CORVALLIS PLANT MATERIALS CENTER

TECHNICAL REPORT: 2010

Prairie junegrass common garden study

Rose checkermallow seed increase

Roemers fescue diuron herbicide study

Pollinator surveys and field days

USDA NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON

CORVALLIS PLANT MATERIALS CENTER

TECHNICAL REPORT 2010

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USDA Natural Resources Conservation Service
Corvallis, Oregon

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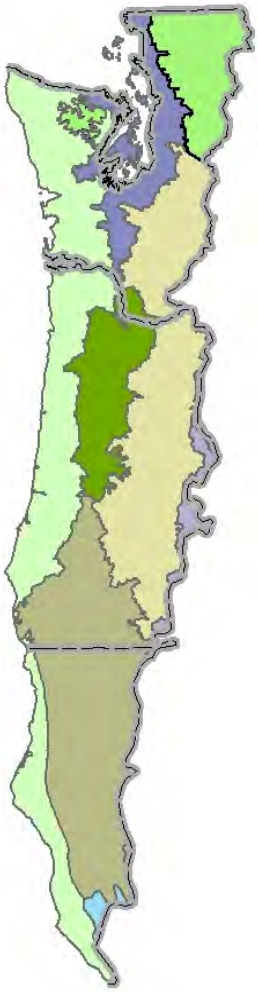
INTRODUCTION



Corvallis PMC Service Area of western Washington, western Oregon, and northwestern California

Since 1957, the Corvallis Plant Materials Center (PMC) has selected and developed conservation plants and planting technology to solve resource concerns critical to the Pacific Northwest.

A unit of the USDA Natural Resources Conservation Service (NRCS), the PMC works in partnership with local, state, federal and private organizations to develop new technology in plant propagation and establishment, seed production, re-vegetation, restoration and erosion control. Plant specialists test and release new plant sources used to restore and protect streamside areas, wetlands, uplands, cropped lands and critical wildlife habitats. A vast majority of the work focuses on native grasses, forbs and shrubs.

The Corvallis PMC service area includes the northern Pacific Coast Range, Willamette Valley and Puget Sound, as well as the Olympic, Cascade and Siskiyou Mountains.

Active Studies for the Corvallis Plant Materials Center

Study Number and Name: 14-alsi-si. Seed increase activities and methods for Sitka alder

Study Objective: To evaluate seed increase potential for Sitka alder (9040484) and provide seed to producers upon release

Study Number and Name: 24-daca. Evaluation and increase of California oatgrass

Study Objective:
(1) To evaluate, select, increase and release of California oatgrass
(2) To produce and maintain seed stocks (G1, G2, etc.)
(3) To evaluate establishment and seed increase technology

Study Number and Name: 25-dece-si. Evaluation and increase of tufted hairgrass

Study Objective:
(1) To evaluate establishment and seed production technology
(2) To produce and maintain selected class releases of tufted hairgrass for commercial increase and field plantings

Study Number and Name: 26-elgl-si. Evaluation and increase of blue wildrye

Study Objective:
(1) To evaluate, select, and release of blue wildrye for woodland and critical area erosion control
(2) To maintain breeder and foundation seed as needed

Study Number and Name: 46-hodi-pi. Seed and plant increase of oceanspray

Study Objective: To evaluate seed increase and propagation methods (seed and vegetative) of oceanspray and provide propagules to producers in anticipation of the release of two selected class pre-variety germplasms

Study Number and Name: 49-topa-si. Seed increase and evaluation of weak alkaligrass

Study Objective: To evaluate seed increase and production technology of weak alkaligrass

Study Number and Name: 5-hobr-si. Evaluation and Increase of meadow barley

Study Objective:
(1) To collect, evaluate, propagate and release one or more sources of meadow barley

(2) To evaluate the effect of post harvest residue management (burning vs. no burning) on seed increase of meadow barley

Study Number and Name: 61-caca-si. Evaluation and increase of Canada bluejoint

Study Objective: To evaluate seed germination requirements and seed increase potential of Canada bluejoint, a potential competitor with reed canarygrass

Study Number and Name: 62-glel-si. Evaluation of seed germination and increase potential of tall mannagrass

Study Objective: To evaluate the seed stratification requirements and seed increase potential of tall mannagrass

Study Number and Name: 67-shrb-cb. Vegetative increase of select native shrubs for riparian and wetland restoration and erosion control

Study Objective: To establish and maintain cutting blocks of easy to root, select native shrubs and trees for the Willamette Valley and Puget lowlands ecoregions

Study Number and Name: 71-cv-cb. Maintenance and harvest of woody cultivar cutting block

Study Objective: To establish and maintain cutting blocks of six woody cultivar releases and potential releases: 'Mason' redosier dogwood, 'Bashaw' Douglas spirea, 'Rogue' arroyo willow, 'Placer' erect willow, 'Multnomah' Northwest sandbar willow, Plumas Sitka willow, 'Clatsop' hooker willow, Pacific willow, Piper willow (inland Hookers willow), and Scouler's willow

Study Number and Name: ORPMC-P-0710-TE.Plant production for critical habitat for the Oregon silverspot butterfly

Study Objective: To produce plants to be planted in a restoration site in the critical habitat of the Oregon Silverspot Butterfly.

Study Number and Name: ORPMC-P-0711-CR. Plant production for revegetation along roadsides in Lassen Volcanic National Park

Study Objective: To develop plant propagation and restoration technology for high elevation roadsides in Lassen Volcanic National Park

Study Number and Name: ORPMC-P-0907-UR. Mass selection of sand fescue for low maintenance turf

Study Objective: To develop a pre-variety of sand fescue through several cycles of mass selection for the purpose of low maintenance and low input turf and cover crop.

Study Number and Name: ORPMC-S-0103-WL. Seed increase of Roemers fescue

Study Objective:
(1) To increase and evaluate seed production potential of Roemer's fescue
(2) To evaluate post harvest residue management (burn vs. no burn) on seed production
(3) To seed increase of five polycross (composite) populations for future release from Roemers fescue common garden study

Study Number and Name: ORPMC-S-0203-WE Seed increase and technology development of difficult wetland species for the Eugene District, BLM

Study Objective: To increase seed in small plots to evaluate agronomic potential of wetland species

Study Number and Name: ORPMC-S-0307-CR. Seed increase and evaluation of slender wheatgrass

Study Objective: To increase seed of slender wheatgrass and evaluate its use on upland prairies for restoration and critical areas for erosion control

Study Number and Name: ORPMC-S-0308-WL. Seed increase and evaluation of Lemmon's needlegrass

Study Objective: To increase seed of Lemmon’s needlegrass and evaluate establishment requirements for upland prairie restoration and other revegetation purposes

Study Number and Name: ORPMC-S-0403-CR. Seed increase and technology development for Elwah River restoration.

Study Objective: To produce plants and seed that will be used to stabilize slopes, control erosion, and exclude invasive weeds after dam removal on the Elwah River in Olympic National Park

Study Number and Name: ORPMC-S-0404-WL. Seed Increase for fire rehabilitation in the Medford District BLM.

Study Objective: Increase of grass and forb seed for restoration in the Medford Oregon District of the BLM

Study Number and Name: ORPMC-S-0602-WL. Seed increase and technology development of native grasses and forbs for the Roseburg District BLM

Study Objective: Seed increase and technology development of one legume and three grasses for wildlife habitat improvement in the Roseburg District of the BLM

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Study Number and Name: ORPMC-S-0603-TE. Seed increase and technology development of violets and nectar sources for the Oregon silverspot butterfly

Study Objective: To increase seed and develop technology for creation and restoration of critical habitat for the endangered Oregon silverspot butterfly

Study Number and Name: ORPMC-S-0706-TE. Seed Increase of two populations of Kincaid's Lupine.

Study Objective: Develop seed increase technology for an endangered lupine

Study Number and Name: ORPMC-S-0707-TE. Seed increase of Willamette Valley daisy

Study Objective: Develop seed increase technology for the endangered Willamette Valley daisy

Study Number and Name: ORPMC-S-0903-TE. Seed increase of endangered Nelson's Checkermallow in two recovery zones

Study Objective: To increase seed and produce plugs of an endangered plant to work towards recovery goals

Study Number and Name: ORPMC-S-0904-TE. Seed increase of coastal meadow forbs for the US Fish and Wildlife Service in southwest Washington

Study Objective: To produce seeds and plants of species that are critical to habitat restoration of the endangered Oregon silverspot butterfly in SW Washington

Study Number and Name: ORPMC-S-0905-CR. Seed increase technology for revegetation of Nisqually Entrance, Mt. Rainier National Park

Study Objective: To improve seed increase technology for three grass species for Mt. Rainier National Park.

Study Number and Name: ORPMC-S-0906-CR. Seed increase and technology development for prairie restoration in San Juan Islands National Historical Park

Study Objective: To produce seeds and develop technology to restore native prairies in the San Juan Islands National Heritage Preserve

Study Number and Name: ORPMC-T-0001-WE. Increase and evaluation of great camas from seed and bulbs

Study Objective:
(1) To evaluate methods of seed and bulb production of great camas
(2) To increase seed and bulbs of great camas for research and field plantings

Study Number and Name: ORPMC-T-0105-OT. Demonstration of native upland, woodland, wet prairie and marsh grasses and select introduced grasses and forbs

Study Objective:
(1) To demonstrate the growth habit and flowering of native wetland, forest, and upland grasses in a garden planting
(2)To demonstrate the growth of select introduced grasses, grass-like plants, and forbs

Study Number and Name: ORPMC-T-0301-UR. Evaluation of native upland grasses as low maintenance turf

Study Objective: To evaluate select native upland grasses for their ability to grow and function as low maintenance turf in the Willamette Valley Ecoregion

Study Number and Name: ORPMC-T-0613-WL. Evaluation of seed yield and production methods of native upland and wetland grasses

Study Objective: To evaluate the yield potential and seed increase methods for native upland and wetland grasses grown for seed

Study Number and Name: ORPMC-T-0701-CR. Effect of small grain cover crop residues on establishment and growth of two native grasses

Study Objective:
(1) To evaluate the effect of 10 commonly used small grain species-varieties, including 'Regreen' sterile wheat x wheatgrass and 'Quickguard' sterile triticale, and their associated plant residues, on the subsequent establishment and appearance of blue wildrye and pine bluegrass
(2) To evaluate the establishment and possible suppression of annual bluegrass and other weeds by cover crop residues of 'Quickguard' sterile triticale and 2 varieties of oats

Study Number and Name: ORPMC-T-0702-CR. The tolerance of carbon-seeded blue wildrye, Roemers fescue, riverbank lupine, meadow barley, and tufted hairgrass to preemergence applications of diuron

Study Objective: To evaluate the effect of four rates of diuron preemergence herbicide on the establishment, tolerance, seed production and weed control of forbs and native grasses grown for seed

Study Number and Name: ORPMC-T-0708-TE. Breeding system study on Willamette Valley daisy

Study Objective: To study the breeding system of the endangered Willamette Valley daisy in order to assess population sizes in the recovery plan for the species

Study Number and Name: ORPMC-T-0801-WL. Evaluation of pollinator hedgerow species planting

Study Objective: Hedgerow planting to evaluate potential native species for use as pollinator and beneficial insect habitat in croplands

Study Number and Name: ORPMC-T-0803-RA. Genecology of prairie junegrass

Study Objective:
(1) To explore genetic variation in putative adaptive traits in prairie junegrass from a wide range of source environments in the Pacific West
(2) To explore the relationships between genetic variation in putative adaptive traits and the climates of source environments
(3) To develop seed transfer guidelines and possible releases to ensure adapted populations for restoration and revegetation

Study Number and Name: ORPMC-T-0901-BF. Adaptability of 'Tropic Sun' Sunn Hemp for cover cropping

Study Objective: To determine the areas of the country with potential to use sunn hemp for green manure (30-45 day green manure crop) and cover crops

Study Number and Name: ORPMC-T-0902-WL. Effect of scarification and stratification treatments on seed germination of California oatgrass

Study Objective: To determine the effect of acid and mechanical scarification treatments, hulling, nicking, and warm moist and cold moist stratification on seed germination of three populations of California oatgrass

Study Number and Name: ORPMC-T-1001-WL. The effect of timing and rate of nitrogen fertilization on seed yield of Roemers fescue

Study Objective: To determine the effect of four different dates and five rates (combinations) of nitrogen fertilization on seed yield of Roemers fescue

Study Number and Name: ORPMC-T-1002-WE. Effect of timing and rate of nitrogen fertilization on seed yield of meadow barley

Study Objective: To determine the effect of four different dates and five rates (combinations) of nitrogen fertilization on the seed yield of meadow barley

RESEARCH

The Effect of Scarification and Stratification Treatments on the Germination of *Danthonia californica* Seed from Three Populations

Dale Darris

Introduction

Danthonia californica Bolander (California oatgrass) is an important cool season perennial grass for prairie restoration as well as rangeland and wildlife habitat improvement in Pacific Coastal States USA. However, establishment is often confounded by delayed germination attributed to one or more types of seed dormancy. Dormancy varies from low to high among populations and among and within seed lots of the same population (Darris et al. 2008). Hulling/scarification (Trask 1996) or the use of concentrated sulfuric acid to erode or weaken the pericarp (Laude 1949) have been among the most successful methods promoting germination, but cold moist stratification or a combination of treatments have worked as well. This suggests the possibility of combined dormancy in some seed lots (Darris et al. 2008). In order to break dormancy, a series of four experiments were conducted to compare the effects of single and multiple treatments on the germination of *Danthonia californica*, including cold moist stratification (moist chilling), warm moist stratification, hulling, and acid or mechanical scarification of the seed coat.

Methods and Materials

Seed from three natural populations of *Danthonia californica* [Polk Co, OR (9040747=747, Baskett Slough Germplasm), Douglas Co., OR (9079415=415), and California (9083030=030)] were used in a series of four germination experiments. All experimental samples consisted of a random mix of terminal inflorescence seed and cleistogenes, typical of machine harvested *Danthonia* seed lots that have been aggressively threshed. Terminal inflorescence seed and cleistogenes can respond differently to scarification treatments (Laude 1949), but handling and treating the two types separately is impractical because of the mixing that occurs when combining fields grown for seed. Seed was stored under ambient air conditions in the office until used.

All tests used standard germination boxes and paper placed in a growth room with a photoperiod of 16 hr light/8 hr dark at 20°C/15°C (Tables 1-2) or 25°C/20°C (Tables 3-4). Germination was recorded weekly for 21 days. Experimental design consisted of a completely randomized design with four replications and 50 seeds per replication. All data were transformed with an angular transformation and means compared using analysis of variance and LSD test at the alpha 0.05 level of significance.

Cold moist stratification occurred for 90 days at 3°C (Table 1) or 60 days at 3°C plus 30 days at 11°C (Table 3). Warm moist stratification was conducted in the dark by wrapping germination boxes in aluminum foil and placing them in a growth room at 25°C/20°C for 14 or 28 days prior to being uncovered (Table 4). Seeds were manually hulled by rubbing and peeling off the lemma and palea by hand to minimize any damage to the pericarp, and mechanically hulled by moving the seed between two rubber belts travelling at slightly different speeds (called a belt thresher). Scarification of the pericarp was accomplished with concentrated sulfuric acid (98% concentration or sp. gr. 1.84, as per Laude 1949), with a 50% dilute solution of sulfuric acid (sp. gr. 1.4), or with a Forsberg seed scarifier using 320 grit sandpaper, all at varying time intervals (Tables 1-2). Seed was "nicked" by making a cut with a scalpel over the endosperm on the dorsal side of manually hulled seed (Laude 1949) (Tables 2-3).

Results and Discussion

Means with the same letter are not significantly different (P=.05) (Tables 1-4). Manually hulled then nicked seed germinated within 2% of total viability as determined by tetrazolium test (Tables 2-3), but manual hulling alone did not significantly improve germination over the controls for two of three populations. This suggests that for at least some populations, delayed germination is the result of a single, seed coat imposed dormancy. This result concurs with work by others (Laude 1949, Trask 1996), and does not indicate a combined dormancy mechanism. While the hull may still impose partial dormancy in some seed lots, manual removal is impractical and mechanical removal did not improve germination over no treatment. Mechanical hulling also increased the number of abnormal seedlings which suggests damage occurred to the embryo (Table 2). The fact that the embryo is in a vulnerable position and subject to physical injury (Laude 1949) is also a likely explanation for the highly reduced germination from all sandpaper scarification treatments using a mechanical seed scarifier. In sharp contrast to Laude (1949), concentrated sulfuric acid treatments did not improve germination but were instead detrimental, if not lethal to the seed (Tables 1-2). However, soaking the seed in 50% dilute sulfuric acid for 20 minutes significantly improved germination over the control (80% vs. 65%) for population 9083030 (Table 2). Besides scarifying the seed coat, all acid treatments removed the hulls.

Other observations about germination were made during the warm stratification and cold/cool stratification experiments. It has been reported that seed of *Danthonia californica* requires light to germinate (Maslovat 2001). However, the requirement is not absolute for all seeds. While less than 1% of the seed germinated in complete darkness for populations 9040747 (Baskett Slough Germplasm) and 9056415, 4.8% did so for population 9083030 (data not shown). In addition, dehydration of the seed for one week after imbibition of moisture may have reduced viability but did not kill every seed.

Germination ranged from 4 to 58% after seeds were remoistened (Table 4). These observations suggest only a low percentage of seed will germinate with deep burial in the soil and support present recommendations for shallow seeding depths of 0.6 mm (.25 in) or less. However, many will still germinate despite a period of desiccation following initial moisture uptake. Finally, for the cold/cool moist stratification treatment of 60 days at 3°C plus 30 days at 11°C, a few seeds germinated while still in the cooler (data not shown). This suggests that some germination could occur outdoors in moist soil of a similar temperature (11°C or 52°F) after a period of moist chilling.

In this study, 90 days of cold moist stratification alone or 28 days of warm moist stratification in the dark were virtually equivalent (Tables 1,3, 4). The two methods probably involve biochemical degradation or physical changes to the pericarp allowing for a higher percent germination. The process may simply take longer under cooler temperatures. However, if the process is progressive, it is uncertain why germination actually dropped below the level of the controls with only 14 days of warm moist stratification while significantly increasing with 28 days (Table 4). Nevertheless, given enough time in moist stratification, the net or end result may be similar to the immediate physical eroding, weakening, or nicking (penetration) of the seed coat without injury to the embryo. Because complete germination of all viable seed (ie. within 2%) occurred by making a simple physical change, leaching or the breakdown of inhibitors over time does not appear to be a factor. Also, a change in moisture imbibition is probably not the cause because both scarified and untreated seed of *Danthonia californica* have been shown to take up similar amounts of water. Improved gas exchange (such as enrichment of oxygen) and removal of mechanical restraint on the embryo are possible explanations for improved germination (Laude 1949). Simpson (1990) cites comparable research work with other grasses where total water uptake also remained similar between untreated seed and nicked, cut, or pierced seed. The author suggests that improvements in germination in such cases could also be the result of an improvement or change in water relationships. More specifically, a faster rate of moisture uptake was observed in scarified caryopses compared to untreated ones and not improved gas exchange. *Danthonia californica* would need to be tested for this possibility as well as the possibility of enrichment of oxygen by nicking or cutting the pericarp.

Because of the injury or lower germination caused by mechanical and acid scarification seed treatments and the neutral effect of mechanical hulling, cold moist or warm moist stratification are the simplest and most practical means to maximize germination of some populations of *Danthonia californica*. Practical implementation supports fall sowing as a natural means of cold moist stratification overwinter to overcome the seed coat imposed dormancy. The success of warm moist stratification suggests that summer sowing when soils are warmest combined with frequent irrigation may provide another option for improved germination and establishment.

Table 1. Effect of mechanical hulling, moist chilling, and scarification on germination of two populations of *Danthonia californica*

Treatment	% germination by population[1]	
	415	747
Total viability (TZ test)	96	93
90 d	88 a	81 a
Hulled + 90 d	53 b	52 b
None (control)	52 bc	39 c
90 d + 15 sec sand	50 bc	47 bc
Hulled	44 c	50 bc
90 d + 5 min acid	31 d	18 e
Hulled + 15 sec sand	17 e	8 f
Hulled + 90 d + 5 sec sand	8 f	28 d
Hulled + 90 d + 10 sec sand	8 fg	7 f
Hulled + 90 d + 15 sec sand	4 fgh	1 g
Hulled + 90 d + 20 sec sand	4 gh	7 f
20 min acid	2 h	20 de
Hulled + 90 d + 5 min acid	0 i	0 g
Hulled + 90 d + 10 min acid	0 i	0 g
Hulled + 90 d + 20 min acid	0 i	0 g
Hulled + 90 d + 30 min acid	0 i	0 g
Hulled + 90 d + 40 min acid	0 i	0 g
Hulled + 20 min acid	0 i	0 g
90 d + 20 min acid	0 i	0 g

[1]Means with the same letter are not significantly different at the .05 level of significance based on LSD test.

