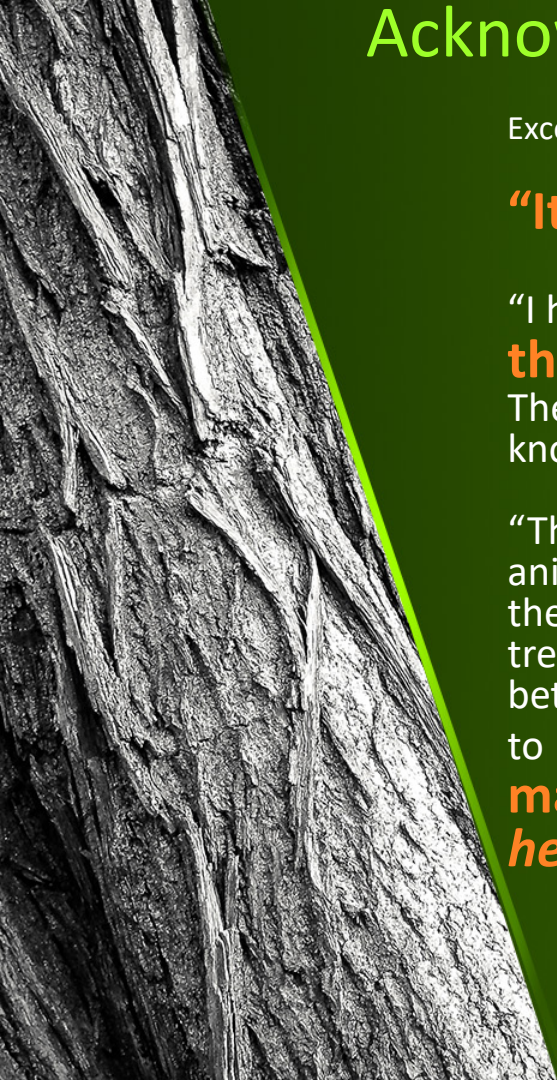


Stressed Out Trees

Ricardo Austrich, PLA | Manager of Landscape Architecture

Gillian Davies, PWS, SSSNE, NHCWS, CESSWI | Senior Ecologist/Natural Climate Solutions Specialist

Katie Kemen, MBA | Climate Adaptation & Resilience Specialist



Acknowledgement: People, Standing People [a.k.a. Trees], and Land

Excerpts from *Braiding Sweetgrass*

“It’s all in the pronouns...”

“I have heard **our elders give advise like ‘You should go among the standing people’** or ‘Go spend some time with those Beaver people’. They remind us of the capacity of others as our teachers, as holders of knowledge, as guides.”

“The animacy of the world is something we already know, but the language of animacy teeters on extinction...Our toddlers speak of plants and animals as if they were people....until we teach them not to...When we tell them that the tree is not a *who*, but an *it*, we make the maple an object; we put a barrier between us, absolving ourselves of moral responsibility and opening the door to exploitation. Saying *it* makes a living land into ‘natural resources’. **If a maple is an *it*, we can take up the chain saw. If a maple is a *her*, we think twice...**”

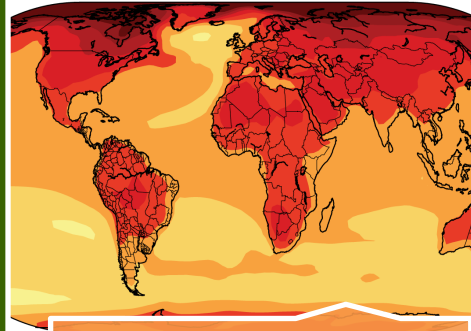
- Robin Wall Kimmerer, mother, scientist, decorated professor & enrolled member of the Citizen Potawatomi Nation



Trees are critical infrastructure

- Provide shading and cooling which lowers emissions and utility bills
- Improve air quality
- Provide habitats and support biodiversity
- Carbon sequestration
- Noise pollution
- Stormwater management & less soil erosion
- Mental health & quality of life
- Property values

