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Rocky Prairie Restoration and Native Plant Propagation Project

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Abstract

Rocky Prairie is designated a Natural Area Preserve to protect *Castilleja levisecta,* Golden Indian Paintbrush, which has been proposed for listing under the federal Endangered Species Act as a threatened species. Changes in land management practices and processes of natural succession have altered rare plant habitat values at Rocky Prairie. A restoration project is underway to prevent further losses of habitat, and to enhance the potential for a stable and successfully reproductive population of the rare plant. This project is taking place in phases over a period of at least three years. In the first phase, approximately 85 large trees were felled and removed by helicopter in February, 1996. This paper focuses on aspects of the project related to restoration of native herbaceous and grass species on exposed sites left following tree removal. On site seed collections in 1995 and 1996 were used to produce nursery grown plugs for spring and fall planting in 1996 and 1997. Approximately 30,000 *Festuca idahoensis,* Idaho fescue, seedlings were planted to establish the primary grass species of Puget prairies. Smaller lots of *Eriophyllum lanatum, Microseris laciniata,* and *Potentilla gracillus* were also planted. Germination and grow-out trials were conducted on certain species to expand the practical information available for propagating herbaceous prairie species. Monitoring plots were established on planted sites to evaluate survival of Idaho fescue.

Introduction

Rocky Prairie is designated as a Natural Area Preserve by the WA Dept of Natural Resources to conserve a remnant of high quality native Puget Sound prairie and to protect *Castilleja levisecta*, Golden Indian Paintbrush. This species was recently proposed for listing as a threatened species under the federal Endangered Species Act. A restoration project is underway to prevent further losses of rare plant habitat at the site, and to enhance the potential for a stable and successfully reproducing population of the rare plant. Funds for the project are provided to the Department through a grant from the US Fish and Wildlife Service.

The project was designed to meet specific objectives: reduce shading of *C. levisecta* from conifers, reduce/eliminate Douglas-fir cone production, and reverse trends toward acidic soils with heavy litter/duff accumulation that result from forest succession. Long term restoration objectives include developing a comprehensive native plant propagation program for large scale restoration efforts. This paper presents an overview of the initial phases of the project and results of native species propagation trials.

Ecological Context and Restoration Need

In addition to supporting the largest known population of *C. levisecta*, Rocky Prairie contains a great diversity of prairie species and

high quality Idaho fescue grassland. Due to the absence of fire within recent decades and the increase of non-native species, the prairie environment at the preserve has undergone significant changes in structure and species composition. Structural changes include the gradual encroachment of Douglas-fir trees and other woody species. Scotch broom, *Cytisus scoparius*, is an invasive, non-native shrub which dominates old fields, cut banks, and degraded prairies in the region. Scotch broom is a threat wherever soil disturbance or an existing seed bank is present.

Non-native grasses and weedy herbaceous species are present on the restoration site, and respond vigorously to disturbance. These species include velvet grass, *Holcus lanatus,* sweet vernal grass, *Anthoxanthum odoratum*, and weedy forbs such as Cats ear, *Hypochaeris radicata*, common tansy, *Senecio vulgaris,* St. Johnswort, *Hypericum perforatum*, and bull thistle, *Cirsium vulgare*. Native shrub species including snowberry, *Symphoricarpos albus*, wild rose, *Rosa pisocarpa,* kinnikinnick, *Arctostaphylos uva-ursi,* are present at Rocky Prairie and have modified *C. levisecta* habitat in some areas. These native shrub species and other shrubs respond favorably to tree removal and could pose problems for the prairie restoration project over time.

Scotch broom has been managed by hand control at the site for the last 11 years. Flowering and seed production of broom is nearly 100% controlled in *C. levisecta* habitat. This is relevant to the current project because the scotch broom seedbank is limited and does not pose an unmanageable threat. However, nearby seed sources for scotch broom guarantee the need for future control efforts.