Table 2. Effect of hulling and scarification treatments on germination of *Danthonia californica* (population 030)

Treatment	% germination[1]	
	abnorm	normal
Total viability (TZ test)		96
Manually hulled + nicked	2	97 a
Manually hulled	0	82 b
20 min 50% dilute acid	0	80 bc
5 min 50% dilute acid	0	76 bcd
Machine hulled	7	71 cd
None (control)	0	65 de
Mach. hulled + 5 sec sand	21	57 ef
5 min acid	5	48 f
Mach. hulled + 20 sec sand	24	19 g
Mach. hulled + 5 min acid	3	18 gh
20 min acid	8	10 h
Mach. hulled + 20 min acid	2	0.5 i

[1]Means with the same letter are not significantly different at the .05 level of significance based on LSD test.

Table 3. Effect of manual hulling and moist chilling on germination of *Danthonia californica californica*

Treatment	% germination by population[1]		
	030	415	747
Total viability (TZ test)	96	96	93
Man. hulled + nicked coat	---	95 a	91 a
Man. hulled + 90 d cold/cool	85 a	---	---
90 d cold/cool	70 b	83 b	59 b
Manually hulled	---	23 c	20 c
None (control)	53 c	15 c	14 c

[1]Means with the same letter are not significantly different at the .05 level of significance based on LSD test.

Table 4. Effect of warm moist stratification on germination of *Danthonia californica*

Treatment	% germ. by population[1]		
	030	415	747
Total viability (TZ test)	96	96	93
28 d warm	72 a	88 a	81 a
None (control)	68 a	75 b	47 b
14 d warm	44 b	42 c	46 b
Demonstration (nonrepl.)			
7 d warm	50	50	32
7 d warm + 7 d dehydrate	26	4	58
21 d warm	84	66	90
21 d warm + 7 d dehydrate	50	56	58

[1]Means with the same letter are not significantly different at the .05 level of significance based on LSD test.

Conclusions

- Manual hulling then weakening or penetrating the seed coat (pericarp) by nicking was the most effective means of eliminating dormancy and improving germination without damaging the seed; however, it is impractical for field scale work.

- Results indicate that for at least some seed lots, there is no combined or double dormancy but only a single, seed coat imposed one. However, dormancy contributed in part by the hull cannot be ruled out in other populations.
- Contrary to other published work, concentrated sulfuric acid to scarify, erode, or weaken the seed coat was far too detrimental to the seed, at least for the three populations in this study. However, soaking seed in a 50% dilute solution of this acid for 20 minutes may benefit germination in some seed lots. Acid must be handled with specific safety precautions and seed lots pre-tested in small amounts if this option is considered.
- Mechanical hulling alone, even with a machine as gentle as a belt thresher, did not improve germination over no treatment and is not recommended.
- For short intervals (as little as 5 seconds) machine sanding of the seed coat was too injurious and substantially reduced germination in two of three seed lots. For the third lot it provided no benefit. Sanding the seed coat with a machine such as a seed scarifier is not recommended.
- As a practical method, cold moist stratification of the seed for 90 days provided the highest germination with little or no apparent injury to the embryo. Presumed biodegradation or associated physical changes in the seed coat under high moisture conditions for 90 days may be akin to an immediate physical weakening, nicking, or erosion of the seed coat. Cold moist stratification is recommended. Fall sowing and over-wintering the seed outdoors will probably provide a similar benefit. This is already the recommended practice for establishing California oatgrass from seed.
- Warm moist stratification for 28 days in the dark produced virtually the same high germination results as 90 days of cold moist stratification. This method is an alternative where shorter time frames are needed. It might be achieved outdoors by summer sowing in warm soil, provided there is frequent irrigation. Field confirmation is needed.
- Light appears to be required for most California oatgrass seeds to germinate, but not all. This finding supports the recommendation that seed should be sown no deeper than 6 mm or ¼ inch.

Acknowledgements

The author wishes to thank the dedicated efforts of Peter Gonzalves, Vanessa East, and Jeanna Ramos who assisted with these experiments.

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Tolerance of Carbon-Seeded Meadow Barley and Blue Wildrye to Diuron

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Introduction

Several species of grasses native to the Pacific Northwest are being grown for seed on small acreages in the Willamette Valley. There are currently no herbicides registered for the control of grass weeds during stand establishment of these native species. The application of diuron prior to crop emergence where the seed row has been protected with a band of carbon is a standard practice for some of the conventional grass species grown for seed in the Willamette Valley. Although annual bluegrass (*Poa annua*) has developed resistance to diuron on much of the valley grass seed acreage, many other grass and broadleaf weed species are controlled with this decades old practice. Two of the native species that are being tested for tolerance to diuron in carbon seedings are meadow barley (*Hordeum brachyantherum*) and blue wildrye (*Elymus glaucus*). The data being collected from this series of trials will be used in support of potential additions to a diuron label.

Methods

Two trials were initiated in the fall of 2006 at the OSU Hyslop Research Farm and two trials were initiated in 2007 at the nearby OSU Schmidt Research Farm. All trials were a collaborative effort with the USDA NRCS Plant Materials Center. The soil at the Hyslop site was a Woodburn silt loam with a pH of 5.6 and an organic matter content of 2.5%, while the Schmidt Farm soil was a Willamette silt loam with a pH of 5.2 and an organic matter content of 3.9%. The soil was dry when the diuron treatments were applied in 2006 and wet when they were applied in 2007.

The experimental design in both years was a randomized complete block with four replications. Individual plot dimensions were 6.5 ft by 25 ft in 2006 and 8 ft by 25 ft in 2007. Diuron treatments were applied with water at 20 gallons per acre at 20 psi on October 13, 2006, and October 12, 2007—the day after carbon seeding each year. Diuron rates ranged from the lowest recommended rate of 0.8 lb active ingredient per acre to 4.8 lb active ingredient per acre which is twice the maximum rate for any soil type. Activated carbon was applied at a rate of 300 lb per treated acre in a 1-inch-wide band over the seed row at planting. Visual evaluations of crop injury were conducted periodically following diuron application, and the grasses were swathed, threshed and the seed was cleaned.

Results

The final crop injury ratings are presented in Tables 1 and 2. Although visual ratings of both species were zero in 2007, blue wildrye seed yield was reduced by the highest rate

of diuron (Table 1). Stunting of both species was recorded at the highest rate of diuron in 2008, but seed yields of neither species were reduced by any of the diuron treatments in that year. Meadow barley and blue wildrye tolerance to diuron in carbon seedings appears comparable to that of other grass species that are currently established with this technique. These data may allow the addition of these and several other native grass species to a diuron label.

Table 1. Visual injury ratings and seed yield of blue wild rye following applications of diuron to carbon seedings.

		Injury[2]		Seed yield[3]	
Treatment[1]	Rate	2007	2008	2007	2008
	(lb ai/A)	----------(%)----------		----------(lb/a)---------	
Diuron	0.8	0	0	86	427
Diuron	1.2	0	1	82	441
Diuron	2.4	0	8	91	441
Diuron	4.8	0	38	66	440
Check	0	0	0	72	296
LSD(0.10)				18	62

[1]2007 treatments applied on October 13, 2006; 2008 treatments applied on October 12, 2008
[2]2007 treatments evaluated March 7, 2007; 2008 treatments evaluated April 9, 2008
[3]Harvested in July both years

Table 2. Visual injury ratings and seed yield of meadow barley following applications of diuron to carbon seedings.

		Injury[2]		Seed yield[3]	
Treatment[1]	Rate	2007	2008	2007	2008
	(lb ai/A)	----------%----------		----------lb/a----------	
Diuron	0.8	0	0	60	481
Diuron	1.2	0	1	76	519
Diuron	2.4	0	4	80	532
Diuron	4.8	0	30	86	545
Check	0	0	0	41	380
LSD(0.10)				15	69

[1]2007 treatments applied on October 13, 2006; 2008 treatments applied on October 12, 2008
[2]2007 treatments evaluated March 7, 2007; 2008 treatments evaluated April 9, 2008
[3]Harvested in July both years

Tolerance of Established Blue Wildrye to Herbicides

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Introduction

Blue wildrye (*Elymus glaucus*), a perennial grass native to the West Coast, is grown on a small acreage in Oregon for seed production. Currently dimethenamid-p (Outlook [R]) is the only herbicide that is registered for the control of weedy grasses in established blue wildrye. Two trials were conducted to evaluate the tolerance of established blue wildrye to other herbicides that are being used for the control of weedy grasses in grass seed production in the Willamette Valley.

Methods

The 2006-2007 study at the OSU Hyslop Research Farm was comprised of 6.5 ft by 30 ft plots, while the 2007-2008 study at the OSU Schmidt Research Farm consisted of 8 ft by 25 ft plots. Both trials were a collaborative effort with the USDA NRCS Plant Materials Center. The experimental design of both trials was a randomized complete block with four replications. Herbicide treatments were applied in water at 20 gallons per acre at 20 psi. Herbicides included were flufenacet-metribuzin (Axiom), pendimethalin (Prowl H2O), oxyfluorfen (Goal), and metribuzin (Sencor). Oxyfluorfen was omitted from the 2007-2008 trials and flufenacet (Define) was substituted for flufenacet-metribuzin. Four rates of dimethenamid-p were included in the 2007-2008 study.

The soil at Hyslop Farm was a Woodburn silt loam with a pH of 5.7 and an organic matter content of 2.9%. The Schmidt Farm soil was a Willamette silt loam with a pH of 5.2 and an organic matter content of 3.9%. The Schmidt site has a moderate infestation of annual bluegrass (*Poa annua*). The blue wildrye stands at both sites had been established by the USDA Plant Material Center for seed increase and were in their third year of production. Visual evaluations of crop injury and annual bluegrass control were conducted periodically after herbicide application. The crop was swathed and threshed in July.

Results

The final visual ratings are included in Tables 1 and 2. Oxyfluorfen caused significant crop stunting at the higher rate of application (Table 1), but seed yield was comparable to that from the untreated check. Visible injury caused by the other herbicide treatments in the Hyslop study was very minor and all seed yields were equal to or greater than those from the check. None of the herbicide treatments in the 2007-2008 study caused significant injury symptoms and there were no statistical differences among the seed

yield means (Table 2). Pendimethalin provided less control than the other herbicides on the annual bluegrass in this trial.

Dimethenamid-p may be applied to blue wildrye under conditions and at rates specified on the Outlook label. None of the other herbicides in these two studies are currently registered for use in blue wildrye grown for seed.

Table 1. Visible injury and seed yield of established blue wildrye following herbicide applications at Hyslop Farm, 2006-2007.

Treatment[1]	Rate (lb a.i./a)	Blue wildrye injury[2] (%)	Blue wildrye seed yield (lb/a)
Flufenacet-metribuzin	0.42	0	91
Flufenacet-metribuzin	0.85	0	126
Pendimethalin	3	5	114
Pendimethalin	6	0	104
Oxyfluorfen	0.19	2	103
Oxyfluorfen	0.38	35	93
Metribuzin	1	5	122
Check	0	0	91
LSD (0.10)		--	21.4

[1]Applied November 8, 2006
[2]Evaluated March 7, 2007

Development and Seed Increase of Polycross (composite) Populations of Roemers Fescue (*Festuca roemeri)* as Pre-Variety Germplasm

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Abstract

Results of a recent common garden study (2003-2006) provided evidence about appropriate seed transfer zones for *Festuca roemeri* (Roemers fescue) and their general correspondence to Level III Ecoregions in western Washington, western Oregon, and northern California. That information in now being used as the basis to develop pre-variety germplasm releases to provide ecologically and genetically appropriate seeds for habitat restoration, erosion control, and other revegetation projects in five regions of the Pacific Northwest. Multiple seed sources were chosen to form polycross (composite) populations representing as much genetic diversity as possible within each region (seed transfer zone), while using plants that overlap in flowering time, have moderate to high seed yield, and originate at similar elevations. The supporting genecological work is reviewed and the process used to select appropriate seed sources, develop polycross populations for germplasm releases, and conduct seed increases is described.

Introduction and Background

Description, ecology, and importance

Festuca roemeri (Pavlick) E. B. Alexeev is a fine-textured, C3 bunchgrass with most of the foliage clustered in a dense basal tuft. Leaves are light blue to green. Culms are 30 to 100 cm (12-40 in) tall, terminating in an open panicle. It is cross-pollinated by wind. Plants are slow-growing perennials, rarely flowering before they are one and one half to two years old suggesting the species has a strong vernalization requirement. Individual plants have variable longevity, perhaps with the potential to survive for decades like related *Festuca idahoensis* Elmer (Liston et al. 2003).

This grass was originally described relatively recently as *F. idahoensis* var. *roemeri* Pavlick (Pavlick 1983) and later treated as a species (Alexeev 1985). Southern, inland populations differ from more northern and coastal populations in details of leaf anatomy and isozymes (Wilson 1999) and have been recognized as a different subtaxon, *F. roemeri* var. *klamathensis* B. L. Wilson (Wilson 2007). Hairs are longer and more abundant on the inner surface of the leaves of *F. roemeri* var. *klamathensis* compared to *F. roemeri* var. *roemeri* which has fewer and shorter hairs at the same position.

There is also a consistent difference in the band pattern of the isozyme malate dehydrogenase (MDH) between the two botanical varieties.

F. roemeri is an important component of plant communities on sites as diverse as gravel outwash prairies, coastal headlands, and oak, pine, and serpentine savannas at elevations of 30 to 1830 m (100-6,000 ft), from southern British Columbia to the San Francisco area of California, entirely west of the Cascade Range. It tolerates moderately acid to slightly basic soils, including serpentine and other unusual soils, in full sun to partial shade. It grows best in well drained soils with fine to medium texture. It is drought tolerant, but generally grows in mesic rather than xeric sites. Large populations of *F. roemeri* var. *roemeri* survive on gravel outwash prairies in Thurston County, Washington, and *F. roemeri* var. *klamathensis* is common in serpentine habitats in southwest Oregon and northwest California. Elsewhere *F. roemeri* exists in small, isolated, remnant populations, most consisting of a few dozen to a few hundred individuals.

F. roemeri was once a community dominant in extensive upland prairies and savannas in western Oregon and Washington (Wilson 1999). Because of its ecological importance, it is valued for habitat restoration projects. Its non-aggressive habit suggests compatibility with native forbs. The species modest stature coupled with an extensive root system that can hold soil makes it desirable as a ground cover and for erosion control; for example in vineyards, young orchards, turf and naturalized landscapes. Commercially available seed sources are needed because wild-collected seed is expensive, the species is often misidentified, and practitioners have genetic concerns about seed movement, ecological adaptation, genetic diversity, and other issues.

In response to this need, the purpose of this work is to 1) develop ecologically appropriate, genetically diverse polycross populations of *F. roemeri* based on genecological evidence from a common garden study, 2) produce certified seed of these materials for research and further multiplication by commercial growers, and 3) release these populations as selected class, pre-varietal germplasm for use in habitat restoration, revegetation, and erosion control. Expanded geographic ranges and roles outside of restoration (for example cover crop, low maintenance turf) by one or more pre-varieties may be suggested after further evaluation and testing.

Species identification and genecological issues

One serious problem with developing *F. roemeri* seed sources is that *the species* often grows in mixed populations with *F. rubra* L., and the two are easily confused (Dunwiddie and Delvin 2006; Wilson 1997). Most *F. rubra* now growing wild in the Pacific Northwest appears to be from lineages introduced from Europe for pastures, erosion control, and lawn. Ensuring that wild-collected seed is actually *F. roemeri* requires careful examination of each individual plant from which seed is collected, or growing the seed in cultivation for at least one generation and removing those plants that are not *F. roemeri.* Therefore, it is more practical to get pure *F. roemeri* seed is from cultivated sources that have been checked repeatedly for identification.

Second, questions have been raised about how far *F. roemeri* seed should be moved. Using local seeds is desirable (McKay et al. 2005) but many issues go into deciding how far it is genetically and ecologically appropriate to move plants (Rogers and Montalvo 2004). Consistent differences between northern and southern populations suggest that populations of *F. roemeri* var. *klamathensis* should not be moved into the range of *F. roemeri* var. *roemeri,* and vice versa (Wilson 2007). Furthermore, good evidence has been lacking about the genetic similarity of *F. roemeri* in the Puget Trough and Willamette Valley centers of distribution. Even moving plants within the Willamette Valley has been questioned, in part because the small remnant populations in that area differ from one another in color, height, and other traits (Wilson, pers. obs.).

Common garden study and seed zones

To address the genecological issues surrounding *F. roemeri,* a common garden study was recently completed (2003-2006) in western Oregon. Common garden studies are recognized as a robust way to ascertain differences in adaptive traits among plant populations of the same species by growing representative individuals in a common, uniform environment. Two or more locations are preferred for best determining plant adaptation, but resources limited this study to one site. Data is collected on key phenotypic traits, then statistical methods such as multivariate and principal components analyses (SAS Institute Inc. 1999), are utilized to explore population differences related to the environments of source locations. In the analysis, patterns or groupings of genetic variation may emerge across the landscape, and if they relate to plant traits considered important for adaptation, they can form a basis for defining seed transfer guidelines and seed zones. Deployment of seed or propagules according to the guidelines or within the same zone from where the material naturally originated, is generally considered safe with low risk of plant maladaptation.

This methodology was employed for *F. roemeri* by a coalition of partners including the Institute for Applied Ecology, Corvallis, Oregon, the USDA NRCS Plant Materials Center, Corvallis, Oregon, The Carex Working Group, Eugene, Oregon, and the USDA Forest Service, with additional support from the Eugene, Roseburg, Salem, and Medford Oregon Districts of the USDI Bureau of Land Management. Conducted at the Corvallis Plant Materials Center, the study compared 47 populations (Table 1) assembled from throughout the range of *F. roemeri*. Each population was represented by three to eight families and there were eight replications or single plant plots for each family in the study. Certain geographically peripheral populations were removed because they distorted the analysis of more typical *F. roemeri* populations. As a result, 43 of the populations were used in the final analysis. Numerous traits were measured in order to describe growth, morphology, disease occurrence (leaf rust, *Puccinia* spp.), phenology, survival, and seed yield. Plants were highly variable in color, leaf size, leaf width, fecundity, and other characteristics. Some individual populations were recognizable, but patterns were difficult to discern in the field (Figure 1). Subsequent principal components analysis helped identify clusters or unique genetic groups with similar phenology and growth characteristics (Wilson et al. 2008).

The principal components analysis was also modified to estimate a “growth” variable and a “timing” variable using a reduced dataset. In this case, “Growth” was defined as the first principal component for the analysis using the five variables height and width in 2003 and 2004 and survival in 2006 (Table 2, 2003 data not shown); it explained 46% of the variation in these five traits. “Timing” was the first principal component of the analysis using the 2004 traits anthesis date, seed maturity date, and phenological score on March 3 (Table 2); it explained 79% of the variation in these three traits. This analysis, like previous ones using the larger dataset (Wilson et al. 2008), clustered low elevation (<3000 ft) populations into genetic groups (Figure 2) representing the Willamette Valley/Oregon Coast, western Washington (Puget Trough/San Juan Islands), and the Siskiyou/Klamath region, plus some divergent populations. When mapped on the landscape, the population clusters (aside from the Oregon Coast) largely corresponded with Level III Ecoregions: 2 - Puget Lowlands, 3 - Willamette Valley, and 78 - Klamath Mountains (Figure 3) (Pater et al. 2001). High-elevation populations in the common garden study are geographically disjunct and were too widely scattered in both timing-related and growth-related traits to form a single cluster (Figure 2). While they differ substantially from low-elevation populations, they do not warrant a seed zone.

