# Techniques Used to Restore Puget Prairie Communities and Rare Plant Habitats

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## Abstract

Prairie restoration is an important land management practice for a number of agencies and landowners in the Puget Sound region. As prairie habitat has diminished, a significant number of plants and animals have become rare, necessitating restoration of this disappearing landscape. Prairie restoration involves controlling invasive shrubs, trees, and weeds, and propagating of plants to augment native prairie communities. Restoration methods such as determining the unit size, site preparation, species selection, and planting patterns are key components in the success of restoration projects.

Roemers' fescue is the dominant native bunchgrass in Puget prairies and is commonly planted in prairie restoration projects. Herbaceous species are selected based on their ability to thrive and functional role in the ecological community. Long term maintenance and control of scotch broom plants and seed banks are the keys to permanent establishment of restored prairies.

**Keywords**

Roemers' fescue, Scotch broom, propagation, native species

## Introduction

This report summarizes some of the restoration activities that have occurred over the past 8 years within Puget trough grassland communities of Western Washington. Land managers consulted for this presentation are in involved in restoration

*Proceedings of the Conference: Native Plant Propagation and Restoration Strategies. Haase, D.L. and R. Rose, editors. Nursery Technology Cooperative and Western Forestry and Conservation Association. December 12-13,* 2007. *Eugene, OR.*

and monitoring at Yellow Island (The Nature Conservancy), Fort Lewis prairies, Glacial Heritage (The Nature Conservancy), Scatter Creek Wildlife Area (WA Department of Fish and Wildlife), and Mima Mounds and Rocky Prairie Natural Area Preserves [WA Department of Natural Resources (DNR) Natural Areas Program (NAP)].

Puget prairies exist as remnants of a landscape that was once widespread in the lower Puget Sound region. Approximately 3% of the native prairie landscape remains, and a very small fraction of this is in excellent condition (Crawford and Hall 1997). Puget prairies exist primarily on very well drained glacial outwash soils, and have species in common with rocky bald grasslands and sandy meadow communities. Certain plant and animal species associated with Puget prairies have become extremely rare, prompting land managers to increase the quality and extent of protected prairie habitats through restoration.

## Restoration

Prairie restoration activities in the Puget prairies address species habitat needs and the control of exotic species. Some of these activities include: control of native and non-native woody species, non-native grasses and fortis, removing trees from areas that were previously occupied by prairie, restoring direct damage to soils/plant communities, and restoring habitat structure and plant species composition required by endangered and threatened species.

The outcome of various restoration activities depends on local site conditions, restoration goals, funding, and equipment/technologies available to the land manager. For instance, on state managed Natural Area Preserves, tree removal is accomplished primarily by helicopter, minimizing the use of ground equipment. Site managers at the Thurston County Glacial Heritage prairie are carrying out restoration work with light on-the-ground equipment traveling on pre-existing access roads. Fort Lewis and Glacial Heritage managers have explored the use of seed drilling equipment, while such equipment would be difficult to manage on the mounded topography of Mima Mounds NAP (Dunn, pers. comm. 2001, Randolph, pers. comm. 2001).

### Defining project goals

Prairie restoration goals vary considerably between sites and projects. When the goal is to exclude weeds and create protective ground cover, a dense single species planting may suffice. If the restoration of native species is not feasible, planting less expensive, non-invasive grass species may support a limited goal such as soil protection. For example, certain prairies used for Fort Lewis military training are rehabilitated to repair ongoing soil disturbance (Randolph, pers. comm. 2001).

Endangered animal species frequently favor a certain plant species or genus for their various life history needs. Consequently, the restoration goal might focus on increasing the numbers of a given plant species. For example, showy fleabane, *(Erigeron speciosus),* is being propagated for it's late season nectar values at Scatter Creek Wildlife Area (Dave Hays, pers. comm. 2001). Early blue violet, *(Viola adunca)* is being intensively restored to create butterfly larva feeding habitat on Long Beach Peninsula sand dune meadows. This supports an eventual re-introduction project for the Oregon silverspot butterfly (Hays 2000).

