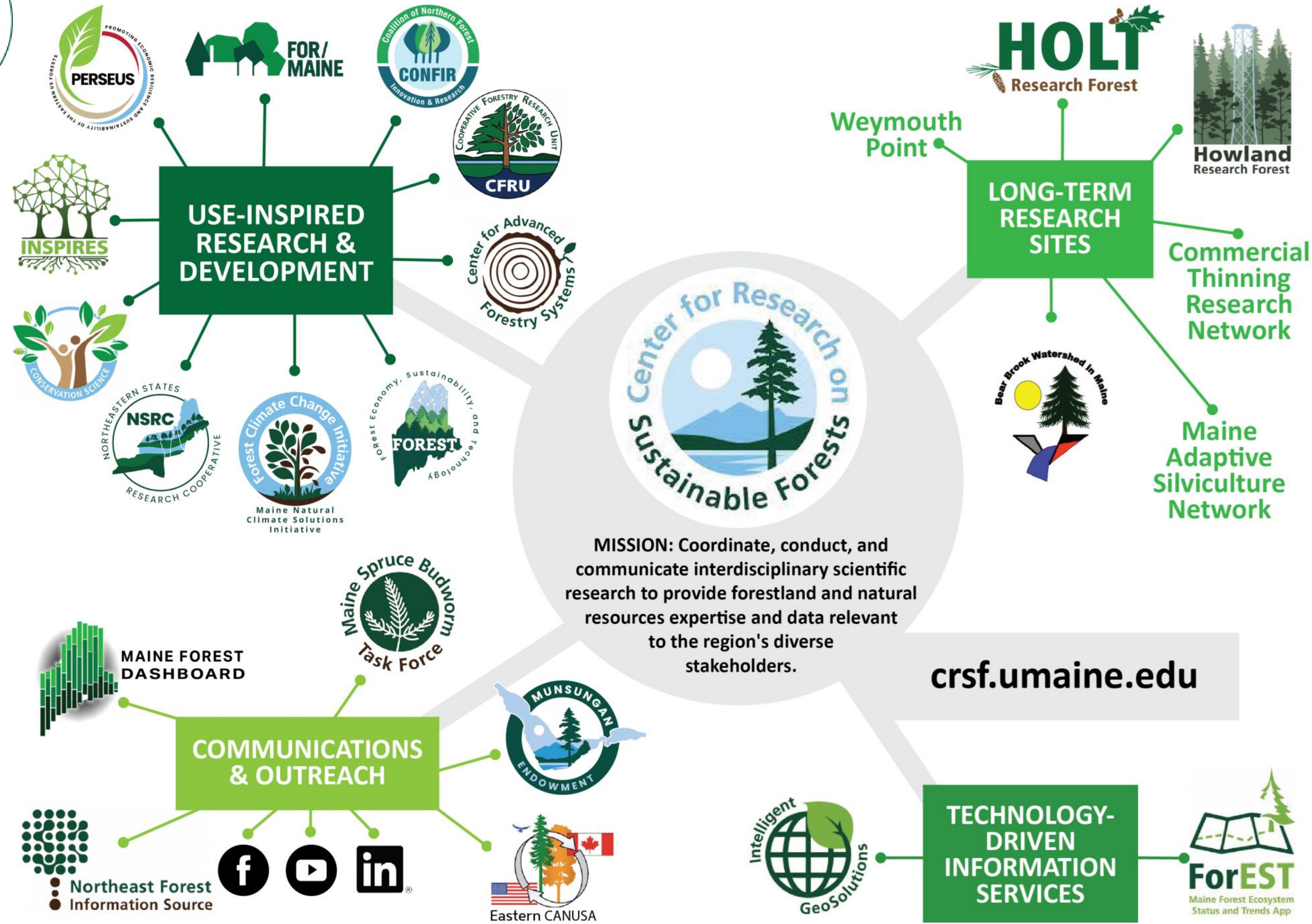
Center for Research on Sustainable Forests

Aaron Weiskittel, Director

University of Maine

Center for Research on Sustainable Forests

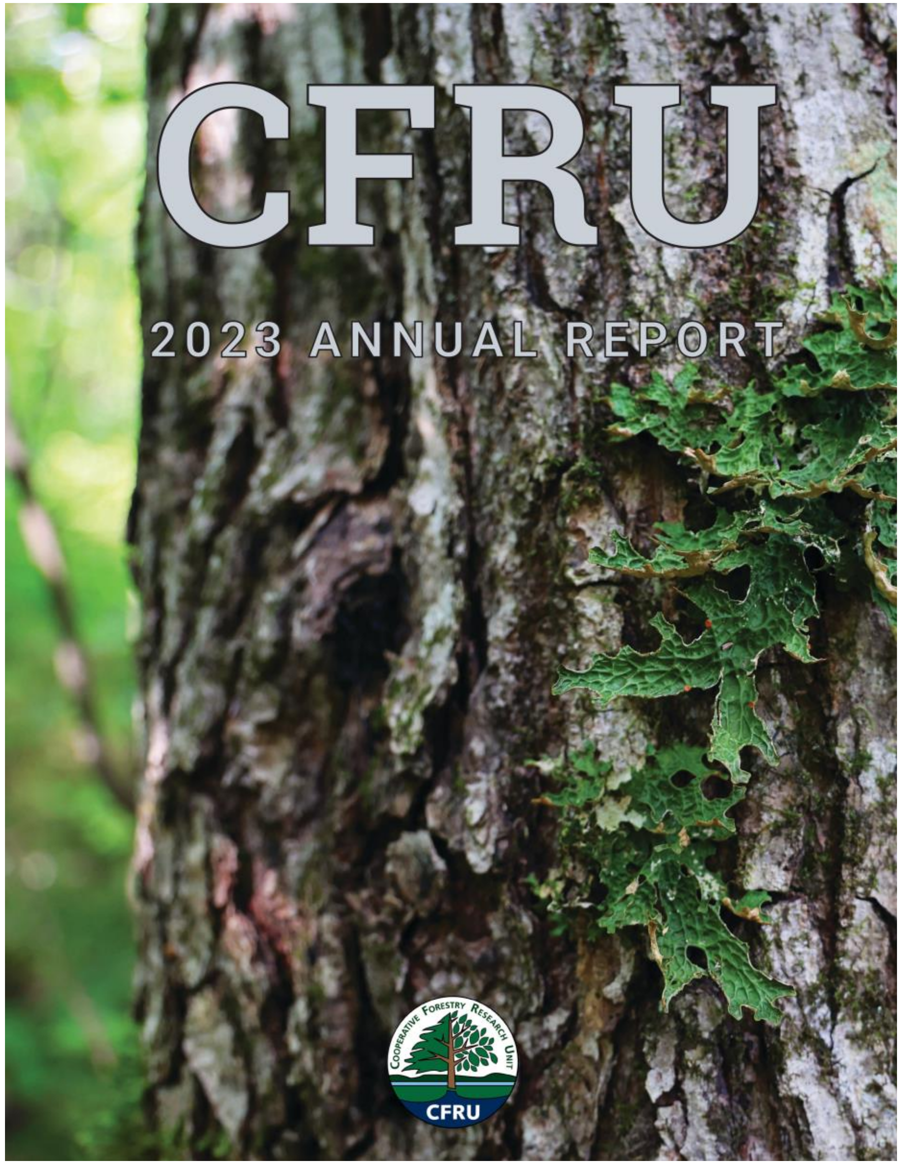


Cooperative Forestry Research Unit

- Fully staffed and funded
  - Program Manager (Regina Smith)
  - Research Coordinator (Eric McPherson)
  - Admin (Leslee Canty-Noyes)

- Largest and most diverse research portfolio since 2008
  - 25 active projects from SBW L2 to NAIP to wood turtles
  - Good engagement of early-career faculty

- Revised Program Prospectus with top R&D priorities being:
  - Silviculture & Productivity
  - Remote Sensing
  - Forest Health
  - Wildlife Habitat
  - Carbon



https://umaine.edu/cfru/

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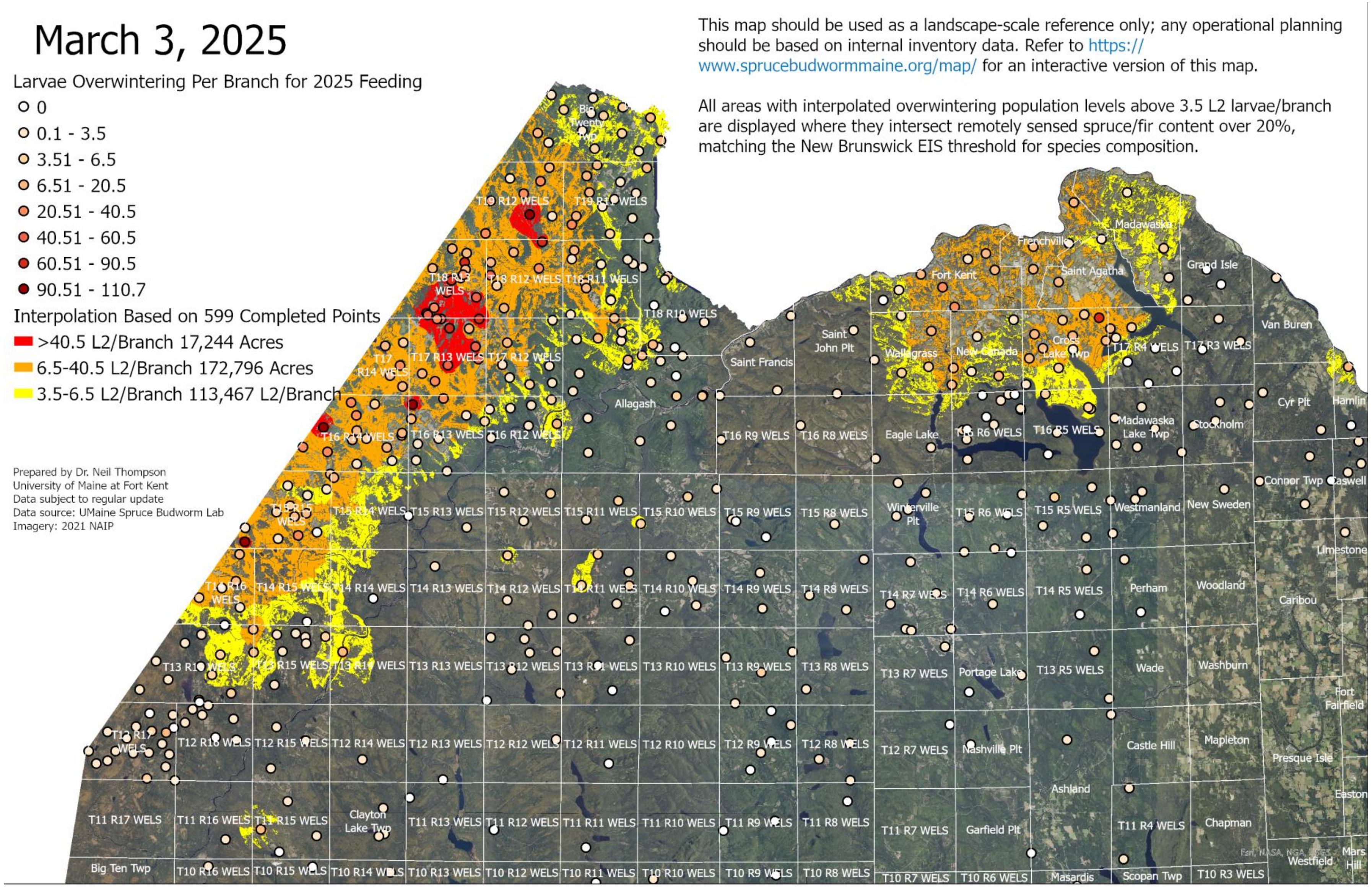