After further evaluation, the western Washington/Puget Lowland grouping was split into a Puget Trough or mainland seed transfer zone that includes large populations on extensive prairies in Thurston County, and a San Juan Islands zone comprised of smaller more isolated populations on islands in the Puget Sound. The decision was based on minor genetic differences, the natural geographic isolation between these two groups, and concerns of local practitioners about moving seed from the mainland to the islands (Wilson et al. 2008, Darris et al. 2008). The seed zones are largely analogous to two groups of Level IV ecoregions; the San Juan Island Zone corresponds primarily to the San Juan and Olympic Rain Shadow while the Puget Trough Zone generally equates to the South Puget Prairie and Cowlitz/Chehalis Foothills (Pater et al. 2001)

Although the Willamette Valley populations were more diverse than the Washington populations (Figure 2), these populations were designated as one seed transfer zone because the diversity did not fall into internal geographic or ecological patterns. Defining the Willamette Valley as a single seed zone is consistent with conclusions from genetic studies involving other species (Wilson et al. 2008). Although the two Coastal Oregon populations (Cape Perpetua and Cummins Creek) overlapped with the Willamette Valley populations in the principal components analysis, they are geographically isolated from them. Also, they differed from the other populations in fitness-related traits. They had the highest average seed yields, above average rust “resistance” and one population (Cape Perpetua) had the highest survival rate (Tables 2 and 3). The Cummins Creek population was also unique in that every plant in the study flowered and set seed, but none became summer dormant (Wilson et al. 2008, Darris et al. 2008).

Finally, the few Siskiyou populations from the Klamath Mountain Ecoregion used in this study clustered together and established another seed transfer zone. Coincidently, most populations in this region are recognized as a separate subtaxon, *F. roemeri* var.

klamathensis B.L. Wilson (Wilson 2007) which has its center of distribution here. The variety does not occur further north in areas of *F. roemeri* var*. roemeri*. The taxonomic split is based in large degree on morphological and isozyme differences between the groups (Wilson 1999). An examination of leaf cross section provided evidence that the Edgewood Weed, Lodgepole, Hukill Hollow, and Silver Fork Elliot Creek (high elevation) populations from the Ecoregion included in the study fall into the taxonomic limits of *F. roemeri* var*. klamathensis*. At least one population, Pyramid rock, has traits transitional between the two subtaxa (Wilson per. obs.).

Aside from the common garden study results, these taxonomic distinctions may represent adaptive differences as well, lending further support to delineation of a separate Siskiyou seed transfer zone naturally dominated by *F. roemeri* var*. klamathensis*. For example, the longer and more abundant hairs on the inner leaf surfaces of var. *klamathensis* compared to var. *roemeri* may be an adaptation for moisture conservation and hence drought tolerance, since the leaf stomata occupy the same position on the leaves. The climate of the Siskiyou (Klamath) region is hotter and dryer than locations more associated with *F. roemeri var. roemeri*.

In summary, five seed zones for *F. roemeri* in the Pacific Northwest, USA, have been delimited based in large part on principal components analysis of traits determined from a common garden study conducted near Corvallis, Oregon, from 2003 through 2006. The proposed seed transfer zones provide a practical guide for restoration efforts using this species. Results of this study suggest that movement of propagules within each zone should pose minimal risk of maladaptation (Wilson et al. 2008).

Germplasm development

In conjunction with the delineation of *F. roemeri* seed transfer zones, the results from the common garden study also provide a basis to target populations found within each zone for agronomic increase so that adequate seed can be supplied for restoration and revegetation use within the same zone from which the parent populations originated. Cultivation can provide far greater quantities and more affordable, ecologically adapted seed than wild collections. In the process, genetic integrity can be managed and species identity ensured through careful monitoring (e.g. removal of the common contaminant *F. rubra*). Furthermore, unlike many cultivated crops selected or bred for a narrow set of traits, our goal is to maximize genetic diversity in the production of *F. roemeri* seed crops. Therefore, unless there was reason to exclude a population, we chose to merge and inter-mate the populations originating within each seed transfer zone to form five separate polycross populations (Figure 4) (Darris et al. 2008). Tentative names for each germplasm are the same as the corresponding seed transfer zone: Willamette Valley, Puget Trough, San Juan Islands, Coastal, and Siskiyou.

Establishing a genetically diverse polycross germplasm of *F. roemeri* may be considered especially useful for the Willamette Valley seed transfer zone. In general, local populations are thought to be better adapted to local conditions than are plants from distant locations (Montalvo and Ellstrand 2001), but on average the 17 Willamette Valley populations of *F. roemeri* did not perform best in the Willamette Valley common

garden (Tables 2 and 3). The two coastal populations performed much better, having average seed yields 125% as great as the next highest yielding population. Willamette Valley populations tended to do worse than those from the Puget Trough as well However, further review showed that 13 of the Willamette Valley populations that performed the poorest were all small (25-300 plants each), while three of the remaining four that survived and yielded well were large populations (1000 plants +). We suggest that atypical growing conditions for *F. roemeri* at the common garden site do not explain the lower fitness but rather, the results are due to inbreeding in small, remnant populations. Therefore, we hypothesize that healthier Willamette Valley populations of this species for habitat restoration and erosion control can be generated by crossing plants from the small wild populations. Producing a cultivated polycross seed source (germplasm) may overcome the lowered fitness resulting from the inbreeding. Anecdotal observations of more vigorous plants produced by crossing several Willamette Valley populations coincide with this hypothesis. Plant is in the F1 generation were of larger size and had less rust, greater longevity, and higher seed yields (Wilson et al.2008).

Two to nine populations were chosen to contribute to each polycross (composite) germplasm (Figure 4). Seed yield, flowering period, source elevation, and other fitness and morphological traits were weighed for each population within each seed transfer zone (Table 2 and 3).

Willamette Valley Germplasm (9079511, PVGOR102): Nine of 17 populations from the Willamette Valley seed transfer zone where chosen to form the polycross germplasm. The Bald Hill west and southeast populations were treated as a single population for the purpose of crossing and increase. Populations over an elevation of 3000 ft from adjacent areas were excluded (Horse Rock Ridge, Table Rock Wilderness). So were the Beazel and Open Spaces populations which were outliers in the common garden study analysis (Figure 2) and had the lowest seed yields (Table 3) from the Willamette Valley seed zone. They were also two of the four poorest survivors in the group at 45 and 58 percent respectively in 2005 (Table 2). The Morton Farm population was excluded based on low seed yields and the short lifespan experienced under agronomic seed production. The Kingston Prairie population has atypical morphology and adaptation for *F. roemeri* so it was not included, nor was the Novick Property population because of a lack of seed.

The nine populations comprising the Willamette Valley Germplasm remain a diverse group. Kloster Mountain, Rock Hill, and Weiss Road Ridgeline were the highest seed producers (14-24 g/plant) (Table 3) and among the tallest and widest plants from within the seed transfer zone (Table 2). In 2005, Kloster Mountain and Rock Hill also had the highest number of fertile tillers among the group. The anthesis period for the nine populations is broad, with a range in mean Julian dates from 134 for Rock Hill to 146 for Bald Hill (west). However, the mean for the latest flowering family within the Rock Hill population is 138 and the means for the earliest flowering families within the Bald Hill and Fire Knob populations are 138-139, suggesting cross pollination between these disparate families is possible. Ocular scores for summer foliage color ranged widely from blue (1.0) to green (2.8) (Table 2). Moderate to high incidences of leaf and stem

rust (14-51%) reported among these populations in the G1 plants may decline in the G2 and G3 generations if fitness improves as hypothesized (Wilson et al. 2008).

Puget Trough Germplasm (9079512, PVGOR105): Seven of nine populations from the Puget Trough seed zone were selected for the germplasm. The excluded populations were Rocky Prairie, left out due to difficulties with permissions, and the Yelm population. The few surviving plants in the tiny, low-yielding Yelm population grew in a vacant lot in a town and did not flower the year that when seed collection was attempted. Rocky Prairie and Yelm ranked as two of the three poorest seed producers among all Puget Trough populations (Table 3). The seven selected populations had similar bluish foliage (mean scores of 1.0-1.1), tall culm heights (99-106 cm), mean flowering dates (Julian dates 134-136), and mean seed maturity dates (Julian dates 167-168) (Table 2).

Siskiyou Germplasm (9079511, PVGOR): Four populations, Edgewood Weed, Lodgepole, Hukill Hollow, and Pyramid Rock, were selected from the Siskiyou seed transfer zone to represent the Siskiyou Germplasm. Leaf cross sections confirmed the identity of the first three as *F. roemeri* var. *klamathensis* and the fourth (Pyramid Rock) as transitional between *F. roemeri* var. *klamathensis* and coastal *F. roemeri* var. *roemeri* (Wilson per. obs). The Silver Fork Elliot Creek population was not included because of its high elevation origin (6500 ft). Both the Cobleigh Road and Ace Williams Mountain populations were excluded for being *F. roemeri* var. *roemeri*. To supplement the Siskiyou Germplasm, a fifth population (*F. roemeri* var. *klamathensis*) collected near Ft. Jones, California, (41.4786° north latitude, 122.4575° west longitude, 3000 ft elevation) but not in the original common garden study, was added to more fully represent the genetic diversity in this region.

The four Siskiyou populations had low to moderate incidences of leaf rust (2-13%) and foliage color ranged from blue (1.0) to green (2.8) in summer. Mean anthesis ranged from Julian dates 136 to 142 with at least 10 days overlap in flowering when means among all families (early vs. late) within the populations are compared (Table 2). Seed maturity ranged from Julian dates 166 to182, suggesting harvest date must be carefully chosen or multiple harvests (such as with a seed stripper) may be advisable. On average, Lodgepole Meadow lags behind the other three populations in key phenological stages.

San Juan Islands Germplasm (9079513, PVGOR105): Based on the delineation of the San Juan Islands Seed Transfer Zone, all 3 populations originating on islands within the area were chosen. All three scored low in rust (0-4%) and had similar mean culm heights (86-88 cm), basal widths (12-14 cm), flowering date (Julian date 136) and maturity dates (Julian dates 170-172). The Yellow Island population has bluer foliage (1.4) in summer compared to Fidalgo Island and Whidbey Island which have greener leaves and stems (2.6-2.7) (Table 2).

Coastal Germplasm (9079484, PVGOR101): As the only two populations from Coastal seed transfer zone, both Cummins Creek and Cape Perpetua were chosen to form the germplasm. While they overlapped with the Willamette Valley populations in the principal components analysis (Figure 2), they are geographically isolated from them.

They also differed substantially in fecundity and certain fitness related traits from the Willamette Valley group (Table 2 and 3). Compared to all populations in the study, these two yielded the most seed per plant (34-35 g), had among the lowest incidences of rust (2-3%), achieved among the highest scores for number of fertile tillers (5.8-6.1 in 2004 and 3.5-4.0 in 2005), had the highest survival rates in 2005 (97-98%), and one (Cape Perpetua) had the highest survival rate in 2006 (28%). Cummins Creek had bluer foliage (1.0) than Cape Perpetua (2.1). Although mean flowering and maturity dates differed by 5-6 days, certain families within each population overlapped in flowering dates. While some traits of Cummins Creek and Cape Perpetua compared favorably with the two coastal California populations (Mt. Tamalpais and San Bruno Mountain), extreme differences in latitude of origin and other factors precluded the latter two from inclusion in this seed transfer zone.

Certification, seed increase, and release

Seed increase of the five polycross germplasms will be certified by the Oregon State Seed Certification Service and then released by the USDA Natural Resources Conservation Service and cooperating organizations as public pre-varieties. The populations have been compared for various fitness, phenological and morphological traits in a common environment, placed into seed transfer zones based in large part on principal components analysis, and selected for crossing and increase according to geographic origin and other factors such as seed yield. While the five polycross germplasms have yet to be progeny tested for heritability of traits, they should qualify as selected class pre-varieties for the purposes of seed certification and public release. We chose to produce selected class seed and make selected class releases in anticipation that this process will lead to improved availability of diverse native *F. roemeri* germplasm of known origin for habitat restoration and other uses. Each germplasm is targeted for use within the same seed zone from which the parent populations originated and is presumed best adapted.

Methods and Materials (Crossing and Seed Increase)

Crossing blocks

F. roemeri is an allotetraploid (2n = 28) species that is highly cross –pollinated by wind (Wilson 1999). With an overlap in flowering periods, crossing blocks are a simple way to achieve random pollination among parents. To produce plants of the selected populations, G0 wild seed collected in 2001-2002 for the common garden study was sown in shallow plastic flats in July 2006. For populations lacking seed, original stands were re-sampled during the summer of 2006 and the new seed likewise planted. In late August, seedlings were transplanted from the flats into conical shaped plugs (7 cu. in) Ray Leach cone-tainers. They were grown outdoors until outplanted into isolated field locations between January and March 2007 (Appendix I). An isolated G1 crossing block was planted for each of four of the five germplasms: Willamette Valley, Puget Trough, San Juan Islands, and Siskiyou. The four blocks were situated on three research farms in the vicinity of Corvallis, Oregon (elevation 215-225 ft). The sites are owned by the Oregon State University Agricultural Experiment Station and operated by

the OSU Crop and Soil Science Department. The crossing blocks were managed and harvested by the NRCS Corvallis Plant Materials Center.

Each crossing block functioned as a polycross nursery (Figure 5). A Latin Square design was use because it maximizes the opportunity for crossing among all representatives. Blocks were separated from one another by more than 900 ft which is the minimum isolation distance set for G1-G2 pre-variety seed certification of cross-pollinated plants. Each plot consisted of 3 to 9 plants of the same parent population, depending on the crossing block. Spacing was 6 in within plot and 24 in between rows and plots. Each plot was replicated by the number of populations included in each crossing block, or by an exact multiple thereof. The number of plot rows and columns were the same. Because of low survival and weed encroachment, the crossing block for the Willamette Valley Germplasm was removed in November 2009.

G1 seed increase for the Coastal Germplasm was handled differently. G0 seed was collected for both the Cape Perpetua and Cummins Creeks populations in July 2006 and July 2007. To establish a G1 increase field, the seed was bulked then sown directly in October 2006 and October 2007. Also, individuals from these Coastal populations that survived in the common garden were transplanted to the field in 2006. Row spacing was 12 in and the field is 0.29 acres in size (Figure 6, Appendix II).

Weed control in the G1 crossing blocks and increase field was accomplished by hand hoeing and the use of herbicides labeled for grass seed production. A single fall application of Outlook® (dimethenamid-P) herbicide was made for control of annual weedy grasses after plots and fields were established for a year. Broadleaf weeds in new and established stands of *F. roemeri* were controlled with the herbicides bromoxynil and dicamba. Further control of remaining weeds was by spot spraying with glyphosate. Crossing blocks and fields were fertilized once each March with 50 lbs/ac of actual nitrogen (33-0-0-12). No irrigation water was applied.

Production of seed stocks

G1 seed of *F. roemeri* from the crossing blocks was used to establish G2 seed increase fields of the San Juan Islands (9079513), Puget Trough (9079512), Willamette Valley (9079510), and Siskiyou Germplasms (9079511). To maintain the maternal identity of populations for an additional generation, special methods were applied to grow each population separately but still allow for cross pollination between populations. First, seed from each plot in the crossing blocks was harvested separately and bulked by individual population in July of 2008. Second, this G1 seed was used to immediately grow plugs (7 cu. in. cone-tainers) of the parental populations. These seedlings were then transplanted with a Holland two row transplanter in November 2008 or by hand in March 2009 into separate but adjacent beds (Appendix II). Each bed consists of 2-4 rows. The spacing is 24 inches between beds, 14 in between rows, and 12 in within rows. Only the Yellow Island population of the San Juan Islands Germplasm was established directly from seed and not plugs. Each bed represents the half-sib increase of each individual population chosen to represent a germplasm. A group of beds as a whole constitutes an isolated G2 increase field (Appendix II). The field design allows

each bed to be swathed and combined or stripped of seed at different times if maturity varies among populations. With this method, better representation of each line can be secured before the seed is fully bulked and distributed to growers for commercial increase (G3-G4 production). Additionally, in October 2008 the remaining G1 seed lots of each population representing the Puget Trough, Willamette Valley, and Siskiyou Germplasms were bulked and sown directly in the field to establish a mixed bed representative of each pre-variety.

Weed control in 2009-2010 for each field consisted of hand hoeing, spot spraying with glyphosate herbicide, the application of the broadleaf herbicides dicamba and bromoxynil, and the application of the annual grass herbicide Outlook® (dimethylamid-P). All four herbicides are labeled for grasses grown for seed and were applied according to label instructions. To control stem and leaf rust (*Puccinia* spp.) the fungicide Quilt® (azoxystrobin + propiconazole) was applied once in 2009 (May) and twice in 2010 (late April, early May) to each field. Nitrogen fertilizer (33-0-0-12) was applied once each March at a rate of 50 lbs N/ac. No irrigation water was applied.

Results and Discussion

Seed increase results are reported in Table 4. Certified seed was hand harvested from all plots within each G1 crossing block in 2008, ensuring representation of each parental population in the G2 increase fields. In 2009, the G1 seed was again hand harvested and retained for future use if needed.

The G1 seed increase field of the Coastal Germplasm was harvested on July 7, 2009 using a Woodward flail-vac seed stripper. Seed maturity appeared to differ among plants by several days in the field, presumably due to the difference in maturation between the two parental populations. The Coastal Germplasm produced 12 lbs (5448 g) of seed or 172 lbs/ac in 2008. Unfortunately, seed fill was extremely poor in 2009 and no seed crop was taken. Poor production may have been due to heavy rains during pollination or other unusual climatic factors.

No significant amounts of G2 seed were produced by the San Juan Islands, Siskiyou, Willamette Valley, or Puget Trough germplasm seed increase fields in 2009. Despite the early head start on fall growth by starting the seedlings as plugs in August of 2008, the vast majority of plants apparently failed to vernalize and accordingly did not flower in 2009.

Future Work

Once enough G1 certified seed of Coast Germplasm and G2 certified seed of San Juan Islands, Puget Trough, Siskiyou, and Willamette Valley Germplasms are on hand at the PMC, stock will be made available to qualified commercial growers for increase and subsequent sale of G2 (Coast Germplasm), G3, and G4 seed. Concurrently, supporting documentation will be prepared and submitted for final approval of all five polycross populations as selected class pre-variety germplasm releases. The PMC will maintain G1 and/or G2 seed for further research purposes and certified production. Production

will be permitted through the G4 generation. Agencies and organizations invited to participate in the public release with the USDA Natural Resources Conservation Service will be the Institute for Applied Ecology, Bureau of Land Management, USDA Forest Service, and Oregon State University Agricultural Experiment Station.

Research and progeny testing of each germplasm release both alone and in mixes with other native species, will be conducted as needed to ascertain adaptation to site specific and regional environments for habitat restoration. In addition, applicability to other uses including low maintenance turf, cover crop systems, roadside right-of-way plantings, and wildlife use will be assessed. Finally, agronomic seed increase technology, including herbicide tolerance and weed control, fertility requirements, harvest methods, and seeding rates to maximize yields will also be investigated.

Acknowledgements

While the pre-variety development and associated seed increases are primarily the efforts of the USDA Natural Resources Conservation Service, Plant Materials Center (PMC), Corvallis, Oregon, participation by many members of several organizations in the preceding common garden study made this work possible. We wish to thank the Native Seed Network and its parent organization the Institute for Applied Ecology, Corvallis, Oregon, the Carex Working Group, Eugene, Oregon, the USDA Forest Service, Corvallis, Oregon, and Washington D.C, and the Eugene, Medford, Roseburg, and Salem Districts of the USDI Bureau of Land Management for their support and assistance. Peter Gonzalves created the field location drawings (Appendix II) in this paper and was instrumental in the establishment, management, and harvest of the crossing blocks and seed increase fields (2007-2009). Finally, we also thank the Crop and Soil Science Department, Oregon State University, and the Oregon Agricultural Experiment Station, Corvallis, Oregon, for their participation on Roemers fescue seed production technology research.