Successful restoration of a site for a rare plant species may require adequate gaps for the rare plant to colonize, and weed control to prevent competition for open space. Golden Paintbrush is a federally listed Threatened species that is a facultative root parasite, meaning it may benefit from the presence of a host plant (Wentworth 1997). By establishing native prairie plants in openly spaced patterns, the rare paintbrush has recolonized a number of restored microsites among typical companion plants.

Prescribed fire is frequently used in Puget prairie restoration because fire is a natural process that enhances many grassland communities and rare species (Tveten and Fonda 1999, Schuller 1997). This important tool can be detrimental in a restoration process, by increasing weedy species. Fire can also damage organic soils if heavy fuels exist such as shrubs, thick duff, or woody material. To achieve the goal of re-introducing fire without severely damaging soils and exist-

ing perennial prairie plants, site managers often remove excess woody material by hauling and chipping limbs, pile burning, etc.

A common management goal is to restore a site to the original condition or the condition of the adjacent grassland community. Replicating the complexity of the entire suite of species in a prairie plant community is a difficult task. Restoration practitioners will retreat from this goal after investing propagation efforts in species that repeatedly fail to germinate or survive. Instead, we often select a suite of forbs and minor grasses to accompany the dominant grass to approximate prairie structure and achieve an *economically* feasible restoration project (Davenport 1997).

## Scale and Implementation

The scale of prairie restoration projects has a relationship to the quality of the outcome for several reasons. If the intent is to replicate a good quality plant community, small-scale projects or large projects implemented in phases are used to ensure that the restored site receives the intensive maintenance required to be successful. The cost of long-term maintenance and phased designs should not be underestimated in grant and budget proposals.

Each site has unique characteristics that influence the size of each restoration "unit." The type and abundance of invasive species present must also be factored into the scale and cost of the project. Aggressive weeds may limit the area that is practical as a restoration unit. Other important factors that need to be considered for the successful maintenance of a restoration project are: the ease of access for maintenance activities, whether herbicides or manual weed control methods will be used, and the ability of project staff or helpers to identify native plants versus weeds. Although maintenance of the plants adds considerable cost, it is essential to a successful project. Without intensive maintenance activities, exotic species can compete with and overwhelm the newly planted plants.

A final consideration related to unit size is the potential benefit to the site ecosystem. Prairies and other grasslands are often composed of a subtle successional mosaic, supporting a variety of species. A phased design with a number of units may increase habitat and species diversity across the prairie landscape (Dunwiddie, pers. comm. 2001).

### Site preparation

The amount of site preparation varies depending on the type of restoration project. In the case of tree removal, it is necessary to first remove Douglas-fir trees and limbs (limbs can be chipped or burned), and then the "micro-site" that remains is further prepared for planting (raking, burning, etc.). Exotic species such as scotch broom are often treated effectively through mowing and/or herbicide treatment. However, if many scotch broom seeds exist in the soil, new seedlings may overwhelm the restoration site. Mowing followed by herbicide treatment of seedlings has created a reasonably suitable planting site for Roemer's *fescue* at Mima Mounds NAP Similarly, areas dominated by non-native grasses have been treated with Roundup and planted. A technique used at the Glacial Heritage site involves repeated tilling of areas dominated by non-native grasses and/or scotch broom to reduce competition and exhaust seed in the soil. These areas are intensively planted with Roemer's fescue *(Fatima* romeri), and additional broom cohorts are eradicated with a selective herbicide that does little harm to fescue (Dunn, pers. comm. 2001).

Another site preparation variation proven successful at Rocky Prairie NAP involves removing lower tree limbs and under-planting around existing trees. The trees were later removed after prairie plants were well established. As a result, weeds are less likely to invade a semi-shaded restoration plot. This method is effective where trees are widely spaced.

