From Forest Nursery Notes Winter 2013

37. © Local adaptation and the effects of grazing on the performance of *Nassella pulchra*: implications for seed sourcing in restoration. Hufford, K. M. and Mazer, S. J. Restoration Ecology 20(6):688-695. 2012.

Restoration Ecology
THE JOURNAL OF THE SOCIETY FOR ECOLOGICAL RESTORATION INTERNATIONAL

RESEARCH ARTICLE

Local Adaptation and the Effects of Grazing on the Performance of *Nassella pulchra*: Implications for Seed Sourcing in Restoration

Kristina M. Hufford[1,2,3] and Susan J. Mazer[1]

Abstract

The use of local seed sources for revegetation is accepted practice to reduce the potential that propagules will be poorly adapted to site conditions. However, data are often lacking to determine the distance within which seed sources represent local genotypes. Short-term reciprocal transplant studies represent a class of tools to detect local adaptation of target species. We conducted a reciprocal transplant of *Nassella pulchra* between two central California locations to test for adaptation to local environmental conditions over a 3-year period. Experimental plots at one location were split between grazed and ungrazed sites to evaluate the potential influence of livestock grazing on the detection or magnitude of local adaptation. During each year of the study, evidence of a home-site advantage depended on the location, traits studied, and population. At the end of the 3-year study period, however, we detected consistent evidence of a home-site advantage for seedling biomass among grazed sites at one location and ungrazed plots at the other location. In effect, local adaptation was only apparent in the final year of the study. Short-term reciprocal transplant studies are an effective tool to guide the selection of seed sources most likely to germinate and to become established at a restoration site, but such studies cannot rule out local adaptation, which may not be immediately detectable.

Key words: California grassland, home-site advantage, reciprocal transplant.

Introduction

The use of local seed sources for revegetation is an accepted practice around the world to improve the establishment of target species in ecological restoration (Krauss & He 2006; Bischoff et al. 2010; Mijnsbrugge et al. 2010). Strong evidence exists for local adaptation among plant populations in numerous species such that non-local seed sources may comprise germplasm maladapted to restoration site conditions (Linhart & Grant 1996; Keller et al. 2000; Crémieux et al. 2010). Information documenting the occurrence and extent of local adaptation, however, is not available for many native plant species targeted for restoration (Hufford & Mazer 2003; McKay et al. 2005). Reciprocal transplant studies are an effective method to detect local adaptation and to determine the distances or the environmental conditions among which seeds of focal species may be collected with reasonable assurance that restoration programs are likely to succeed.

Reciprocal transplant experiments are designed to test for a genotype × environment interaction characterized by the consistently superior performance of local genotypes relative to those introduced from a novel population or location; the higher fitness of local genotypes is called a 'home-site advantage' (Kawecki & Ebert 2004). The home-site advantage of local genotypes among populations or demes results from local adaptation. Adaptive differentiation among plant populations can lead to poor establishment of propagules if non-local seed sources are introduced to restoration sites where there are novel environmental conditions (Keller et al. 2000; Crémieux et al. 2010). Alternatively, differential vigor among seed sources in the absence of a consistent home-site advantage may result in the introduction of invasive genotypes (Saltonstall 2002; Bischoff et al. 2010). Although reciprocal transplant studies are the best method to test empirically whether alternative seed sources are likely to fail or to have the potential to become invasive, they require a significant investment of resources and are often time-prohibitive for restoration site managers. Hufford et al. (2008) tested empirically the value of short-term reciprocal transplants as a cost-effective method to compare and evaluate the performance of genetically distinct populations of two target species, and to identify the seed sources most likely to germinate and establish at restoration sites. In each focal species, the native California bunchgrasses *Elymus glaucus* (blue wildrye) and *Bromus carinatus* (California brome), evidence for local adaptation was detected in a single growing season.

[1] Department of Ecology, Evolution, and Marine Biology, University of California, Santa Barbara, CA 93106-9610, U.S.A.
[2] Present address: Department of Renewable Resources, University of Wyoming, Laramie, WY 82071, U.S.A.
[3] Address correspondence to K. M. Hufford, email khufford@uwyo.edu

doi: 10.1111/j.1526-100X.2011.00843.x