Inadvertent selection in the propagation of native plants

a cautionary note

Peter Dunwiddie and Eric Delvin

ABSTRACT

A series of interacting steps resulted in the use of the wrong species in a prairie restoration. Contributing factors included misidentifying species of fescue, combining seeds from nearby sites, favoring the collection of seeds from one species over another in the wild as well as in the nursery, and compounding the preferential selection of a species when increasing limited seed supplies for commercial production. Avoiding shortcuts and exercising caution not to compromise protocols designed to ensure the integrity of materials used in native plant restoration are important but may not be entirely sufficient to prevent costly mistakes.

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fescue, *Festuca roemeri, festuca rubra,* Poaceae, prairie restoration

NOMENCLATURE

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Figure 1, A typical view of a south Puget Sound prairie in the spring. Camas *(Camassia quamash* (Pursh) Greene [Liliaceae]) and buttercups *(Ranunculus occidentalis* Nutt. [Ranunculaceae]) bloom profusely in a matrix of native Roemer's fescue and other grasses.
Photo by **Peter Dunwiddie,** The Nature Conservancy

Concerns are frequently expressed regarding how the genetic composition of native plant stocks may be altered in undesirable ways as a result of collection and propagation practices (Kaye 2001; Hufford and Mazer 2003). For example, Ellstrand (2005) noted how allowing native species to interbreed with closely related nonnative taxa can genetically swamp less common natives or create progeny capable of becoming aggressively invasive. Practical suggestions have been provided by various authors to minimize selection of particular genotypes that may reduce the diversity occurring in native gene pools (Burton and Burton 2002). Such selection can occur as a result of seed collection practices, processing, nursery propagation, and outplanting (Reichard 2001). Despite precautionary measures, selection can and does occur, sometimes with unexpected consequences. It is useful to examine such occurrences to

understand their causes and how they can be avoided in the future. We present here a case study of one such event, placing particular emphasis on a discussion of preventive measures that might have been taken. Readers interested in the taxonomic details that contributed to the confusion illustrated in this example should consult the work of Wilson (1997, 1999).

Various agencies and organizations are actively restoring native prairies in the Puget Sound lowlands of western Washington (Figure 1). These prairies were historically dominated by Roemer's fescue *(Festuca roemeri (Pavlick)* Alexeev [Poaceae]) and a variety of other native grasses and forbs (Chappell and Crawford 1997) (Figure 2). Livestock grazing and invasive species have resulted in the loss of many taxa, and a major focus of restoration efforts is the re-establishment of the native fescue matrix. These efforts have frequently relied on wild-collected seeds of native species from remnant prairies for propagation in pots, followed by outplanting of plugs in prairie restorations. As the scale of restoration has intensified in recent years, restorationists are increasingly using seed provided by commercial nurseries.

Two very similar species of perennial fescue occur in these prairies. The typical native grass, Roemer's fescue, is a bunchgrass that is morphologically quite diverse but in this region often has rather bluish foliage. It is closely related to Idaho fescue *(Festuca idahoensis* Elmer), which occurs more widely in western North America (Wilson 1997). Red fescue *(Festuca rubra* L.) is also widespread but is not thought to have been a dominant in the native prairies, and is much less common today than Roemer's fescue. This taxon includes both native and nonnative subspecies. Some of these subspecies tend to produce short rhizomes and often have bright green foliage. Both Roemer's and red fescue are quite variable in appearance, however, and can be extremely difficult to differentiate in the field, even when flowering (Wilson 1997, 1999).

Concern about the taxonomy of the fescues used in restoration plantings began to arise as observers noted differences, particularly in leaf color and overall height, between fescue outplantings and nearby wild plants (Figure 3). Because well-fertilized nursery-grown plugs of both species often tend to be greener in color and more robust than the parental stock, these differences were initially disregarded. Correct identification of plants was further impeded because the commonly used flora for the region (Hitchcock and Cronquist 1973) was written before Roemer's fescue had been described, and even now, characteristics for distinguishing Roemer's from red fescue and for differentiating the native and introduced subspecies of red fescue are confusing, overlapping, and often unreliable in the field (Wilson 2003).

Motivated by increasing concerns about the identity of the grasses used in restoration plantings, we collected specimens from the source prairies where seeds were being gathered and reproductive plants from the nurseries growing out the seeds. Using a dissecting microscope, we distinguished the 2 taxa based on characteristics described by Wilson (1999); also duplicate specimens were provided to BL Wilson (Oregon State University), who confirmed our identifications (Wilson 2005). In two of the main native prairies, Roemer's fescue comprised well over 95% of the material examined, but red fescue was common at several other sites. When nursery-grown material was inspected, it proved to be almost entirely red fescue. This complete reversal from what we expected forced us to evaluate every step in the process to try to understand how such a radical shift could have taken place. Because the seed collection—propagating—outplanting process had occurred over several years, some steps could not be reconstructed precisely, but the following summary captures the factors that most contributed to this surprising outcome.

