

Adaptive Silviculture for Climate Change (ASCC)

Established: 2014 as the first installation in a nation-wide effort to provide operational scale, climate adaptation demonstrations in different forest types.

Investigators: Brian Palik, Linda Nagel, Anthony D'Amato, Jacob Mueller, Lisa Schulte-Moore, Rebecca Montgomery

Location: Cutfoot Experimental Forest

Forest type: Fire-dependent northern dry-mesic mixed woodland (FDn33a)

Current condition: 180 ft²/ac-90% red pine; overly dense, dense shrub layer

Issue: Red pine, and associated southern boreal tree species, are projected to have moderate to large reductions in habitat suitability with climate change, which for north central MN includes a substantial reduction in growing season precipitation.

Tree Atlas predictions for regional species:

Reduced habitat suitability: trembling aspen, balsam fir, paper birch, jack pine, bigtooth aspen, white spruce, red pine

Increased habitat suitability: bur oak, red maple, bitternut hickory, black cherry, white oak

Little change: eastern white pine, northern red oak

Managers need scientifically sound, on-the-ground demonstrations of adaptive management approaches that confer resistance or resilience to climate change or that transition forest to a future-adapted condition, with a goal of maintaining functional, healthy forests on the land.

Research objectives: Compare key variables (composition, productivity, health) among three climate change adaptation strategies, of resistance, resilience, and transition (response), following Millar et al. 2007.

Design: randomized complete block with 4 treatments in 5 blocks. Treatment stands are approximately 25 ac each (500 ac total)