Large increase in spruce-budworm populations in northern Maine with active spraying

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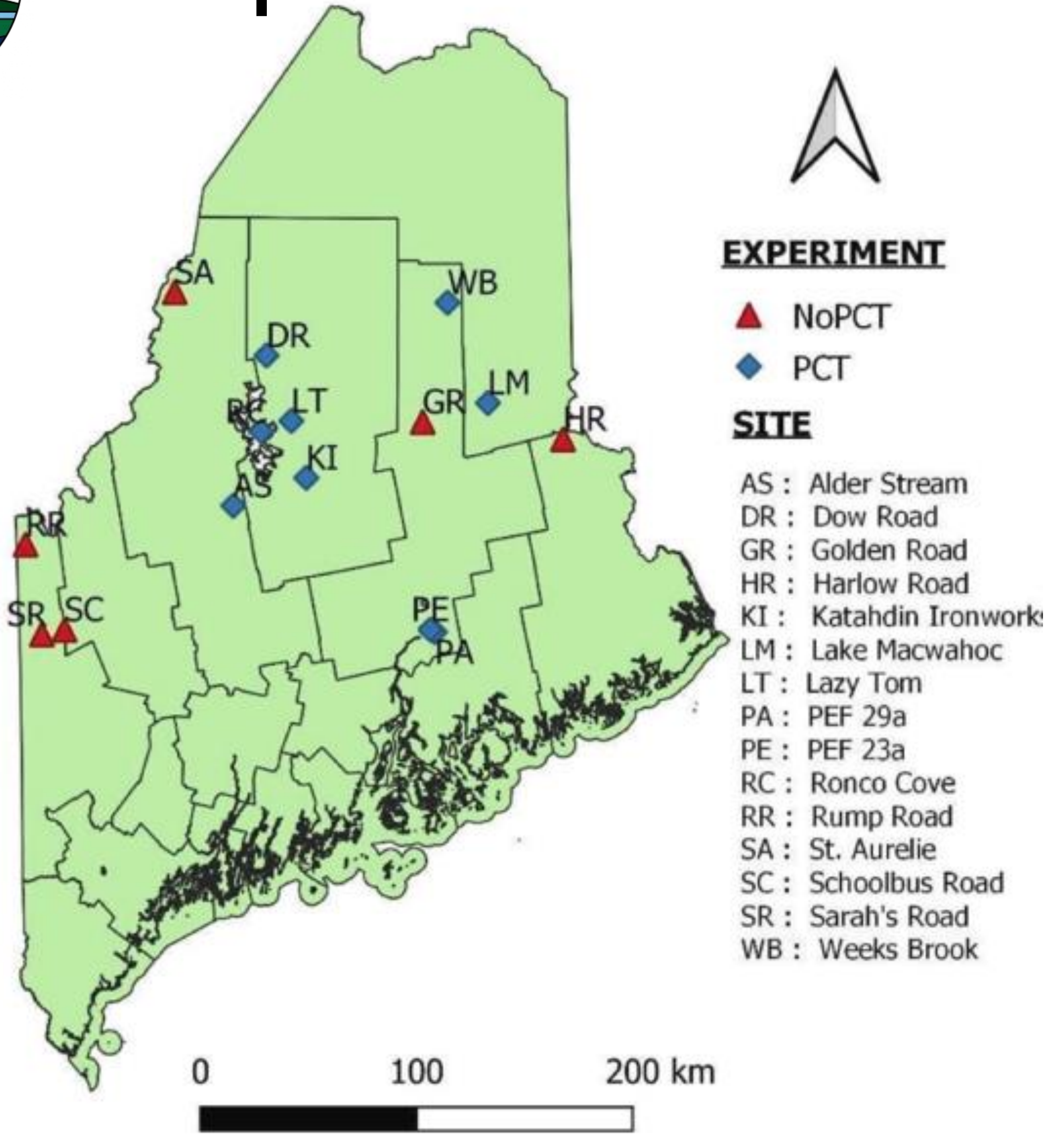

Treatments	Description	Actual removal (% of total BA): Mean ± SD (range)
(A) NoPCT		
LOW.33	Low thinning with 33 % RD reduction	20.8 ± 12.8 (2.5; 35.2)
LOW.50	Low thinning with 50 % RD reduction	40.5 ± 8.3 (30.0; 50.3)
CRN.33	Crown thinning with 33 % RD reduction	41.8 ± 8.7 (28.0; 52.3)
CRN.50	Crown thinning with 50 % RD reduction	55.4 ± 5.5 (49.5; 63.3)
DOM.33	Dominant thinning with 33 % RD reduction	45.7 ± 8.1 (37.1; 56.2)
DOM.50	Dominant thinning with 50 % RD reduction	59.3 ± 5.1 (51.8; 67.0)
Control	Unthinned	0.0 ± 0.0 (0.0; 0.0)
(B) PCT		
0YR.33	RD reduced by 33 % in 2001–2002	34.0 ± 8.2 (15.4; 43.6)
0YR.50	RD reduced by 50 % in 2001–2002	47.5 ± 3.2 (40.5; 51.3)
5YR.33	RD reduced by 33 % in 2006–2007	38.4 ± 4.1 (32.8; 45.4)
5YR.50	RD reduced by 50 % in 2006–2007	51.9 ± 5.2 (45.4; 60.0)
10YR.33	RD reduced by 33 % in 2011–2012	35.3 ± 2.8 (30.2; 38.0)
10YR.50	RD reduced by 50 % in 2011–2012	49.8 ± 2.4 (46.2; 53.0)
Control	Unthinned	0.0 ± 0.0 (0.0; 0.0)

Commercial Thinning Research Network (CTRN) has 20+ years of remeasurements in a replicated spruce-fir commercial thinning experiment with and without PCT

Cooperative Forestry Research Unit

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ELSEVIER

Tree-level growth and survival following commercial thinning of four major softwood species in North America

Arun K. Bose[a,e,*], Aaron Weiskittel[a], Christian Kuehne[a], Robert G. Wagner[b], Eric Turnblom[c], Harold E. Burkhart[d]

[a] School of Forest Resources, University of Maine, 5755 Nutting Hall, Orono, ME 04469-5755, United States
[b] Department of Forestry & Natural Resources, Purdue University, West Lafayette, IN 47907-2061, United States
[c] School of Environmental and Forest Sciences, University of Washington, Box 352100, Seattle, WA 98195-2100, United States
[d] Department of Forest Resources and Environmental Conservation, Virginia Tech, Blacksburg, VA 24061, United States
[e] WSL Swiss Federal Institute for Forest, Snow and Landscape Research, Zurcherstrasse 111, CH-8903 Birmensdorf, Switzerland

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Pacific Northwest US
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Northeast US

ABSTRACT

Thinning is commonly applied to increase the tree growth in forest stands by improving the availability of water, light, and nutrients. However, thinning also can increase soil evaporation and intensify wind penetration into residual stands, potentially increasing moisture stress and wind damage. To strengthen our understanding of tree-level responses to thinning, we used long-term measurements from three controlled, replicated thinning experiments for four commercially important softwood species in North America, including the shade-intolerant loblolly pine (*Pinus taeda* L.), moderately shade-tolerant Douglas-fir (*Pseudotsuga menziesii* Mirbel), and shade-tolerant red spruce (*Picea rubens* Sarg.) and balsam fir (*Abies balsamea* L.). The objectives of this study were to assess the long-term (13–24 years) pattern of individual-tree growth and survival after a variety of commercial thinning treatments. Our results showed that on average tree volume growth was 31% higher in thinned stands relative to unthinned stands irrespective of species and tree size. However, the rate of growth decreased over time following thinning for loblolly pine and Douglas-fir, while a curvilinear relationship was observed for red spruce and balsam fir. Tree size was important only for loblolly pine where growth increased linearly with the size of residual trees. Tree survival was also higher in thinned stands than unthinned stands across all species in the long-term, but a significant initial decrease in survival was found in balsam fir and red spruce immediately after thinning due primarily to windthrow and breakage. Stand relative age and total basal area at time of thinning were negatively related with growth for all tree species, which may indicate that the trees examined in this study had reached their maximum growth potential or had a period of suppression prior to thinning. The relatively minor influence (i.e., 5% of total R^2) of thinning intensity on growth may suggest that the timing of thinning (i.e., age of trees when thinned) and stand characteristics (species, tree age, and stand basal area) were more important in promoting individual-tree growth. However, a heavier intensity of thinning increased survival of loblolly pine and Douglas-fir trees. Overall, our results indicated that thinning can increase tree growth and survival across species of varying shade tolerance. To ensure the maximum benefits of thinning, the timing and intensity of the treatment needs to be adjusted for species characteristics, stand structure, and tree age.

1. Introduction

Commercial thinning is often applied as an effective means to extract timber in the short-term by selecting stems approaching imminent natural mortality. The long-term goal is generally to increase the growth of residual trees following thinning by decreasing the competition for available environmental resources (primarily light, nutrients, and water) (Kostler, 1956; Zeide, 2001). Despite its widespread use, results from thinning experiments have reported a wide range of outcomes, including increased mortality (e.g., Ruel et al., 2001; Ahnlund Ulvcrona et al., 2011; Kuehne et al., 2016) and growth stagnation of residual trees after thinning (Lagergren et al., 2008). However, the ultimate response to thinning is usually difficult to generalize because the growth and mortality of individual trees can vary substantially depending on the pre- and postthinning characteristics of the stand (i.e., stand age, density, and size distributions), site characteristics (i.e.,

* Corresponding author at: WSL Swiss Federal Institute for Forest, Snow and Landscape Research, Zurcherstrasse 111, CH-8903 Birmensdorf, Switzerland.
E-mail addresses: arun.bose@wsl.ch (A.K. Bose), aaron.weiskittel@maine.edu (A. Weiskittel), christian.kuehne@maine.edu (C. Kuehne), rgwagner@purdue.edu (R.G. Wagner), ect@u.washington.edu (E. Turnblom), burkhart@vt.edu (H.E. Burkhart).

