

How can Genetic Information be Useful in Natural Resource Management?

Why We Care About Genetics Vol.2

Genetic information, determined from appropriately designed studies, can assist natural resource managers in the conservation and restoration of native plant species. Because genetic diversity is a value in its own right, its protection can help to maintain health and longer-term viability. In addition, genetic information can provide insights into other plant characteristics (such as mating system) and relationships with other species (such as those that pollinate flowers or distribute seeds). Some of the many ways in which genetic information can be useful to natural resource managers have been summarized below within six themes.

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Determining identity and genetic relationships.

Genetic information can help to resolve taxonomic confusion about the degree of relationship among plant taxa — for example, whether they belong in the same or different species or subspecies. For plants that can reproduce asexually, such as quaking aspen (*Populus tremuloides*) or coast redwood (*Sequoia sempervirens*), one can determine whether particular plants are members of a clone or are different individuals. Sometimes it is of interest to know if there is considerable inbreeding (in the case of monoecious plants that can self-pollinate because they have both sexes in the same plant) within a population, or if one or a few plants are responsible for

most of the pollination (relative to a situation where all the pollen parents are more equally represented). Genetic studies can help determine whether plants are hybrids (between populations, subspecies, or species, for example) and the degree of relationship with either parent. Cultivated varieties (cultivars) can be identified — a useful tool when planting records have been lost or are incomplete or inconclusive. Similarly, genetic studies can help determine the original seed source of plants in a plantation or restoration project when that information is otherwise unavailable. Such studies have helped to elucidate the seed source of some ponderosa pine (*Pinus ponderosa*) plantations in Colorado that were suspected to have been planted with nonlocal seedlings and were showing signs of maladaptation.

Determining the amount of genetic diversity.

As loss of genetic diversity can be detrimental, questions that are helpful to address include: How much genetic diversity exists in this species or population? How does it compare with other populations of the same species? Has diversity changed over time or as a function of management practices? Has the genetic variation in this small isolated population been reduced?

Determining the regional dynamics of a species.

Genetic information can elucidate how plant populations communicate with each other and migrate over time. This information can help determine how influences on one plant population (e.g., habitat conversion) can affect other populations and the capacity for a species to move in response to environmental changes. Genetic studies can help to determine: Where is the pollen coming from for locally produced seeds in natural populations? How genetically connected are members of



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Clark's Nutcracker

different populations of this species? Are genes mainly moving across the landscape by seeds or pollen, what are the patterns for each? How far are pollen or seeds traveling in one generation for specific plants or populations?

Designing, assessing, and protecting the genetic integrity of seed collections. Knowledge of the genetic diversity of a species is important in determining where and how to collect seeds for a representative collection or to serve specific restoration needs. Historic collections can be assessed to determine how representative they are of current range-wide diversity or whether there have been genetic impacts of long-term storage.

Understanding species' characteristics and resolving ecological relationships. Genetic studies can determine species characteristics such as the degree of inbreeding versus outcrossing, or the relative contributions from asexual or sexual reproduction. Such studies can also allow insights into a species' evolutionary history — suggesting, for example, if they have migrated great distances over time or have experienced severe restrictions in size called 'bottlenecks'. Indirectly, they can offer behavioral information on seed dispersers and pollinators. For example, genetic analysis of whitebark pine (*Pinus albicaulis*) seed caches can yield information on the caching behavior (such as how far the seeds have been transported, whether they reflect seeds from one or many cones or one or many trees) of the

Clark's nutcracker. Information is now emerging about community-level interactions involving genetic diversity. Studies of genetic diversity in one species (for example, Fremont cottonwood (*Populus fremontii*) can yield information about species-level biodiversity of the dependent arthropod species.)

Tracking human-assisted plant movements. Finally, genetic studies can be used in a 'forensic' manner, helping to determine the source of plants that have been moved from their natural environments. This can be useful in determining the origin of invasive exotic plant species, whether there were multiple introductions, and the likely range of adaptations of the introduced species. Genetic

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contamination of local populations by introduced nonlocal populations can be investigated. Genetic studies also have the potential to provide evidence for enforcing conservation regulations by identifying plants that have been illegally harvested from conservation



Quaking Aspen

Photo credits: (top left) Terry Spivey, USDA Forest Service, (bottom) Doug Page, USDI Bureau of Land Management, www.forestryimages.org.



Redwood

areas or have been illegally transported across country boundaries. This kind of technology has already been successful in identifying illegal whale hunting, based on genetic analysis of otherwise unidentifiable whale meat in the marketplace.

For all applications, the ability to derive the intended information from genetic studies depends on: the study design, the genetic information already available for the species (including appropriate reference material), and the type of genetic markers and analysis. See Volumes 5 and 8 for more information. ■

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