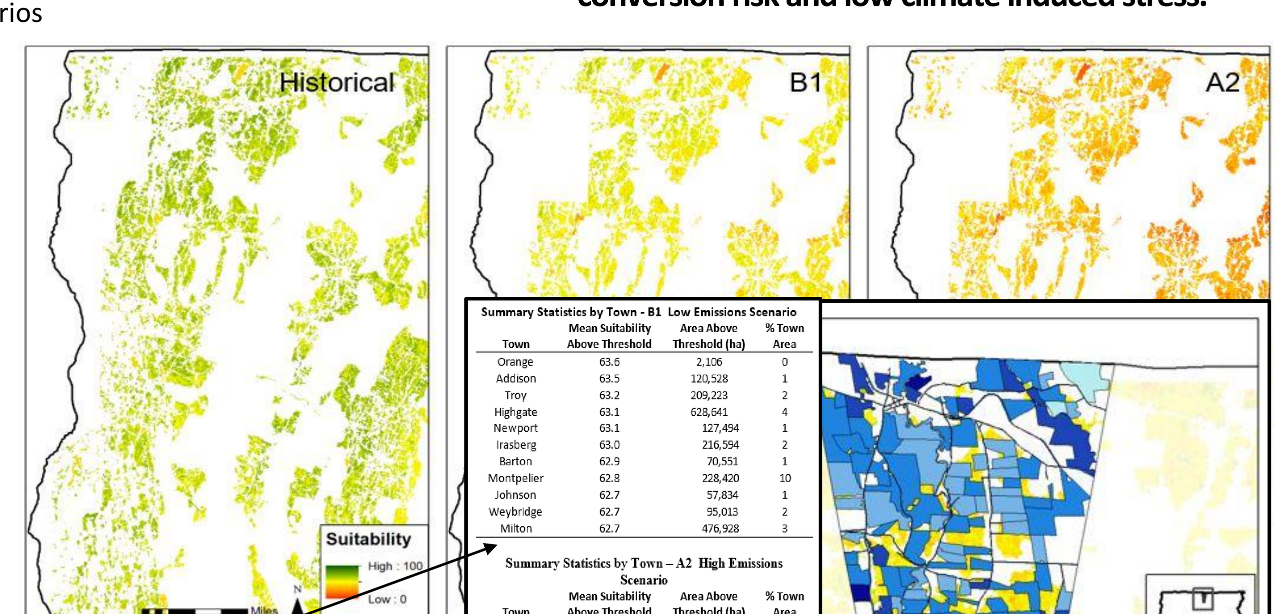
Decision Framework Customization:

This exercise allows a **Land Trust** to identify and compare potential properties for sugar maple conservation in locations where forest conversion risk is relatively high, but sugar maple abundance and resilience in the face of climate change is high. This represents a tangible, decision product that can be used to guide and justify actions taken by the Land Trust to preserve potential sugar maple refugia and attract potential funding.

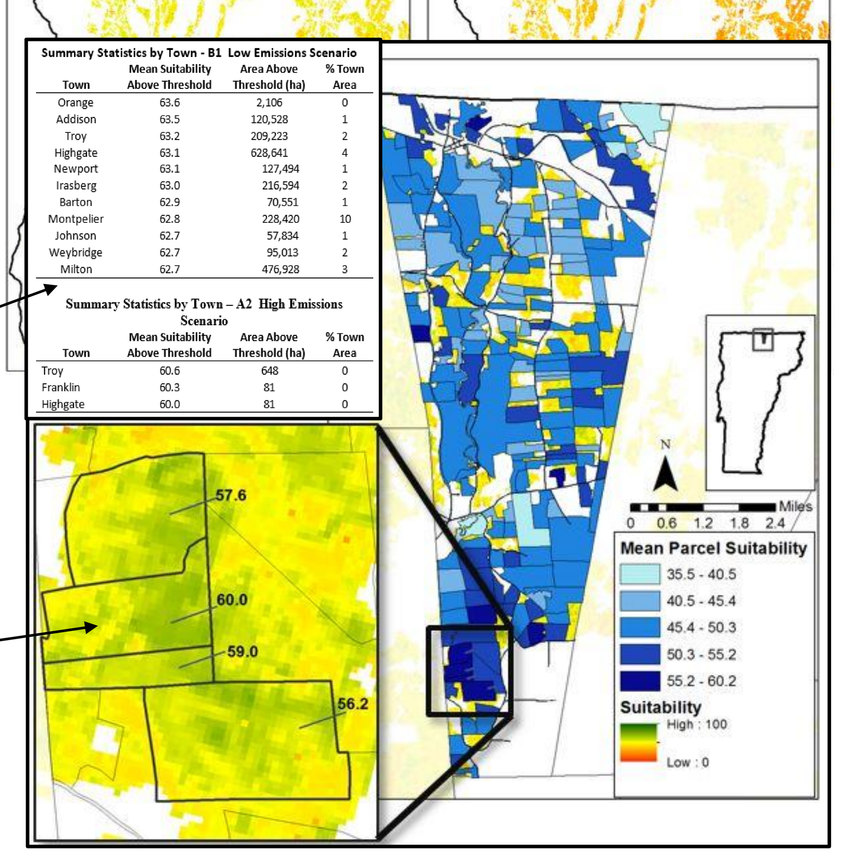
Area of Interest: Private non-conserved lands in Vermont providing habitat connectivity
Input empirical models: Sugar Maple Stress Index Model, Percent Sugar Maple Basal Area, Forest Conversion Model
Ancillary data layers:
Town and parcel boundaries, VT Habitat Blocks and Wildlife Corridors, Conserved Lands   (VT Protected Lands Database)
Summarize by: Town and Parcel
Climate Scenarios: Historic norms, A2 (High emissions) and B1 (low emissions) scenarios

