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RESEARCH ARTICLE

Can an Ecoregion Serve as a Seed Transfer Zone? Evidence from a Common Garden Study with Five Native Species

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Abstract

Prairie restoration is often limited by the availability of appropriate local plant materials. Use of locally adapted seed is a goal in restoration, yet little information to inform seed transfer guidelines is available for native plant species. We established common gardens of five plants (*Eriophyllum lanatum* var. *leucophyllum, Epilobium densiflorum, Potentilla gracilis* var. *gracilis, Lupinus polyphyllus* var. *polyphyllus*, and *Saxifraga oregana*) frequently used in prairie restoration in the Pacific Northwest of North America to determine if populations differed in morphological and phenological traits and whether this variability was structured by geography, climate, or habitat. Ordination techniques were used to summarize the observed variability of multiple traits for each species. Ordination distance was significantly correlated with geographic distance in *L. polyphyllus* var. *polyphyllus*, and populations of this species differed significantly among geographic groups within an ecoregion. Little or no spatial structure was detected in the remaining species, despite correlations between ordination scores and monthly temperatures. We suggest that a single seed zone in the Willamette Valley ecoregion may be appropriate for all species examined except *L. polyphyllus* var. *polyphyllus*. Ecoregions in general may be useful boundaries for seed transfer zones, especially in regions with relatively little topographical or climatic variation.

Key words: common garden, ecoregion, restoration, seed transfer zone.

Introduction

Native seeds are widely used for restoration, reintroduction, and the creation of new populations by government and private organizations (Reinartz 1995). Maximizing establishment of plant materials is an essential goal in restoration efforts, as is protecting the genetic integrity of native plant populations in proximity to restoration sites (Knapp & Rice 1994; Kaye 2001; McKay et al. 2005). Locally adapted plant materials are widely recommended because of their increased chances of establishment success and lower potential for genetic swamping of surrounding populations with maladaptive genes (Lesica & Allendorf 1999; Hufford & Mazer 2003; Rogers & Montalvo 2004; Gustafson et al. 2005). However, substantial uncertainty remains regarding how to select populations within a species as seed sources for restoration efforts (McKay et al. 2005).

Although the use of locally adapted seed is prudent, it is also important to consider the genetic diversity of restored populations to maximize their adaptive capability and long-term sustainability (Moritz 1999). Small relict plant populations near restoration sites, which may be located in areas of considerable habitat loss or degradation, are likely to be genetically depauperate or inbred because of recent isolation or fragmentation (Ellstrand & Elam 1993; Keller & Waller 2002). Restricting the use of plant materials to populations near the restoration site may result in restored populations with low genetic diversity and limited potential to evolve in response to a changing environment (Broadhurst et al. 2008). The costs of producing seeds from small populations for use at a single restoration are higher than seed production at a larger scale for use at multiple sites (Ward et al. 2008).

Seed transfer zones are geographic areas within which plant materials can be moved freely with little disruption of genetic patterns or loss of local adaptation. When developed by relating patterns of genetic variation among populations to environmental factors (McCall 1939; Erickson et al. 2004; Johnson et al. 2004; Doede 2005), they can allow restorationists to achieve a balance between minimizing unintended consequences of moving plant materials and maximizing efficiency and genetic diversity (Kramer and Havens 2009). However,

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