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Table 1. *Festuca roemeri* collection sites in the common garden study and selected populations for each polycross (composite) germplasm

Site	Group	State	County	Elev.	Latitude	Longitude	Polycross
Abiqua Road	Willamette Valley	OR	Marion	450	45.0076	122.6752	Willamette V.
Ace Williams Mt.	roemeri south	OR	Douglas	1900	43.28	123.0898	
Bald Hill southeast	Willamette Valley	OR	Benton	460	44.5637	123.3283	Willamette V.
Bald Hill west	Willamette Valley	OR	Benton	500	44.5662	123.3396	Willamette V.
Baskett Butte	Willamette Valley	OR	Polk	360	44.9651	123.2579	Willamette V.
Beazel property	Willamette Valley	OR	Benton	1000	44.6556	123.4189	
Blue Mountain	High -- NW WA	WA	Clallam	5970	47.955	123.2588	
Cape Perpetua	Coastal	OR	Lincoln	700	44.2868	124.1072	Coastal
Cobleigh Road	roemeri south	OR	Jackson	2270	42.5991	122.6088	
Cummins Creek Trail	Coastal	OR	Lincoln	1000	44.2798	124.0622	Coastal
Drano Lake	Columbia Gorge	WA	Skamania	240	45.7137	121.6463	
Duncan Spring	Klamath Co.	OR	Klamath	4775	42.0411	121.0672	
Edgewood-Weed Rd.	Siskiyou	CA	Siskiyou	3200	41.4315	122.4184	Siskiyou
Fairview Peak	High -- WV	OR	Lane	5800	43.5853	122.6535	
Fidalgo Island	San Juan Islands	WA	Skagit	300	48.4101	122.6444	San Juan Is.
Fire Knob	Willamette Valley	OR	Marion	700	44.8925	122.8153	Willamette V.
Glacial Heritage	Puget Trough	WA	Thurston	100	46.7864	123.0431	Puget Trough
Horse Rock Ridge	High -- WV	OR	Linn	3200	44.2936	122.8737	
Hukill Hollow	Siskiyou	OR	Jackson	2840	42.1926	122.981	Siskiyou
Hurricane Ridge	High -- NW WA	WA	Clallam	5150	47.9694	123.4972	
Johnson Prairie	Puget Trough	WA	Thurston	400	46.9231	122.7346	Puget Trough
Kingston Prairie	Willamette Valley	OR	Linn	780	44.7803	122.7417	
Kloster Mountain	Willamette Valley	OR	Lane	1875	43.867	122.8428	Willamette V.
Lodgepole Meadow	Siskiyou	OR	Curry	2250	42.3436	124.2895	Siskiyou
Mary's Peak	High -- WV	OR	Benton	4000	44.5037	123.5506	
Memaloose Park	Columbia Gorge	OR	Hood River	400	45.6938	121.3518	
Mima Mounds	Puget Trough	WA	Thurston	240	46.9037	123.0482	Puget Trough
Mortar Point 3	Puget Trough	WA	Thurston	240	47.0271	122.6235	Puget Trough
Morton Farm	Willamette Valley	OR	Benton	450	44.583	123.402	
Mt. Tamalpais	San Francisco	CA	Marin	500	37.90389	122.4303	
Novick Property	Willamette Valley	OR	Lane	975	43.9747	123.1169	
Open Spaces Park	Willamette Valley	OR	Benton	900	44.5719	123.3734	
Pyramid Rock	Siskiyou	OR	Curry	2400	42.3579	124.2702	Siskiyou
Rock Hill	Willamette Valley	OR	Lane	800	44.1843	123.0531	Willamette V.
Rocky Prairie	Puget Trough	WA	Thurston	200	46.9158	122.9783	
Row Point	Willamette Valley	OR	Lane	840	43.7882	122.9437	Willamette V.
San Bruno Mt.	San Francisco	CA	San Mateo	1300	37.6875	122.4353	
Scatter Creek	Puget Trough	WA	Thurston	190	46.8323	122.9863	Puget Trough
Silver Fork	Siskiyou	OR	Jackson	6450	42.047	122.9022	
Spencer Butte	Willamette Valley	OR	Lane	400	44.0581	123.0945	Willamette V.
Smith Prairie	San Juan Islands	WA	Island	100	48.205	122.618	San Juan Is.
Table Rock	Willamette Valley	OR	Clackamas	4390	44.9642	122.3118	
Thirteenth Div.. Pr,	Puget Trough	WA	Pierce	400	47.0143	122.4584	Puget Trough
Upper Weir Prairie	Puget Trough	WA	Thurston	540	46.9102	122.7052	Puget Trough
Weiss Road ridgeline	Willamette Valley	OR	Lane	1100	43.8988	123.1329	Willamette V.
Yellow Island	San Juan Islands	WA	San Juan	40	48.5861	123.0306	San Juan Is.
Yelm	Puget Trough	WA	Thurston	340	46.9364	122.5907	

Figure 1. Variation in *Festuca roemeri* plants grown in the common garden study at Corvallis, Oregon (2003-2006).

Table 2. Morphology, phenology, and disease occurrence of Roemers fescue. Selected populations for each germplasm (seed zone) are highlighted.

Seed Zone or Group	Population	rust03	col03	ht04	wid04	til04	fol04	phen	anth	an-e	an-l	mat	surv05	fol05	ferl05	surv06
Coastal (Oregon)	Cummins Creek Trail	3%	1.0	110	17	6.1	4.7	2.4	130	127	135	170	98%	5.4	3.5	13%
Coastal (Oregon)	Cape Perpetua	2%	2.1	87	16	5.8	5.5	1.9	136	131	139	175	97%	6.1	4.0	28%
Coastal (California)	Mt. Tamalpais	5%	1.9	82	16	6.6	5.1	2.4	130	124	136	172	81%	5.3	3.2	8%
Coastal (California)	San Bruno Mt.	2%	2.1	68	13	5.2	4.8	1.8	133	130	137	179	84%	5.0	3.1	10%
Columbia Gorge	Memaloose Park	0%	1.3	65	15	5.8	3.4	2.9	136	126	145	172	67%	3.2	4.0	0%
Columbia Gorge	Drano Lake	19%	1.1	97	14	4.1	3.7	2.2	141	127	148	180	75%	3.3	0.6	6%
High elevation	Fairview Peak	31%	1.2	90	17	5.4	5.2	2.0	132	127	138	169	88%	4.4	3.2	8%
High elevation	Blue Mt. near Deer Park	6%	1.1	74	14	3.2	4.3	2.4	121	114	131	161	83%	3.8	0.3	13%
High elevation	Mary's Peak	11%	1.0	76	16	1.8	5.7	1.4	144	136	155	176	77%	5.0	0.6	13%
High elevation	Hurricane Ridge	5%	1.9	66	9	2.2	2.3	1.8	125	121	132	163	29%	2.0	0.5	2%
High elevation	Silver Fork Elliot Cr.	13%	1.0	81	14	5.1	4.5	3.2	125	122	131	160	81%	3.6	3.7	5%
High elevation	Horse Rock Ridge	20%	1.0	89	18	5.3	4.7	2.2	136	127	140	172	83%	4.3	1.1	0%
High elevation	Table Rock Wilderness	5%	1.1	81	15	3.1	4.4	1.8	134	130	142	169	75%	3.4	0.6	2%
Puget Trough	Glacial Heritage Preserve	11%	1.1	103	15	3.6	5.0	2.1	134	128	138	167	95%	5.2	2.1	13%
Puget Trough	Mortar Pt. 3	13%	1.1	106	14	4.0	4.5	2.2	135	133	140	167	89%	5.1	2.6	14%
Puget Trough	Thirteenth Division Prairie	13%	1.0	102	14	3.6	4.5	2.1	134	131	142	168	92%	4.8	2.0	13%
Puget Trough	Scatter Creek	9%	1.1	102	13	3.7	4.5	1.9	134	129	138	167	89%	4.8	2.3	17%
Puget Trough	Mima Mounds	8%	1.0	101	11	3.2	3.6	1.9	134	131	142	167	80%	5.1	1.8	5%
Puget Trough	Johnson Prairie	16%	1.0	99	13	3.5	4.1	2.0	136	129	144	167	86%	4.2	1.8	9%
Puget Trough	Yelm	10%	1.0	94	11	3.4	4.0	2.0	136	133	141	169	59%	4.2	2.2	5%
Puget Trough	Upper Weir Prairie	11%	1.0	102	11	3.2	3.5	2.1	135	129	141	168	89%	3.0	1.3	13%
Puget Trough	Rocky Prairie N.A.P.	5%	1.0	103	11	3.0	3.9	1.8	141	134	145	169	81%	3.9	1.3	11%
San Juan Islands	Fidalgo Island; Ravine Trail	2%	2.6	88	14	4.3	3.9	2.0	136	131	141	172	66%	3.9	1.3	6%
San Juan Islands	Yellow Island	4%	1.4	88	14	4.1	6.0	2.0	136	130	143	172	96%	6.2	1.2	24%
San Juan Islands	Smith Prairie, Whidbey Is.	0%	2.7	86	12	3.0	4.9	1.6	136	130	145	170	77%	5.2	1.3	6%
Siskiyou	Pyramid Rock	11%	1.5	73	14	4.4	3.9	2.0	139	129	148	177	79%	4.0	2.9	2%
Siskiyou	Lodgepole Meadow	8%	2.8	79	12	4.0	3.3	1.6	142	127	149	182	81%	3.4	0.9	5%
Siskiyou	Hukill Hollow	2%	2.2	78	10	4.1	2.9	2.8	136	126	142	166	56%	2.4	1.8	3%
Siskiyou	Edgewood-Weed Road	13%	1.0	82	12	2.7	4.7	2.0	136	130	140	169	69%	3.9	2.3	0%
Siskiyou	Cobleigh Road	21%	1.1	74	10	2.7	2.9	1.7	144	137	152	178	34%	2.9	1.8	5%
Siskiyou	Ace Williams Mt.	19%	1.2	79	10	2.8	2.8	1.6	140	136	147	178	52%	2.5	0.4	2%

Table 2 continued on next page.

Table 2. (cont.) Morphology, phenology, and disease occurrence of Roemers fescue. Selected populations for each germplasm (seed zone) are highligh

Seed Zone or Group	Population	rust03	col03	ht04	wid04	til04	fol04	phen	anth	an-e	an-l	mat	surv05	fol05	ferl05	surv06
Willamette Valley	Kloster Mountain	36%	1.0	105	17	5.3	4.6	2.0	139	136	143	177	83%	4.5	2.7	5%
Willamette Valley	Rock Hill	19%	1.0	94	17	4.4	5.5	2.1	134	130	138	169	83%	5.3	2.3	11%
Willamette Valley	Weiss Road ridgeline	51%	2.8	91	14	4.3	4.3	1.8	144	134	153	175	63%	4.0	1.2	0%
Willamette Valley	Morton Farm	42%	1.3	82	13	4.6	4.5	2.1	139	134	142	172	85%	4.8	1.3	0%
Willamette Valley	Bald Hill west[1]	36%	2.5	81	13	4.1	4.6	1.6	146	139	159	176	70%	5.2	1.4	7%
Willamette Valley	Kingston Prairie	13%	2.2	93	14	3.6	4.9	1.9	142	131	162	171	75%	5.6	1.2	2%
Willamette Valley	Spencer's Butte	30%	2.3	89	16	4.5	4.8	2.0	138	134	143	172	80%	5.0	1.9	2%
Willamette Valley	Row Point, Dorena Reservoir	17%	1.9	90	12	4.1	3.7	2.1	140	135	148	172	52%	2.8	0.4	0%
Willamette Valley	Bald Hill southeast[1]	38%	2.8	80	12	4.0	4.1	1.8	143	138	150	177	67%	4.6	1.4	3%
Willamette Valley	Novick Property	39%	2.5	83	13	3.4	3.9	1.5	142	134	152	175	56%	3.7	0.6	2%
Willamette Valley	Baskett Butte	23%	2.8	84	14	4.0	5.4	1.8	141	134	150	173	73%	5.7	1.2	2%
Willamette Valley	Abiqua Road	14%	1.1	108	14	3.2	3.6	1.8	144	134	157	175	65%	3.4	0.1	2%
Willamette Valley	Fire Knob	17%	1.5	84	13	2.7	4.3	1.5	141	138	145	169	64%	3.8	0.5	0%
Willamette Valley	Open Spaces Park	51%	2.2	69	10	2.6	3.2	1.4	145	133	153	178	58%	3.8	1.5	0%
Willamette Valley	Beazell	31%	1.4	77	10	2.5	3.6	1.4	148	136	155	178	45%	4.4	0.7	0%

[1]Bald Hill west and Bald Hll southeast were treated as one population for the Willamette Valley germplasm

rust03 = % of leaf rust (Puccinia spp.) infection on plants, 2003
col03 = color of foliage score from 1=blue to 3=green, 2003
ht04 = culm height, 2004
wid04 = basal width, 2004
til04 = fertile tiller score, 1=fewest, 10=most, 2004
fol04 = foliage abundance score, 1=lowest, 10=highest, 2004
phen = phenology score on March 23, 2004 (1=vegetative, 2=boot, 3=jointing, etc.)
anth = Mean Julian date of anthesis for entire population
an-e = earliest Julian date of anthesis for any family in a population
an-l = latest Julian date of anthesis for any family in a population
mat = Mean Julian date of seed maturity
surv05 = % survival of plants in a population, 2005
fol05= foliage abundance score, 1=lowest, 10=highest, 2005
fert05 = fertile tiller score, 1=fewest, 10=most, 2005
surv06 = % survival of plants in a population, 2006

Figure 2. Principal components analysis of 43 *Festuca roemeri* populations in the common garden study using a reduced set of traits related to growth and phenology. The clustering of populations by geographic region supports the designation of each area as a seed transfer zone (refer to Figure 3).

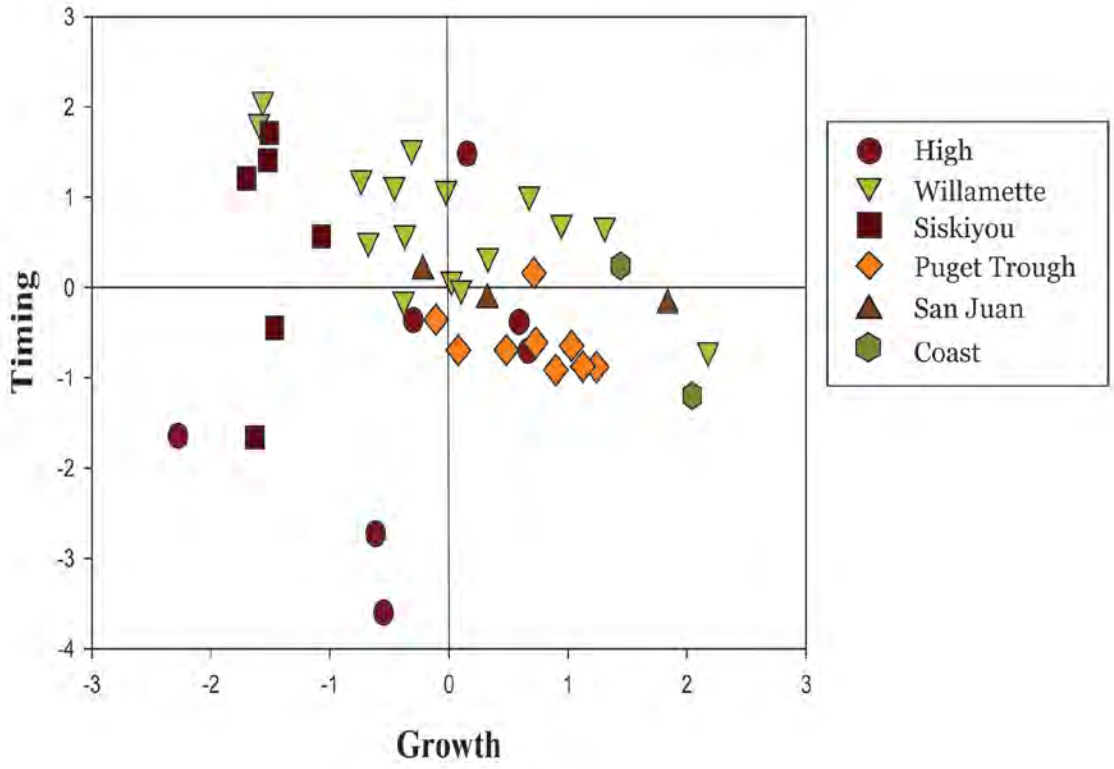


Table 3. Seed Yield of Roemers fescue. Selected populations for each germplasm (zone) are highlighted.

Seed Zone or Group	population	yield/plant (g)	Std.Dev.	Minimum	Maximum	Variance
Coastal (Oregon)	Cummins Creek Trail	34.69	5.55	26.38	43.50	30.76
Coastal (Oregon)	Cape Perpetua	34.25	10.24	21.13	51.14	104.87
Coastal (California)	Mt. Tamalpais	33.16	12.85	19.50	53.50	165.03
Coastal (California)	San Bruno Mt.	26.22	8.16	14.88	41.57	66.56
Columbia Gorge	Memaloose Park	19.56	15.90	2.00	33.00	252.93
Columbia Gorge	Drano Lake	17.86	7.44	4.67	31.25	55.40
High elevation	Fairview Peak	27.74	14.88	10.25	48.88	221.40
High elevation	Blue Mt. near Deer Park	9.69	4.77	4.38	19.57	22.73
High elevation	Mary's Peak	5.17	5.36	0.50	14.80	28.69
High elevation	Hurricane Ridge	4.02	1.88	1.40	6.40	3.54
High elevation	Silver Fork Elliot Cr.	24.81	11.28	12.67	43.43	127.31
High elevation	Horse Rock Ridge	24.26	9.64	13.00	41.71	92.91
High elevation	Table Rock Wilderness	10.65	8.12	1.25	26.67	65.91
Puget Trough	Glacial Heritage Preserve	14.67	5.91	3.17	21.75	34.89
Puget Trough	Mortar Pt. 3	12.29	4.14	6.50	17.50	17.14
Puget Trough	Thirteenth Division Prairie	12.05	4.21	7.25	19.29	17.71
Puget Trough	Scatter Creek	11.11	4.11	4.57	17.14	16.87
Puget Trough	Mima Mounds	10.93	5.84	2.29	19.17	34.13
Puget Trough	Johnson Prairie	10.73	4.61	4.80	16.50	21.27
Puget Trough	Yelm	9.94	5.25	2.33	19.29	27.60
Puget Trough	Upper Weir Prairie	9.14	4.42	2.20	15.67	19.52
Puget Trough	Rocky Prairie N.A.P.	7.82	3.85	1.00	13.25	14.85
San Juan Islands	Fidalgo Island; Ravine Trail	14.09	4.02	7.00	19.13	16.19
San Juan Islands	Yellow Island	10.29	4.25	3.63	15.50	18.07
San Juan Islands	Smith Prairie, Whidbey Is.	8.64	2.69	4.60	12.00	7.23
Siskiyou	Pyramid Rock	15.80	8.74	1.25	25.50	76.31
Siskiyou	Lodgepole Meadow	12.30	4.75	4.50	20.60	22.54
Siskiyou	Hukill Hollow	10.51	5.61	4.00	19.88	31.47
Siskiyou	Edgewood-Weed Road	7.65	4.17	3.40	14.13	17.43
Siskiyou	Cobleigh Road	5.74	3.50	1.40	10.60	12.24
Siskiyou	Ace Williams Mt.	5.42	2.39	2.29	10.43	5.73
Siskiyou	Duncan Spring	4.27	5.32	0.67	16.00	28.33
Willamette Valley	Kloster Mountain	24.24	9.50	11.43	42.00	90.26
Willamette Valley	Rock Hill	15.56	6.32	7.00	22.60	39.99
Willamette Valley	Weiss Road ridgeline	13.70	7.52	0.33	24.40	56.59
Willamette Valley	Morton Farm	13.05	10.65	4.67	28.50	113.47
Willamette Valley	Bald Hill west	12.53	5.32	4.00	20.38	28.33
Willamette Valley	Kingston Prairie	11.45	5.13	4.25	20.00	26.35
Willamette Valley	Spencer's Butte	10.86	6.86	2.86	21.38	47.05
Willamette Valley	Row Point, Dorena Reservoir	9.19	4.43	5.17	19.00	19.59
Willamette Valley	Bald Hill southeast	7.58	1.41	4.86	9.50	2.00
Willamette Valley	Novick Property	7.49	5.82	1.33	17.29	33.87
Willamette Valley	Baskett Butte	6.97	3.58	3.00	12.83	12.85
Willamette Valley	Abiqua Road	6.77	4.46	1.00	12.71	19.90
Willamette Valley	Fire Knob	6.15	6.21	1.20	16.17	38.51
Willamette Valley	Open Spaces Park	5.59	3.86	0.67	9.67	14.92
Willamette Valley	Beazell	5.07	4.60	0.50	14.50	21.16

Figure 3. Five seed transfer zones for *Festuca roemeri,* showing location of populations used in the common garden study and Level III Ecoregions for Washington, Oregon, and northern California.