Objectives	Weight	Desirability Setting
Sugar Maple Basal Area	40	High Desirable (1)
Hemlock Basal Area	0	
Sugar Maple Stress	40	Low Desirable (-1)
Hemlock Susceptibility	0	
Forest Conversion Risk	20	High Desirable (1)
Sum	*100*	

Customized objective weights and desirability settings identify high sugar maple abundance, high conversion risk and low climate induced stress.



Output maps of weighted suitability for every 30m pixel where sugar maple is present on privately owned parcels across the selected study area demonstrate how relative suitability differs geographically and under various climate change scenarios.



A summary by town allows the Trust Manager to identify and examine high suitability towns under current and future climate scenarios.

Parcel maps can then be used to identify key properties to target within those towns for conservation purchase.

Locate potential hemlock refugia on state lands to maintain critical deer yards

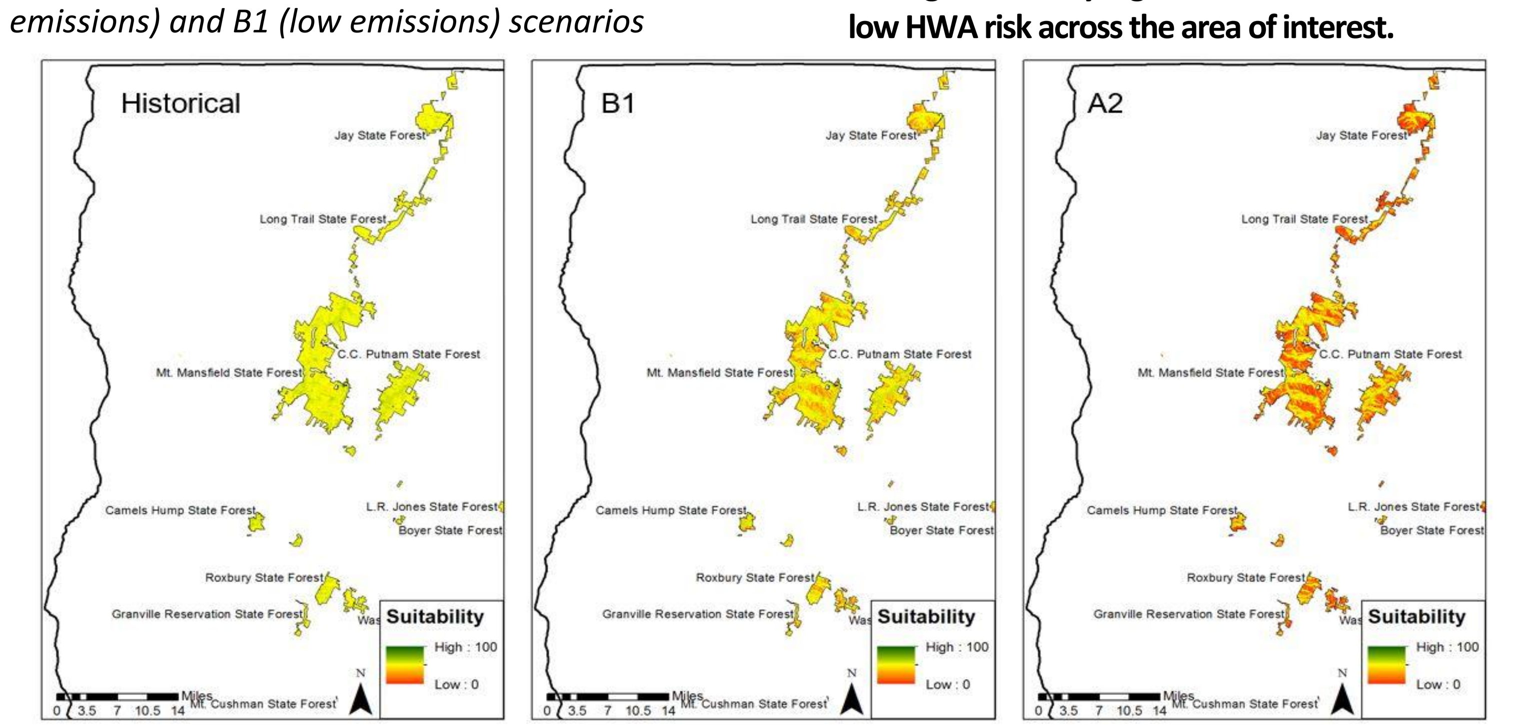
Decision Framework Customization:

This exercise allows a **State Forest Planner** to identify hemlock stands within state forests that contain high density eastern hemlock stands that are most likely to tolerate hemlock woolly adelgid (HWA) infestation. The goal is to manage for hemlock in areas that are likely to serve as long-term seed source for this species as climate continues to change and risk from HWA increases.

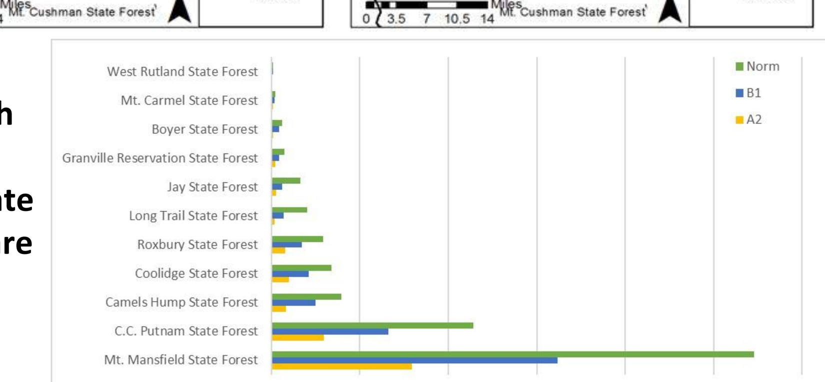
Area of Interest: *Vermont State Forests*
Input empirical models: *Percent Hemlock Basal Area, Forest Conversion Model, Hemlock Risk Model*
Ancillary data layers:
Conserved lands (VT Protected Lands Database)
Summarize by: *Forest Unit*
Climate Scenarios: *Historic norms, A2 (High emissions) and B1 (low emissions) scenarios*

Objectives	Weight	Desirability Setting
Sugar Maple Basal Area	0	
Hemlock Basal Area	50	High Desirable (1)
Sugar Maple Stress	0	
Hemlock Susceptibility	50	Low Desirable (-1)
Forest Conversion Risk	0	
Sum	*100*	

Customized objective weights and desirability settings to identify high hemlock abundance and low HWA risk across the area of interest.



Output maps and summary figures of this weighted prioritization indicates that much of the state's forest land is suitable for hemlock management under current climate conditions. However, some state forests are particularly at risk from the invasive HWA under future climate scenarios, with some smaller forests maintaining no suitable hemlock habitat under future climate projections.



Acres above a suitability threshold of 60.

Examine how climate change may alter the sustainability of both hemlock and sugarbush