Seed Collection and Propagation

Restoration of Rocky Prairie and other Puget prairie natural areas require a nursery stock of native species. The following describes early progress in creating stock for specific projects and general results of native species propagation. On site seed collections at Rocky Prairie in 1995 and 1996 were used to produce nursery grown plugs for spring and fall planting in 1996 and 1997. *Festuca idahoensis* was collected in July and early August. Herbaceous species were collected from June through September. Volunteers collected seed in 1995, which yielded large volumes of the most easily collected seed. A part time seed collector was hired in 1996 ensuring consistent, quality collection throughout the seed ripening period for each species. All species were carefully hand stripped, labeled, cleaned, dried, weighed, and promptly stored in a seed storage cooler (Rentmeester, unpublished paper, 1996).

Many of the species collected have limited or no information available for propagation requirements. To aid in selection of native herbaceous species, criteria were developed that helped refine the list of good candidates for commercial propagation.

Criteria for Herbaceous Selection

- Relative importance in prairie community
- Seed abundance
- Ease of collection and cleaning
- Reasonable seed viability
- Simple stratification/germination requirements
- Will grow in production containers as plugs
- Resistance to pests and disease
- Transplant well
- Survival in the field

Species Summaries

Microseris laciniata (cut leaf microseris) seed is extremely abundant and easy to collect, and requires no elaborate cleaning. The seed germinates readily with or without stratification and grows rapidly. However, the plants do poorly in styro blocks and develop taproots that are difficult to extract and transplant. Many field transplanted plants died back or became dormant, and survival won t be certain until emergence the following spring.

Potentilla gracillus (slender cinquefoil) rates well for collection and propagation. The seed usually germinates short or no stratification; however our trial results were mixed. The sturdy plants grow well in the greenhouse and survive with moderate vigor in the first season after field planting.

Eriophyllum lanatum (wooly sunflower) rates highly under these criteria and is one of the best performing plants to date. This plant is easy to propagate and grows fast - vegetative pruning becomes necessary if plants are started early. *E. lanatum* flowered the first season in the field.

It is important to track progress from seed collection through the first year in the field to properly assess the potential for large scale propagation and restoration success. This process has helped identify a diverse and representative complement of prairie plants for the project without expending resources on propagation of difficult species.

Festuca idahoensis (Idaho fescue) is the dominant native bunchgrass of Puget prairies, and its seed is easily collected and propagated in large quantities. Idaho fescue has demonstrated excellent results as the primary restoration plant at Mima Mounds Natural Area Preserve in an installation of 100,000 plugs in 1994. Based on this success, the Rocky Prairie project relies on Idaho fescue as the cornerstone of the restoration design, while increasing diversity by including prairie species with less well known propagation requirements.

Approximately 30,000 Idaho fescue seedlings were grown out at IFA, a commercial nursery. Seed was cold stratified for three weeks prior to planting in mid October, 1995. Seed was sown in styrofoam planting blocks with a 1" diameter and 4" plug length. Although the finished plants were small compared to other fescue crops, root development was good and the plants put on rapid growth in the field.

In late fall, 1995, students and horticulture teacher Michael VanWinkle at Cascade High School in Everett, WA sowed *Potentilla gracilus*, *Eriophylum lanatum*, and *Microseris laciniata* for spring 1996 planting. Van Winkle also conducted trials with several other species. These results contribute to table #1 (Van Winkle et.al., 1996, unpublished) .

Table 1 shows the results of our screening process for herbaceous natives to date. The following example illustrates how some species have rated according to selection criteria.

Species	Frequency & Importance	Seed Abundance/Ease of Collection	Germination	Greenhouse Qualities Container/Disease	Transplant Health	Total Score
Achille millefolium	Common	High/Easy	Medium	Good	Good	13
Antennaria microphylla	Common	Medium/Moderate	Medium	Good	Good	12
Aster curtus	Common/ Endemic	Medium/Moderate	None	--	Unknown	7
Aquilegia fomosa	Infrequent	Low/ Easy	Low	Good	Unknown	9
Balsamorhiza deltoidea	Patchy,Important	Medium/ Easy	Medium	Slow Develop/ Tap Root	Unknown	11
Camassia quamash	Very Common	High/ Easy	Low	Damping off Problem	Difficult	11
Campanula rotundifolia	Infrequent	Low/ Difficult	Medium	Good	Unknown	7
Cerastium arvense	Somewhat Common	Medium/Moderate	Medium	Good	Unknown	10
Danthonia californica	Common	Medium/ Easy	Low	Good	Good	10
Delphinium nuttlallii	Somewhat Infrequent	Medium/Moderate	None	--	Unknown	6