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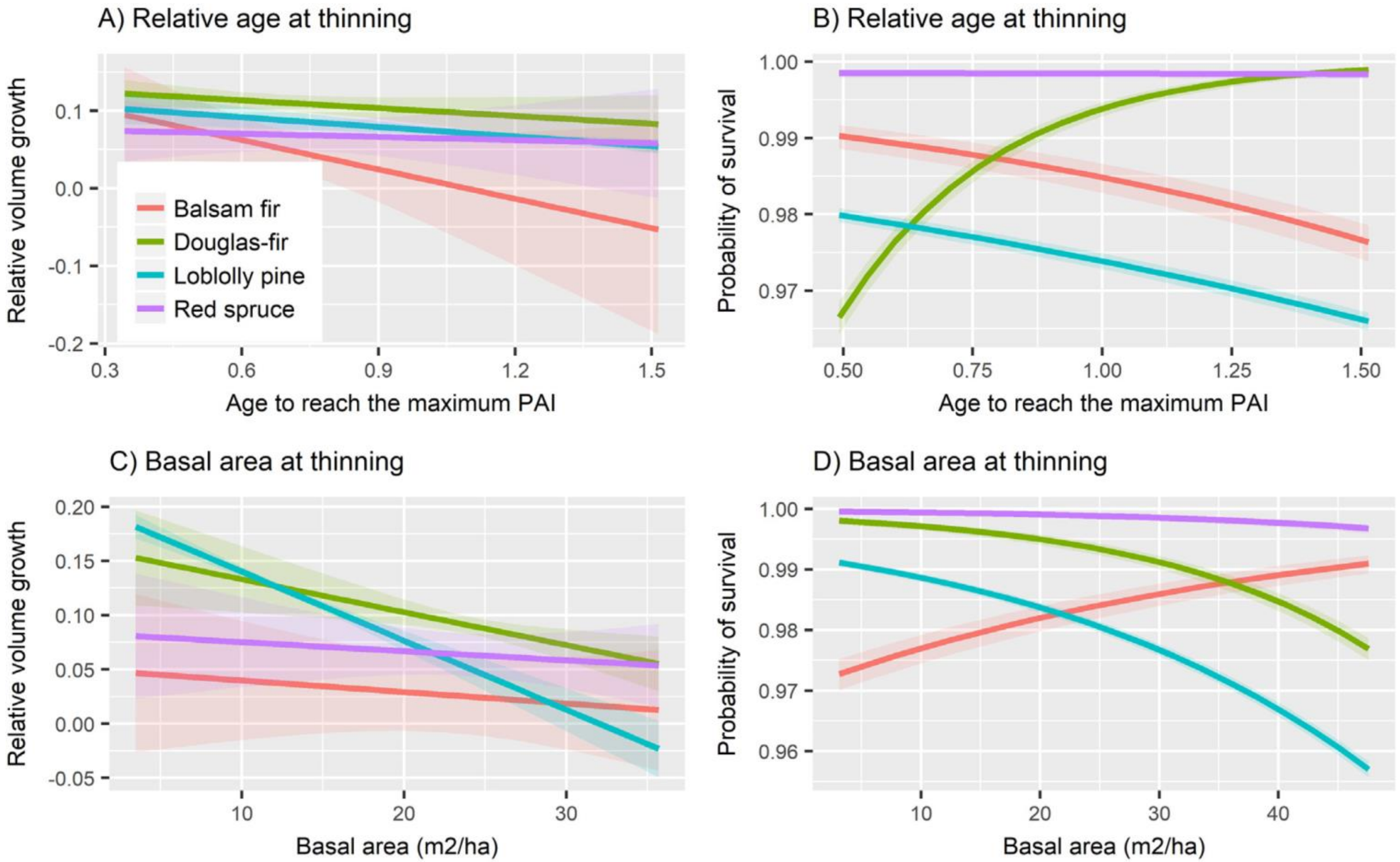

Commercial Thinning Research Network (CTRN) used to compared thinning response of spruce-fir to Douglas-fir and loblolly pine

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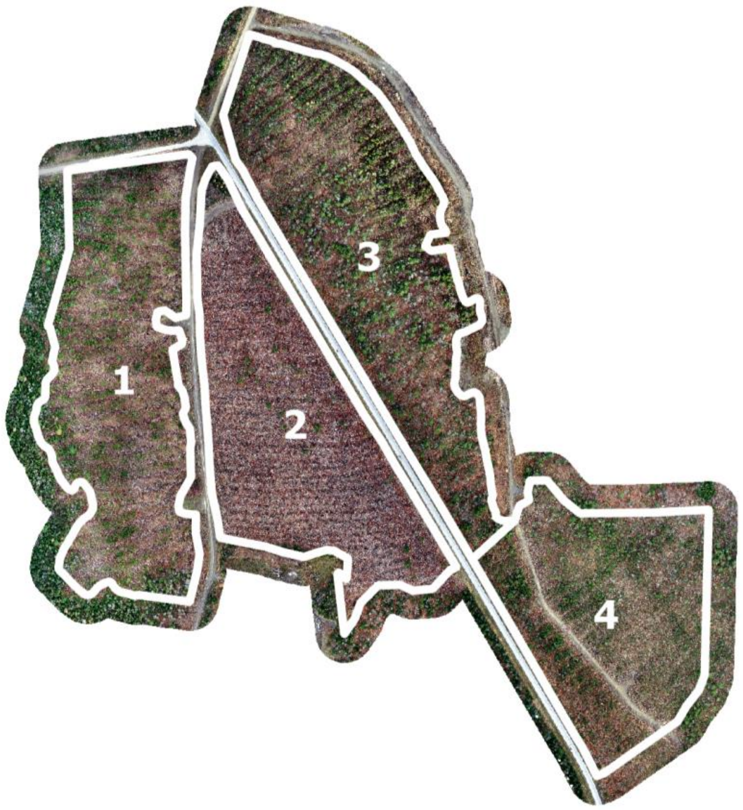


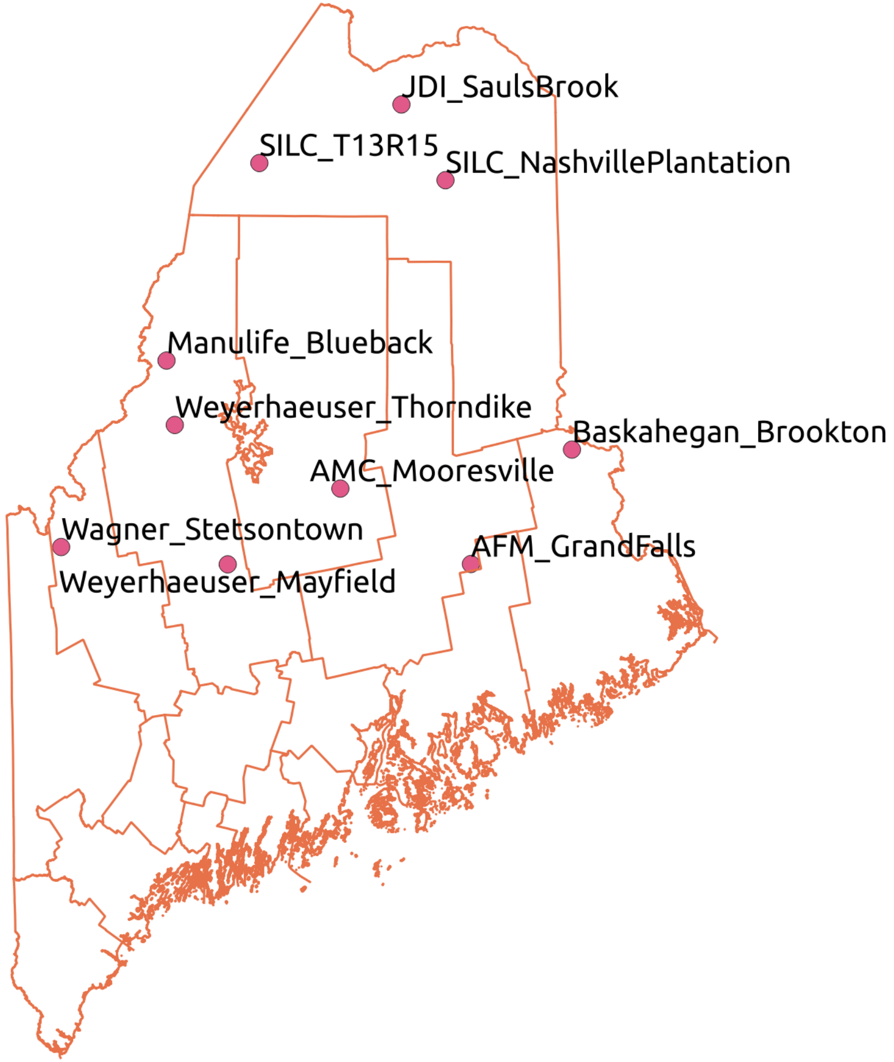
True-Color Orthomosaic

Treatment:

1 - Shelterwood Removal Cutting
2 - Clearcut
3 - Improvement Cutting
4 - Shelterwood with Reserves

sUAS Data Acquisition Provided By:
Wheatland Geospatial Lab
wheatlandlab.org
Ground Resolution: 1.0 in/pixel
Flying Height: 360 ft
Image Frames: 1,405
Total RMSE (XYZ): 1.44 in

0 500 1,000 2,000 Feet



Maine Adaptive Silviculture Network (MASN)

- Large replicated blocks of midrotation treatments (25-50 acres) with multiple installations throughout the state