Climate Projections



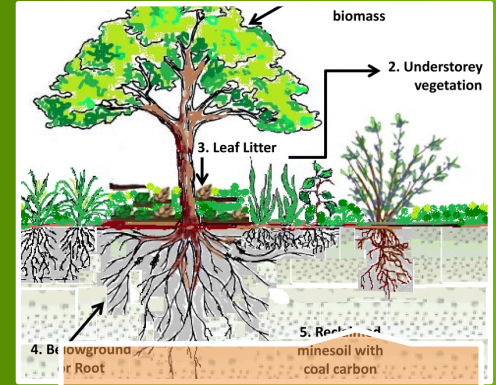
Rising Temperatures



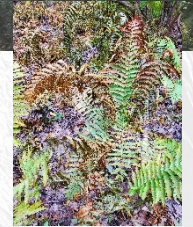
Changes in Precipitation



Extreme Weather Events



Carbon



- IPCC 2018 1.5° C Report:
 - Reduce emissions by **2030** or risk irreversible global warming (**keep below 1.5° C**)
 - Poor and disadvantaged populations disproportionately affected
- IPBES 2019 Global Assessment Report on Biodiversity & Ecosystem Services
 - **Imminent** extinction of 1 million species

A close-up photograph of tree bark, showing its rough, textured surface with various cracks and fissures. The bark is dark brown and grey, with some lighter, fibrous areas. The image is positioned on the left side of the slide, partially overlapping the green background.

Forests: What's in the Bank?

- Globally, forests store ~45% of terrestrial carbon
- Temperate forests store 30% - 50% of their carbon in soil
- Wetlands store 30% of world's soil carbon, occupy 5% – 8% of land surface

Sources: Ford & Keaton (2017), Nahlik & Fennessy (2016)



FORESTED WETLANDS

Photo: G. Davies



Forests: Carbon Banks

- Forests offset 30% of the world's global CO₂ emissions
- **Intact, natural, high biodiversity forests have the largest forest carbon reservoirs – greatest accumulations of carbon**
- **Mature forests with greater structural complexity – high levels of carbon storage, high levels of biodiversity**
- Global loss of forests: 36% over past 200 years.
- Estimated 10,000 – 14,000 acres of deforestation per year in Massachusetts.
- Deforestation & forest degradation are a leading cause of carbon emissions
- Sources: Ford & Keaton (2017), Moomaw *et al.* (2020), The Critical Role of Forests in Protecting Climate and Public Health (2020)
<https://www.youtube.com/watch?v=ljAQsqACuWU>



Forests: Significance of Temporal Loss

- **Meeting Paris Agreement Targets:** Need to increase ecosystem uptake of atmospheric carbon (in addition to reducing anthropogenic emissions) – “Negative Emissions”
- **Temporal Loss:** Harvested forests take 30 to > 100 years to reach “carbon parity” with pre-harvest conditions (“renewable” only on very long timescales), **IF** they regrow as forests
- **Will reforestation happen?** (Risk of land conversion, increased climate vulnerability, fire, disease, pests, poor management practices)
- **Ensure carbon accounting is complete** (includes soil loss, harvesting & transportation costs, end use, etc.), **accurate & transparent**

Sources: <https://www.wri.org/blog/2017/12/insider-why-burning-trees-energy-harms-climate>; Griscoll et al. (2017), Hudiburg *et al.* (2019); National Academy of Sciences (2019), Moomaw *et al.* (2020)

Climate Resilience Value of Tree Shade & Trees Standing Together

FORESTS:

- Maintain cooler, moister environment
- Cool streams, rivers, ponds, vernal pools & associated aquatic life
- Create wind-breaks
- Maintain unique forest habitats & supports biodiversity
- Provide flood control
- Create regional & continental water vapor pumps
- Reduce risk of tornados & hurricanes



Photo: G. Davies



Forests: Carbon Banks & Climate Resilience

Priorities for the Critical Next Few Decades

- **Let Forests & Trees Grow**
- Prevent Conversion of Forests to Development, No Net Loss of Forest Policy
- Reforestation & Forest Restoration
- Require Transparent, Accurate and Complete Carbon Accounting for Forest Impacts
- Avoid/Minimize/Mitigate Temporal Loss of Carbon Accumulation
- Avoid/Minimize Loss & Degradation of Soil

Sources: Ford & Keaton (2017), Hudiburg *et al.* (2019).