When possible, site managers should try to avoid removing thatch and duff thereby exposing bare soil on restoration sites. This organic material serves an important function as weed mulch and to conserve water for the seedlings. Occasionally it is necessary to reduce some of the organic duff layer to ensure that seedlings have full soil

contact. Where a micro-site has been burned for cleanup and mineral soil is exposed, careful maintenance must be carried out to control weeds for the following two seasons.

### Species selection and propagation

A typical prairie restoration project involves collecting seed on site and growing plugs. Roemer's fescue is the dominant grass species used as a foundation for most prairie restoration projects. The seed is easily collected and propagated, and small plugs have a high rate of survival. Mature Roemer's fescue seed cleaned with an air separator frequently yields tetrazolium viability test results of greater than 90% viability.

Herbaceous species and other grasses are selected based on several criteria. For propagation these include: availability and ease of collecting seed, germinability, ability to grow into a reasonably well rooted plug within 6 months of planting, tolerance to transplantation, and habit in the field (does the plant compete and occupy space sufficiently to hold its own within one or two seasons?). Note that beauty and aesthetics are not criteria, so many lovely prairie flowers don't make the cut for projects. We also consider the ecological niche the plant is likely to fill. For instance, a mix of composites and other flowering plants provide a range of nectar and larval food sources for native prairie butterflies. Table I details a list of species successfully used for prairie restoration.

On state Natural Areas and Nature Conservancy managed sites, seed is collected and cleaned by a specially trained corps of volunteers (recruited by The Nature Conservancy). Experienced staff work with the volunteer team leaders to ensure the quality of seed produced. Plant propagation has been arranged through contracts and cooperative agreements with state and commercial tree nurseries, native plant nurseries, high school horticulture programs, and correctional facilities.

### Installation

Trained volunteers play a major role in getting plants in the ground in the spring, usually mid- March to early April. When the number of plants exceeds available volunteer help, "prairie crews" are sometimes contracted. Careful handling and quality transplanting work has a direct impact on seedling survival, especially of more sensitive herbaceous species.

Direct seeding and drilling of Roemer's fescue has been done on a more limited basis, primarily at the Glacial Heritage site. Early results have been promising, with 5 plants per square meter surviving in drilled plots after one year (Dunn, pers. comm. 2001). Fort Lewis prairie managers are also developing a program for drilling Roemers' fescue utilizing seed produced in seed plots (Randolph, pers. comm. 2001).

The pattern of planting can create unexpected results as the site develops structure. Roemers' fescue plugs often grow unusually tall in the second season. When fescue was interspersed with forbs in a regular pattern, we found that the less competitive forbs were overtopped and sometime eliminated by the second year. This problem was addressed by planting herbaceous species in large clumps or blocks, planting fescue in weedier areas and along the edge of existing prairie.

One hundred thousand Roemers' fescue plugs were installed at Mima Mounds in 1994, following a large tree removal project. These plugs were planted on approximately 2-foot centers. The plants had a high rate of

**Table 1. Species Successfully used for Prairie Restoration**

| Latin name | Common name | Features |
|---|---|---|
| *Festuca romeri* | Idaho fescue | Dominant bunchgrass |
| *Danthonia californica* | California oatgrass | Sub-dominant bunchgrass |
| *Luzula campestris* | Field woodrush | Hardy, fills unique niche |
| *Potentilla gracilus* | Slender cinquefoi | June flowering, |
| *Eriophyllum lanatus* | Woolly sunflower | June flowering, very sturdy |
| *Erigeron speciosus* | Showy fleabane | July-August flowering |
| *Achillea millefolium* | Common yarrow | June flowering |
| *Solidago spathulata* | Dune goldenrod | May flowering |
| *Microseris laciniata* | Cut leaf microseris | May flowering |
| *Viola adunca* | Early blue violet | April-May flowering |

survival, but the open spacing allowed a large influx of weedy species such as hairy cat's ear and velvet grass to take hold. There was no funding for weed maintenance of this large project, nor any provision to increase diversity by including herbaceous species. This experience prompted Natural Areas site managers to reduce new projects to a scale that allows for better maintenance, and to do research on the propagation of a wider range of species (Davenport 1997).