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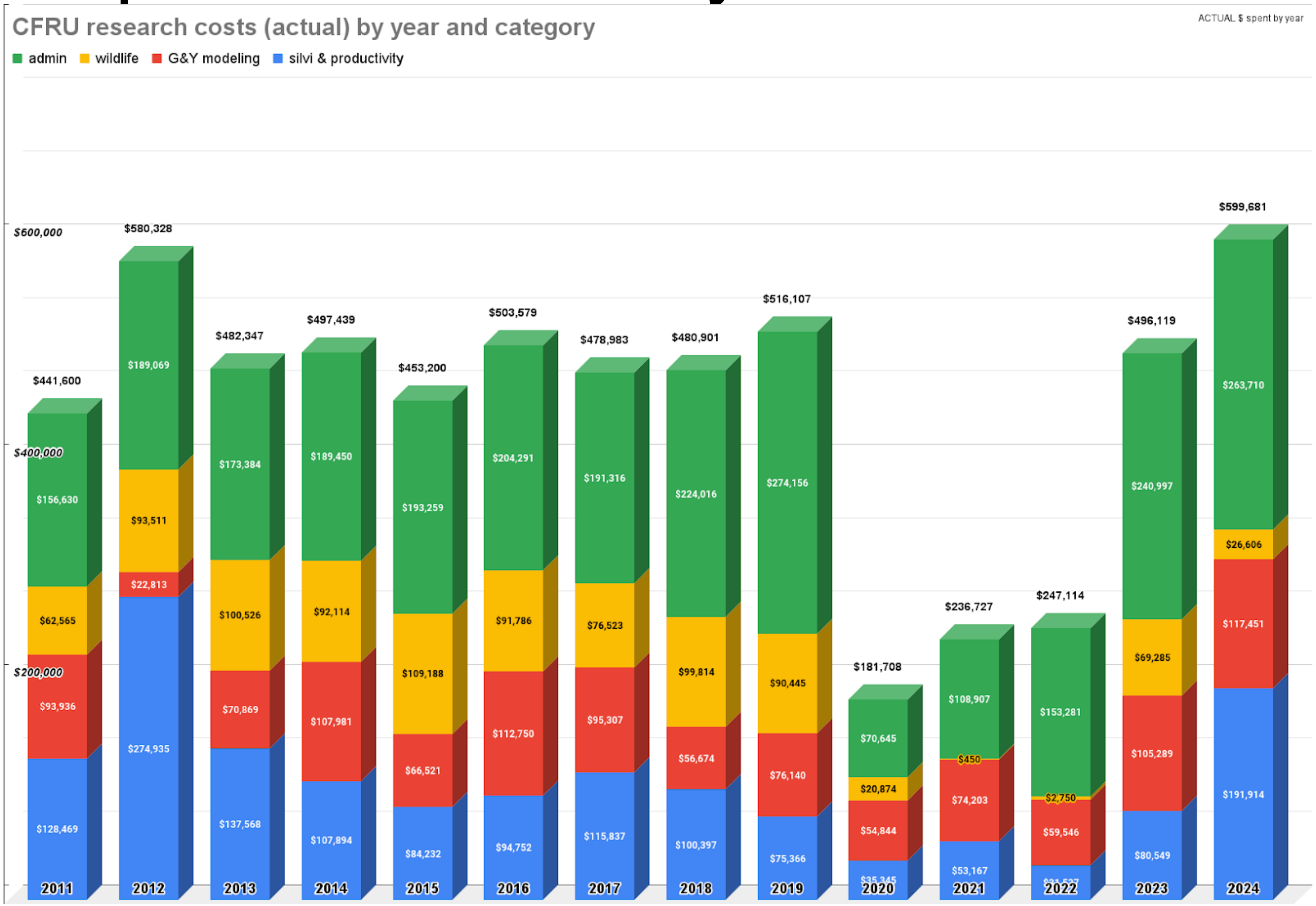
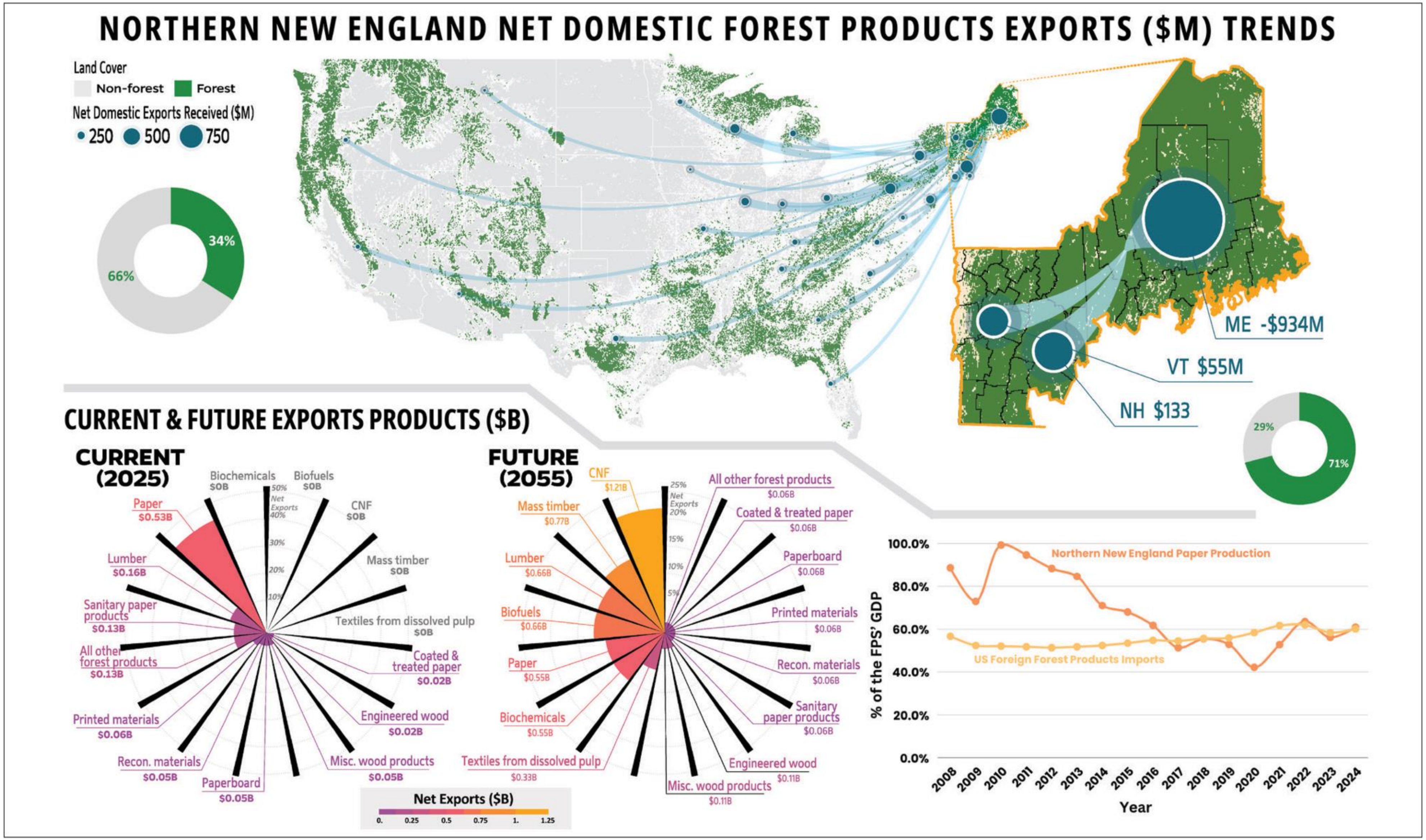
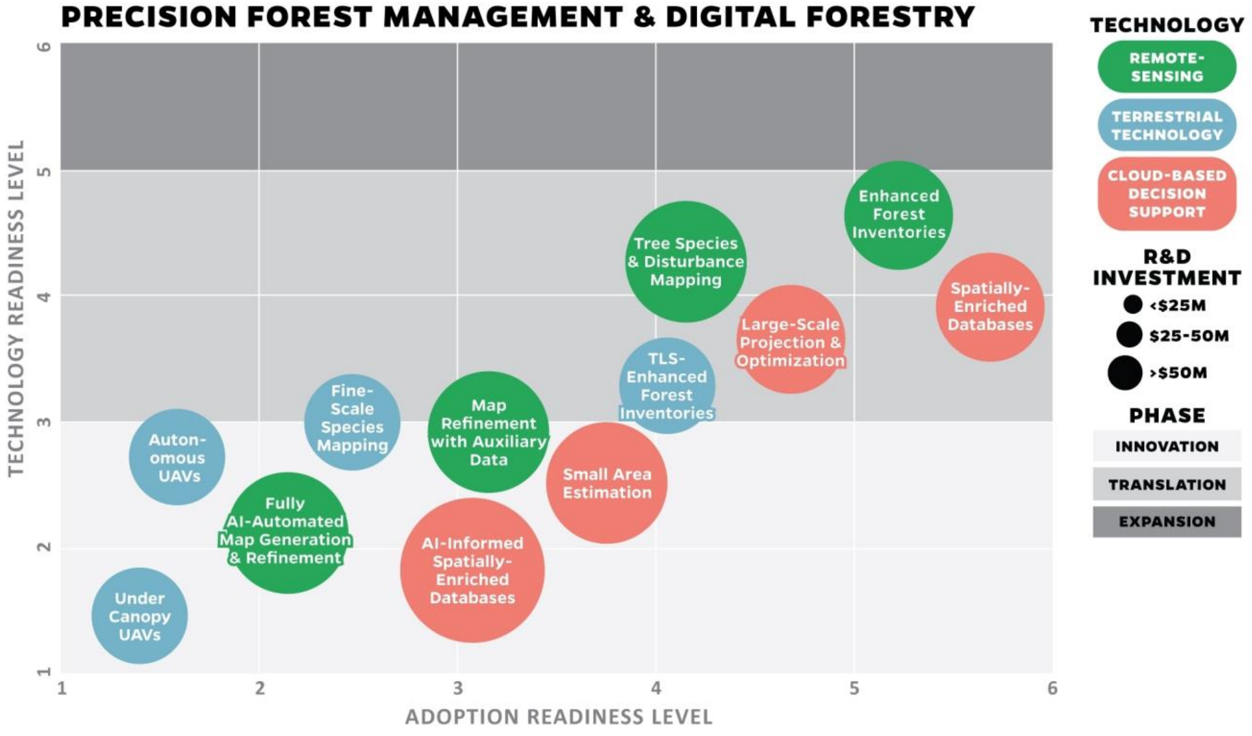


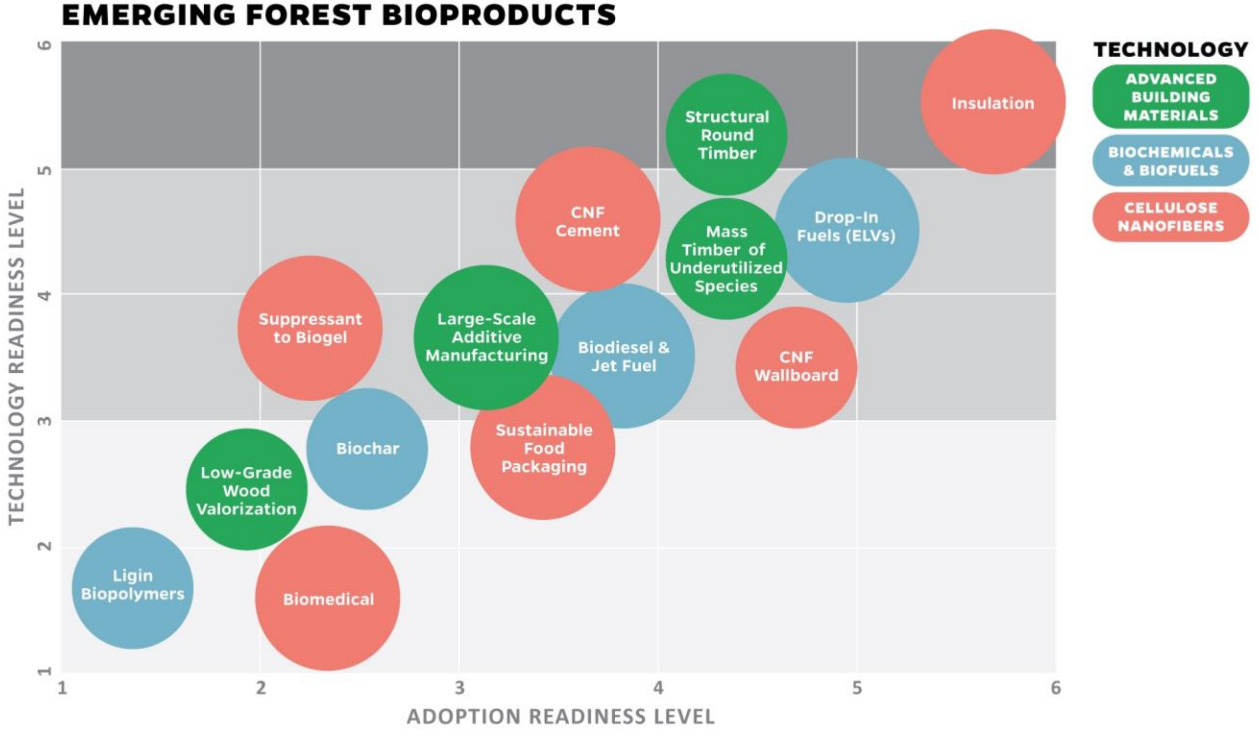
Coalition of Northern Forest Innovation & Research (CONFIR)



National Science Foundation Regional Innovation Engine Type-1 $1M award and $160M proposal submitted April 15