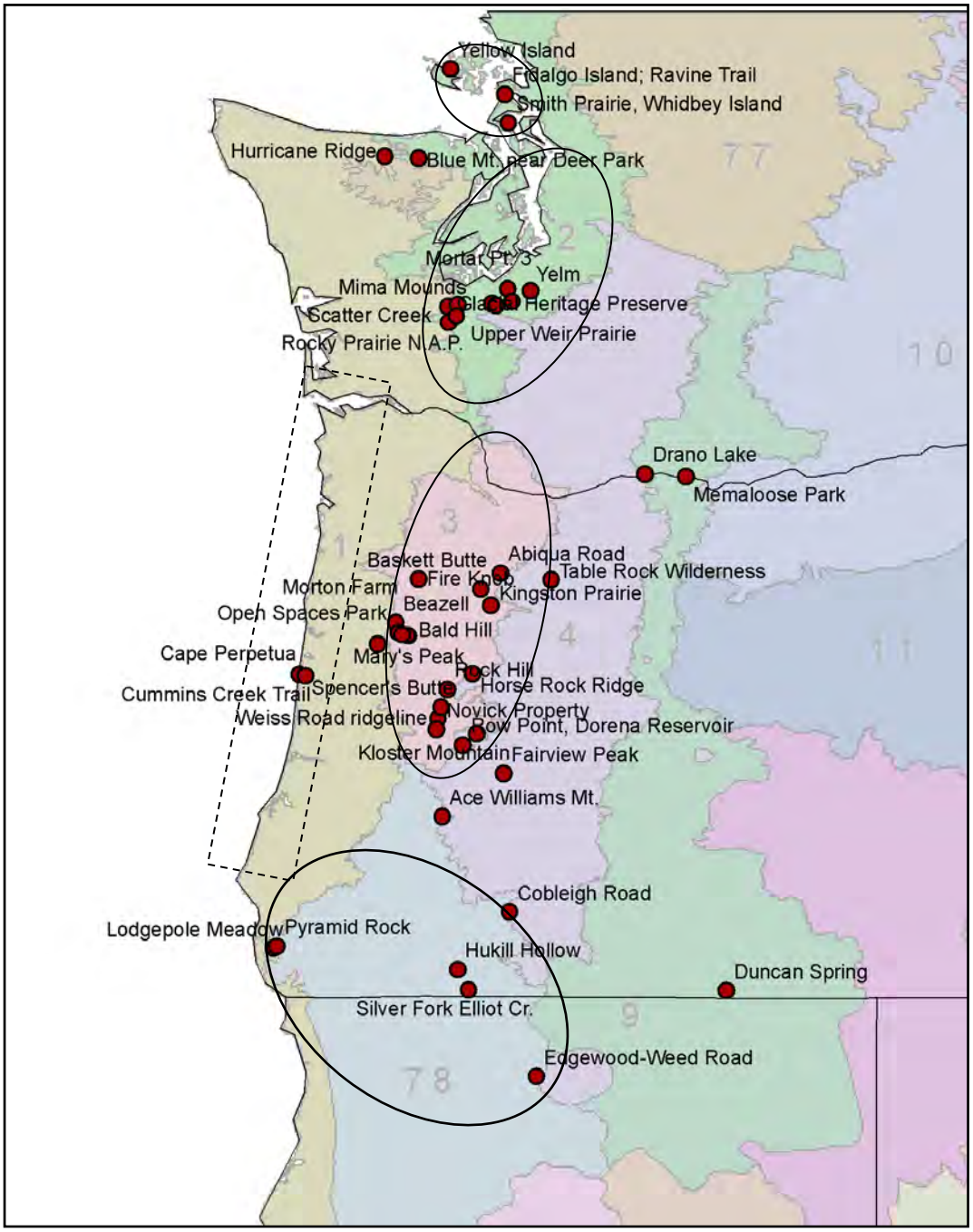
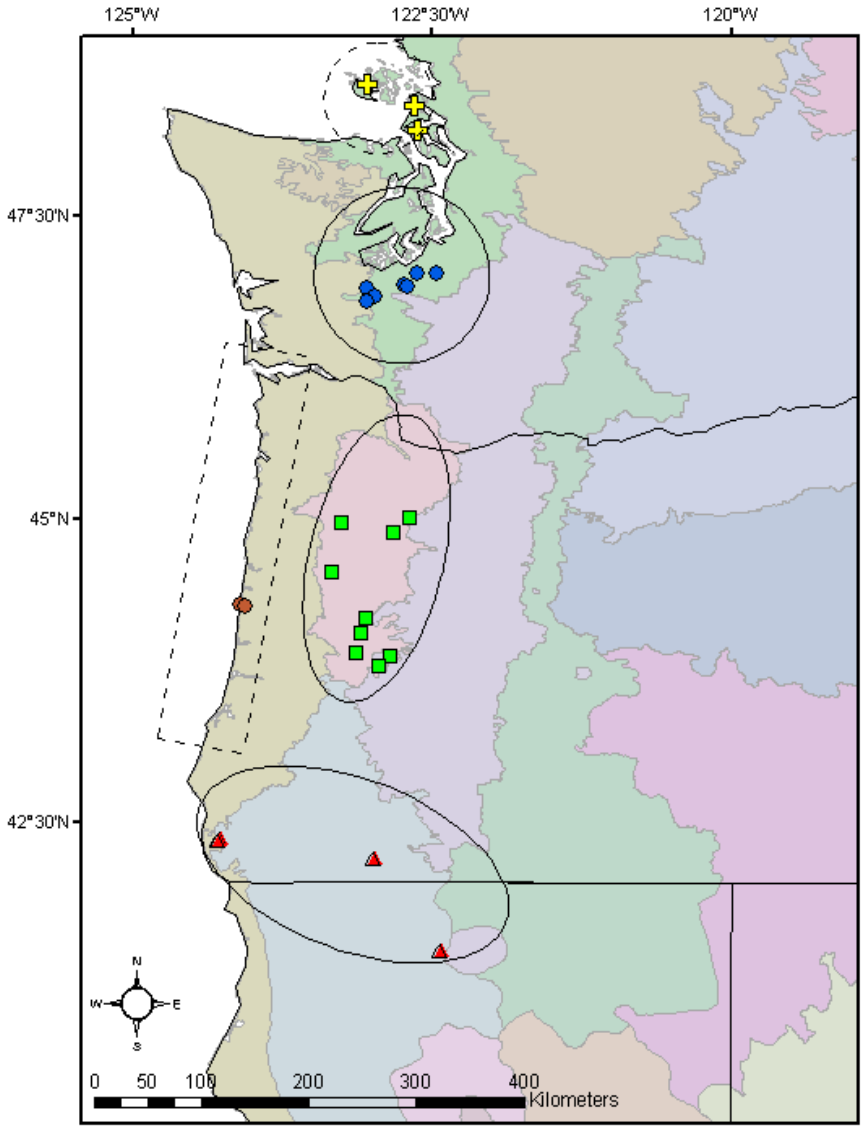


Figure 4. Geographic distribution of populations used to create the five selected class, pre-variety germplasms of Roemers fescue. Yellow: San Juan Islands, Blue: Puget Trough, Green: Willamette Valley, Brown: Coastal[1], Red: Siskiyou[1].



[1]For both the Coastal and Siskiyou zones, two selected populations occur in close proximity near the coast and appear as a single mark.

Figure 5. Crossing Block of Puget Trough Germplasm (9079512, PVGOR104) of *Festuca roemeri,* planted in a Latin square design to maximize cross pollination: 4 plant plots replicated 7 times. Each of 7 populations compromising the germplasm is represented in each row and column.

Figure 6. Certified, selected class G1seed increase field of Coastal Germplasm (9079484, PVGOR101). G0 seed was sown in October 2006 (center section) and October 2007 (outer sections).

Table 4. Production information on *Festuca roemeri* pre-variety germplasms.

Germplasm/accession	Location	Year	G1 (grams)[1]	Comments	G2[2,3] Acres
San Juan Islands (9079513)	Field 2-2 Hyslop Field Laboratory	2008	111	Hand harvested	0
		2009	42	Hand harvested	0.12
Puget Trough (9079512)	Field 7-7 PMC Schmidt Farm	2008	105	Hand harvested	0
		2009	128	Hand harvested	0.24
Willamette Valley (9079511)	Field 1 OSU East Farm	2008	210	Hand harvested	0
		2009	450	Hand harvested. Crossing block removed in 2009	0.32
Coastal (9079484)	Field 7-13 PMC Schmidt Farm	2008	5448	Minor red fescue contamination. Harvested with flail-vac seed stripper	0.07
		2009	0	Crop failure, poor seed set	0.29
Siskiyou (9079510)	Field 6 OSU East Farm	2008	50	Hand harvested	0
		2009	205	Hand harvested	0.15

[1]All G1 seed produced from crossing blocks except for Coastal Germplasm.
[2]G2 production was minimal in 2009 as plants did not vernalize. All Coastal Germplasm production is G1.
[3]Refer to Appendices I and II for layout of each field.

APPENDIX I. PLANTING PLANS FOR ROEMERS FESCUE G1 CROSSING BLOCKS (2007-2009)

Locations of crossing blocks and/or initial seed increases:

Puget Trough Germplasm (9079512)	field 7-7 (s. end) PMC
San Juan Islands Germplasm (9079513)	field 2-2 (w. end) Hyslop Farm
Willamette Valley Germplasm (9079510)	field 1 (s. end) OSU East Farm
Siskiyou Germplasm (9057511)	field 6 (n. end) OSU East Farm
Coastal Germplasm (9079484)	field 7-13 (n. end) PMC

Puget Trough Germplasm (7 plant plots replicated 7 times, east-west rows)

GH	MP	TD	SC	UP	JP	MM
TD	SC	GH	MM	MP	UP	JP
MP	MM	UP	JP	TD	SC	GH
SC	JP	MP	GH	MM	TD	UP
MM	UP	SC	TD	JP	GH	MP
JP	GH	MM	UP	SC	MP	TD
UP	TD	JP	MP	GH	MN	SC

NORTH

GH = Glacial Heritage
MM = Mima Mounds
MP= Mortar Point**
SC= Scatter Creek
TD = Thirteen Division Prairie
JP = Johnson Prairie
UP = Upper 'Weir
**Shortage of plants. Divided equally among replications.

San Juan Islands Germplasm (6 plant plots replicated 9 times, east-west rows)

YI	SP	FI
SP	YI	FI
FI	YI	SP
YI	SP	FI
FI	YI	SP
SP	FI	YI
SP	FI	YI
YI	FI	SP
FI	SP	YI

YI=Yellow Island
SP=Smith Prairie
FI=Fidalgo Island**
**Shortage of Plants. Planted equal number per plot.

Planted area is 18 ft. X 13.5 ft

NORTH

Willamette Valley Germplasm (3 plant plots repl. 9 times, north-south rows)

AR	RP	BH	KM	WR	FK	SB	RH	BB
KM	AR	SB	FK	RP	BB	BH	WR	RH
BB	BH	WR	AR	RH	KM	RP	SB	FK
RP	KM	RH	BH	BB	AR	WR	FK	SB
WR	BB	AR	SB	BH	RH	FK	RP	KM
RH	SB	FK	RP	AR	WR	KM	BB	BH
BH	FK	RP	BB	KM	SB	RH	AR	WR
FK	RH	BB	WR	SB	BH	AR	KM	RP
SB	WR	KM	RH	FK	RP	BB	BH	AR

NORTH

AR= Abiqua Road
BH= Bald Hill
RP= Row Point**
WR= Weiss Road Ridgeline**
RH= Rock Hill
BB= Baskett Butte
KM= Kloster Mountain**
SB= Spencer Butte
FK= Fire Knob**
**Shortage of plants. Divided equally among replications.

Siskiyou Germplasm (9 plant plots replicated 16 times, rows run north-south)

LP	PR + 2 FJ	EW	HH	LP	EW	HH	PR + 2 FJ
HH	HH	EW	PR + 2 FJ	EW	PR + 2 FJ	LP	LP
PR + 2 FJ	LP	HH	LP	EW	EW	PR +2 FJ	HH
EW	PR + 1 FJ	LP	HH	PR + 1 FJ	HH	EW	LP
EW	LP	PR + 2 FJ	EW	HH	LP	PR +1 FJ	HH
LP	EW	HH	PR + 1 FJ	LP	PR	HH	EW
PR + 2 FJ	HH	PR + 2 FJ	LP	HH	LP	EW	EW
HH	EW	LP	EW	PR + 1FJ	HH	LP	PR + 1 FJ

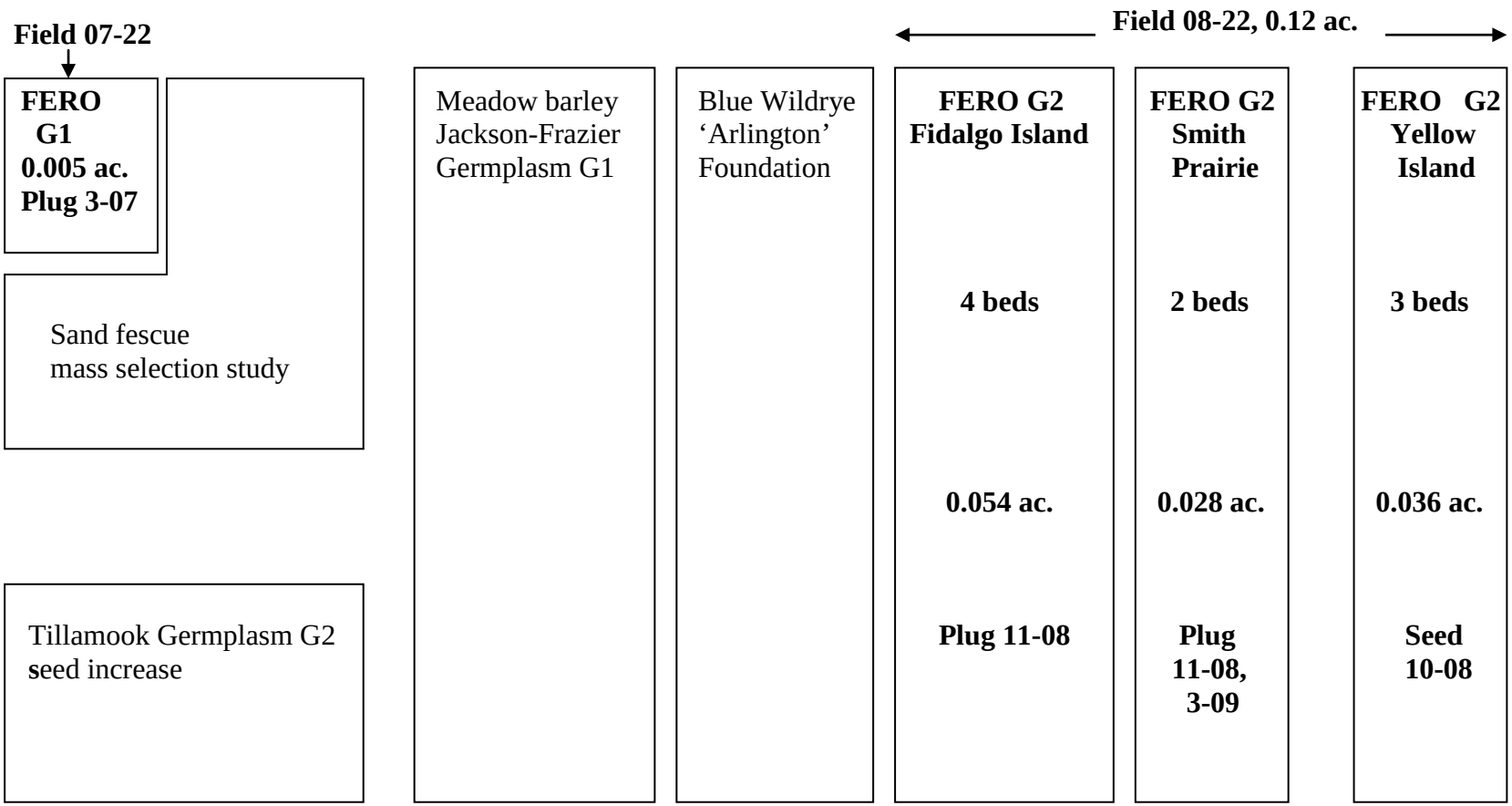
NORTH

LP= Lodgepole
HH= Hukill Hollow
EW= Edgewood weed
PR= Pyramid Rock**
FJ = Fort Jones (not in common garden study)
**Shortage of plants. 24 Plants from Ft. Jones (FJ) population were added to supplement PR plots. All plugs planted 1/31/07 and 2/1/07.

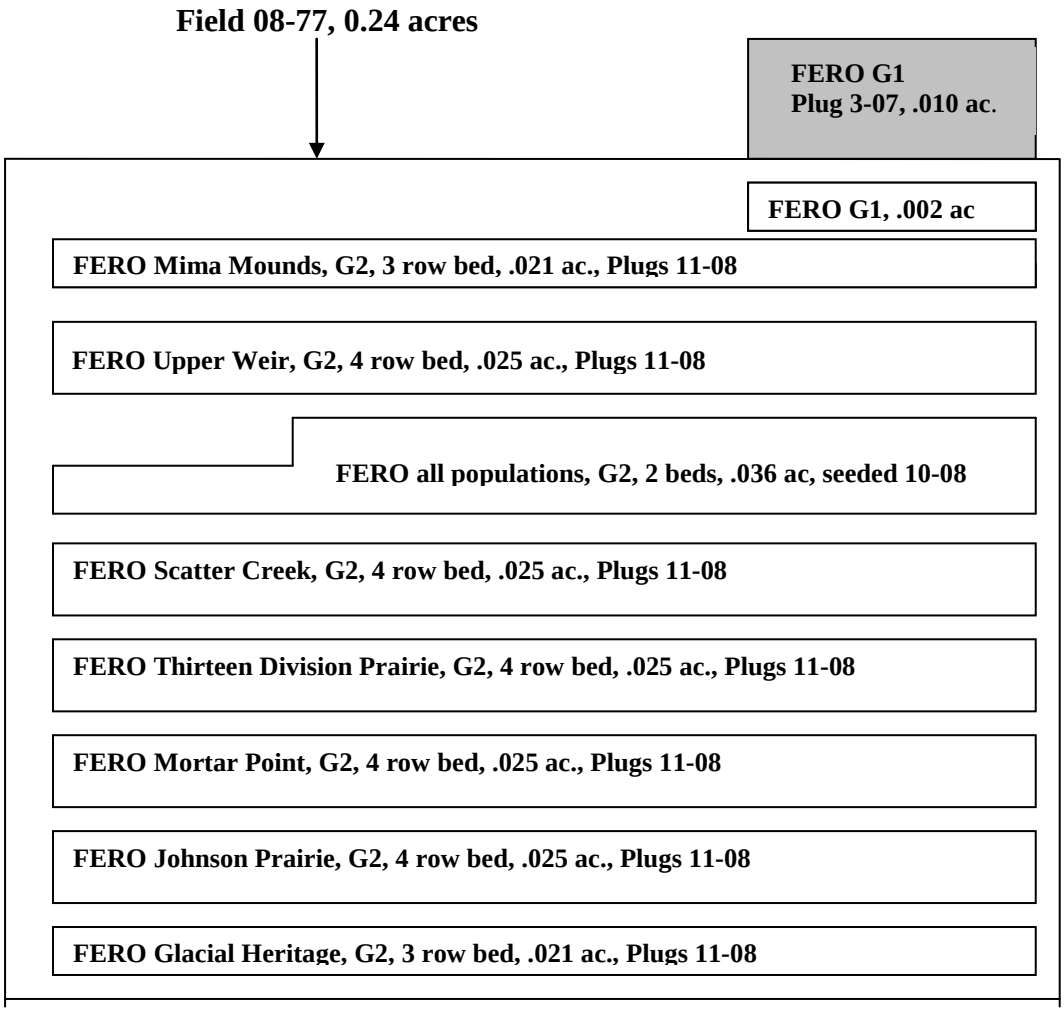
Coastal Germplasm (no crossing block) Solid seeded/planted rows from bulked G0 seed were sown in October 2006 and October 2007. Surviving plants from the common garden were also salvaged. Refer to Appendix II for field layout.