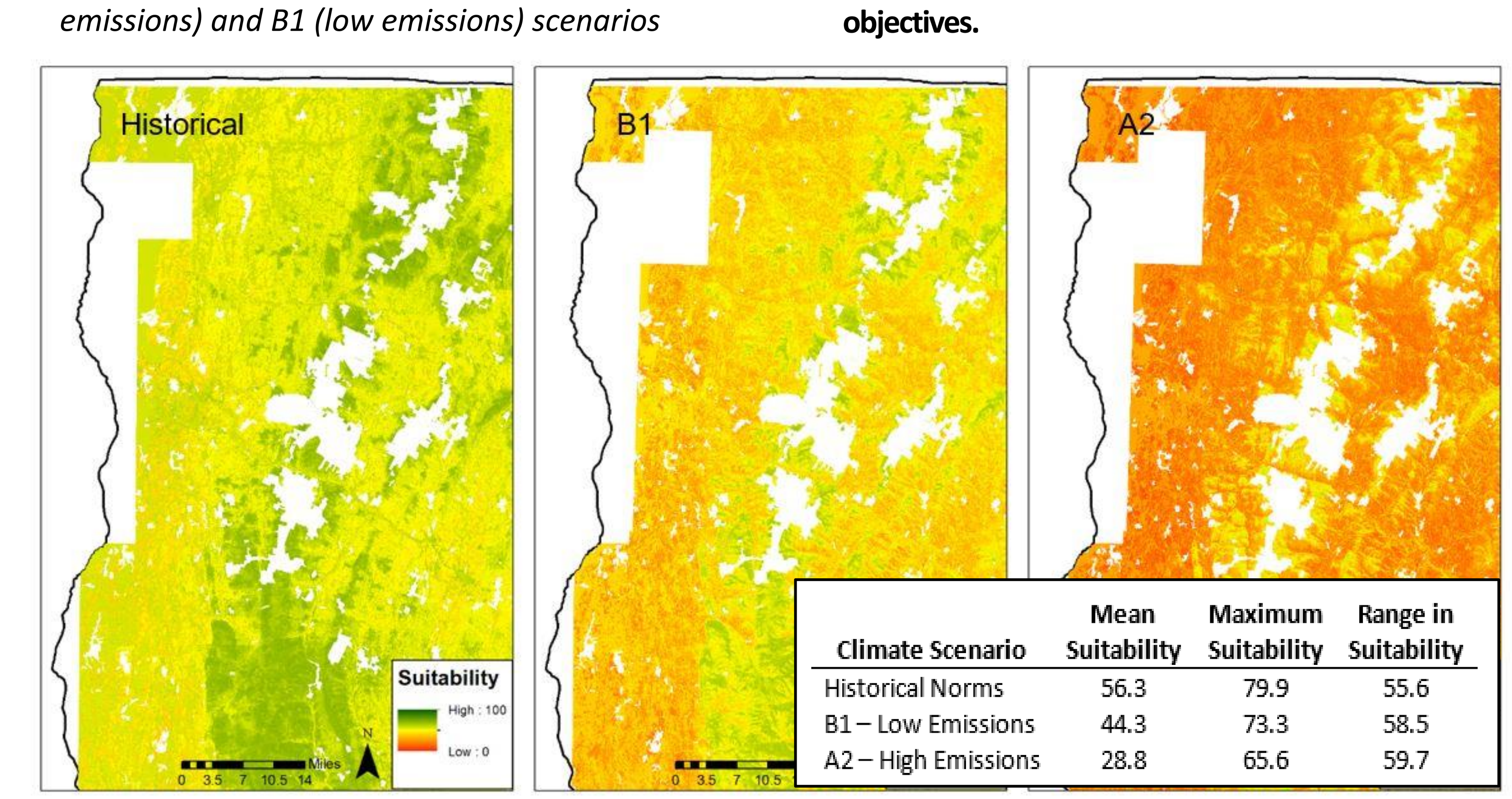
Decision Framework Customization:

This exercise allows a **Climate Action Advocacy Group** to demonstrate the potential severity of climate change impacts on the state's privately owned forests to encourage legislators to provide new incentives for landowners to implement climate-resilient management strategies. They choose to equally weight all available management objectives for a broad view of how climate change may impact forests.

Area of Interest: *Vermont private lands*
Input empirical models: *Percent Hemlock Basal Area, Percent Sugar Maple Basal Area, Sugar Maple Stress Index, Forest Conversion , Hemlock Risk Models*
Ancillary data layers:
Conserved lands (VT Protected Lands Database)
Summarize by: *Whole region*
Climate Scenarios: *Historic norms, A2 (High emissions) and B1 (low emissions) scenarios*

Objectives	Weight	Desirability Setting
Sugar Maple Basal Area	20	High Desirable (1)
Hemlock Basal Area	20	High Desirable (1)
Sugar Maple Stress	20	Low Desirable (-1)
Hemlock Susceptibility	20	Low Desirable (-1)
Forest Conversion Risk	20	Low Desirable (-1)
Sum	*100*	

Customized objective weights and desirability settings to integrate across all management objectives.



Climate Scenario	Mean Suitability	Maximum Suitability	Range in Suitability
Historical Norms	56.3	79.9	55.6
B1 – Low Emissions	44.3	73.3	58.5
A2 – High Emissions	28.8	65.6	59.7

Using the current suitability values as a baseline representing the current "standard" of forest health, we can quantify the proportion of the region's forests that fall more than a standard deviation below this "baseline" suitability. In this prioritization scenario, we can say that 65% of the region's forest will become less suitable to sustaining a healthy sugar maple and hemlock forests under a low emissions scenario. This increases to 95% under a high emission scenario. This provides a tangible value to present to policy makers.