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SYNTHESIS

Seed supply for broadscale restoration: maximizing evolutionary potential

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Abstract

Restoring degraded land to combat environmental degradation requires the collection of vast quantities of germplasm (seed). Sourcing this material raises questions related to provenance selection, seed quality and harvest sustainability. Restoration guidelines strongly recommend using local sources to maximize local adaptation and prevent outbreeding depression, but in highly modified landscapes this restricts collection to small remnants where limited, poor quality seed is available, and where harvesting impacts may be high. We review three principles guiding the sourcing of restoration germplasm: (i) the appropriateness of using 'local' seed, (ii) sample sizes and population characteristics required to capture sufficient genetic diversity to establish self-sustaining populations and (iii) the impact of over-harvesting source populations. We review these topics by examining current collection guidelines and the evidence supporting these, then we consider if the guidelines can be improved and the consequences of not doing so. We find that the emphasis on local seed sourcing will, in many cases, lead to poor restoration outcomes, particularly at broad geographic scales. We suggest that seed sourcing should concentrate less on local collection and more on capturing high quality and genetically diverse seed to maximize the adaptive potential of restoration efforts to current and future environmental change.

Introduction

Negative environmental impacts associated with vegetation clearing have precipitated a significant increase in the restoration of degraded landscapes around the globe. The scale of these restoration projects varies from small, local initiatives (ca. 1–10 ha) that aim to re-establish historic community composition, to extremely large projects that concurrently plant several key species across broad geographic scales (ca. 10^2–10^6 ha). Irrespective of the restoration scale, however, access to high quality and appropriately sourced germplasm is a primary consideration to improve planting success and ensure that new populations become functional, self-sustaining and resilient to environmental challenges. As restoration targets continue to grow, however, it is timely to review the state of knowledge underpinning the major paradigms that drive seed sourcing guidelines. This is particularly important since many guidelines were developed in the 1990s, and our understanding of the demographic and genetic effects associated with landscape fragmentation, evolutionary and population genetic patterns, small population theory and effects, and gene flow have increased significantly. For example, despite negative genetic and demographic effects