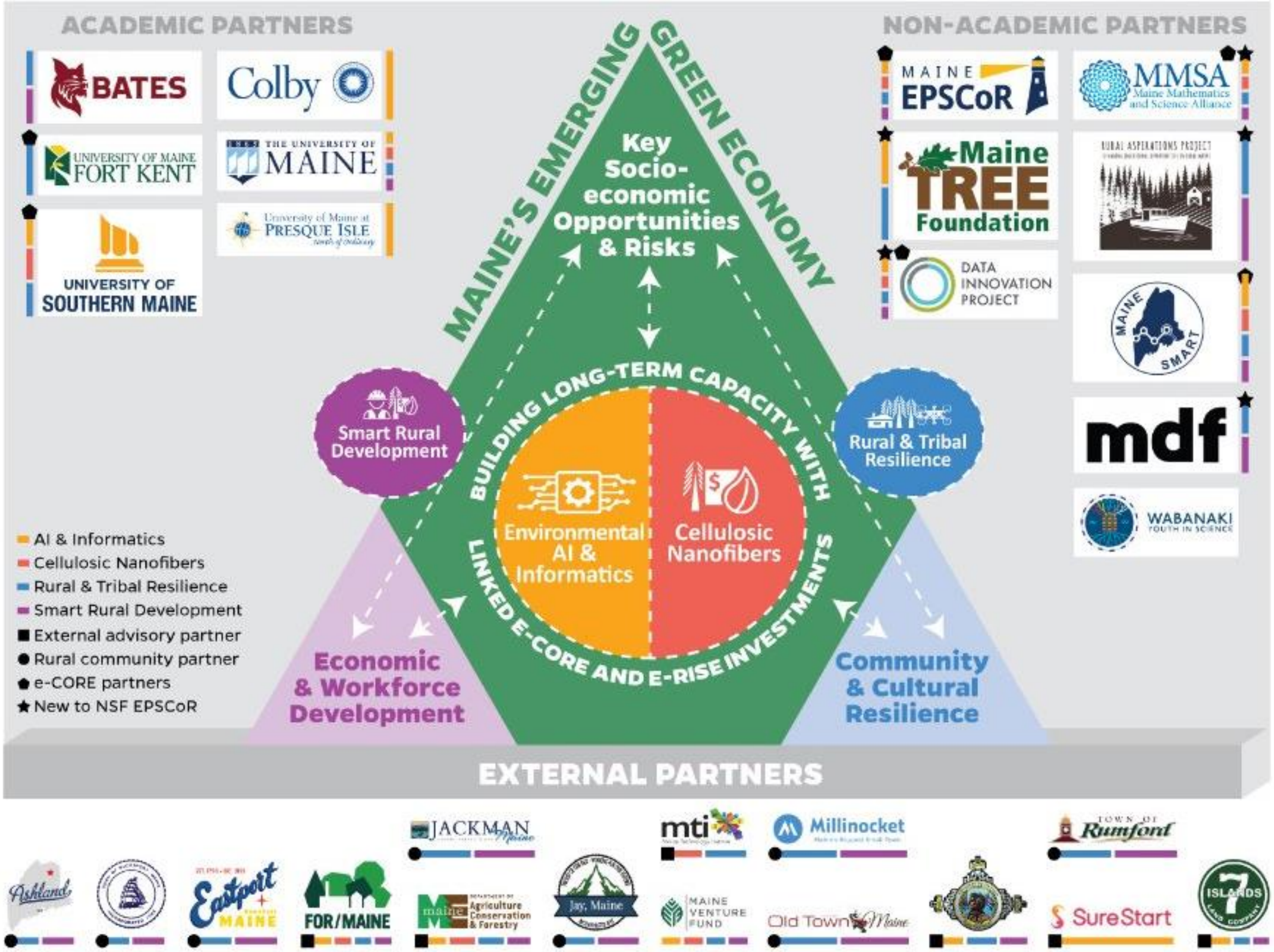
Coalition of Northern Forest Innovation & Research (CONFIR)



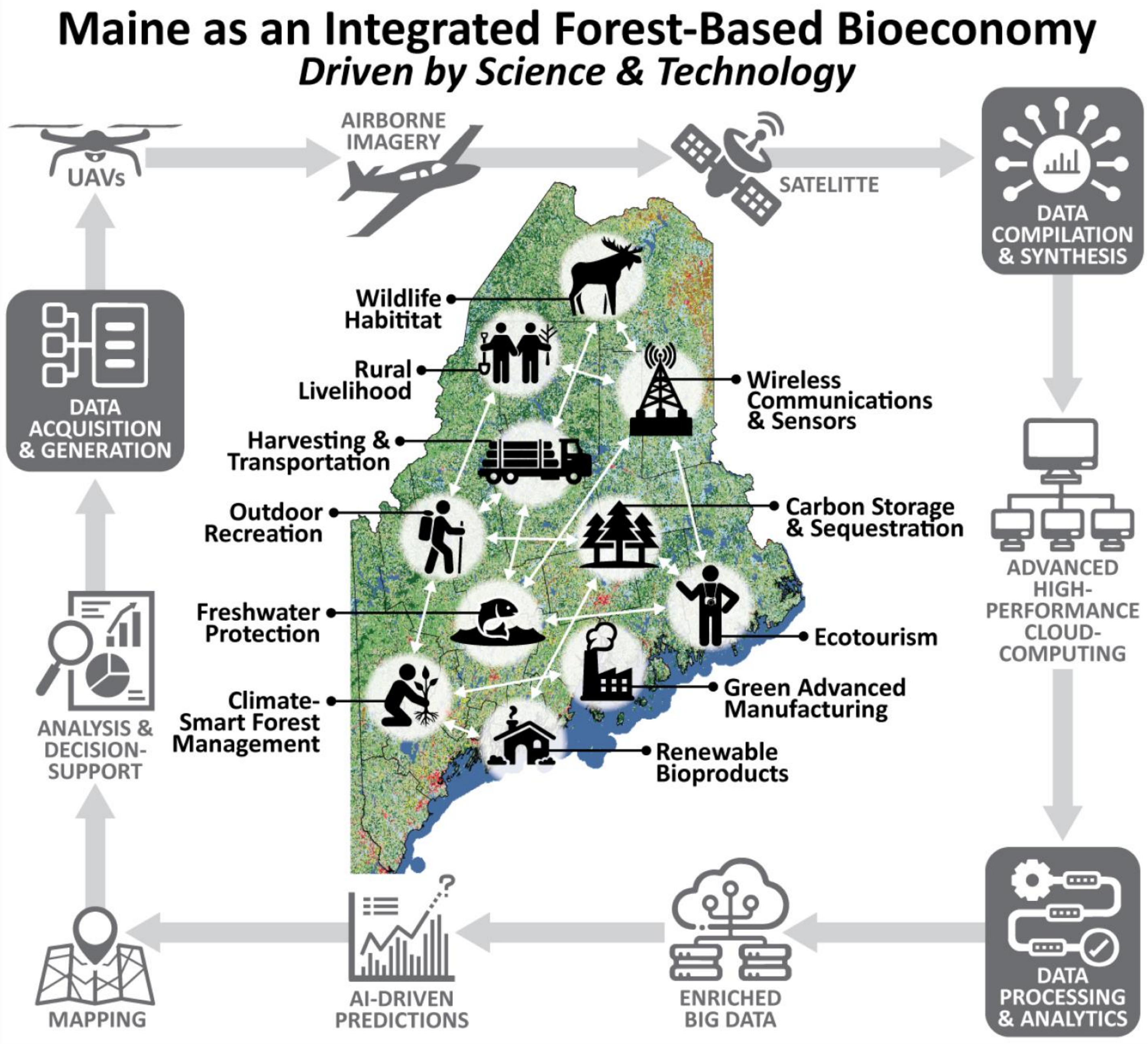


Accelerate the development and commercialization of technologies related to precision forestry and wood-based bioproducts

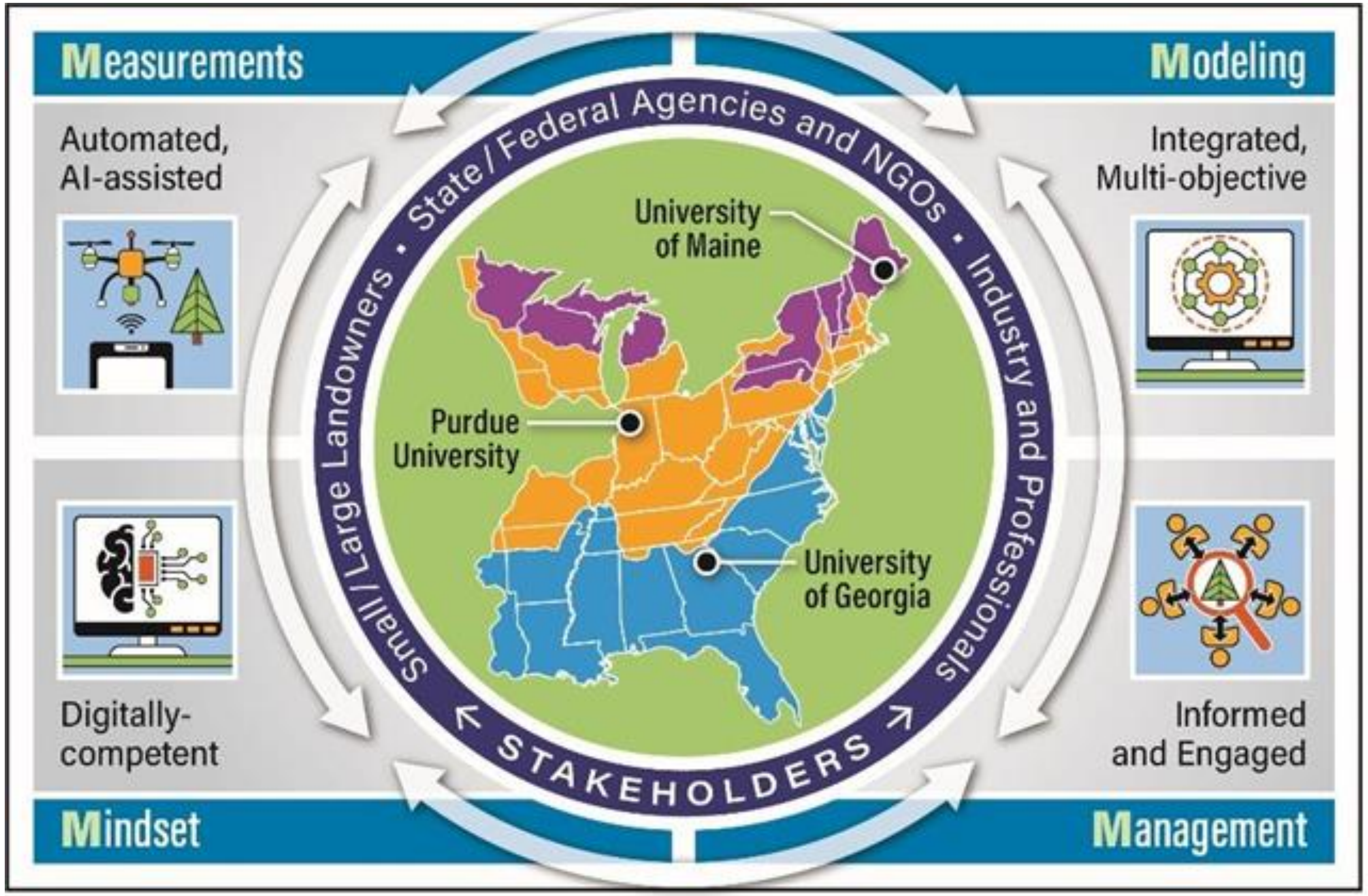
Maine-FOREST $12M NSF Award



Maine-FOREST $12M NSF Award



PERSEUS $10M USDA Award



Advanced Workforce Development

- Increased diversity in forestry workforce (S/M/L)
- Interdisciplinary pathways (S/M)
- Informed practitioners (S/M)
- Digitally-competent students (L)

Resilient Eastern Forests

- Educated stakeholders (S/M)
- Climate-smart management (S/M)
- Increased carbon sequestration (S/M/L)
- Increased timber and fiber production (M/L)
- Reduced environmental footprint (L)
- Sustainable ecosystem services (L)