## Site Management Affecting Restoration

The greatest challenge affecting most of the restoration projects covered in this review is the management of non-native shrubs such as scotch broom and pernicious pasture grass species (Parker et al. 1997). Hairy cats-ear *(Hypochaeris radicata),* has also created problems in the Long Beach dune meadow restoration, Fort Lewis prairies, and in burned restoration areas at Mima Mounds NAP (Hays 2000, Tveten 1999, Schuller 1997). Ecologically important prairies that have serious scotch broom infestations include Fort Lewis prairies, Mima Mounds NAP, Scatter Creek Wildlife Area, and Thurston County-Glacial Heritage. Site managers have developed strategies for managing broom with varied success, depending on funds and consistent agency support.

The initial broom control strategy for Mima Mounds depended on the frequent use of prescribed fire. Beginning in 1992, large burns (> 100 acres) were carried out to control broom. Additional units were burned in 1993, 1994, and 1996. Issues developed which have subsequently limited options for burning, including: a rapid increase in home development around the preserve; severe fire seasons which precluded the use of prescribed fire; shortage of funds; concerns about the lack of recovery in butterfly species following burns; and reluctance on the part of DNR fire managers to take on the risk of burning under the above conditions. Young broom plants usually survive burns in areas of low fuels, limiting the utility of fire as a broom control tool.

Over the last five years, broom at Mima Mounds NAP has been managed through targeted mowing, both by hand and with tractor mounted brush hogs. A negative side effect of mowing is that survivors develop into tough, multiple-topped shrubs. The only viable permanent control is to treat these plants with herbicide or extract them. In high quality areas of limited infestation, work crews and volunteers have hand pulled broom. These methods have gradually increased the high quality, broom free areas, while controlling seed production and spread in more heavily infested areas.

A similar but perhaps more intensive scotch broom control strategy is in place at Thurston County Glacial Heritage (a 1050 acre site), matching the control technique to the age and density of the broom, utilizing mowing, hand pulling, fall herbicide application, and herbicide wiping. A large area formerly described as "acres of solid broom" is now 25% broom free, with 2/3 of the area supporting prairie with broom under 1/2 meter in height. Site managers also conducted a 12-acre prescribed burn at Glacial Heritage in 2001 (Dunn pers. comm. 2001).

Scotch broom control strategies have a direct relationship to the success of native species restoration on prairies affected by broom infestation. Many projects have been compromised by the rapid re-invasion of broom. The high priority of controlling broom and other exotics may require postponement of expensive native plant propagation projects. Reducing a scotch broom seed bank is time consuming, but such efforts prior to plant installation are worthwhile.

## Conclusions

Developing well-defined goals, which identify the key species, habitat structure, and appropriate scale of a project, enhances prairie restoration. Considerations of scale and unit size are important for a number of reasons including successional diversity and realistic maintainability. Potential problems with weed invasions should be anticipated and control actions incorporated into plans prior to beginning the project. Species used for restoration should be selected based on a number of factors including habitat

value, ease of seed collection, germinability, greenhouse suitability, vigor, transplant success, and long-term persistence. High standards in plant handling and transplanting, and later maintenance of planted areas, will greatly influence survival. Restoration may be delayed until persistent weed seed banks are suppressed (or released and controlled) to levels that will not severely compromise project success.

As prairie and grassland managers gain experience with restoration, our methods continue to improve and develop refinement. We have adjusted the scale of each phase to fit our funds and ability to provide maintenance, and learned to advocate for long term needs for restoration. It is particularly encouraging to be part of this network of managers dedicated to prairie conservation and restoration, whose experience and shared knowledge made this report possible.

## Acknowledgements

This report was greatly enhanced by discussions with Peter Dunwiddie of The Nature Conservancy, David Hays with Washington Department of Fish and Wildlife, Patrick Dunn of The Nature Conservancy, and Lisa Randolph, Fort Lewis. Funding for prairie restoration projects has been provided by US Fish and Wildlife Service, Natural Resource Conservation Service, and The National Natural Landmark Program.

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