Forest Management BMPs

- Managing forests for old-growth structure & function:
 - **High carbon storage & accumulation value**
 - **AVOIDS TEMPORAL LOSS OVER NEXT FEW DECADES**
 - Biodiversity
 - Soil conservation co-benefits
 - Maintain localized cooling and regional/continental water vapor pump co-benefits
 - Flood control co-benefits
- Commercial Forestry
 - Employ “Exemplary Forestry” practices (New England Forestry Foundation) to minimize carbon losses & impacts to biodiversity in context of commercial forestry
 - Exemplary Forestry manages for sustainable forestry & long-term forest health

Forests: Strategies



Photo: G. Davies

- **Wetlands Bylaw Climate Updates & Performance Standards:**
 - Wetland Resource Areas & Buffer Zones
 - Carbon & Resilience
 - Forest/Tree Cutting Performance Standards: Base on Carbon & Resilience impacts, avoid temporal loss, protect root zone, soil & planting BMPs
- **Community Education & Participation**
- **Incentivize forest carbon accumulation & biodiversity**
 - Value large, older trees & intact, natural forests
 - Financial incentives
 - Other incentives

Convergence: Science & Traditional Knowledges

Meeting climate and biodiversity challenges: diversity of ideas, solutions, approaches

Forest Science:
Research insights
on healthy
forests: old
growth, “talking”
trees, forest as
“cooperative
systems”, “wood
wide web”



Photo: G. Davies

Indigenous Peoples &
Local Communities
Traditional Knowledges:
“KAWSAK SACHA
[LIVING FOREST] is a
living being, with
consciousness,
constituted by all the
beings of the Jungle...in
intercommunication
with human beings...”
- Kichwa Native People,
Sarayaku, Ecuador

“Together we stand,
divided we fall”

Sources: Simard *et al.* 1997, Kimmerer 2013, Song *et al.* 2015, Wohllenben 2015, Studley 2019, <https://kawsaksacha.org/>



