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Determining suitable locations for seed transfer under climate change: a global quantitative method

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Abstract Changing climate conditions will complicate efforts to match seed sources with the environments to which they are best adapted. Tree species distributions may have to shift to match new environmental conditions, potentially requiring the establishment of some species entirely outside of their current distributions to thrive. Even within the portions of tree species ranges that remain generally suitable for the species, local populations may not be well-adapted to altered local conditions. To assist efforts to restore forests and to maximize forest productivity in the face of climate change, we developed a set of 30,000 quantitatively defined seed transfer "ecoregions" across the globe. Reflecting current and future conditions, these were created by combining global maps of potentially important environmental characteristics using a large-scale statistical clustering technique. This approach assigns every 4 km^2 terrestrial raster cell into an ecoregion using non-hierarchical clustering of the cells in multivariate space based on 16 environmental variables. Two cells anywhere on the map with similar combinations of environmental characteristics are located near each other in this data space; cells are then classified into relatively homogeneous ecoregion clusters. Using two global circulation models and two emissions scenarios, we next mapped the predicted environmentally equivalent future locations of each ecoregion in 2050 and 2100. We further depicted areas of decreasing environmental similarity to given ecoregions, both in current time and under climate change. This approach could help minimize the risk that trees used for production, restoration, reforestation, and afforestation are maladapted to their planting sites.

Keywords Restoration · Conservation genetics · Quantitative ecoregions · Multivariate clustering · Seed sources · Human-assisted migration

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