PROVISIONAL SEED ZONES FOR NATIVE PLANTS

Andrew Bower[1], Brad St. Clair[2], and Vicky Erickson[3]

[1] Area Geneticist, USFS Pacific Northwest Region, Olympia, WA (Email: abower@fs.fed.us)
[2] Research Geneticist, USFS Pacific Northwest Research Station, Corvallis, OR (Email: bstclair@fs.fed.us)
[3] Regional Geneticist, USFS Pacific Northwest Region, Portland, OR (Email: verickson@fs.fed.us)

BACKGROUND

Deploying vigorous, well adapted, and ecologically appropriate plant materials is a core component of a successful restoration project. The key to identifying appropriate plant materials (e.g. seeds) lies in understanding the genetics of adaptation through common garden studies or reciprocal transplant experiments. However, restoration practitioners are frequently required to make seed collection and deployment decisions for species and landscapes which lack seed zones and transfer guidelines established through genetic research. So what are practitioners to do when no seed transfer guidelines exist for a species of interest?

SEED ZONE = an area within which plant materials can be transferred with little risk of being poorly adapted to their new location.

One approach for choosing germplasm in the absence of genetic information is to try and match the seed source and planting site conditions as closely as possible. Our provisional seed zone model provides a powerful decision support tool for characterizing site conditions and choosing plant material sources that originate from similar environments. The model integrates climate factors that are known to affect plant survival and growth (temperature and precipitation) and ecological factors. It builds on earlier efforts such as USDA plant hardiness zones (Cathy 1990, www.arborday.org) and "Plant Adaptation Regions" (PARs, Vogel et al. 2005). The provisional zones can be utilized to guide movement of plant material until species specific information becomes available via genetic research studies on adaptive traits.

METHODS

The provisional seed zones were delineated using overlays of high resolution (800x800m) observed temperature and precipitation data (PRISM, http://www.prismclimate.org) in combination with Level III ecoregions (Omernick 1987, 1995, U.S. EPA 2003). ArcMap version 9.3 (ESRI, Redlands, CA) was used for all analyses.

Climate variables used in the delineations include (1) winter minimum temperature (December-February), (2) maximum mean monthly temperature and (3) annual precipitation. All variables were derived from climate normals for the period 1971-2000. Winter minimum temperature was classified into 5°F bands that ranged from <10° to >55°. Maximum temperature was classified into 10°F bands, ranging from <60° to >100°. Annual precipitation was classified into six bands: <10", 10-14", 14-24", 24-48", 48-100", and >100". The Union function of ArcMap was used to intersect the minimum winter

temperature and maximum temperature layers individually with the annual precipitation layer to create unique climatically delineated (temperature-precipitation) provisional seed zones. Omernick's level III ecoregions were then superimposed on the climatic zones to identify areas that differ ecologically despite having similar temperature and precipitation regimes.

RESULTS

We propose two set of provisional seed zones (Fig. 1). For trees, shrubs, and woody vegetation with apical buds, we recommend the use of provisional seed zones based on minimum winter temperature and annual precipitation. For grasses and herbaceous plants that usually die back during the winter, there is evidence that summer temperatures (and associated aridity) are more of a limiting factor to plant survival and growth (Johnson et al., submitted; St. Clair et al. unpublished data). For these taxa, we propose the set of provisional seed zones based on average maximum temperature and annual precipitation. Ecoregion delineations may be added as "soft" boundaries to aid in determining appropriate movement of plant material within a seed zone, as compared with the "hard" boundaries delineating areas of differing climate.

Some caveats regarding the provisional zones:

- They are NOT species specific.
- They're intended as guidelines for species and geographic areas for which there is currently no data available on genetic diversity and local adaptation.
- A particular species is likely to occur in only a subset of the delineated seed zones.
- Microsites must be appropriate for the species (e.g., use riparian species on riparian sites, not dry upland sites).
- Provisional seed zones are a "starting point". Genetic information is still needed.
- Local and species specific knowledge can be used to adjust zones.

Analysis is ongoing to compare the provisional seed zones with species-specific seed zones based on measurement of adaptive traits in common garden studies. The results will be published in a peer-reviewed journal. In the meanwhile, National Forests in the Pacific Northwest and elsewhere are evaluating and adopting the provisional seed zones as a first choice for plant material collection and use when genetic data are unavailable.

Users may view provisional seed zone maps and download data by visiting the following website: http://www.fs.fed.us/wwetac/threat_map/SeedZones_Intro.html

Species-specific seed zones from common garden studies are also available on this website. The viewing and mapping applications range in functionality from a simple geobrowser (requires only a web browser) to ArcGIS ArcMap, a full-feature GIS software platform that allows the user to integrate their own data and create map layouts.

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Fig. 1. Climate and ecological data layers used to delineate provisional seed zones for woody plants and grasses/herbaceous species.