APPENDIX II. FIELD LAYOUT PLANS FOR ROEMERS FESCUE SEED INCREASE

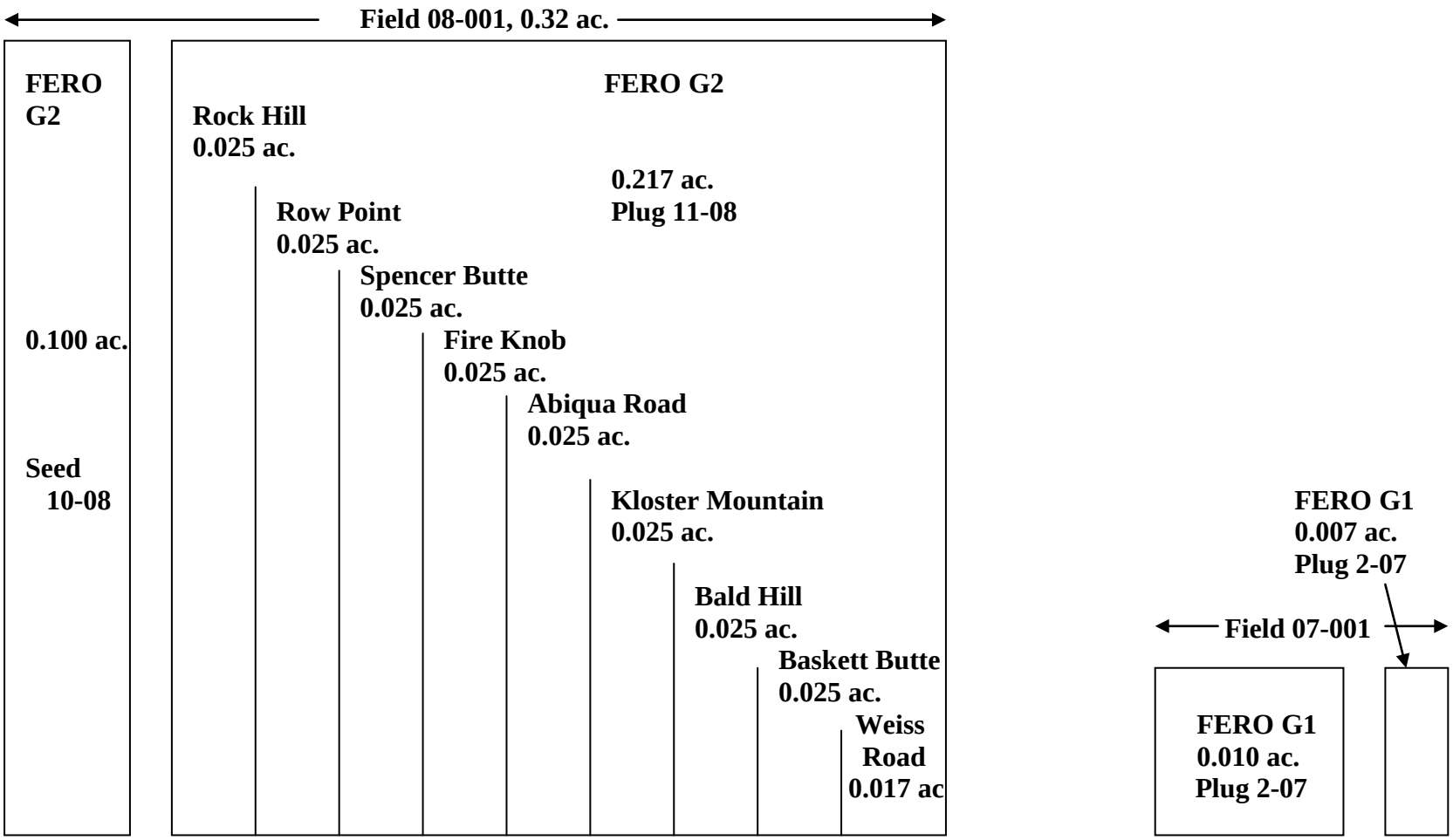
San Juan Islands Germplasm Roemers fescue (FERO) G2 seed increase
Selected Class, Accession #9079513 (PVGOR105)
Hyslop Farm Field 2-2 (OSU Seed Certification field 08-22)
North ^ Scale: none



Puget Trough Germplasm Roemers fescue (FERO) G2 seed increase
Selected Class accession #9079512 (PVGOR104)
Schmidt Farm Field 7-7 (south end). OSU seed certification field 08-77.
North ^ Scale: none

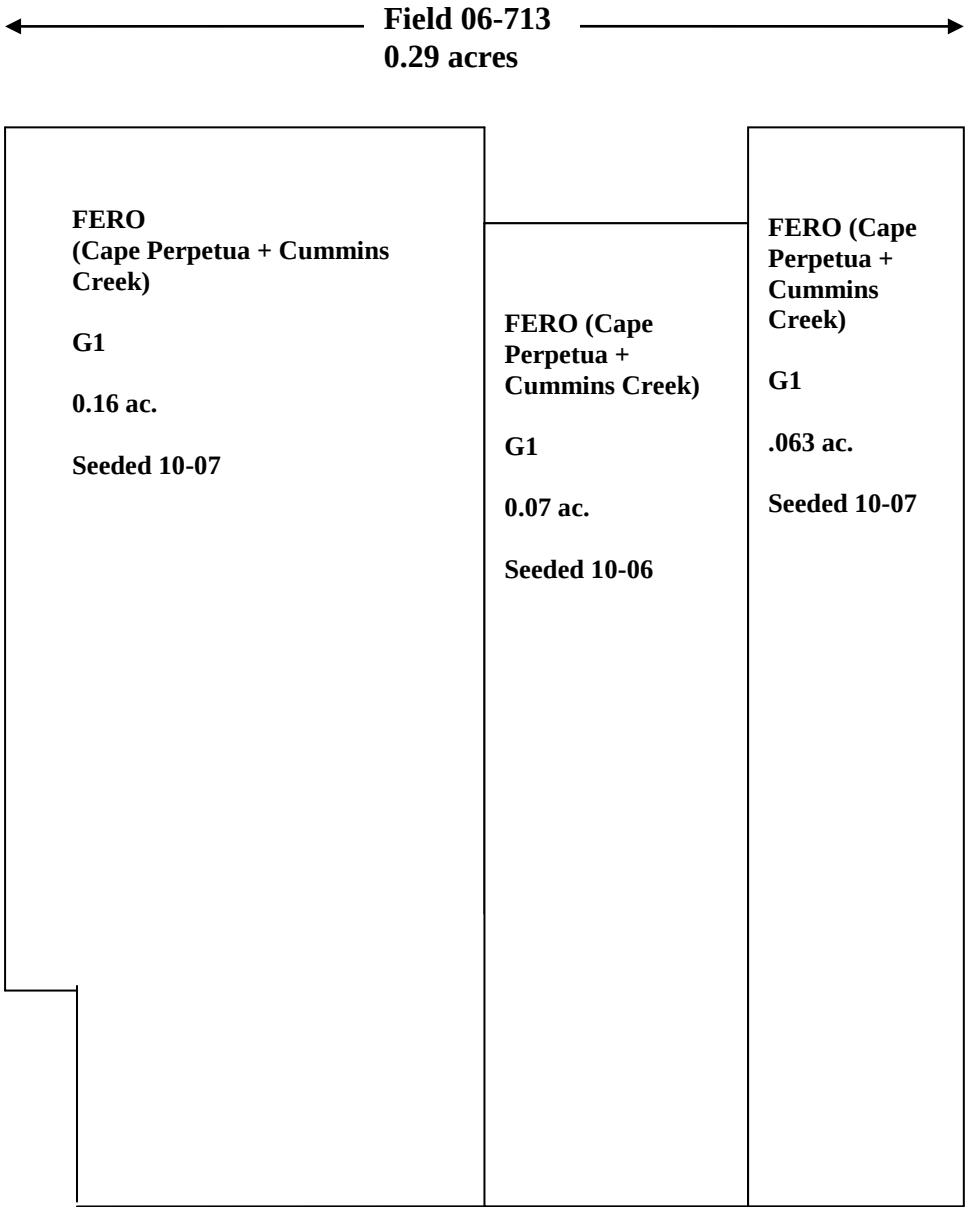


Willamette Valley Germplasm Roemers fescue (FERO) G2 seed increase
Selected Class, Accession #9079511(PVGOR102)
OSU East Farm Field 1. (OSU Seed Certification field 08-001)
North ^ Scale: none

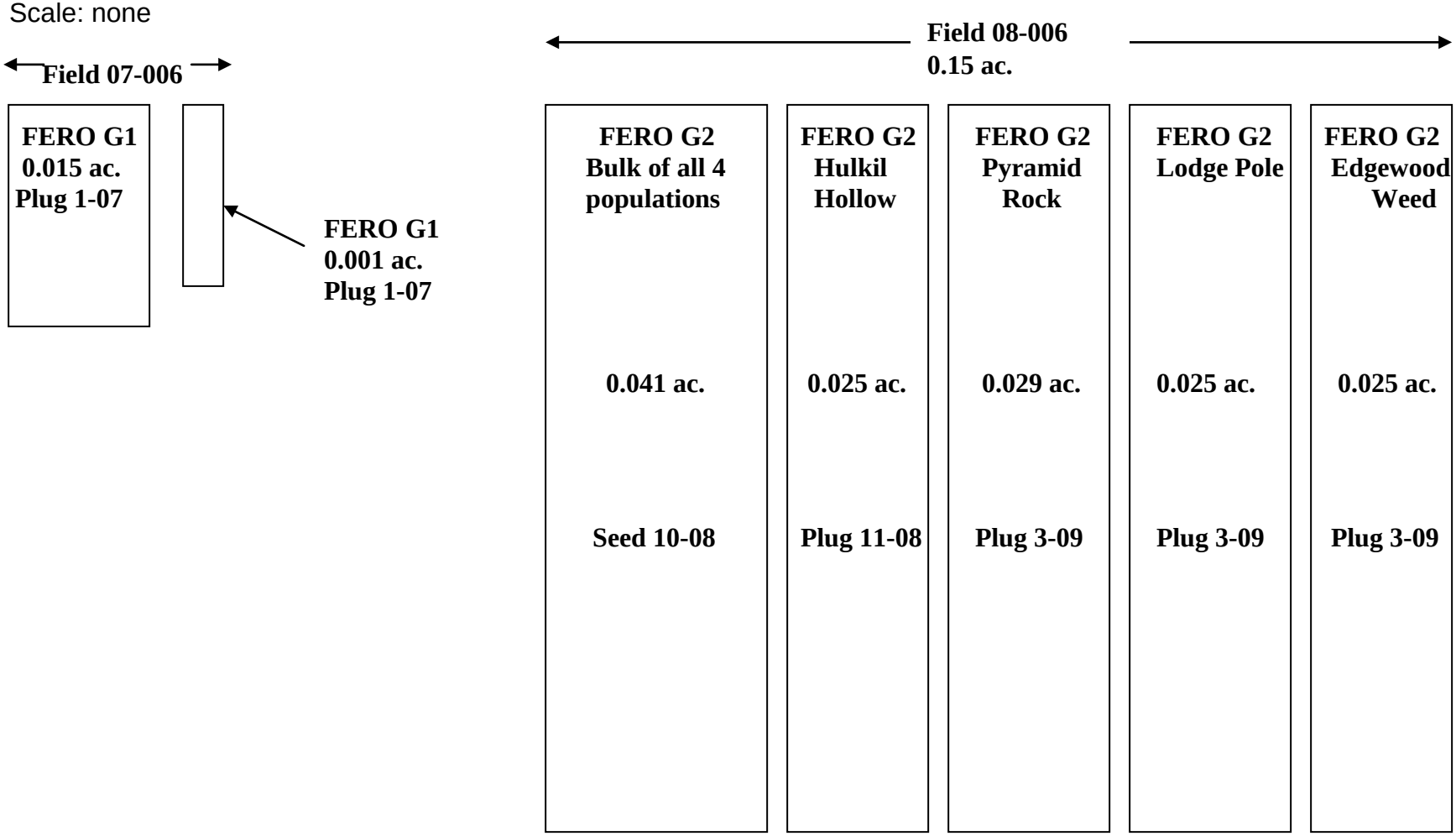


Coastal Germplasm Roemers fescue (FERO) G1 seed increase
Selected Class, Accession 9079484 (PVGOR101)
Schmidt Farm Field 7-13 (OSU Seed Certification field 06-713)

North ^
Scale: none



Field layout of Siskiyou Germplasm Roemers fescue (FERO) G2 Seed Increase
Selected Class, Accession #9079510 (PVGOR103)
OSU East Farm Field 6 (OSU seed certification field 08-006)
North ^
Scale: none



Genecology of Prairie Junegrass (*Koeleria macrantha*): Interim Report

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Introduction

Koeleria macrantha (Ledeb.) J.A. Schultes (prairie junegrass) is a highly variable, moderately long-lived, cool season perennial bunchgrass that grows 15 to 60 cm (0.5 to 2 ft) tall. It is adapted to a wide variety of climates and soils and is an important component of many native plant communities. The North American distribution of this circumpolar species ranges from eastern Alaska, down through California into Mexico, and east to Alabama, Delaware, and Ontario (Gonzalves and Darris 2008, Ogle et al. 2006).

One of the most important uses of *Koeleria macrantha* is in seed mixes for restoration of native prairie, savanna, coastal scrub, chaparral, and open forest habitats across much of North America. Good drought tolerance and fibrous roots also make it beneficial for revegetation and erosion control on mined lands, over septic systems, and on construction sites, burns, and other disturbed areas. Active growth begins early in spring, providing good forage for livestock, deer, antelope, and elk. Declining palatability during seed formation rebounds in late summer when there is adequate moisture. Bighorn sheep and mountain goats graze this species from rocky soils at high elevation. It provides feed for upland game birds, small mammals, and numerous grasshoppers and leafhoppers. *Koeleria macrantha* may also be cultivated for forage or fodder, and is used as a low input turfgrass (e.g. golf courses) and an ornamental grass. There is at least one turf variety and additional ones are being bred by private seed companies. Two native germplasms selected for roadside planting, prairie restoration, and landscaping have been released from the Elsberry Plant Materials Center in Elsberry, Missouri. Native Americans used the seeds to make flour for bread and mush. They also fashioned paint brushes and brooms from the leaves (Gonzalves and Darris 2008, Ogle et al. 2006).

There is a need for greater genetic knowledge of *Koeleria macrantha* to ensure adapted populations are used for restoration and revegetation projects. The objectives of this study are: (1) to explore genetic variation in putative adaptive traits in this species from a wide range of source environments in the Pacific Northwest; (2) to explore the relationships between genetic variation in putative adaptive traits and the climates of the source environments; and (3) to develop seed transfer guidelines to ensure adapted populations for restoration. Most

information will be generated from two common garden studies conducted on separate contrasting environments in Oregon. These studies are a joint effort between the USDA Forest Service in the Pacific Northwest and the USDA Natural Resources Conservation Service in Oregon.

Methods and Materials

Population sampling

Seed was collected by USDA Forest Service employees and collaborators from endemic stands of *Koeleria macrantha* during the summers of 2003 to 2006. Populations came from Oregon, Washington, and adjacent areas of Idaho, primarily from east of the Cascade Mountains. Two families (maternal parents) were sampled from each of 114 populations, while only a single family was sampled from 12 populations, for a total of 240 families from 126 populations.

Locations and growing conditions

Common garden studies were established in 2008 at two contrasting sites in Oregon: the USDA Natural Resources Conservation, Plant Materials Center, Corvallis, Oregon, and Oregon State University's Agricultural Experiment Station at Powell Butte, Oregon. The two locations offer very different environments. The Corvallis site is west of the Cascades in the Willamette Valley, and has milder winters and greater precipitation than the Powell Butte site which is east of the Cascades in central Oregon near Prineville.

The Corvallis site is at an elevation of 69 m (225 ft) and located at 44.6251 north latitude, -123.2168 west longitude. The soil type is a well drained Willamette silt loam on uniform, level ground (USDA Natural Resources Conservation Service 2010). Because the site is within 120 km (75 mi) of the Pacific Ocean, the climate has a distinct maritime influence, modified by the Coast Range Mountains of Oregon. The average annual precipitation is 1,040 mm/yr (41 in/yr) with 70% falling from November through March. Measurable precipitation occurs 150-160 days a year. Average annual snowfall is 15 cm/yr (6 in/yr). The highest average maximum temperature is 27°C (81°F) in July and August and the lowest average minimum temperature is 1°C (33°F) in January. The average annual growing degree days is 2,121 (base 50°F) (Western Region Climate Center 2010).

Soils are lighter textured and climatic conditions semiarid and more continental at Powell Butte compared to Corvallis. The Powell Butte site is located at 44.2530 north latitude, -120.9478 west longitude at an elevation of 975 m (3,200 ft). The soil type is a well drained Buckbert ashy sandy loam on uniform, somewhat rocky, level ground (USDA Natural Resources Conservation Service 2010). The average annual precipitation is 262 mm/yr (10.3 in/yr) with monthly averages near 25 mm (1 in) in winter and 13 mm (0.5 in) in summer. Average annual snowfall is 507 mm/yr (20 in /yr). Measurable precipitation occurs 70-80 days a

year. The highest average maximum temperature is 30°C (86°F) in July and August and the lowest average minimum temperature is -6°C (21°F) in December and January. The average annual growing degree days is 1,506 (base 50°F) (Western Region Climate Center 2010).

Plant establishment and management

Prairie junegrass seeds were germinated in Petri dishes in spring of 2008, seedlings transplanted into 115 cc (7 cu. in.) Ray Leach cone shaped containers (plugs), and plants grown in a greenhouse in Corvallis, Oregon, by the USDA Forest Service. Seedlings were trimmed to control growth over the summer until ready to be planted in late summer and fall. Both the Corvallis and Powell Butte study sites were prepared by plowing or disking and harrowing during the summer of 2008. The experimental design at each location is a randomized block design with a single plant from each of 240 families randomly assigned to planting spots in a replication. There are ten replications at each site for a total of 2,400 individual plant plots per site.

The time of transplanting and the treatment of the plants differed between the Corvallis and Powell Butte sites. Two weeks prior to planting at Corvallis, medium textured, Douglas-fir bark mulch was applied (blown on) to the study site at an average thickness of 6 cm (2 in.) to help control weeds. Plugs were then transplanted into a weed free planting bed on October 21, 2008. The spacing is 90 cm (36 in.) between rows and 60 cm (24 in.) within rows. Each block or replication consists of 12 rows with 20 plants per row (240 plants) and there are 10 blocks. At the time of transplanting, each plug received 6 g (0.21 oz) slow release fertilizer [Apex® 14-14-14 (14-6-11.6 elemental) with a release period of 5 months at 16°C (60°F)] in the bottom of the 13 cm (5 in.) deep planting hole. All holes were made with planting dipples to create depressions similar in dimension to the container plugs. A single outside border row of known families was planted to offset environmental edge effects. To aid in fall establishment, approximately 1/2 inch of water was applied by sprinkler irrigation system the day after planting and again a week later. No supplemental water was applied thereafter or in subsequent years. No herbicides were applied to the study site. All weed control is manual. To control stem and leaf rust diseases (*Puccinea* spp.) in 2009 only, the fungicide Quilt® (azoxystrobin and propiconazole) was applied on May 18, 2009, at the rate of 20 oz of product per acre (Syngenta Crop Protection Inc. 2009). No fungicides will be applied in 2010 in order to evaluate possible variation in susceptibility to rust among families at Corvallis.

At the Powell Butte site, plugs were transplanted to the plot area on August 27, 2008. The spacing was 60 cm (24 in.) between rows and 50 cm (20 in.) within rows. Unlike Corvallis, no fertilizer or bark mulch was applied to the plants or plot area. However, each plant was watered with a hose. Supplemental water was also applied afterwards by sprinkler irrigation to aid in establishment during the fall. No irrigation water was applied thereafter. Each block or replication consists

of 6 rows with 40 plants per row (240 plants) and there are 10 blocks. The long replications were oriented to account for a gradient in moisture from a nearby irrigation ditch. The replications were oriented to be either in or out of an area that had been previously burned as part of a previous study on bitterbrush. A single outside border row was added to offset environmental edge effects. Like Corvallis, all weed control is manual so no herbicides were applied. Unlike Corvallis no fungicides were applied for disease control. The study area was fenced to exclude wildlife and livestock, and rodents were actively controlled.

Trait measurement

Plants were measured for a variety of traits including growth, morphology, phenology, and fecundity in 2009 and will be measured again in 2010. A list of traits sampled is given in Table 1. Additional traits such as leaf color and winter dormancy may be collected in 2010.

Statistical analyses

Statistical methodology follows procedures used in previous genecological studies for mapping genetic variation across the landscape (Campbell 1979, 1986; Erickson et al. 2004; St.Clair et al. 2005). The general procedure considers differences among populations in traits and how population differences may or may not be related to the environments of the source locations. Large population differences related to the environments of source locations that make sense from the perspective of plant adaptation are indicative of traits that may be important for adaptation and should be considered when delineating seed zones or seed transfer guidelines.

