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RESEARCH ARTICLE

Testing the "Local Provenance" Paradigm: A Common Garden Experiment in Cumberland Plain Woodland, Sydney, Australia

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Abstract

Seed for restoration projects has traditionally been sourced locally to "preserve" the genetic integrity of the replanted site. Plants grown from locally sourced seeds are perceived to have the advantage of being adapted to local conditions, and the use of local provenance is a requirement of many restoration projects. However, the processes of climate change and habitat fragmentation, with the subsequent development of novel environments, are forcing us to reconsider this basic tenet of restoration ecology. We tested the "local provenance is best" paradigm, by comparing the performance of plants grown from local with non-local seed sources within a common garden experiment. We selected six species representing a range of growth forms (*Acacia falcata*, *Bursaria spinosa* ssp. *spinosa*, *Eucalyptus crebra*, *E. tereticornis*, *Hardenbergia violacea* and *Themeda australis*) from an assemblage known as the Cumberland Plain Woodland, a threatened community in western Sydney. Multiple provenances were collected from within the range of each species and grown at two field sites on the Cumberland Plain. Growing time varied between species and ranged from 7 months to 2 years. With the exception of *B. spinosa*, and to a lesser extent *T. australis*, we found little evidence that local provenance plants were superior to distant provenances in terms of survival and establishment.

Key words: adaptive potential, home-site advantage, local adaptation, local superiority, restoration, seed source.

Introduction

The changing environment poses many challenges for restoration ecology. Small populations in fragmented landscapes will be particularly vulnerable to rapid change in the future. Genetic diversity within these populations is a key consideration for climate change adaptation strategies, but many seed-sourcing guidelines used by restoration practitioners do not allow for the incorporation of a broad range of genotypes in restoration projects (N.S.W. Department of Environment and Conservation 2005; State of Minnesota 2010).

Traditionally, it has been considered desirable to use seeds collected within a defined radius of the restoration site to "preserve" the genetic integrity of the replanted site. Plants sourced from local seed (hereafter referred to as "local provenance") are generally assumed to be better adapted to local conditions, with superior survival and faster growth rates conferring a greater probability of restoration success. In addition, the use of non-local provenance is considered to increase the potential for the negative effects of outbreeding depression (Edmands 2007) and to initiate unplanned gene flow into neighboring populations either by hybridization between subspecies (Sampson & Byrne 2008; Millar et al. 2012), or by "cryptic" invasions (Hufford & Mazer 2003 and references therein). This may result in maladapted offspring and altered trophic interactions with associated organisms (Vander Mijnsbrugge et al. 2010 and references therein). Increasingly, these potential negative impacts are being weighed against the positive effects of avoiding inbreeding depression (Broadhurst et al. 2008; Lopez et al. 2009) and a recent review concluded that current concerns about outbreeding depression are excessive (Frankham et al. 2011). Furthermore, there is a growing recognition that the exclusive use of local material may hinder adaptive potential in the face of a rapidly changing climate (Weeks et al. 2011 and references therein). A broader approach to seed sourcing has been adopted by some restoration practitioners (Corangamite Seed Supply & Revegetation Network 2007; Native Seed Network 2011), but empirical evidence is needed to underpin improved guidelines.

Local adaptation of plants has previously been demonstrated over strong environmental gradients: altitudinal (Gimenez-Benavides et al. 2007), latitudinal (Davis & Shaw 2001 and references therein), and in novel environments such as polluted soils (Antonovics & Bradshaw 1970). A recent meta-analysis found that local adaptation is common, but if large environmental gradients between sites are used, the frequency and magnitude of local adaptation may be overestimated due

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