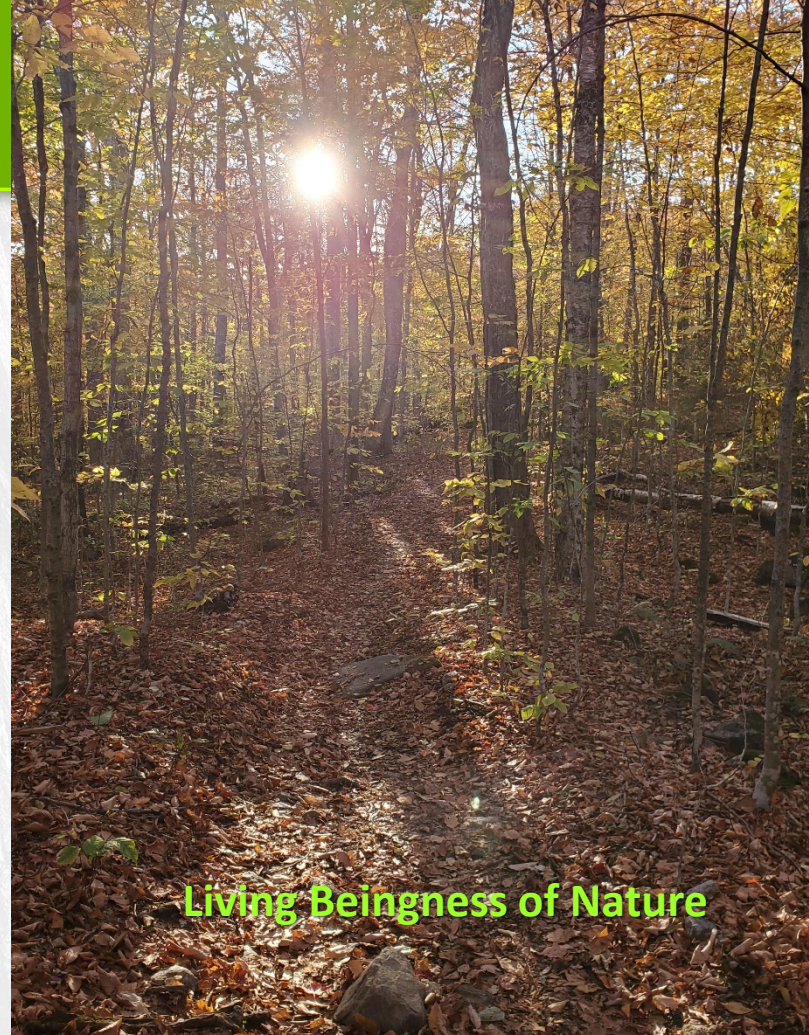
Language-Ethics-Law



Gratitude-Reciprocity
-Respect



Perspectives



Living Beingness of Nature

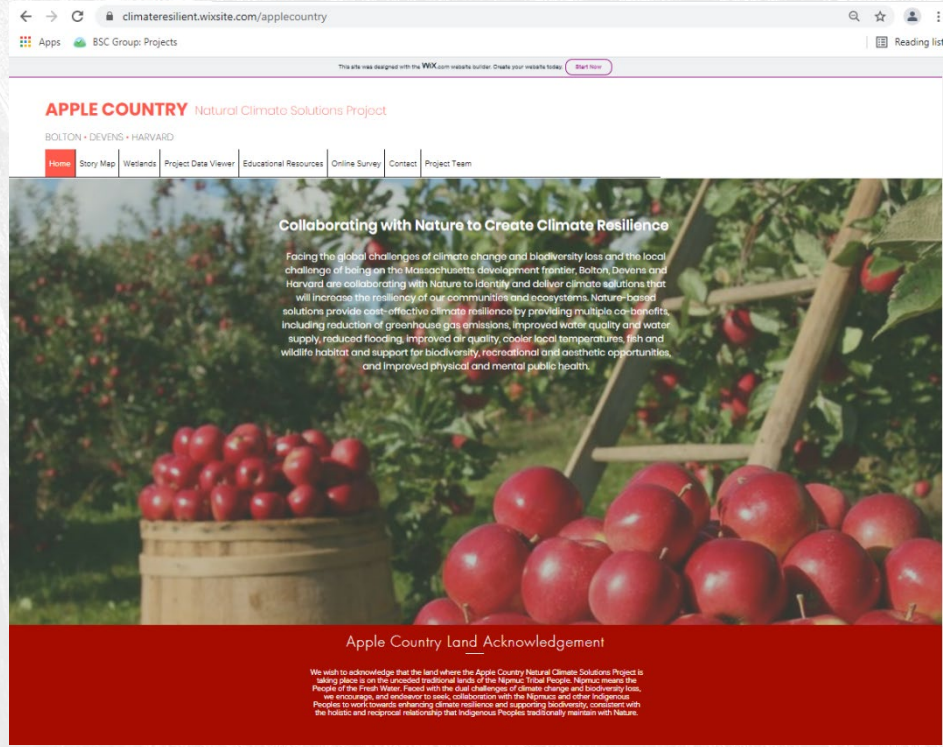


Web of Life

What
will it
take?

RESOURCES: Apple Country Natural Climate Solutions

- <https://climateresilient.wixsite.com/applecountry>



← → ↻ 🌐 climateresilient.wixsite.com/applecountry 🔍 ☆ 👤 ⋮

📱 Apps 🌱 BSC Group Projects 📖 Reading list

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APPLE COUNTRY Natural Climate Solutions Project

BOLTON • DEVENS • HAIRVARD

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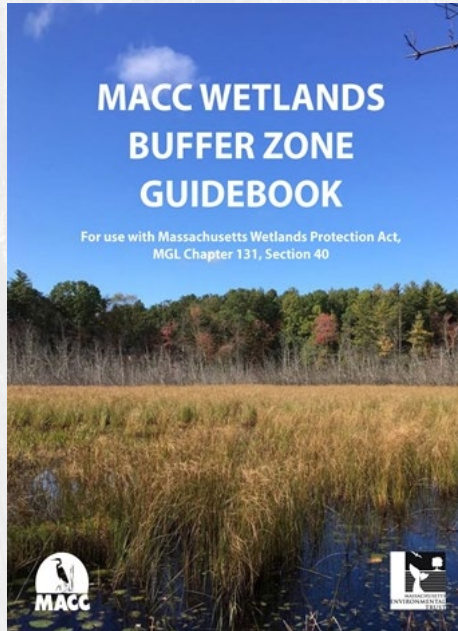
Collaborating with Nature to Create Climate Resilience

Facing the global challenges of climate change and biodiversity loss and the local challenge of being on the Massachusetts development frontier, Bolton, Devens and Harvard are collaborating with Nature to identify and deliver climate solutions that will increase the resiliency of our communities and ecosystems. Nature-based solutions provide cost-effective climate resilience by providing multiple co-benefits, including reduction of greenhouse gas emissions, improved water quality and water supply, reduced flooding, improved air quality, cooler local temperatures, fish and wildlife habitat and support for biodiversity, recreational and aesthetic opportunities, and improved physical and mental public health.