Dodecatheon hendersonii	Somewhat Common	Low/ Difficult	None	--	Unknown	4
Eriophyllum lanatum	Very Common	High/ Easy	Medium	Very Good/ Disease Resistant	Very Good	16
Erigeron speciosus	Common/ Patchy	Medium/ Easy	High	Good	Good	14
Festuca idahoensis	Dominant Species	High/ Easy	High	Very Good	Very Good	17
Fritillaria lanceolata	Infrequent	Low/ Moderate	Medium	--	Unknown	4
Hieracium cynoglossoides	Common	Medium/ Moderate	No Trial	Good	Fair	12
Lomatium tritematum	Somewhat Common	Low/ Moderate	High	Tap Root/ Special Container	Sensitive	6
Lomatium utriculatum	Somewhat Common	Medium/ Moderate	Medium		Sensitive	10
Luzula campestris	Somewhat Common	Low/ Moderate	High	Good	Good	11
Lupinus albicaulis	Common/ Patchy	Low/ Difficult	High	Mildew/ Sensitive Roots	Sensitive	8
Lupinus lepidus	Common/ Patchy	Low/ Difficult	None	--	Unknown	5
Microseris laciniata	Common	High/ Easy	High	Tap Root/ Strong Plant	Sensitive	13
Potentilla gracilis	Common	High/ Easy	Medium	Good	Fairly Good	14
Prunella vulgaris	Common	High/ Easy	High	Very Good	Good	13
Ranunculs occidentalis	Common	Medium/ Moderate	High	Very Good	Good	13
Sisyrinchium angustifolium	Infrequent	Low/ Difficult	None	--	Unknown	3
Solidago canadensis	Common	High/ Easy	High	Good	Unknown	13
Solidago spathulata	Common	High/ Easy	Medium	Good	Good	13
Viola adunca	Common	Low/ Difficult	Low	Good	Unknown	7
Zigadenus veneosus	Somewhat Infrequent	Medium/ Moderate	Medium	--	Unknown	7

Propagation Trials

Propagation trials were started at the DNR nursery in spring, 1996. A sample of each seed lot collected in 1995 was planted and germinated under cool and warm greenhouse conditions. A stratification treatment was not used in this trial. Because seeds were stored through the fall and winter, seed dormancy due to after-ripening requirements may have been reduced. Seed of species that responded readily in this trial were then sown in a variety of containers to evaluate practical production methods. Options for producing taprooted plants such as *microseris laciniata* and *lomatium* spp., sensitive rooted plants such as *lupinus* spp., and transplanting and holding requirements for other species were evaluated. A longer list of plants that are reliable for production growing, and some of their requirements were developed through these trials (refer to Table 1). This creates a basis for commercial contracts with realistic specifications for producing native plants.

Further trials started in September, 1996, compared various durations for wet chilling treatments (stratification), and germination on a number of species from both the 1995 and 1996 collections. Seeds were evenly divided but not counted and sown in 4" pots, so percentage of seed germinated was not calculated. Date sown, length of stratification, weeks until germination, and high, medium and low germination were recorded. In addition, the difference in germination between fresh and stored seed without stratification was observed. This can indicate whether a strong after ripening effect is keeping fresh seed in dormancy (Evans, et al, 1977; Goodwin et al 1995). Germination is much faster and in higher numbers for some species which have been in 35 degree refrigerated storage for a year. The results of this trial are shown in Table 2.

