

A Proposed Protocol for Prioritizing National Forest Seedlots for Reforestation and Restoration Given Concerns of Climate Change

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Overview:

- To ensure that reforestation and restoration treatments yield healthy, productive ecosystems that are adapted to the climates in which they are growing, a protocol has been developed by the U.S. Department of Agriculture, Forest Service, Pacific Northwest Region to match seedlots of forest trees and nontree restoration plants to potential planting sites based on predicted future climate.
- The proposed protocol has two components: (1) a methodology for determining the differences in climate between a planting site and specific seedlots in the Forest Service seed inventory for past and future time periods; and (2) use of web-based tools to visualize the differences in climate and guide both deployment and future collection of seed.
- Climatic factors important for adaptation that are used to guide seed deployment in the Pacific Northwest include winter temperatures, summer aridity, and conditions conducive to needle diseases such as continentality or summer precipitation.

Summary:

Management problem: Healthy, productive ecosystems require diverse plant populations that are adapted to the climates in which they are growing. The concept of local adaptation has been recognized as a critical component to reforestation success and forest productivity for nearly a century, leading to the development of seed zones for forest trees and, more recently, nontree restoration species. Fixed-boundary seed zones, however, assume that climates are static over time, which is no longer the case.

Management need: A protocol for matching seedlots of forest trees and nontree restoration plants to potential planting sites based on predicted future climate is needed. A methodology is needed to evaluate the climatic distance between seedlings and planting sites in order to

determine which seedlots will be suited to future climates while still being within critical climatic transfer distances in the near-term .

Silvicultural Concepts:

- Forest Service geneticists in the Pacific Northwest Region have developed a protocol for prioritizing seedlots for reforestation and restoration (St. Clair et al. in press). The proposed protocol has two components: (1) a methodology for determining the differences in climate between a planting site and specific seedlots in the USFS seed inventory for past and future time periods; and (2) use of the Seedlot Selection Tool (<https://seedlotselectiontool.org/sst/>) to visualize the differences in climate and guide future collections.

Management Applications:

- Climatic factors important for adaptation in the Pacific Northwest include winter temperatures, summer aridity, and conditions conducive to needle diseases such as continentality or summer precipitation. Seedlots in the Forest Service seed inventory are characterized for adaptation for these climatic factors, and prioritized for revegetation of a site by selecting the sources with a minimum climatic transfer distance for a mid-century warmer climate while still being within critical climatic transfer distances for summer aridity and continentality, as well as for winter temperatures in the near-term to avoid cold damage.



Seedlot Selection Tool

About Tool Layers Saved Runs

4 Select climate scenarios
Which climate are the seedlots adapted to?
1961 - 1990
When should trees be best adapted to the planting site?
2041 - 2070 RCP8.5

5 Select transfer limit method
Custom Zone Function
Select a species
Generic
Select zone
USFS Generic Breeding Zone 03012, 1500 - 2500

6 Select climate variables
Units: Metric Imperial
Name Center Transfer limit (+/-)
MCMT 3.3 °C 1.75 °C
SHM 66.3 21.0

Figure 1—Sample Seedlot Selection Tool settings.

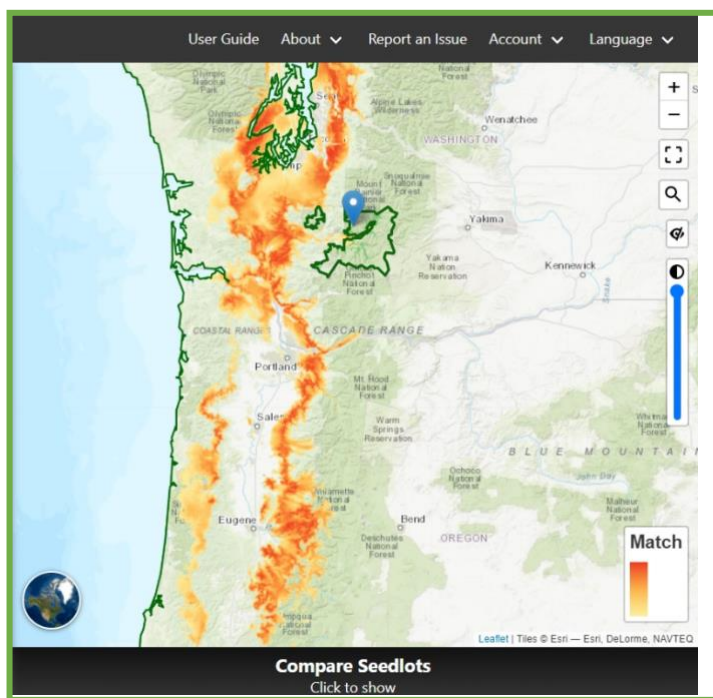


Figure 2—Sample Seedlot Selection Tool mapped output.

Table 1—Example of spreadsheet developed to calculate climatic transfer distance between seedlots in inventory and planting site for recent past and three future time periods.

Climatic Transfer Distances					MCMT	MCMT	MCMT	MCMT
For seedlots in Forest Service inventory westside National Forests					1961-1990	2011-2040 RCP8.5	2041-2070 RCP8.5	2071-2100 RCP8.5
Climate at planting site:					0.80	2.20	3.40	5.00
Climate change at planting site:					0.00	1.40	2.60	4.20
Sort ID	Seedlot ID	Breeding zone	Elev. band	Species	1961-1990	2011-2040 RCP8.5	2041-2070 RCP8.5	2071-2100 RCP8.5
135	PSME-11-082-01000-20-71	82_2000	2500	PSME	-4.36	-2.96	-1.76	-0.16
226	PSME-12-12031-400-0010-89 SB	12031	5000	PSME	-4.20	-2.80	-1.60	0.00
227	PSME-12-12031-500-85 SB	12031	3000	PSME	-4.20	-2.80	-1.60	0.00
228	PSME-12-12031-502-85 SB	12031	1500	PSME	-4.20	-2.80	-1.60	0.00
221	PSME-12-12021-400-0010-89 SB	12021	3000	PSME	-3.86	-2.46	-1.26	0.34
222	PSME-12-12021-400-0010-90 SB	12021	2000	PSME	-3.86	-2.46	-1.26	0.34

Reference

St. Clair, J.B.; Richardson, B.S; Stevenson-Molnar, N.; Howe, G.T.; Bower, A.D.; Erickson V.J.; Ward, B.; Bachelet, D.; Kilkenny, F.F.; Wang, T. [In press.] Seedlot Selection Tool and Climate-Smart Restoration Tool: web-based tools for sourcing seed adapted to future climates. Ecosphere.