Figure 2. The remarkable mounded surface of many south Puget Sound prairies is emphasized by a proliferation of nonnative ox-eye daisies *(Leucanthemum vulgare* Lam. [Asterateae]) growing in a matrix of native Roemer's fescue and other grasses.

CONTRIBUTING FACTORS

Species Identification

A fundamental issue at all stages was the difficulty in readily distinguishing the fescue species in the field. A tacit assumption made by many restorationists,

including ourselves, is that seeds collected from native prairie remnants are most suitable for nearby restorations. In our case, this assumption proved problematic because both native and nonnative fescues that were difficult to differentiate existed in the source sites. Collected species and propagated material should he regularly inspected by people trained in plant identification to confirm that the correct taxa are being used.

Site Differences

Fescue seeds provided to the nursery for increase were collected by volunteers and staff from multiple prairies near one another. Although Roemer's fescue was the dominant fescue at some sites, this was not universally the case. Failure to ensure the correct species was collected at every site likely resulted in the final, pooled seeds being less pure than what occurred at several of the individual contributing sites. Had these collections been kept separate, differences among them might have become apparent when they were initially grown out.

Plant Differences

In our reassessment, we observed that red fescue plants are often somewhat taller, with more flowering stems, than Roemer's fescue. Red fescue also may produce seeds slightly later, or retain them longer, than Roemer's fescue. Although we did not collect data to quantify such differences, if any of them did exist, they could have contributed to a preferential shift toward red fescue during seed collection. One year, very few seeds were collected because adverse growing conditions resulted in low seed production. This was exacerbated by collectors being delayed that year in getting out on the sites, such that some of the seeds may already have dispersed. Collectors could have significantly favored red fescue if that species retained more seeds at the time of gathering.

Figure 3. Rows of drill-seeded fescue thrive in a newly planted prairie restoration project. Most of the plants in this picture proved to be *Festuca rubra* rather than the native *Festuca roemeri*
Photo by Peter Dunwiddie, The Nature Conservancy

Propagation

The nursery initially supplied with wild-collected seeds used some of their production from the first year to augment their grow-out beds and increase the acreage under production. Red fescue plants may produce more seeds than Roemer's produces and may be faster growing and more productive during the first year. If there are slight differences in phenology, as suggested above, the harvest may have been inadvertently timed to further favor red fescue seeds. Finally, additional selection of red fescue seeds may have occurred when seeds produced by this nursery, which by this time may have been already enriched with red fescue seeds, were provided to a second nursery for further propagation. Wild-collected seeds were in short supply that year, and at the time this practice was rationalized to meet the increasing demands for greater seed production.

Variations on the scenario described here probably are frequent within the industry. What we found particularly troubling about our own experience was that, for many of the steps that may have contributed to this problem, there were few obvious warnings. Clearly, we should have avoided compromising protocols that are designed to ensure the integrity of materials used in native plant restoration. Taking shortcuts may be justified for any number of reasons, and probably rarely result in the production of the wrong species, as occurred in this instance. A more common scenario may be propagation practices that select for nonlocal genotypes, or which favor genotypes that grow best in nursery or greenhouse conditions. But as we learned, problems resulting from shortcuts and compromises can be compounded by unknown changes arising from unanticipated sources.

RECOMMENDATIONS

In hindsight, all seed handling and propagation procedures should have been periodically assessed to identify potential problems and the final product regularly evaluated to ensure quality. Based on our experience from this example, we make the following recommendations to help others avoid our mistakes.

People trained in the identification of collected taxa should regularly inspect propagated material to confirm taxonomic identities.

Avoid pooling collections in the propagation process, even from sites in close proximity. Unexpected differences in performance, phenology, or taxonomy

related to site source are more likely to be revealed by keeping collections separate.

Be aware that variation in size and phenology of plants in the field and nursery may result in selection bias. Collecting seeds front plants regardless of size, and at multiple times during a season, may help to capture genetic variability within a taxon but may also reveal previously unsuspected taxonomic complexity.

Whenever possible, avoid propagation practices that may result in heavy selective pressures in a nursery environment. Concerns should increase if multiple generations are produced away from the native site.

Restorationists should be alert for the sorts of problems we encountered, particularly where native taxa have similar invasive counterparts that grow in the same area. Examples in the Pacific Northwest might include *Prunella vulgaris* ssp. *lanceolata* (W. Bart.) Fern. (Lamiaceae) versus *P. vulgaris* ssp. *vulgaris; octoflora* Rydb. (Poaceae) and *V. microstachys* Munro versus *V. bromoides* S.F. Gray and V. myuros K.C. Gmel.); *Achillea millifolium var. occidentalis.; and A. millefollium pacifica (Rydb).* G.N. Jones versus A. *milllifolium* var. *mille follium;* and species of *Bromus* L (Poaceae) and *Lotus* L. (Fabaceae). Even more difficult to recognize and avoid are situations where local ecotypes exist that may not be taxonomically recognized or morphologically distinct.

Finally, although common sense will help avoid some of the more obvious pitfalls, restorationists may benefit by having ready access to a set of standard accepted practices developed specifically to avoid both obvious and cryptic hazards that can potentially compromise the integrity of materials used in native plant restoration.

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