Seed Testing

Idaho fescue seed from 1995 and 1996 was tested for viability and germination by the state Department of Agriculture seed lab. Seed from 1995 had the highest germination rate, while viability was approximately the same for 1995 and 1996. This result might indicate that stored seed could maintain viability, eliminate the need for stratification, and increase flexibility in planting time. In addition to probable after ripening dormancy, *Danthonia californica* has a hard seed coat which prevents germination. *D.*

californica seed without stratification or scarification had 15% germination in tests conducted by the state seed lab. Higher germination rates (20 -40%) have been recorded following acid scarification, while no treatment controls had 2.5% - 16% germination (Laude, 1949). Certified viability testing (tetrazolium) for herbaceous species is expensive and not generally included in a restoration budget. If arrangements can be made, it may be cost effective to do this work in-house.

Prairie species started in the summer trials and transferred to containers are being planted at intervals to evaluate the best timing for fall planting. In addition, small plots directly field seeded in October, 1996 include *Festuca idahoensis, Camassia quamash, Zigadenus venenosus, Microseris laciniata, Lomatium utriculatum*, and *Erigeron speciosus*.

Project Design and Planning

This paper reports on the first phase of a long term restoration project. Restoration of a portion of the site was planned in manageable increments. Future phases could be implemented when funding and resources permitted without jeopardizing the success of this project. The first phase took place on the north end of the preserve, providing habitat protection to the largest *C. levisecta* population.

The first phase goal was to remove trees with minimal disturbance to the rare plants, soils and native prairie vegetation.

This phase consisted of large tree removal followed by native species planting of bare areas to prevent non-native species establishment. The first step was to map and mark *C. levisecta* populations with wire flags to avoid direct impacts. The design for the tree removal maximized habitat protection by removing solitary trees and tree clusters that shaded *C. levisecta* populations and good condition prairie habitat. Helicopter logging was chosen as the most efficient and least disruptive method of tree removal for this site. Open grown trees produce copious amounts of seeds, which rapidly fill in prairie habitat with seedling trees. Areas not chosen for the current round of tree removal include more degraded prairie, and patches of closed canopy Douglas-fir stands with no *C. levisecta* and little remaining prairie vegetation.

Future phases will restore prioritized portions of the prairie until all *C. levisecta* habitat is rehabilitated. This step by step approach provides time to evaluate success, apply new techniques, and gradually add species to the restoration palette as the knowledge base develops.

Table 2. Propagation trials of prairie forbs with various seed collection dates, stratification regimes and germination conditions. Brackets indicate number of days to germination

Species	Frequency & Importance	Seed Abundance / Ease of Collection	Germination	Greenhouse Qualities Container/ Disease	Transplant Health	Total Score
Achillea millefolium	Common	High/ Easy	Medium	Good	Unknown	13
Antennaria microphylla	Common	Medium/ Moderate	Medium	Good	Unknown	11
Aster curtus	Common Endemic	Medium/ Moderate	None	--	Unknown	7
Aquilegia formosa	Infrequent	Low/ Easy	Low	Good	Unknown	9
Balsamorhiza deltoidea	Patchy, Important	Medium/ Easy	Medium	Slow Develop/ Tap Root	Unknown	11
Camassia quamash	Very Common	High/ Easy	Low	Damping Off Problem	Difficult	11
Campanula rotundifolia	Infrequent	Low/ Difficult	Medium	Good	Unknown	7
Cerastium arvense	Somewhat Common	Medium/ Moderate	Medium	Good	Unknown	10
Danthonia californica	Common	Medium/ Easy	Low	Good	Good	10
Delphinium nuttallii	Somewhat Infrequent	Medium/ Moderate	None	--	Unknown	6
Dodecatheon hendersonii	Somewhat Common	Low/ Difficult	None	--	Unknown	4