Apple Country Land Acknowledgement

We wish to acknowledge that the land where the Apple Country Natural Climate Solutions Project is taking place is on the ancestral traditional lands of the Nipmuc Tribal Peoples. Nipmuc means the People of the Fresh Water. Faced with the dual challenges of climate change and biodiversity loss, we encourage, and endeavor to seek, collaboration with the Nipmuc and other Indigenous Peoples to work towards enhancing climate resilience and supporting biodiversity, consistent with the holistic and reciprocal relationship that Indigenous Peoples traditionally maintain with Nature.

Resources



- MACC Buffer Zone Guidebook
- Massachusetts Healthy Soils Action Plan
- The Critical Role of Forests in Protecting Climate and Public Health (2020)
<https://www.youtube.com/watch?v=ljAQsqACuWU>



Image: Institute for Local Self Reliance



A landscape architecture perspective

- How can communities & landscape architects collaborate (LA's)? What are some shared values?
- Where are the areas of interaction?
- What are each group's perspective?

Allies with varied perspectives

- Local Conservation Commissions - Focused on wetlands & environmental protection

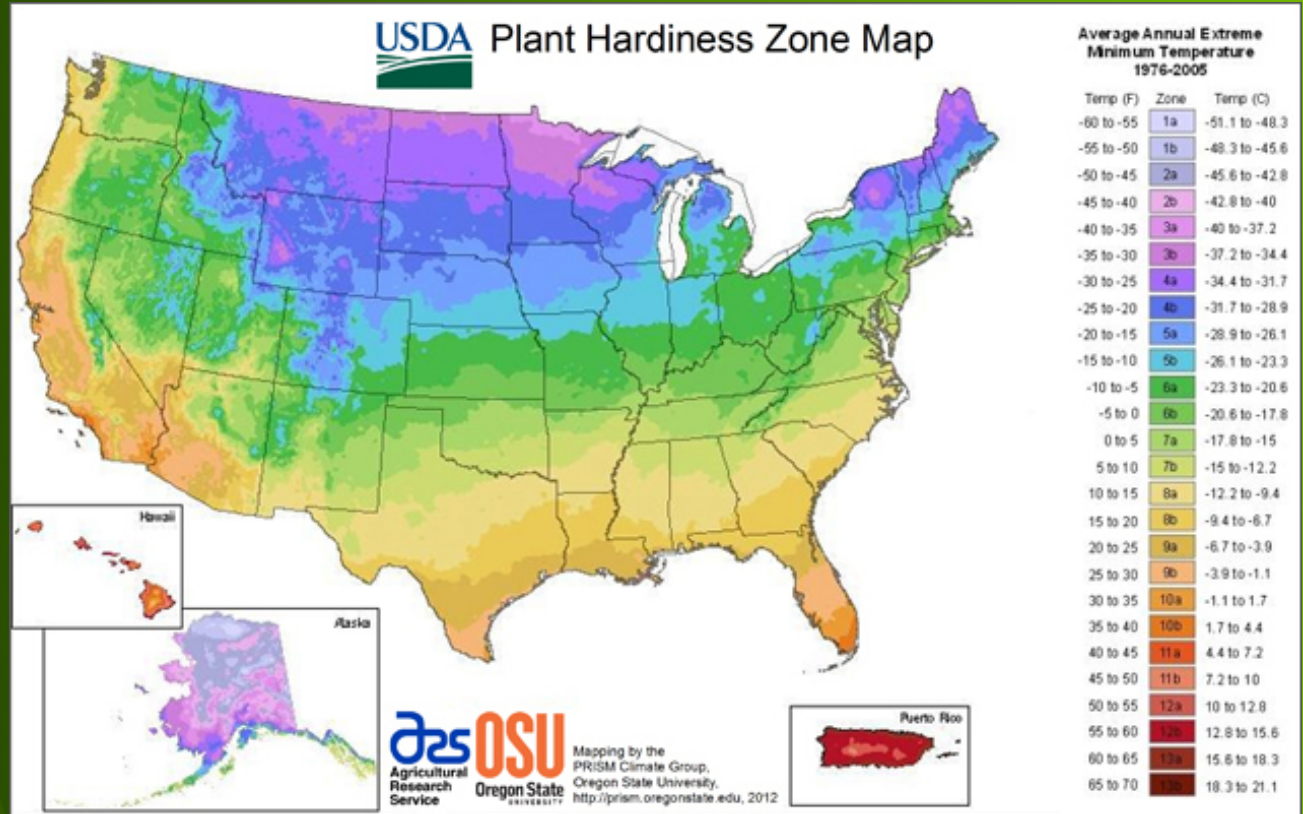
- LA's - Focused on place making

Areas of alignment

- Working on green solutions to address climate change.