Enhanced Economic Resilience

- Narrowed digital divide (S/M)
- Informed policymaking (S/M)
- Enhanced carbon market viability (M/L)
- Reduced volatility (M/L)
- Improved rural development (L)

KEY

Major Forest Ecoregions in Eastern US: Northern Transition (40.5M ha); Central Hardwoods (54.7M ha); Southern Pine/Mixed Hardwoods (52.8M ha)

Goals: S = Short-term; M = Medium-term; L = Long-term

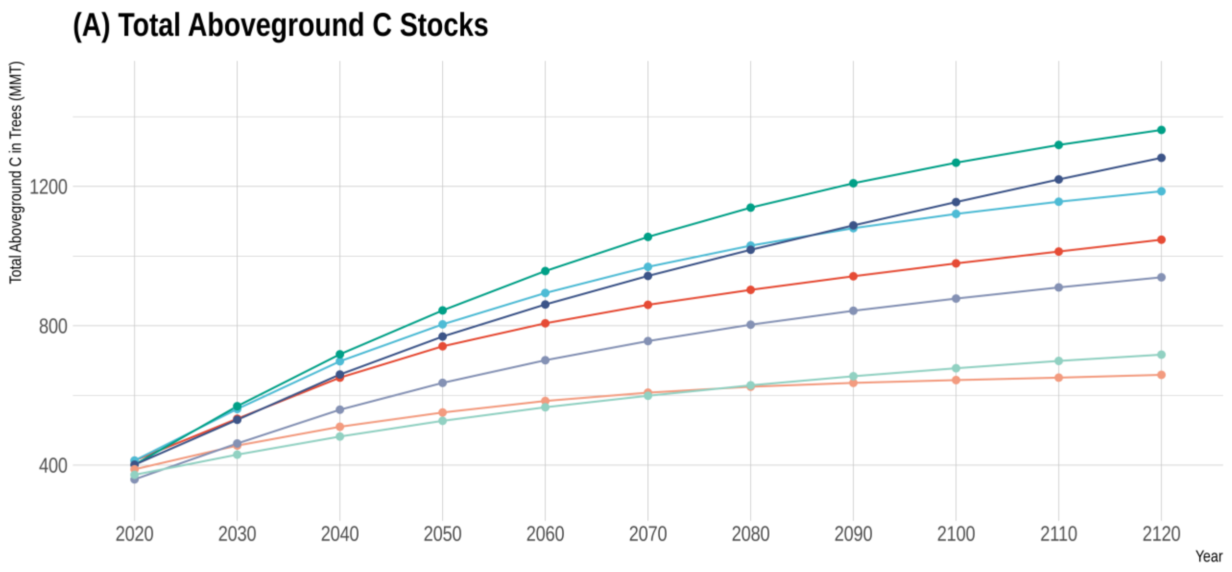
PERSEUS $10M USDA Award

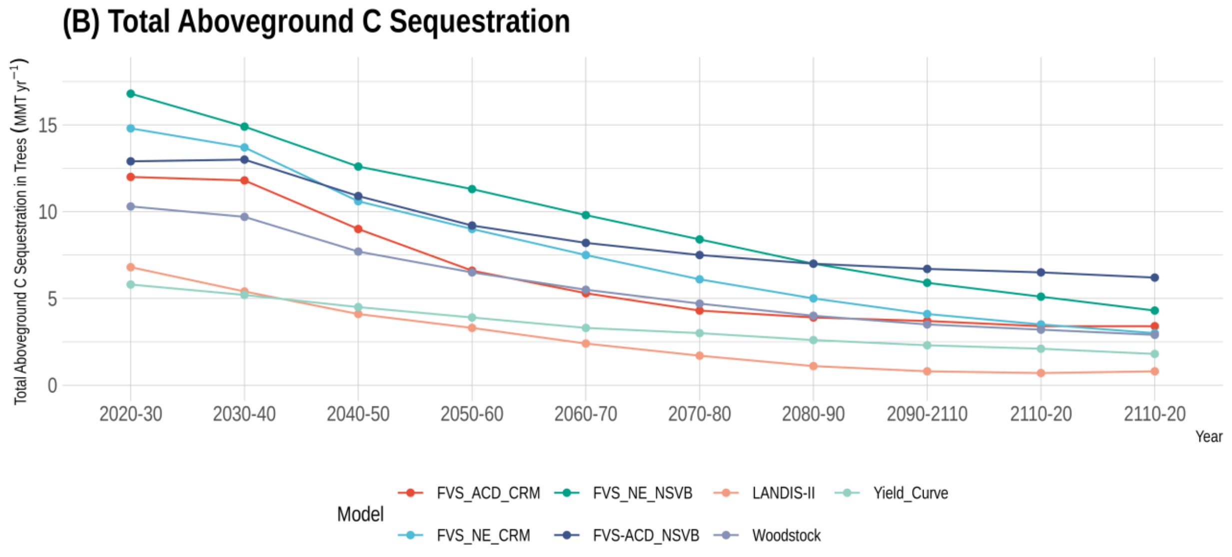
Support Tool Category and Definitions	Mean (SD)* Round 2	Round 3
Imagery This tool would feature low-cost, freely accessible 2D/3D imagery, including 3DNAIP, GEDI, and LiDAR. These data would allow new opportunities to extract important information for management, including forest canopy height and biomass estimates.	16.4 (10.1)	17.2 (11.4)
Forest Structure & Species Composition Maps This tool would allow use of remote sensing-derived forest structure and species composition information for objectively identifying and classifying specific forest structural information, such as density and basal area by species within a given area.	15.7 (9.4)	17.0 (9.0)
Inventory & Decision-Support Software Systems This tool would provide up-to date, precise forest inventory assessment software to aid in forest management. This would involve stand optimization and planning applications that can inform stand-level decision-making, like assigning relevant metrics (e.g., habitat, site quality, volume, etc.).	13.8 (9.4)	13.0 (9.3)
Forecasting Climate Change Impacts This tool would allow users to explore models that help explain predicted ranges of future climate change impacts on forest ecosystems (e.g., tree species distributions, growth and productivity, etc.). This includes tools that help forecast potential climatic changes to aid in forest management (e.g., culvert planning, disturbances, extreme weather events, etc.).	10.1 (7.4)	10.2 (6.9)
Digital Soil Maps This tool would describe soil types within a designated area and provide applicable management options, as well as include metrics for site productivity.	9.7 (7.9)	10.2 (7.9)
Improved Forest Volume, Biomass, & Carbon Models This tool would allow users to explore forest volume, biomass, and carbon models, and use improved estimation methods for evaluating these tree- and stand-level attributes.	10.1 (6.5)	9.7 (7.5)
Mapping/Classifying Land Use & Cover This tool would provide land coverage and land use delineations that can distinguish plantations, areas of operability, and forest type (e.g., dominant size class, hardwood vs softwood).	8.9 (7.2)	8.8 (6.8)
Harvest Mapping This tool would collect and maintain data surrounding harvests that could support decision-making in real-time. This would include the ability to efficiently record and update stands post-harvest, as well as select future areas for timber extraction.	9.1 (6.5)	7.8 (5.8)
Market Availability & Accessibility This tool would show all available markets and distance to mills. This would give managers more confidence to make decisions when planning tree planting or providing harvest recommendations.	6.1 (6.8)	6.0 (7.1)

*Participants distributed a total of 100 points across all nine tools. More points assigned to a tool signifies that forestry professionals consider that tool a higher priority for development.

PERSEUS Multi-Model Comparison

- Statewide comparisons of project carbon stocks and annual sequestration rates conducted in Maine using available FIA data
    - 4 models: FVS, LANDIS-II, Yield Curve, & Woodstock
- 2x difference in project total carbon after 100 years
- FVS-NE provided highest projected rates of carbon sequestration, while LANDIS-II and Yield Curves were most conservative
- Projections assumed no management and current efforts underway to assess management influences