Eriphyllum lanatum	Very Common	High/ Easy	Medium	Very Good/ Disease Resistant	Very Good	16
Erigeron speciosus	Common/Patchy	Medium/ Easy	High	Good	Good	14
Festuca idahoensis	Dominant Species	High/ Easy	High	Very Good	Very Good	17
Fritillaria lanceolata	Infrequent	Low/ Moderate	Medium	--	Unknown	4
Heiracium cynoglossoides	Common	Medium/ Moderate	No Trial	Good	Unknown	11
Lomatium tritematum	Somewhat Common	Low/ Moderate	High	Tap Root/ Special Container	Sensitive	6
Lomatium utriculatum	Somewhat Common	Medium/ Moderate	Medium	Good	Sensitive	10
Luzula campestris	Somewhat Common	Low/ Moderate	High	Mildew/ Sensitive Roots	Good	11
Lupinus albicaulis	Common/ Patchy	Low/ Difficult	High	--	Sensitive	8
Lupinus lepidus	Common/ Patchy	Low/ Difficult	None	Tap Root/ Strong Plant	Unknown	5
Microseris laciniata	Common	High/ Easy	High	Good	Sensitive	13
Potentilla gracilis	Common	High/ Easy	Medium	Very Good	Fairly Good	14
Prunella vulgaris	Common	High/ Easy	High	Very Good	Good	13
Ranunculs occidentalis	Common	Medium/ Moderate	High	--	Good	13
Sisyrinchium angustifolium	Infrequent	Low/ Difficult	None	Good	Unknown	3
Solidago Canadensis	Common	High/ Easy	High	Good	Unknown	13
Solidago Spathulata	Common	High/ Easy	Medium	Good	Unknown	12
Viola adunca	Common	Low/ Difficult	Low	--	Unknown	7
Zigadenus venenosus	Somewhat Infrequent	Medium/ Moderate	Medium	--	Unknown	7

Project Implementation - 1996 Tree Removal

Eighty-five trees were selected for removal and marked for directional falling to avoid *C. levisecta* populations. Eight trees in particularly sensitive areas were designated for an alternative treatment, consisting of topping, limbing all low branches, and thinning of remaining branches. This alternative may be useful in areas of great sensitivity where dropping a tree could pose disturbance problems, or if helicopter removal is not economically feasible.

After felling, whole trees with limbs attached to reduce impacts from limbing in place were flown to an off-site landing area. Residual limbs were flown separately by a small helicopter. All remaining tree debris was gathered and burned on bare ground surrounding stumps. Winter moisture levels prevented thick duff and fir needle layers from burning This duff layer later posed a problem for planting.

Revegetation

Native plants, primarily *Festuca idahoensis,* (Idaho fescue) were planted at 1' or closer spacing in the newly exposed microsites left by tree removal. Plant materials were placed in small trenches to ensure good soil contact and to enhance survival when the duff layer dried out. Fescue seedlings in styrofoam blocks were delivered to the site on March 15. The plugs were insulated and protected by the styroblocks and could be extracted and planted over several days by work crews and volunteers. Extracting tools were made out of 15" steel rods with a diameter that fit the cells. Planting tools (dibble bars) were made of 1/2" x 3' rebar with a sharpened point and foot peg welded about 5" from the end. Dibble bars facilitate proper planting depth and hole diameter for plugs.

Monitoring and Restoration Success

Planted *Festuca idahoensis* was monitored for mortality in the spring and fall. Herbaceous species in the plots were also counted. *F. idahoensis* had high survival with small amounts of initial mortality and very minor summer mortality. Competition from weeds, rather than establishment problems, appear to be the critical factor in success or failure. *Eriophyllum lanatum* had minor mortality, with many plants thriving and even blooming.

Native species that rapidly responded to tree removal include long stolon sedge, *Carex inops,* and wild strawberry, *Fragaria virginiana.* These species tolerate the partial shade of forest edge, and spread through stolons into cleared sites. Although difficult to propagate from seed,

both species are good candidates for vegetative propagation. Other native species volunteering and germinating in the restoration area include *Lupinus* sp., *Eriophyllum lanatum*, *Aquilegia formosa* (columbine), *Quercus garryana* (oregon white oak), and others.

Future Needs for Puget Prairie Restoration:

1) Compare viability and germinability of seed lots of different aged seeds to evaluate the possibility of prolonged dormancy (Shaidee et al 1968).

2) Establish field plots to enable mass production of seed for more economical restoration projects.

3) Conduct direct seed trials, and determine timing of direct field sowing.

4) Design seed and plant mixtures for representative prairie restoration.

5) Study options for planting stored seed without a stratification requirement, such as Idaho fescue.

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