We first consider differences between the two test sites. Analyses of variance are done to test differences between test sites and among populations, and to evaluate population x environment interactions. The model for the analysis of variance is:

$$Y_{ijk} = \mu + S_l + B_{k(l)} + P_j + F_{i(j)} + S_lP_j + S_lF_{i(j)} + e_{ijk}$$

where Y_{ijkl} is the plot mean performance of the ith family (F) from the jth population (P) in the kth replication (B) at the lth test site, μ is the overall experimental mean, and e is the experimental error consisting of the pooled interactions of both sources and families by replications. Test sites, populations and families are treated as random effects. Differences among test sites, populations, families within populations and the interactions of test site with populations or families within populations will be tested for significance using PROC GLM of the SAS statistical package (SAS Institute Inc. 1999). Population differences will be tested using a Satterthwaite approximation of an F-value utilizing the family within population and site x population mean squares (Snedecor and Cochran 1980). Family differences and site x population

interaction are tested against the site x family interaction. Site x family interaction is tested against the experimental error term. Variance components are obtained using PROC MIXED. The importance of the population x environment interaction will be also be evaluated by considering the magnitude of the correlation of population means between test sites.

Analyses of variance are also done within each test site. The model for the analysis of variance is:

$$Y_{ijk} = \mu + B_k + P_j + F_{i(j)} + e_{ijk}$$

where Y_{ijk} is the plot mean performance of the ith family (F) from the jth population (P) in the kth replication (B), μ is the overall experimental mean, and e is the experimental error consisting of the pooled interactions of both populations and families by replications. Differences among populations and families within populations are tested for significance using PROC GLM of the SAS statistical package (SAS Institute Inc. 1999). Population differences are tested using families within populations as the error term, and family differences are tested against the experimental error term. Variance components are obtained using PROC MIXED.

After all data is collected from both sites in both years, principle component analyses will be done using PROC PRINCOMP. The same traits measured at different test sites may be considered as different traits. When traits are highly correlated, only one trait will be chosen for input into the principle component analysis. Traits with low population variation will not be included in the principle component analysis.

Regression models will be determined relating trait variation (both individual traits and composite traits from the principle components) to environmental variation as measured by climate and geographic variables. Lack of fit to the models will be tested using variation among families within populations as pure error (Neter and Wasserman 1974). Significant lack of fit may be due to unaccounted site factors, such as soils, biotic interactions, or microclimate, to non-uniform patterns of gene flow, or to local patterns of variation that differ from the broad-scale, overall pattern of variation. Geographic variation based on this model is illustrated using GIS and the grid algebra functions in ARC/INFO (see St.Clair et al. 2005).

Different classifications systems will be compared to evaluate options for seed movement guidelines, including ecoregions, conifer seed zones, watersheds, plant associations, and soil types (see Erickson et al. 2004). For each trait, including principle components, analysis of variance on family means will be performed using the model:

$$Y_{ijk} = \mu + Z_k + P_{j(k)} + F_{i(jk)}$$

where Y_{ijk} is the mean of the two plants from the ith family in the jth population in the kth zone, μ is the overall mean, Z_k is the effect of the zone, $P_{j(k)}$ is the effect of the population within a zone, and $F_{i(jk)}$ is the effect of the family within a population. Lack of fit to the classification model will be tested by the significance of the *p* value for population within classes. Components of variance will be estimated for population with and without the classification in the model as a fixed effect. The percentage of population variance accounted for by the classification system will be calculated as:

$$(\sigma^2_P - \sigma^2_{P/Z}) / \sigma^2_P \times 100$$

Results and Discussion

Traits measured at Corvallis were significantly different from traits measured at Powell Butte (Table 2). Plants at Corvallis had wider crowns, larger leaves and later phenology than plants at Powell Butte (Table 3). Plants at Powell Butte, however, flowered profusely compared to plants at Corvallis. In nearly all traits, variation among populations was much greater when plants were grown at Corvallis (Table 3), even though variation among individual plants was similar at both sites (not shown). The percentage of the total phenotypic variation (populations, families, and residual) that was found within populations was high for most traits, especially crown width, leaf width, leaf ratio, and dates of heading and bloom.

The population x site interaction was significant for all traits (Table 2). Correlations of population means between test sites, however, were high or at least moderate (Table 4). Populations that had wide crowns, more flowers, wide leaves, upright habit, and later phenology at one site were generally the same at the other site.

Because population differences were better expressed at Corvallis, relations between traits and source environments are presented for traits measured at Corvallis, although results are similar for both sites. Four traits that had large population variation and were correlated with climates at the source locations are crown width, inflorescence number, leaf width, and bloom date (Tables 3 and 5). As might be expected, leaf width is strongly correlated with leaf ratio (r=-0.74), and bloom date is strongly correlated with heading date (r=0.86) and maturation date (r=0.84). These traits are generally correlated with temperatures, precipitation, and aridity (as measured by the heat moisture index which is a function of the ratio of temperature to precipitation). Regression equations of traits on source climates used various combinations of temperature, precipitation or aridity variables. Regression models were used to map patterns of variation for these four traits (Figure 1). R^2 values ranged from 0.20 to 0.41. Although the magnitudes and nature of the relationships between the source climates and traits differ somewhat between the four traits, general patterns of variation

emerge. Populations from the Columbia Basin have narrow leaves, narrow crowns, fewer inflorescences, and later phenology when grown together in a common environment. Populations from the Blue Mountains have wider leaves, wider crowns, more infloresences, and earlier phenology. Populations from the northern Great Basin are similar to the Columbia Basin in having narrow leaves and fewer inflorescences, but are more similar to the Blue Mountains in having earlier phenology and wider crown widths. The few populations from western Oregon have wider leaves and many inflorescences. From an adaptation perspective, we expect narrow leaves from areas of greater aridity, less precipitation, and warmer summer temperatures, and we expect earlier phenology from areas with colder winter temperatures (i.e., quicker responses to springtime warming). The general patterns that emerge from this preliminary analysis are largely congruent with large-scale ecoregions, suggesting that Omernick's Level III ecoregions may be useful for seed zones.

It should be emphasized that this is a preliminary analysis. We still need to include biomass traits (weighing of samples was not completed in time for this analysis) and measurements from the second year of growth at both sites. We will also more fully explore the relationships among traits and reduce the number of uncorrelated traits through principal component analysis. Variation in stem and leaf rusts (*Puccinia* spp.) will be further explored. Although spring rust infection was suppressed in 2009 with an application of fungicide, fall rust occurred at Corvallis with wide differences in infection rates between plants. As expected, the Corvallis site was more prone to stem and leaf rusts compared to the Powell Butte site. Fungicides will not be used at Corvallis in 2010. A small percentage of plants at Corvallis appeared to spread laterally below ground, either from lateral tillers buried in the soil or short rhizomes. This characteristic did not occur at Powell Butte.

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Table 1. Traits measured in common garden studies of *Koeleria macrantha* established in Corvallis and Powell Butte, Oregon.

Trait	**Units**	**Time of measurement**	**Description**
Aboveground biomass	g	July	Dry weight sampled at maturity cut 1 cm above ground level
Fall regrowth biomass	Score of 1-9	September to November	Evaluate abundance of foliage regrowth after clipping
Crown width	cm	Late July to August	Width of the base of the plant measured at its widest diameter
Inflorescence number	count	June	Number of inflorescences (to nearest 5 or 10 when numbers are high)
Culm length	cm	At maturity prior to harvest (July)	Base of crown to top of a lead culm (minus spike length)
Spike length	cm	At maturity prior to harvest (July)	On a lead culm
Leaf length	cm	May-June	Length of typical fully-emerged leaf
Leaf width	mm	May-June	Width of typical fully-emerged leaf when flattened
Leaf ratio	Ratio	Derived	Ratio of leaf length to leaf width
Plant form	Score of 1-9	June	Rated from 1=prostrate to 9=upright after heading
Spread	Score of 1-9	July	Evaluation of apparent lateral spread of tillers through the soil
Rust disease	Score of 1-9	June and fall	Evaluation of apparent susceptibility to rust (*Puccinia* spp.)
Heading date	Days since Jan 1	March-May	Date when first spike has emerged and base extended 1 cm beyond leaf collar or leaf sheath
Bloom date	Days since Jan 1	Mid April to mid June	Date of first anther extrusion from any spike
Maturation date	Days since Jan 1	Early to late July	Date of first seed ripening as evidenced by start of shatter or hardening seeds[1]

[1]At Corvallis in 2009 only, maturity was recorded when 50% of the seedheads reached maturity, rather than just the first spike.

Table 2. Results from analyses of variance over both sites.

Trait	F-ratio for Site	F-ratio for Populations	F-ratio for Population x Site
Crown width	1849.14***	4.53***	1.42***
Inflorescence number	2442.37***	3.49***	1.96***
Culm length	81.43***	3.56***	1.45***
Leaf length	111.79***	9.35***	1.35***
Leaf width	500.90***	15.12***	1.25*
Leaf ratio	125.33***	8.18***	1.32*
Plant form	190.34***	8.39***	2.26***
Heading date	471.54***	5.96***	2.65***
Bloom date	1420.26***	4.75***	1.34***
Maturation date	2399.67***	2.85***	1.79***

Table 3. Trait means and percentage of total variance at a site attributed to populations for *Koeleria macrantha* grown at Corvallis and Powell Butte, Oregon.

Trait	Mean at Corvallis	Mean at Powell Butte	Variances of populations at Corvallis (%)	Variances of populations at Powell Butte (%)
Crown width	12.0	10.0	28	8
Inflorescence number	12	72	23	8
Culm length	51.3	47.5	3	4
Leaf length	21.8	20.6	23	11
Leaf width	3.5	3.0	49	24
Leaf ratio	65	71	24	15
Plant form	4.8	5.1	17	11
Heading date	126	134	21	5
Bloom date	145	157	23	7
Maturation date	176	191	9	2

Table 4. Correlations of population means between sites.

Trait	Correlation
Crown width	0.56
Inflorescence number	0.47
Culm length	0.39
Leaf length	0.77
Leaf width	0.85
Leaf ratio	0.75
Plant form	0.62
Heading date	0.43
Bloom date	0.57
Maturation date	0.25

Table 5. Correlations between traits measured at Corvallis and select climate variables[1] of seed sources.

Trait	MAT	MWMT	MCMT	MAP	MSP	AHM	SHM
Crown width	-0.16	-0.27	0.14	0.22	0.08	-0.35	-0.29
Inflorescence number	0.26	0.00	0.43	0.45	0.31	-0.23	-0.23
Culm length	-0.15	-0.12	-0.15	0.00	0.08	-0.14	-0.14
Leaf length	0.05	-0.04	0.08	0.10	0.11	-0.22	-0.13
Leaf width	-0.30	-0.36	-0.06	0.26	0.35	-0.45	-0.42
Leaf ratio	0.40	0.39	0.15	-0.20	-0.30	0.35	0.39
Plant form	-0.05	-0.08	0.06	-0.07	0.11	0.07	-0.03
Heading date	0.26	0.13	0.33	0.19	-0.15	0.12	0.28
Bloom date	0.35	0.21	0.41	0.22	-0.20	0.15	0.32
Maturation date	0.23	-0.02	0.50	0.42	0.00	-0.07	0.05

[1] Key to climate variables: MAT=mean annual temperature, MWMT=mean warmest month temperature, MCMT=mean coldest month temperature, MAP=mean annual precipitation, MSP=mean summer (May to Sept) precipitation, AHM=annual heat:moisture index [(MAT+10)/(MAP/1000)], SHM=summer heat:moisture index [(MWMT+10)/(MSP/1000)]. Temperatures are in ˚C and precipitation is in mm.

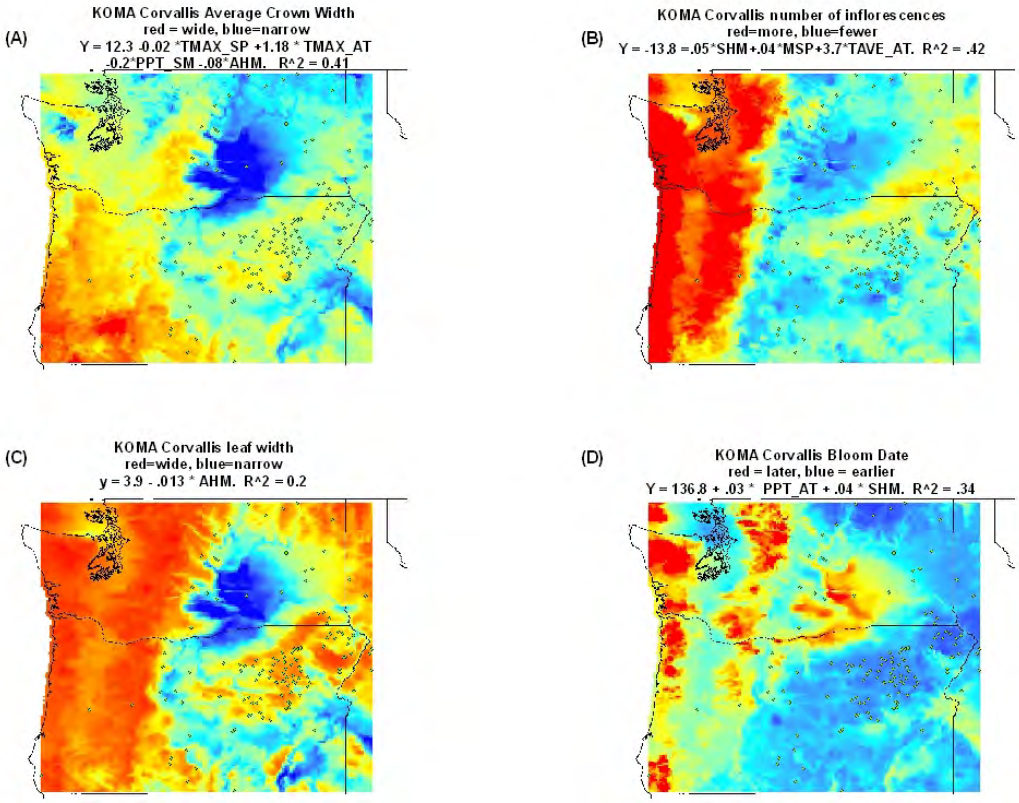

Figure 1. Geographic variation in *Koeleria macrantha* and regression equations used to model variation for (A) crown width, (B) inflorescence number, (C) leaf width, and (D) bloom date.

Can an Ecoregion Serve as a Seed Transfer Zone? Evidence from a Common Garden Study with Five Native Species[4]

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Abstract

Prairie restoration is often limited by the availability of appropriate local plant materials. Use of locally adapted seed is a goal in restoration, yet little information to inform seed transfer guidelines is available for native plant species. We established common gardens of five plants (*Eriophyllum lanatum* var. *leucophyllum, Epilobium densiflorum, Potentilla gracilis* var. *gracilis, Lupinus polyphyllus* var*. polyphyllus* and *Saxifraga oregana*) frequently used in prairie restoration in the Pacific Northwest of North America to determine if populations differed in morphological and phenological traits and whether this variability was structured by geography, climate, or habitat. Ordination techniques were used to summarize the observed variability of multiple traits for each species. Ordination distance was significantly correlated with geographic distance in *L. polyphyllus* var*. polyphyllus*, and populations of this species differed significantly among geographic groups within an ecoregion*.* Little or no spatial structure was detected in the remaining species, despite correlations between ordination scores and monthly temperatures. We suggest that a single seed zone in the Willamette Valley ecoregion may be appropriate for all species examined except *L. polyphyllus* var*. polyphyllus*. Ecoregions in general may be useful boundaries for seed transfer zones, especially in regions with relatively little topographical or climatic variation.

[4]Full text of paper pending publication in Restoration Ecology 2010 (copyrighted).

Insect Surveys on Established Native Forbs and Shrub Plantings at the USDA-NRCS Corvallis Plant Materials Center (PMC)

J. Williams[1], G. Ellen[2], A. Kretchun[3], T. Winfield[3], J Karby[3], and K. Pendergrass[4]

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Summary

In 2007 the USDA-NRCS Corvallis Plant Materials Center, Oregon State University's Integrated Plant Protection Center and the Xerces Society came together to develop and plant a native pollinator/beneficial insect hedgerow and conduct insect surveys on over 20 different native shrub and forbs species located at the PMC. The objective of the project is to gain knowledge of pollinator and beneficial insect associations with native plants of the Pacific Northwest and to publish the results of this information to aid growers and planners in habitat establishment and management for these organisms using native plants within agro-ecosystems in the Willamette Valley of Oregon.

Basic knowledge of pollinator & beneficial insect visitation on native plants within the Willamette Valley of Oregon is lacking or very limited. For the past two growing seasons 3 students from Oregon State University have been taking insect surveys on a variety of native plant species at the PMC between the months of April to August. Weekly surveys were conducted visually, using sweep nets, aspirators, blue vane, beat sheets and the use of pan traps. Flowering dates of the surveyed plants were also recorded throughout the season.

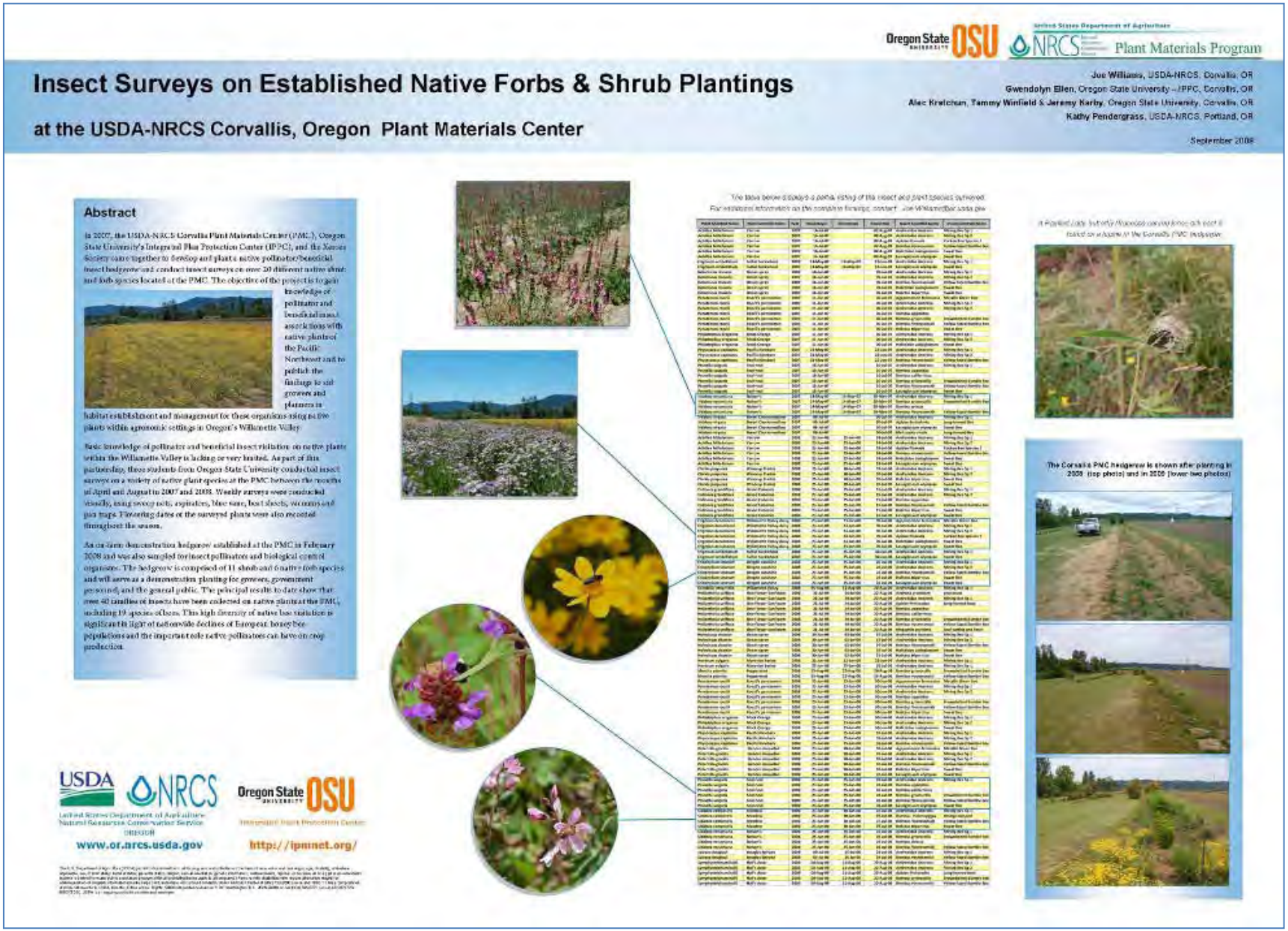
An on-farm demonstration hedgerow was established at the PMC in February 2008 and was also sampled for insect pollinators and biological control organisms. The hedgerow is comprised of 11 shrub and 6 native forbs species and will serve as a demonstration planting for growers, government personnel, and the general public.

