Genetic Integrity: Why Do We Care? An Overview of the Issues

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Abstract—There are many reasons to be concerned about the use of non-native species or non-local genetic material in restoration efforts. An overview of these issues is presented. It is argued that site restoration is more than just successful vascular plant establishment, and that local plant material should be used whenever possible. However, it is recognized that time and money often constrain restoration efforts, and that maintenance of genetic integrity is often an issue of project scale.

Much debate is occurring on the importance of using native plants or locally collected plant material for revegetation efforts. As scientists learn more about the complex and interdependent nature of ecosystems, it is increasingly apparent that alteration of system components can have serious ramifications for continued natural functioning of these systems. The vascular plant community is critical in determining habitat attributes. Consequently, any alteration of this component needs to be approached with caution. Changes in the vascular plant communities can result from planting different species or different genotypes or altering relative species abundance or plant spacing. Since successful restoration is of critical concern to land managers, the effects of using different plant materials needs to discussed by scientists and managers together. For this reason, it was decided to have a symposium addressing this topic.

There are many potential issues associated with changing the structure of vascular plant communities, whether physically or genetically. Unfortunately, there are few long-term data sets to highlight which of these may become problems. Also, since basic aspects of many ecosystems have not been studied, the effects of vegetation changes on these facets cannot be documented. However, there are enough studies and evidence to alert us that problems can, and do, occur. These problems range from unsuccessful plant establishment to effects on other system components.

Long-term plant establishment has historically been the primary goal of restoration efforts. While many plantings of non-native or non-local genotypes appear successful in the short time for which we have data, many problems have occurred as well. These problems have ranged from invasion of neighboring communities by the planted material (such as, *Tamarix*, *Euryops*, *Bromus*, *Eragrostris*) to eventual failure of the plantings, whether through mass die-offs from unfavorable conditions (*Agropyron desertorum*, *A. cristatum*, and *Atriplex canescens* var. *rincon*) or through gradual replacement by less desirable exotics (*Bromus inermis*, *Phleum pratense*, *Dactylis glomeratus* and other seeded non-natives replaced by *Madia glomerata*; *B. tectorum* replacing planted material). Problems have also occurred for non-local native species that germinate, flower or seed set at inappropriate times. In addition, root deployment patterns can vary within plant species. Variations in any such characteristics may mean that non-local plant material dies under conditions that local populations are adapted to, even though the same species is used.

Using non-local (native or not) material can also have a significant effect on surrounding native plant communities. Planted material may use water or nutrients needed by local natives to successfully establish, or may otherwise compete with natives for favorable sites. Use of non-local material may lead to soil, microorganism or nutrient loss. Such site degradation may negatively affect the ability of local material to reclaim the area.

Many attributes of plants determine the micro- and macrobiota associated with them. While it is known that these attributes vary widely among species, less is known about interspecific variation. It is these attributes that we are concerned with when planting non-native plants, or plants with different genetic stock. Examples of these attributes include root mucilage secretion rates, root structure, or root deployment patterns, all of which heavily influence soil food webs (bacteria, fungi, nematodes, protozoa, and microarthropods). Chemical composition of plant litter varies within and between species. Many decomposers are specialists, and changing the types of litter available can affect soil food webs as well. Soil food webs are a critical part of the nutrient cycles in ecosystems. Since different species play distinct roles in nutrient processing, species composition and abundance can heavily influence the type and rate of nutrient processes that occur, thereby affecting nutrient availability by altering rates of nutrient input and plant litter decomposition. In addition, changes in soil communities can affect the rate of nutrient uptake by plants through altering mycorrhizal or nitrogen-fixing bacterial populations.

Aboveground faunal populations are affected as well by changes in the vascular plant community. The type, quantity, and timing of germination, growth, and reproduction of vascular plants is often highly variable both among and between species. Since many pollinators, dispersers and consumers are tightly tied to one or more of these aspects, variation in these characteristics may result in the failure of the system to support the plant or the animal. Chemical composition of plant tissue is used by many invertebrates

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as a cue for oviposition, herbivory and other activities. Since chemical composition is variable among individuals, populations, and species, using non-local plant material may affect dependent organisms. Animal species composition and abundance patterns are also affected by the physical structure of the vascular plant community. This has been shown repeatedly for bird and invertebrate species. It can also be true for larger mammals, as was recently found when coyote predation rates on sage grouse increased dramatically where grasses were planted in rows as opposed to a naturally staggered pattern.

In light of the above discussion, there are many reasons to use all possible resources to preserve genetic integrity in restoration efforts. However, even the best of intentions to preserve genetic integrity of communities are often limited by lack of local material, insufficient financial resources or degraded site conditions. Concern levels need to be matched with the reality of the land managers' position. Project scale generally is the determining factor. For small projects with readily available seed sources, all possible efforts should be made to maintain the genetic integrity of plant populations by using locally obtained plant materials. For large areas, or areas where no original plant material remains (such as vast areas in southern Idaho), concerns for genetic integrity may be limited to the use of native species. Most projects lie somewhere in between these two extremes.

The more we learn about the long- and short-term effects of introducing new genetic material into ecosystems, the more we find that we need to exercise caution. There is much about ecosystem functioning that we do not understand, and unintentional changes are often detrimental. Clearly, judgments on the extent to which genetic integrity will be preserved in any particular instance will have to be made on a case-by-case basis. However, given the lack of long-term data, a conservative approach should be used until we better understand the effects of our actions. Emphasis should be given to preserving, within the limits of our resources, what genetic integrity we can, remembering that ecosystem restoration is more than successful vascular plant establishment.