Planting Zones Moving North



A close-up photograph of a tree trunk, showing the rough, textured bark with deep grooves and ridges. The bark is dark brown and appears to be peeling or flaking in some areas. The image is positioned on the left side of the slide, partially overlapping the green background.

Tree & Forest canopy diversity

- “Future Adapted Trees” – managing for diversity.

Sources: <https://masswoods.org/sites/masswoods.net/files/Forest-Resiliency.pdf> -P. Catanzaro, A. D’amato , E.S. Huff

- Support the use of trees from the southern range of NE or the mid-Atlantic for non-rural areas.
 - Tulip Trees, Kentucky Coffee Trees, Black Gum, Willow Oak, Basswood, etc.



Towards a flexible plant palette

- Urban – State’s cities & towns
 - Appropriate for diverse planting palette
- Residential suburban
 - Suitable for diverse plant palette
- Ex-Urban – commercial & industrial
 - Suitable for diverse plant palette
- Rural communities, farms & forests
 - Best for native & southern range plant palette

A close-up photograph of tree bark, showing a rough, textured surface with vertical fissures and horizontal ridges. The bark is dark brown and appears to be peeling or flaking in some areas. The image is positioned on the left side of the slide, partially overlapping the green background.

Encourage a flexible adaptive plant palette vs. “historic natives” palette

- Use natives like Maples, Hemlocks, Ash, which are vulnerable to insect hosts, SPARINGLY.
- If possible encourage use of plant material from southern sources; Connecticut, New Jersey, Maryland.

A close-up photograph of a hemlock branch. The branch is covered in numerous small, white, woolly insects, which are Hemlock Woolly Adelgids. The needles are green and pointed. The background is a blurred, dark brown color.

Critical Insect Pests to Native Trees

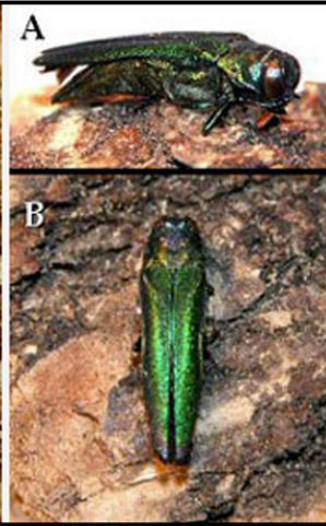
- Hemlock Woolly Adelgid

Critical Insect Pests to Native Trees

Emerald Ash Borer



EAB larva



EAB



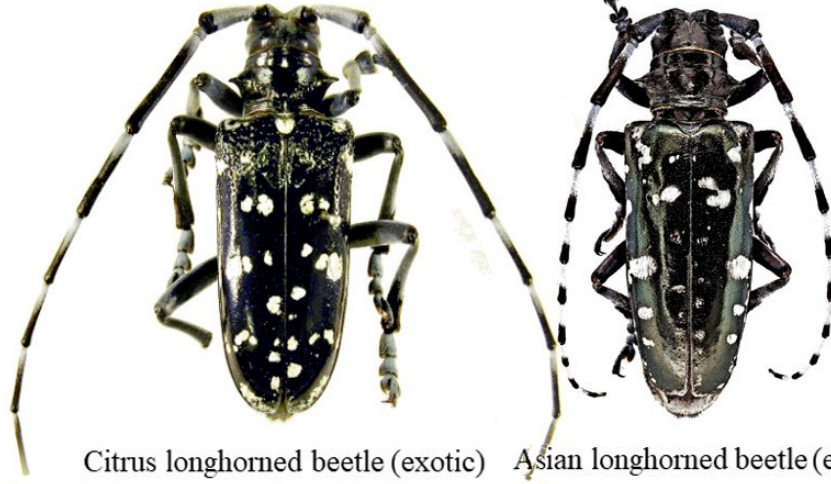
EAB tunnels

Nebraska Department of Agriculture Photos

Critical Insect Pests to Native Trees

Exotic longhorned beetles:

Glossy black body
distinct white spots
black and white banded antennae



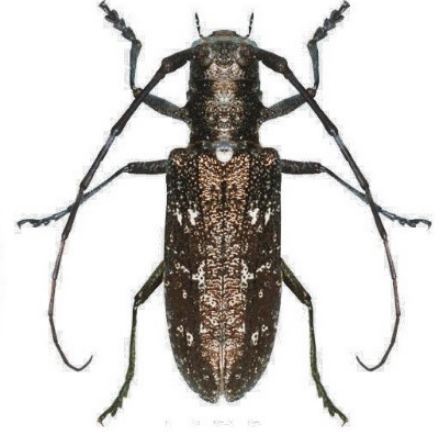
Citrus longhorned beetle (exotic)

Asian longhorned beetle (exotic)

Native longhorned beetle:

Bronzy-black body
indistinct white spots (if any)
faint banding on antennae

DO NOT REPORT



Whitespotted sawyer (native)

A close-up, black and white photograph of a tree trunk, showing the rough, textured bark with deep grooves and ridges. The image is positioned on the left side of the slide, partially overlapping the green background.

When its time to call for help - Educate your Community

- Local Tree Warden + Volunteer Tree Committees can check trees proactively
- Partner with local land trust for assistance with Disadvantaged Communities – Summer Youth Programs
- Tree health is a social justice issue.

Essentials for tree

survival

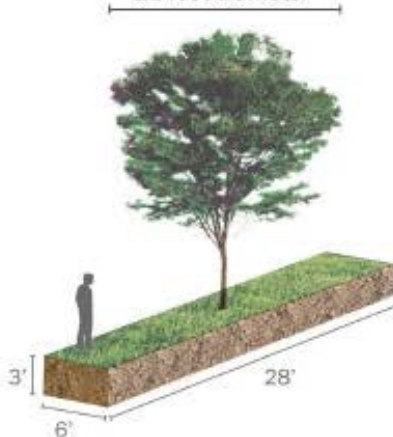
- Water
- Air (Soil Aeration)
- Soil Volume

estimated crown spread =
10 feet diameter



Soil Volume = 120 cubic feet

estimated crown spread =
21 feet diameter



Soil Volume = 500 cubic feet

estimated crown spread =
30 feet diameter



Soil Volume = 1000 cubic feet

Source: CaseyTrees, 2009 Washington DC

Providence Water

An Insurance Policy for a Rhode Island Watershed: Boosting Forest Health and Resilience

By Andrea Watts

As a forester managing 13,000 acres of public woodlands surrounding Providence Water's Scituate Reservoir in Rhode Island, SAF member Christopher Riely faced a common dilemma: How should he address regeneration failure? Ten years earlier, a salvage harvest of dead and dying oak was conducted, with the goal of promoting young native pines in the oak-dominated forest in a section of the watershed called Tunk Hill. The rocky, well-drained soil made it a poor growing site, and the three Ds—defoliation, drought, and deer—had resulted in a loss of both seedlings and the remaining overstory trees. This combination created a stand that he described as “what more of the forest could look like if there is a storm or hurricane.”

In 2015, Riely designed an experimental project that called for planting more than 1,000 conifers and hardwoods, and to complement Providence Water's managed deer hunt and deer impact monitoring efforts, used a pre-existing deer enclosure fence on one site to determine whether seedlings would grow better within the enclosure. What set this plan apart from the previous silvicultural



Students from Jorge Alvarez High School, in Providence, Rhode Island, planted seedlings around Providence Water's Scituate Reservoir. Photograph courtesy of Christopher Riely.

prescriptions he had developed was consideration of not only the desired future structure of the stand, but also the future climate in which this stand would be growing.

WATER ■ Page 14

- Water utility managing 13,000 acres of land as green infrastructure
- Goal: maintain a forest that is resilient to disturbances that could negatively impact water quality
- Began with NIACS training on Climate Change Response Framework

The Forestry Source, January 2018

Seattle, WA

2020 Urban Forest Management Plan

- Equity & Environment
- Regulations, Incentives, and Partnerships to support multiple co-benefits
 - Trees for Neighborhoods
 - City Fruit
 - Green Seattle Partnership
 - Variable stormwater rates



Resources

- FIRST: Forest Identification and Restoration Selection Tool (NYC)
 - <https://naturalareasnyc.org/content/climate/first-tool/#/>
- MN Forest Field Guide: Site level considerations and adaptation
 - https://forestadaptation.org/sites/default/files/ClimateChangeFieldGuide_NMNForests_HiRes.pdf
- Adaptation Workbook: a climate change tool for land management and conservation
 - <https://adaptationworkbook.org/>