Intelligent GeoSolutions

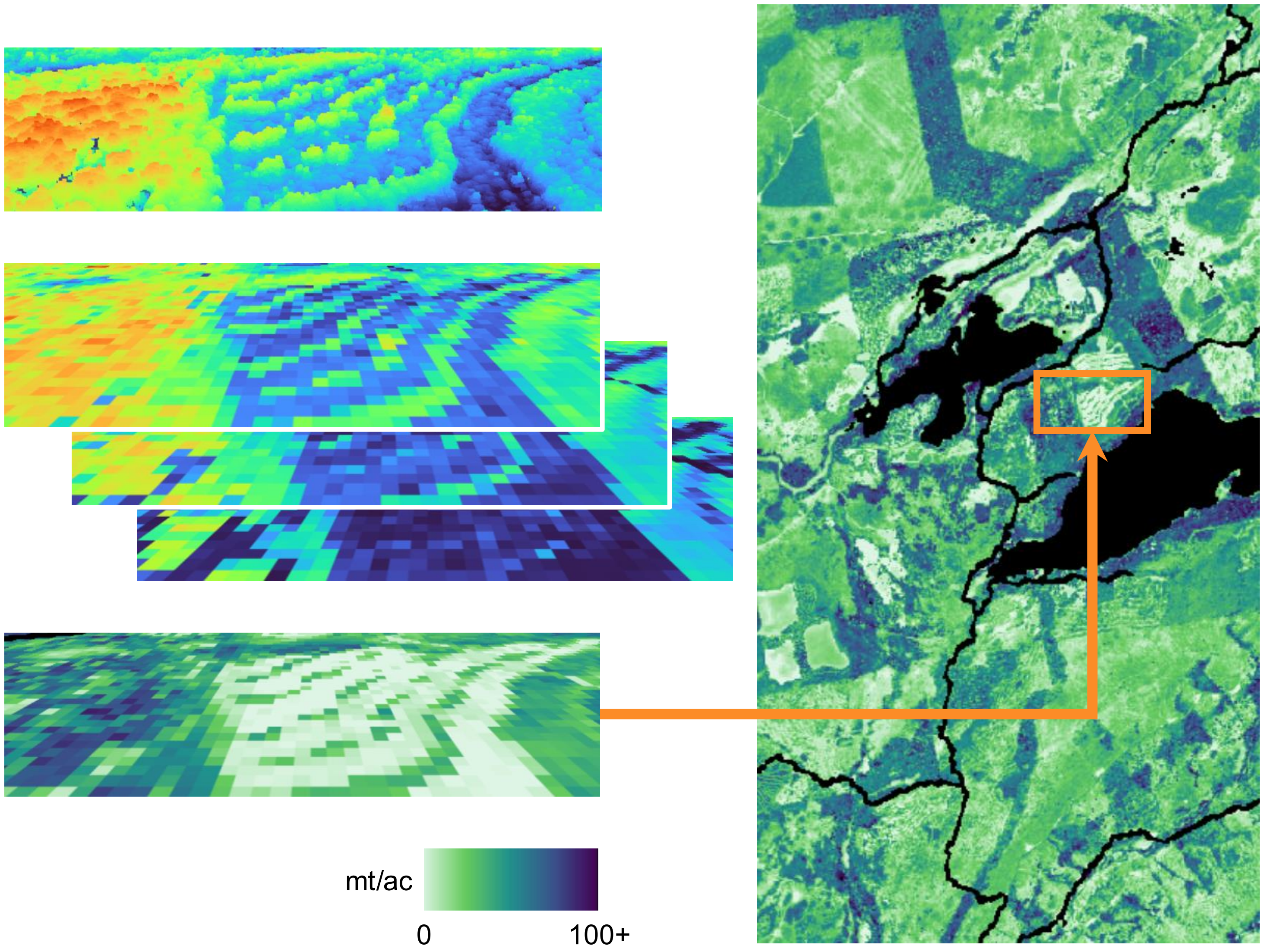
Methods

Statewide biomass mapping from 2021 NAIP

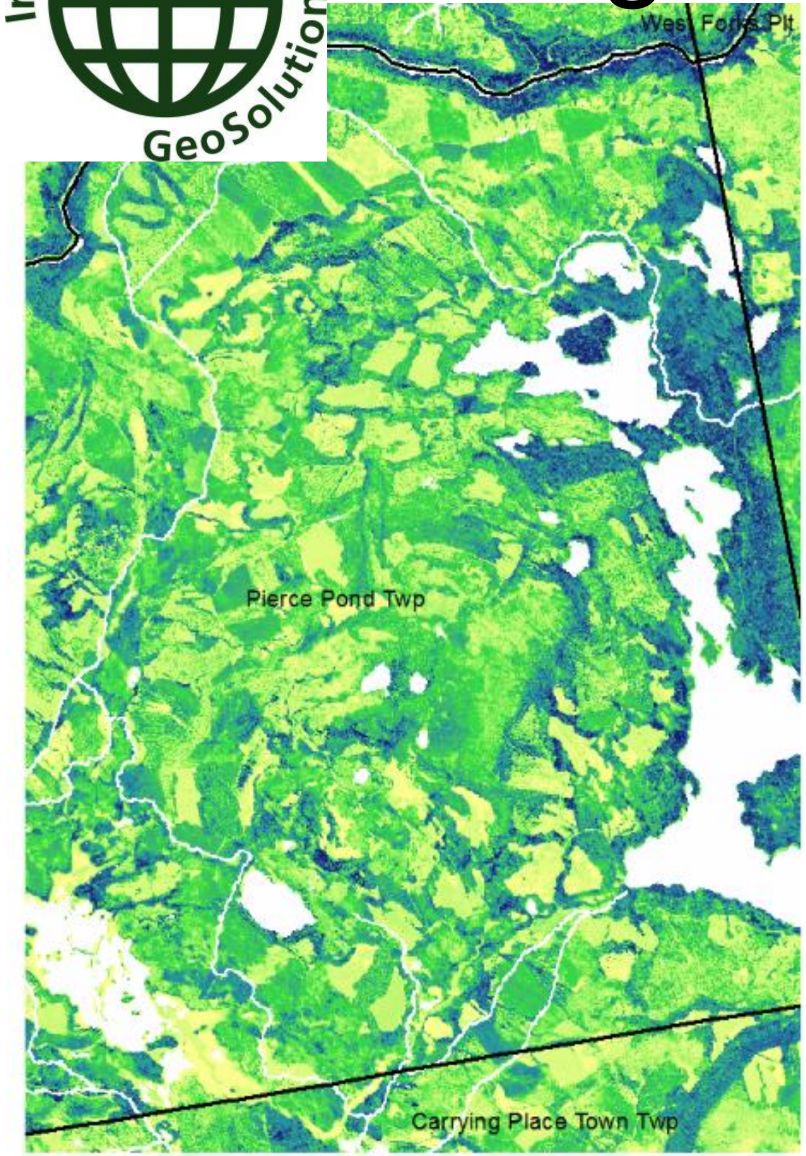
2021 NAIP DSM:

Height metrics computed over 10-meter grid:

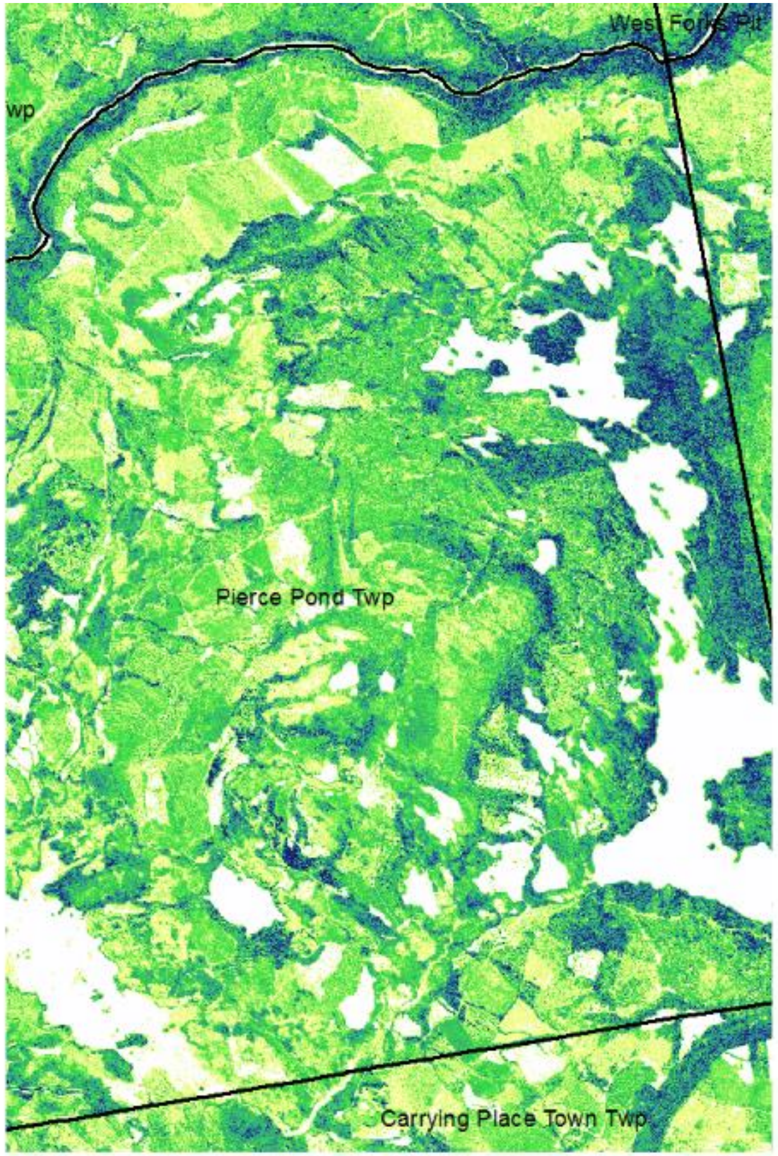
Biomass from ML models trained at FIA plots:



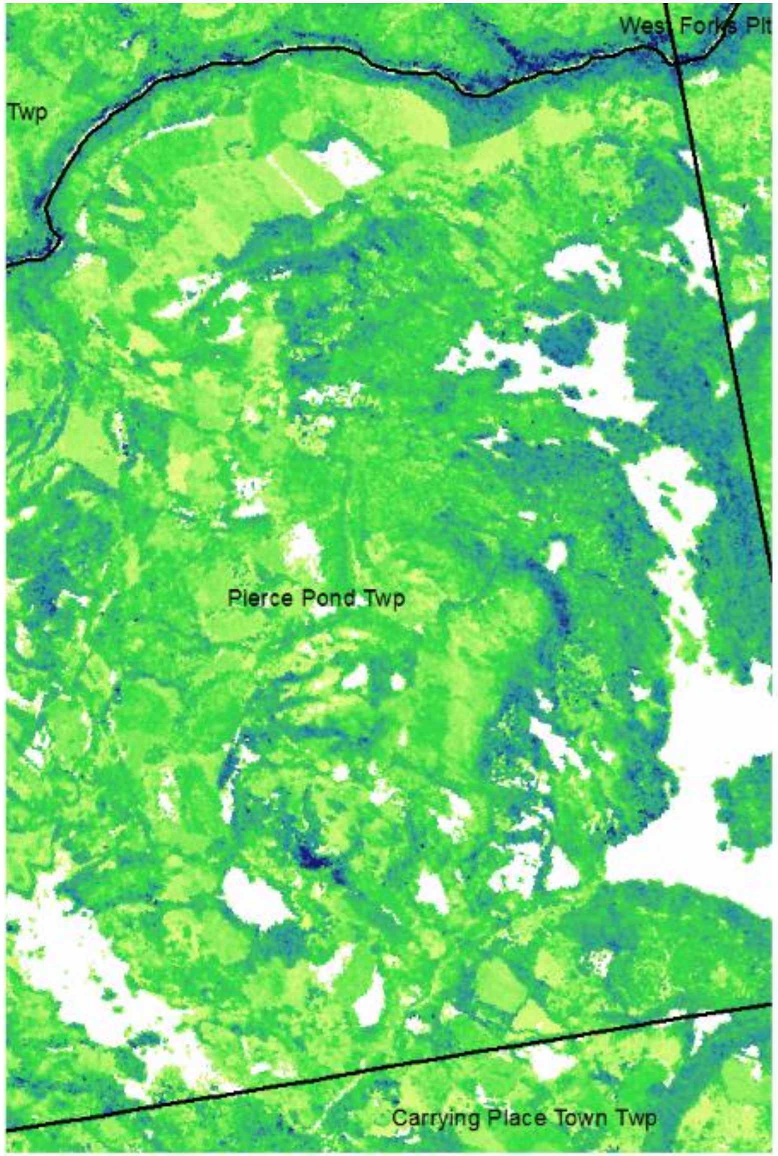
Intelligent GeoSolutions



Legaard et al., 2021



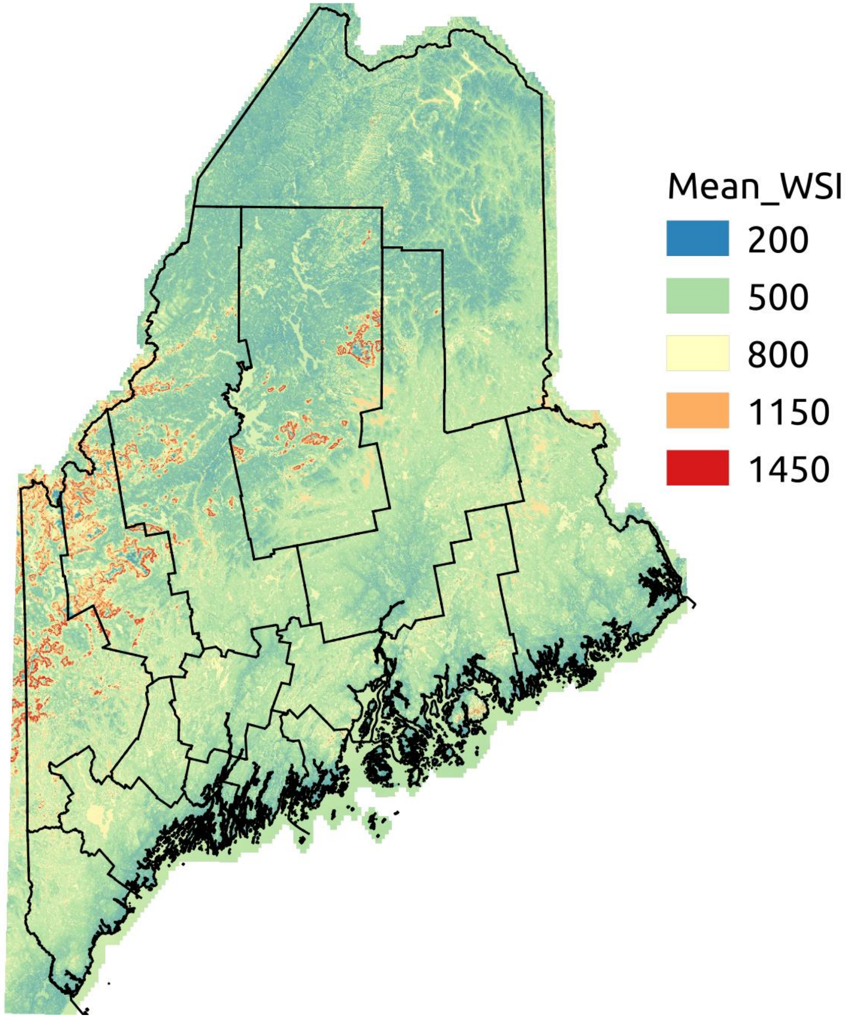
Ayrey et al., 2015



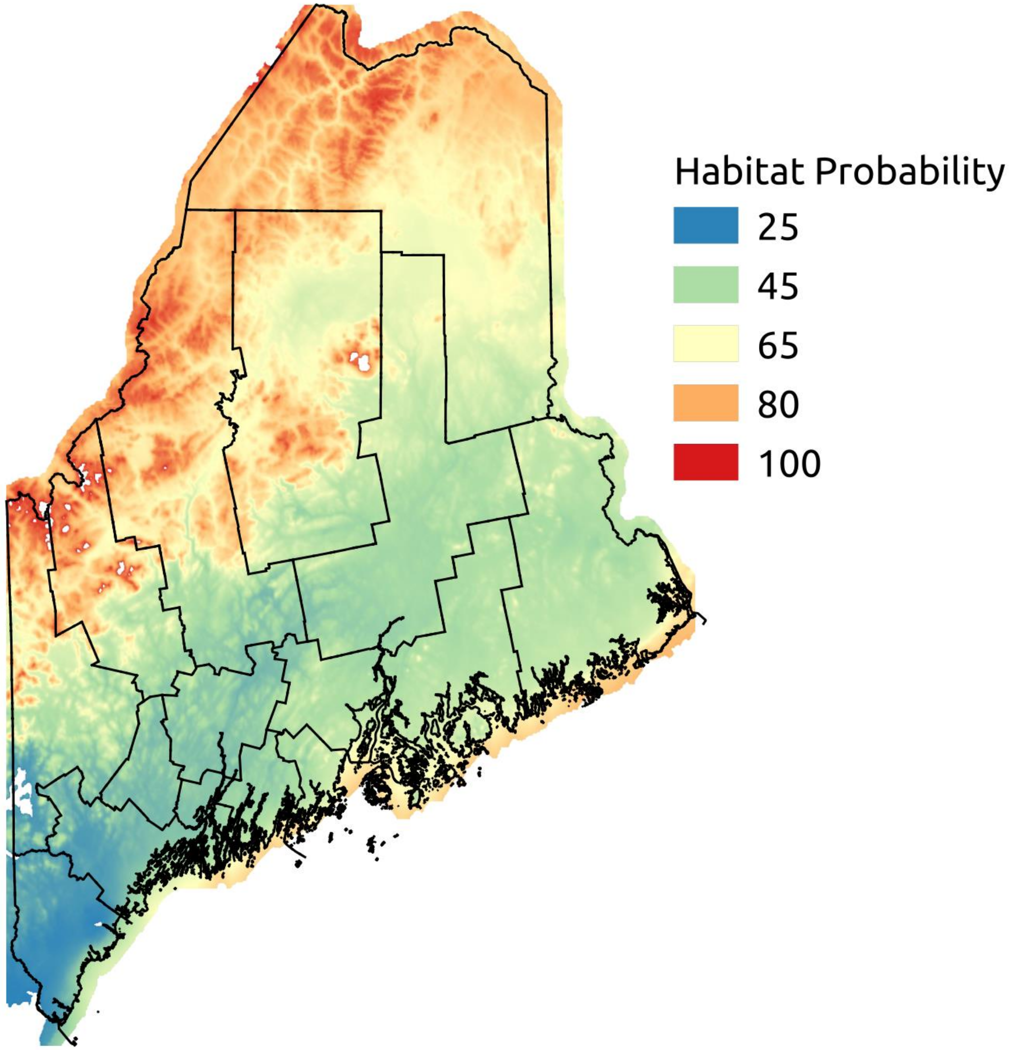
Tang et al., 2015

Maine Forest Management Lab (Mike Premer)

Water Stress Index

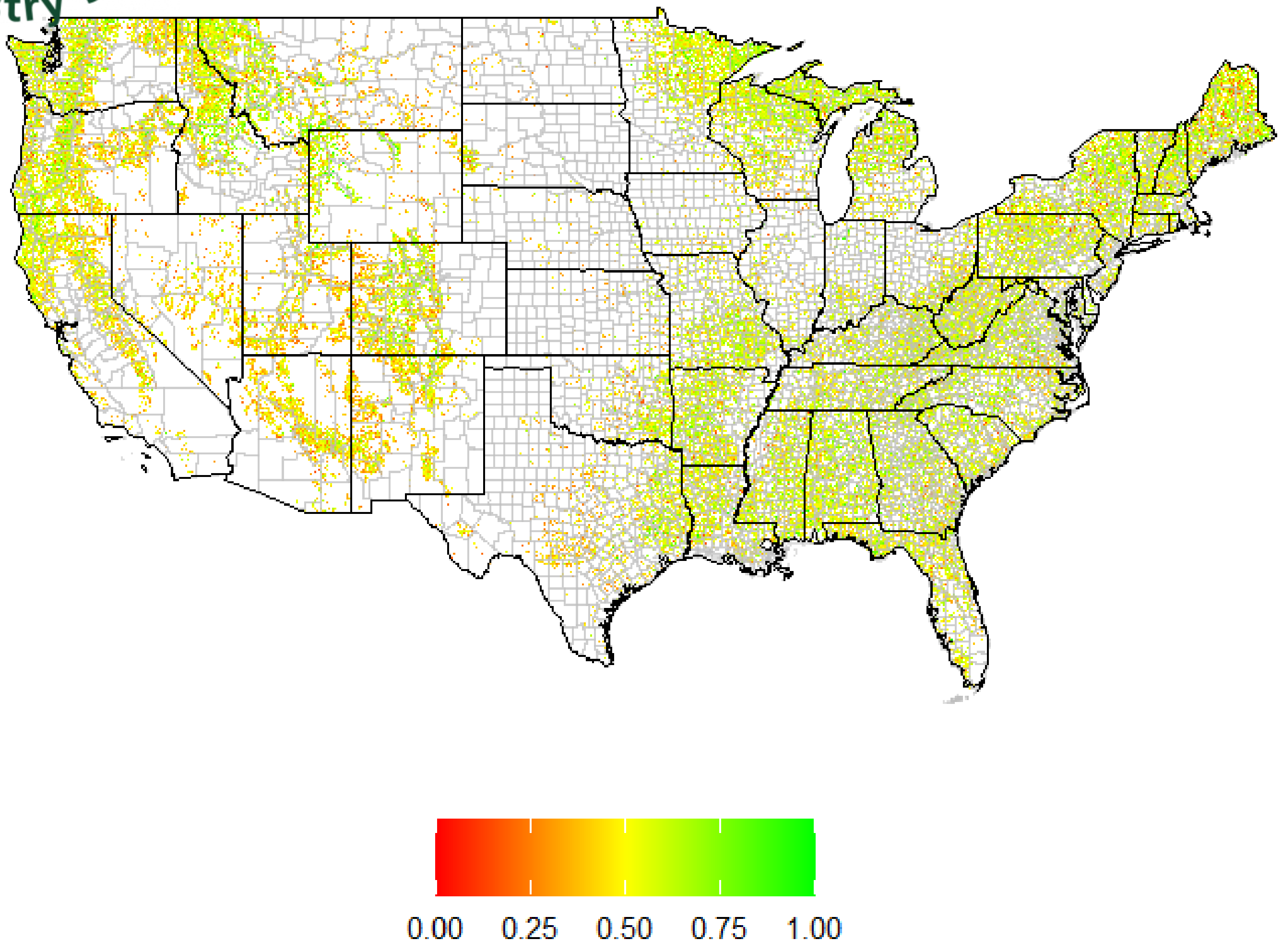


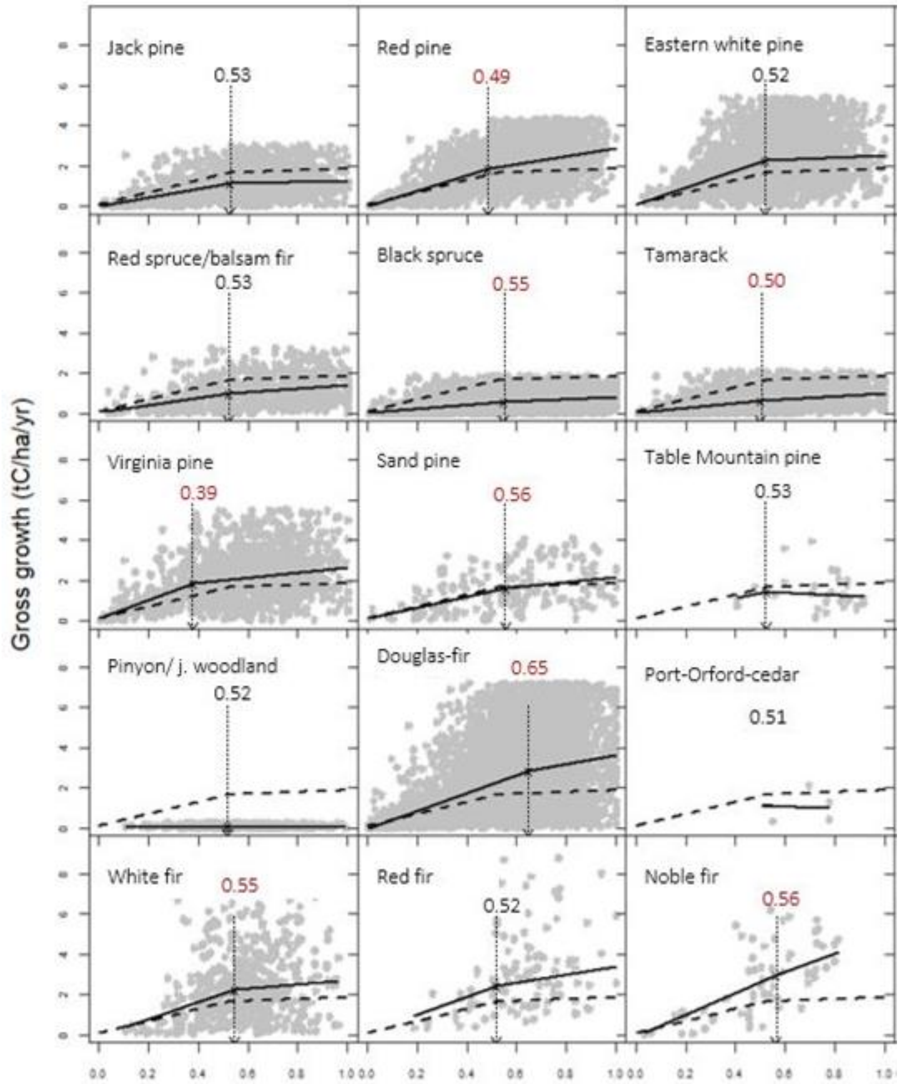
Red spruce occurrence



Development of high-resolution digital soil and species habitat maps

Emmerson Chivhenge's Dissertation





CONUS-wide map of relative density and linkage to net growth by FIA forest type

Questions/Comments?

aaron.weiskittel@maine.edu