Options for adapting forest tree species composition in a changing climate

Skagit Climate Science Consortium – Dialogue on Forests and Climate 11/19/2021 Rolf Gersonde

Rolf.Gersonde@seattle.gov



Motivation: Climate Change Effects

Background: Assisted Migration

Approaches: Adaptation and Assisted Migration



Cedar River Municipal Watershed



Motivation: Climate Change Impacts on Western Cascades Forests

- Mortality of shade tolerant western hemlock understory trees
- Mortality of overstory Douglas-fir due to drought-insect-pathogen disturbance complex





Climate Change Impacts on Western Cascades Forests

- Decline of mature bigleaf maple trees
- Die-off of western redcedar





Climate Change Impacts on Forest Management Goals

- Loss of ecological functions
- Loss of biodiversity
- Reduced resiliency
- Slower habitat recovery





Climate Adaptation Goals for Forest Management

- Maintain Ecosystem Productivity
- Increase Functional Diversity
- Limit Disturbance Impacts





Landscape Scale Forest Vulnerability





Forest Management Options for Climate Adaptation





Background: Tree species distribution and genetic adaptation to climate





Geographic distribution of Douglas-fir (USDA-FS)



The 1912 Douglas-fir Heredity Study

(St.Clair, Howe, and King JoF 2019)



- Douglas-fir can withstand a change in climate, warmer or colder, of about 2°C (4°F) and continue to survive and grow well.
- Climates are expected to warm more than 2°C over the next few decades, leading to lower survival and productivity.
- Maladaptation may take time to develop.



Survival rate from 13 populations of trees grown at five test sites in the Douglas-fir Heredity Study. Change in mean cold month temperature and continentality from the seed source to the test site had the greatest effect on survival.



Climate Envelopes



Source: Development of a Climate Based Seed Transfer (CBST) system to support forest ecosystem resilience, health, and productivity in a changing climate. BC Government, Forest Improvement and Research Management Branch, 2018



Climate Velocity and Tree Species Migration



(b) PCA velocity, 2050s to present, 100 equal interval bins



Hamann et al.: Velocity of climate change algorithms for guiding conservation and management, Global Change Biology (2015) 21, 997–1004



Assisted Migration Options



Williams and Dumroese 2014

"Assisted migration is the deliberate movement of tree species and seeds/seedlings to planting sites that will be most suited to them in predicted future climates. The goal of this strategy is to maintain the adaptability (resilience), health and productivity of planted forests in a changing climate."



Dry Douglas-fir Forest Associations (Western WA)

- Grand Fir
- Garry Oak
- Shore Pine
- Western White Pine
- Bigleaf Maple

Augment primary producers with LOCAL warm and dry adapted species and increase tree species diversity.





Assisted Population Migration and Range Expansion –

To augment primary producers with warm and dry adapted genotypes and species.

Assisted Population Migration:

- Douglas-fir (Washington, Oregon)
- Western White Pine (Oregon)
- o Big-leaf Maple
- o Grand fir

Range Expansion

- Incense Cedar (Oregon)
- Grand/white fir
- Sugar Pine





Identifying Climate Analogs with the Seedlot Selection Tool



Modeling Variables

- Species: Generic (DF, WWP, WRC, GF)
- Planting site specific
- Future climate range
- Emissions scenario
- Climate variables: Mean Coldest Month Temperature Annual Heat Moisture index
- Transfer distance of climate variables

Climate Scenario: Match Seedlot climate: 1961-1990 Low High Planting site climate: 2071 - 2100 RCP 8.5



Adaptive Restoration at Stossel Creek

PLANTING THE RIGHT TREE AT THE RIGHT SITE FOR THE RIGHT REASONS

STOSSEL CREEK IS UNDERGOING RESTORATION THAT EMPHASIZES PLANTING TREE SPECIES THAT ARE RESILIENT TO THE PROJECTED CLIMATE OF THE FUTURE.



https://www.nnrg.org/stossel-creek-case-study









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Tree species and Seed Source Selection for the Stossel Creek Climate Adaptation Project:

Grand Fir

Western White Pine

Garry Oak

Douglas-fir

Puget Sound (231) Oregon Coast Range (071) NorCal. Coast Range (092)

Western Redcedar

Puget Sound Oregon Coast Range

Incense Cedar

Oregon Coast Range

Planting site location: Lat: 47.7225°, Lon: -121.8508° Elevation: 584.0 ft Species: Douglas-fir



Climate Scenario: Match Seedlot climate: 1961-1990 Low High Planting site climate: 2041-2070 RCP 8.5

Generated by the Seedlot Selection To



Managing Risks of Assisted Migration





Focus on areas with high climate exposure

- Small scale projects with monitoring
- Add to existing community, not replacing local species/genotypes
- Add local dry/warm adapted species
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- Increase genetic diversity for climate uncertainty
- Add genotypes from multiple climate analogs
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- Incorporate planting trials



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PNW Forests - Climate Adaptation Community "Treeline"

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Treeline aims to: Engage PNW restoration practitioners, nursery partners and researchers who work for or represent tribes, indigenous groups, nonprofits, agencies, landowners, businesses and more to gather, disseminate, and discuss information and knowledge across a broad region. **Skagit Fisheries Enhancement Group** Join Us **City of Seattle** With support from regional "node" leads and a Research and Extension Team, we are planning outreach activities. Northwest Natural We want to hear from you. **Resource Group Green Seattle** Partnership Washington Please complete this survey to inform State (Pierce Washington State University **University Extension** Conservation next steps and help us learn about the Extension District actions that nurseries, practitioners **OSU** Extension and researchers are taking to support healthy forests in the face of climate **Bonneville Environmental Foundation** Scholls Valley change and other stressors. and Nesika Wilamut Native Nurserv **City of Portland Clean Water Services** Ecotrust Want to "get on the map"? **Oregon Department of Agriculture Confederated Tribes** Email Kira and let her know. More information coming of the Grand Ronde North Santiam soon on webinars and conversations. Watershed Council **Oregon State** University Treeline node leads: USDA **Forest Service** Northwest Nesika Natural Resource Wilamut **Treeline Partners** OSU Extension Group (Willamette River **Research and Extension Partners** Network) Node Leads

Bonneville Environmental Foundation

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Seattle Public Utilities

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Climate Transfer Distance with the Seedlot Selection Tool





Calculating seed source transfer distances at different projection periods

