

Facilitating Gene Conservation With Existing Common Gardens¹

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Species and populations of forest trees stressed by a rapidly changing climate must adjust or they will not survive. Loss of species and populations could occur if they lack the genetic variability to adapt, the capacity to migrate to suitable habitats, or the ability to adjust to new environments through phenotypic plasticity. Fortunately, many forest tree provenance studies were established in the 20th century across the United States. Most of the studies were initiated or funded by the United States Department of Agriculture (USDA). Many of these plantations are now over a half-century old, and represent a valuable resource for understanding how trees respond to climate change. Although the original purpose of these provenance studies was mainly for traits of commercial interests, now they can help us understand and quantify intraspecific genetic variation in presumptively adaptive traits in response to climate change.

In this presentation, we summarize the scope and richness of USDA initiated or funded provenance studies in the eastern United States. We demonstrate that common gardens planted in multiple locations can be used as experiments in climate change, where climate has been manipulated to differ from the climate where the trees (the species or the population) originated and to which they are presumably adapted as a result of generations of natural selection. Thus, except for local controls, the trees in common gardens have been growing for many years in a different climate from the one they were adapted to at the site from which they were collected. In addition, we use two provenance tests to show (1) populations with different climatic origins also are measurably different in their growth and phenology, (2) within-generational rapid phenotypic adjustment to climate change. We advocate that data from common garden experiments can be used to study within- and among-population responses to novel climates and can serve genetic conservation objectives for tree species.

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