Timeline

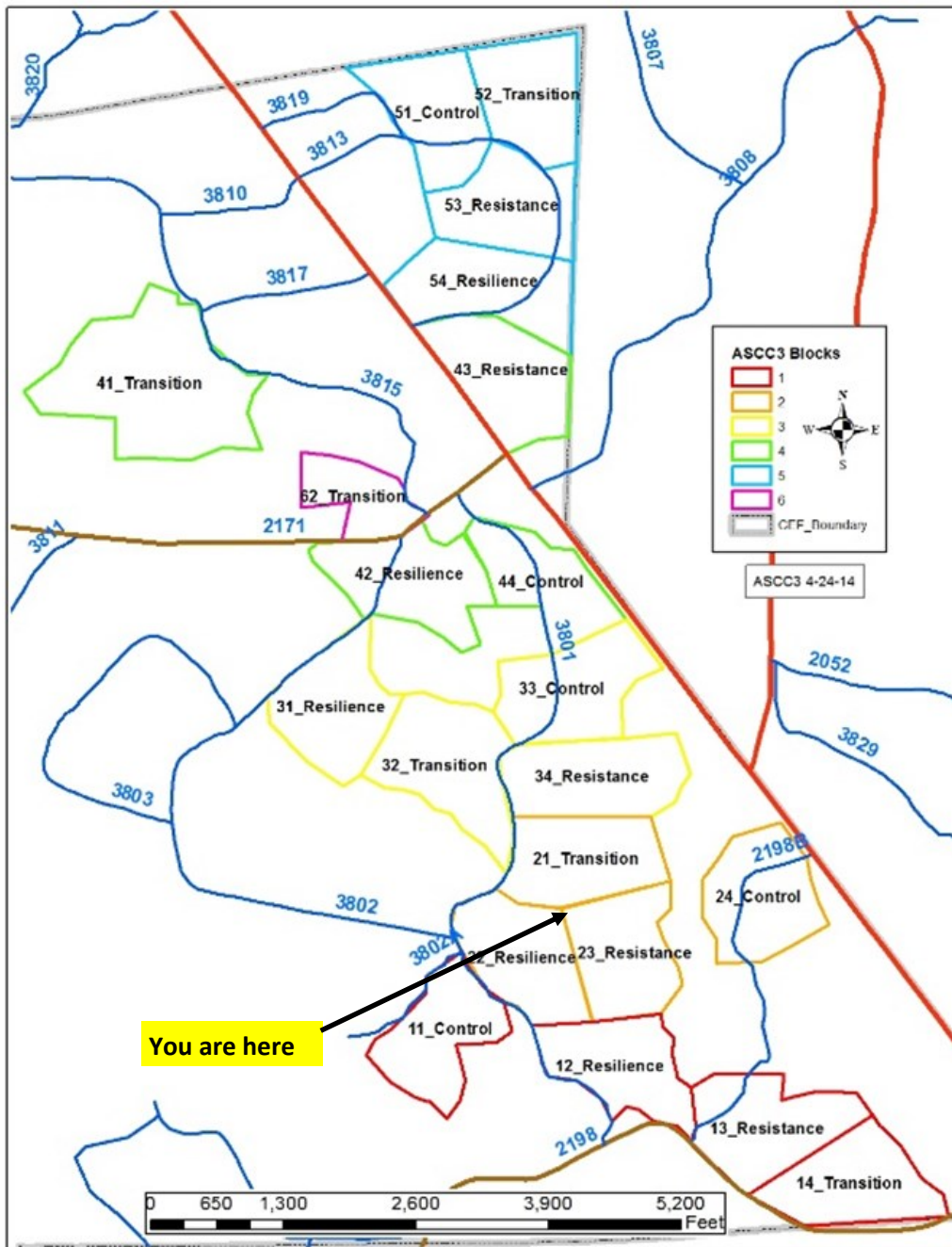
Harvested winter 2014-15

Site preparation summer 2015

Planting spring 2016

Several years of fall bud capping of pines and late spring manual shrub reduction

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Timber Harvest: total-9,743 ccft; pine sawtimber-7,738 ccft; hardwood sawtimber-96 ccft; pine pulp-1,416 ccft; harwood pulp-493 ccft
Planted: 275,000 seedlings

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Treatments:

RESISTANCE

Treatment Goal – Maintain relatively unchanged conditions over time; life boat red pine into a dryer future by increasing soil moisture during drought.

Silv Prescription – Standard Thinning. [Free] Thin to 100-120 ft²/ac, removing primarily red and jack pine to maintain existing species diversity. Protect regeneration. Reserve large-diameter trees. Revisit in 5-10 years, thin to 90-100 ft²/ac.

RESILIENCE

Treatment Goal – Maintain conditions within natural range of variation; facilitate increase in future adapted, native species.

Silv Prescription – Variable Density Thinning. Leave 15-20% of the area unthinned in 8-10 ½-acre skips (reserve areas). Cut 15-20% of the treatment area in 8-10 ½-acre gaps to provide regeneration and wildlife habitat. Disperse thin the matrix to 100-120 ft²/ac, removing red and jack pine. Retain 2-3 large-diameter oaks, white pine or red pine in gaps. Site prep in gaps with harrow disk. Plant **eastern white pine, jack pine, northern red oak, bur oak, and red maple** at a total density of 1000 tpa in gaps only.

TRANSITION

Treatment Goal – Actively facilitate change to encourage adaptive responses to maintain conifer dominated forest.

Silv Prescription – Irregular Shelterwood – Femelschlag. Cut 15-20% of area in 8-10 ½-acre gaps to provide regeneration and meet wildlife objectives. Thin the matrix (70-80% of the area) to an average 60-80 ft²/ac. Site prep with harrow disk. Plant to a total density of 1000 tpa in gaps and matrix. Revisit in 15-20 years; expand gaps if regeneration is insufficient. Species planted: **northern red oak, eastern white pine, red maple, bur oak, white oak, bitternut hickory, black cherry, ponderosa pine (four seed sources).**

NO ACTION

Treatment Goal – Allow the forest to respond to climate change in the absence of direct silvicultural intervention to provide an appropriate baseline to compare adaptive treatments.

Silv Prescription – No harvest. Allow natural processes such as forest succession to occur without management. These stands serve as a reference condition to the other harvested treatments.

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Planted Tree Seed Sources

Species	Seed Source	Location Planted
Bitternut hickory	Central IL Allegan Co.,MI	General area Research Plots/General area
Black cherry	Allegan Co.,MI North Dakota Grant Co, WI	General area General area Research Plots/General area
Bur oak	Iowa Mille Lacs, Todd & Betrami Co.,MN	General area Research Plots/General area
Red maple	Van Buren CO.,MI Pine Co.,MN	General area Research Plots/General area
Northern red oak	Van Buren CO.,MI Pine Co.,MN Morrison Co., MN	General area Research Plots/General area Research Plots/General area
White oak	Kalamazoo CO., MI Mille Lac & Pine Co., MN	General area Research Plots/General area
Eastern white pine	Oconto County, WI	Research Plots/General area
Jack pine	Itasca Co.,MN	Research Plots/General area
Ponderosa pine	Custer NF Rosebud, SD Pine Ridge, SD Chadron, NE	Research Plots/General area Research Plots/General area Research Plots/General area Research Plots/General area

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What we are studying (so far):

- Residual tree survival and growth
- Planted seedling survival and growth
- Songbird communities
- FVS modeling of treatments
- Microclimate
- Natural regeneration
- Woody plant communities

Publications

Nagel, L. M., Palik, B. J., Battaglia, M. A., D'Amato, A. W., Guldin, J. M., et. al. 2016. Adaptive silviculture for climate change: a national experiment in manager-scientist partnerships to apply an adaptation framework. *Journal of Forestry* (In press).