The principle results to date show that over 40 families of insects have been collected on the plant collections including 19 species of bees which is a significant find due to the nationwide decline of European honey bee populations and the important role native pollinators can have on crop pollination.

POSTER PAPERS

Insect Surveys on Established Native Forbs and Shrubs (poster paper)

J. Williams, G. Ellen, A. Kretchun, T. Winfield, J Karby, and K. Pendergrass



Harvest Methods in Forb Seed Production Fields (poster paper)
Amy Bartow

Harvest Methods in Forb Seed Production Fields

Amy Bartow USDA NRCS Corvallis Plant Materials Center, Corvallis, Oregon

Seeds that mature evenly: "moon rover".

These species are easy to harvest. The PMC uses this custom-made swather equipped with a conveyor belt.

Eriogonum nudum
Eriogonum umbellatum
Ranunculus occidentalis
Saxifraga oregana
Potentilla gracillis
Cammas leichtlinii
Iris tenax
Lupinus polyphyllus
Castilleja levisecta
Downingia elegans
Downingia yina

The Corvallis Plant Materials Center (PMC) has been researching forb seed production for over ten years. As interest in prairie restoration increases, so does the demand for forb seed. To meet this demand, the PMC has worked intimately with over a hundred species analyzing their specific seed production traits such as how evenly its seed matures and how readily its seeds shatter. Understanding these traits helps us to match the most efficient harvest method to each species that we work with. Our harvest methods aim to increase yields (making more seed available and lowering prices) and to capture the genetic diversity that is initially present in the seed increase field.

Symphyotrichum hallii
Anaphalis margaritacea
Aster chilensis
Solidago canadensis
Solidago spathula
Erigeron decumbens
Achillea millefolium
Artemisia suksdorfii
Pyrrocoma racemosa
Agoseris grandiflora
Epilobium ciliatum

Seeds with pappas: seed stripper.

These "fluffy" seeded species can be difficult to harvest and may require multiple harvests due to long flowering periods.

Seeds do not shatter easily: combine.

These are the easiest species to harvest . The PMC uses a small plot combine.

Sisyrinchium bellum
Clarkia rhomboidea
Eriophyllum lanatum
Lupinus rivularis
Tanacetum camphoratum
Penstemon roezlii
Prunella vulgaris
Lomatium nudicaule
Perideridia oregana
Perideridia gairdneri
Wyethia angustifolia
Balsamorhiza deltoidea
Delphinium menziesii
Navarettia intertexta
Eryngium petiolatum
Sidalcea virgata
Sidalcea campestris
Sidalcea nelsoniana

Lupinus albifrons
Lotus micranthus
Viola adunca
Silene hookerii
Collomia grandiflora
Montia linearis
Lotus formosissimus
Geranium oreganum
Lupinus bicolor
Madia elegans
Madia glomerata
Gilia capatata
Linathus bicolor
Lasthenia glaberimma
Myosotis laxa
Phlox gracilis
Rorippa curvisiliqua
Orthocarpus bracteosus

Seed matures unevenly and easily shatters: weed fabric.

These species are the most difficult to harvest. The seed can shatter on to the weed fabric then be swept, vacuumed or seed stripped.

Acknowledgments: this work would not be possible without the PMC farmer, fabricator, equipment operator, Kevin Robb. His creativity, enthusiasm, and willingness to try new techniques is invaluable. Thanks to PMC employees Jenny Freitag, Tyler Rosa, and Vanessa East, who make harvest season enjoyable and successful!

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NRCS Natural Resources Conservation Service Plant Materials Program

Large Scale Species Recovery through Local Farms and the Wetland Reserve Program (poster paper)

M. Marshall Gisler, A. Bartow, S. Gisler, D. Johnson, T. Kaye, C. Menke, S. Miller, S. Smith, A. Stanley, and A. Thorpe

Large Scale Species Recovery Through Local Farms & the Wetland Reserve Program

Melanie Marshall Gisler[1]

Amy Bartow[4], Steve Gisler[5], Debbie Johnson[1], Tom Kaye[1], Carolyn Menke[1], Stephanie Miller[1], Steve Smith[3], Amanda Stanley[1], and Andrea Thorpe[1]

THE MODEL:

- **Implementation** of the USFWS Draft **Recovery Plan** for the Prairie Species of Western Oregon and Southwest Washington (1 species).
- 10 recovery zones and goals for species abundance and connectivity identified.

- Our project targets 2 zones with the highest recovery needs, Corvallis West and Salem West.
- Duration 2008-2011.

Recovery Zone	Sidebloom # Populations/Zone	Target # Plants/Zone
SW Washington	1	7,000
Portland	4	5,000
Corvallis East	1	5,000
Coast Range	2	10,000
Salem East	2	10,000
Corvallis West	3	15,000
Salem West	3	15,000
Plus additional populations in any zone within species' range	3	10,000

- Capture remaining genetic diversity in each zone. **Collected seed** at all known sites (50).
- **Agricultural production** of plant materials w/experienced local farmers, conserving genetic diversity.
- **Introduce plants** to high quality habitat on **protected land**. Quantity and distribution of habitat on public lands not sufficient to meet recovery objectives. Project capitalizes on current habitat restoration efforts on private lands enrolled in the NRCS Wetland Reserve Program.
- Post-implementation **effectiveness monitoring** in 2014. Were the recovery objectives met?

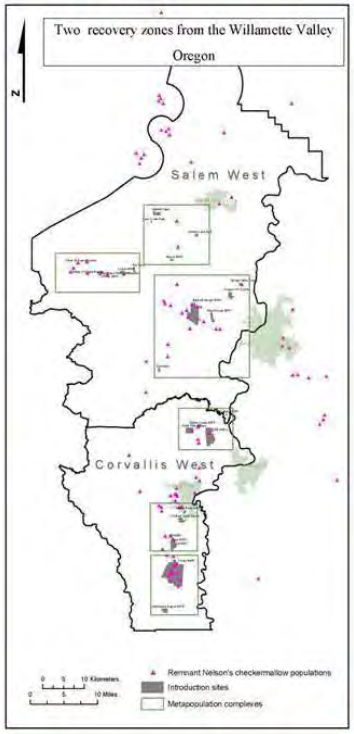
THE SPECIES:

Nelson's checkermallow, *Sidalcea nelsoniana*

- **Threatened species** with a high potential for recovery and delisting.
- Most **populations small**, isolated, and occur on unprotected land.
- Natural **recruitment low** due to weed competition, seed predation*, altered disturbance regimes, female-only populations, and possible genetic issues.
- We are **increasing local awareness** of the species and its habitat through public tours, brochures, and presentations.

* Weevils can consume up to 90% of seed.

Institute for Applied Ecology



PARTNERS: **1.** Institute for Applied Ecology, **2.** Oregon Watershed Enhancement Board, **3.** U.S. Fish and Wildlife Service, **4.** USDA Natural Resource Conservation Service & Plant Materials Center, **5.** Oregon Department of Transportation, and **6.** Benton County.

We are grateful to private & public landowners, Matt Blakeley-Smith, Rob Massatti, Rob Fiegener, Matt Carlson, Oregon Department of Agriculture, and local watershed councils.

THE FARM:

NRCS Corvallis Plant Materials Center

1st year seed production yielded 87 pounds of seed (> 2 million seeds)

- **Reproductive isolation** of 2 recovery zones.
- **Maintenance of genetic diversity**:
  1. Balanced contribution from wild collections.
  2. Diversity enhancement design (metapopulation complexes replicated, tracked, cross pollinating).
- 4 **additional** native seed producers on private **farms** in the valley poised to participate in recovery.

THE INTRODUCTION SITES:

***Recovery objectives could not be met without protected private property.**

- Seasonally-**wet prairie** habitats in the Willamette Valley ecoregion.
- Large scale introduction at **multiple protected sites** (16-24) (see map).
- Metapopulation complexes establish **connectivity**.
- **Public** (i.e., refuges, county parks) and private **easement sites** (11 in the ***Wetland Reserve Program,** previously restored).
- Establish **15,000 plants/zone**. Plant 3 propagule types and compare relative effectiveness.

Habitat enhancements at all sites to ensure long term stability of Nelson's checkermallow.

Which plant material works best?

Seed, Plugs, or Rhizomes

West Eugene Wetlands Propagation and Seed Increase of Fussy Prairie Plant Species

A. Bartow and D. J. Henshel

West Eugene Wetlands

Propagation and Seed Increase of Fussy Prairie Plant Species

The West Eugene Wetlands Partnership started restoring wet prairies in the mid-1990's. Seed of many wetland plant species were collected and sown on restoration sites, but some species did not show up on the sites.

A research effort over the last few years has helped to solve some of the mysteries of germination and propagation of some of these hard-to-grow species from wet prairie, vernal pool, emergent, and upland prairie habitats around the West Eugene Wetlands.

Some species do well when seeded on sites in the fall. Some also germinate just as well when seeded in the spring, but our seed mixes are usually sown on sites in the fall, for efficiency. Species that performed poorly in two-year and five-year frequency and cover monitoring studies were singled out; we then looked for alternative methods to get those species growing on our restoration sites.

Seed of all species were either collected within a twenty-mile radius of Eugene, or cultivated and harvested from plants whose seed was collected within a twenty mile radius of Eugene.

The following website links to our strategies for prioritization of species within the four main habitats of the area:
http://www.ci.eugene.or.us/parks/wetlands/pdf/PMP_Section2.pdf

The Plant Materials Center reports can be found on the web at:
http://www.ci.eugene.or.us/parks/wetlands/pdf/PMP_Section2.pdf
http://www.ci.eugene.or.us/parks/wetlands/pdf/PMP_Section2.pdf
http://www.ci.eugene.or.us/parks/wetlands/pdf/PMP_Section2.pdf

Plant Materials Center: Germination Studies

The Corvallis Plant Materials Center is operated by the USDA Natural Resources Conservation Service in Oregon. Its goal is to evaluate propagation and establishment techniques as well as increase seed and plants for revegetation and restoration in Western Oregon and Washington. Currently, the Corvallis Plant Materials Center has cooperative agreements with three National Parks and two districts of the Bureau of Land Management.

In 2002, Corvallis Plant Materials Center entered an agreement with the Eugene BLM to research germination protocols for ten species that had failed to establish after being seeded on restoration sites.

This agreement has been renewed annually, adding new species, and as of 2005 germination techniques have been documented for approximately 50 species.

Germination requirements have fallen into three main categories:

- will germinate after 60-90 day cold-moist stratification
- will germinate after a 14-28 day cold-moist stratification
- will germinate when sown and placed in a warm greenhouse (no treatment)

Orthocarpus hispidus after successful germination at the Corvallis Plant Materials

Species that require a 60-90 day cold-moist stratification.

Family	Species	Family	Species
Apiaceae	*Perideridia gairdneri*	Juncaceae	*Juncus tenuis/effusus*
Apiaceae	*Perideridia oregana*	Liliaceae	*Allium amplectens*
Asteraceae	*Balsamorhiza deltoidea*	Liliaceae	*Brodiaea coronaria*
Cyperaceae	*Carex densa/grossa*	Liliaceae	*Brodiaea elegans*
Cyperaceae	*Carex tumulicola*	Liliaceae	*Calochortus howellii*
Cyperaceae	*Eleocharis acicularis*	Liliaceae	*Zigadenus venenosus*
Fabaceae	*Lotus formosissimus*	Ranunculaceae	*Delphinium menziesii*
Gentianaceae	*Gentiana sceptrum*	Ranunculaceae	*Thalictrum polycarpum*
Iridaceae	*Sisyrinchium californicum*	Scrophulariaceae	*Castilleja levisecta*
Juncaceae	*Juncus oxymeris*		

Species that require 14-28 days of cold-moist stratification.

Family	Species	Family	Species
Hydrophyllaceae	*Nemophila menziesii*	Polemoniaceae	*Navarretia mellistoma*
Juncaceae	*Luzula comosa*	Polemoniaceae	*Phlox gracilis*
Polygonaceae	*Aconitum fawlei*	Polemoniaceae	*Gilia capitata*
Saxifragaceae	*Saxifraga oregana*	Polemoniaceae	*Collomia grandiflora*

These species do not require a cold-moist stratification and should germinate without treatment.

Family	Species	Family	Species
Asteraceae	*Lasthenia californica*	Onagraceae	*Clarkia amoena*
Asteraceae	*Micropsis oregana*	Onagraceae	*Lythrum portula*
Boraginaceae	*Myosotis laxa*	Poaceae	*Bromus carinatus*
Brassicaceae	*Polyctenium fremontii*	Poaceae	*Deschampsia elongata*
Brassicaceae	*Cardamine pensylvanica*	Poaceae	*Deschampsia cespitosa*
Cyperaceae	*Carex tolmiei*	Poaceae	*Danthonia californica*
Cyperaceae	*Carex vesicaria*	Ranunculaceae	*Lonchorhinchus*
Fabaceae	*Lupinus sellulus*	Ranunculaceae	*Myosurus minimus*
Fabaceae	*Lupinus lepidus*	Rubiaceae	*Galium trifidum*
Gentianaceae	*Gentiana quinquefolia*	Violaceae	*Viola lobata*
Malvaceae	*Sidalcea campestris*		
Malvaceae	*Sidalcea virgata*		

Seed Increase and Harvest Techniques

Problem:
Wild seed collection of some species is inefficient, due to scattered plants, low yields, and variable ripening times.

Solution:
Creating monocultures of uncommon species in small lots increases efficiency for seed collection. One example is *Cardamine pensylvanica*, pictured on the right.

Extra care given to concentrated beds or lots increases seed yields.

Controlling hydrology in the lots allows for successful growth of vernal pool and emergent species, such as *Lythrum portula*, as pictured on the left.

Passive seed collectors

PROBLEM:
Plants such as *Myosotis laxa* exhibit indeterminate flowering. If entire cymes are harvested, only a small fraction of seed is mature at any given time; the rest will not mature after harvest. (*Myosotis laxa*, *Galium trifidum*)

Legume seeds have variable ripening times and are explosive.

Similar collection problems exist with many annual members of the Phlox family, and other wetland species. They have explosive capsules, so collection is difficult to time properly for maximum seed harvest. (*Phlox gracilis*, *Cardamine pensylvanica*, *Collomia grandiflora*, *Linanthus dichotomus*, *Montia linearis*)

SOLUTION:
- Plugs were grown out in the spring and transplanted into 6" square pots.
- Pots were assembled outside in a shadehouse with drip irrigation.
- Full-sized linen sheets were stapled to wooden frames surrounding the pots.
- Slits were cut in the sheets, and young plants were pulled through the slits to rest on top of the sheet.
- Plants flowered and set seed; seed shattered onto the sheets.
- Mature seeds were vacuumed from the sheets weekly using a hand-held vacuum.

Sidalcea virgata Seed Increase Field

PROBLEM:
Sidalcea virgata plants in the West Eugene Wetlands are infested by weevils, producing little viable seed.

SOLUTION:
Plugs were planted into a field covered with a woven plastic ground cover; small holes made for each plug.

This eliminated the need for weed control and also acted as an aid in seed collection.

Seeds fell onto the ground cover when ripe and were swept up weekly during the harvest season.

In 2004, 60 two-year old plants produced a half of a pound of seed. Weevils have not been a problem, but may be in the future. Fields are monitored for weevils throughout the growing season.

Cultivating Native Bulbs for Transplanting into Restorations

Bulb-producing plants in the Liliaceae family, when sown from seed in the field, may not flower until their fourth or fifth season, under ideal growing conditions.

A commercial bulb-growing nursery has started to produce 3-year-old native bulbs from our seed stock, to be planted private during their third dormant season. These bulbs provide robust material to provide early flowering and may offer greater overall chance of survival than hoping that seed and tiny bulbs survive in restorations.

Wet prairie species:
- *Allium amplectens*
- *Camassia quamash* var. *maxima*
- *Triteleia hyacinthina*
- *Brodiaea coronaria*
- *Brodiaea elegans*
- *Zigadenus venenosus* var. *venenosus*

Upland prairie species:
- *Camassia leichtlinii* var. *suksdorfii*
- *Delphinium menziesii*
- *Calochortus tolmiei*

Camas bulbs salvaged from sites that are being developed have also been planted in our restorations. *Camassia quamash* var. *maxima* bulbs are shown to the left.

Bulbs were sown in flats of soil and cared for in a nursery setting. After two or three years, the soil in the flats is sown into the ground between 3/4 and 1-1/2 inches below the surface, in shallow trenches, and covered with soil to the surface. So far, two-year-old bulbs have been put into the field. In 2005, three-year-old bulbs will be transplanted into our restorations for the first time.

Plugs – Grasses, Sedges, and Rushes

Some species were grown as plugs in the nursery and transplanted into the field for seed production:

Deschampsia cespitosa ssp. *holciformis*
Luzula comosa
Glyceria occidentalis
Danthonia californica

Growing *Carex* sp. and *Juncus* sp. from seed in the field has been difficult, although some plants have come up from seed sown directly in our restorations.

- *Carex* seeds do not generally germinate well.
- *Juncus* seeds need light to germinate, and thus do not perform well when seeded under the ground with a seed drill. They may also migrate in water if sown on the soil surface.
- Bare root *Juncus* sp. and *Carex* sp. seedlings were transplanted into wet areas in restorations. We have had good results from transplanting robust bare-root stock; less robust seedlings have not survived as well.

Sidalcea virgata seed increase field at the Corvallis Plant Materials Center September 9, 2003 (above) and April 4, 2005 (below).

Divisions and Stolons

Some species that have dormant rootstocks in the dryness of summer and early fall can be propagated by divisions.

This method provides more chance of success in restoring flowering nectar plants for rare butterfly species.

We have not tried to collect *Fragaria virginiana* var. *platypetala* seed, but vegetative propagation of wild strawberries is easy. We grow plants for divisions, as well as propagating them by rooting stolons.

Iris tenax is also expensive to collect any quantity of seed. Iris is being grown from seed in a nursery, to propagate by divisions into restorations.

Divisions of these species can be repeated every year or so in the nursery, so that we can continue to provide robust material to transplant into the field.

Saxifraga oregana seeds are expensive to collect.

Sisyrinchium idahoense var. *idahoense* flower and seeds. These

These species rarely show up in restorations when sown from seed. Careful production of live plants by sowing seed in the nursery, or transplanting salvaged material, offers a greater overall chance of survival than sowing seed directly into restorations.

Plugs – Perennial Forbs

We have grown plugs of perennial forbs for one growing season in greenhouses and transplanted them into our restorations in the fall.

We grow plugs of some perennial forbs in the Aster family that produce a low percentage of viable seeds or take a long time to get established when sown directly into restorations.

Achillea millefolium
Aster hallii
Erigeron linearis
Wyethia angustifolia (pictured left)

Poaceae plugs provide a stronger start for uncommon species (*Festuca roemeri*) and fussy species (*Danthonia californica* and *Dichanthelium acuminatum*).

We grow plugs to enhance an area with nectar species for the endangered Fender's Blue Butterfly. Robust plugs improve success and lead to earlier flowering than with direct seeding.

Lomatium nudicaule
Ranunculus occidentalis
Sidalcea virgata (pictured right)

Some species are not too hard to grow from direct seeding in the field, but we have grown plugs to augment our populations.

Plectritis congesta
Plectritis ciliosa var. *ciliosa*
Plectritis gracilis
Lupinus sulphureus var. *kincaidii*

Conclusion:

Benefits:

Fussy plant species can be germinated or harvested with care and special attention, increasing seed yields and plant vigor.

Plug, bulb, and bare root plantings in the field may provide earlier flowering than seeds sown directly into the field.

Seeds that are expensive to collect can be sown in carefully cultivated nursery conditions for increased plant survival and increased seed yield.

Drawbacks:

Overall costs are lower when seed can be sown in the field, if seeds germinate and plants survive.

The following agencies and businesses have contributed to this body of knowledge:

- J.H. Stone Nursery, United States Department of Agriculture
- Oregon State Correctional Institute
- Corvallis Plant Materials Center, United States Department of Agriculture
- Horning Seed Orchard, Department of the Interior
- Pacific Northwest Natives – Private Native Seed Grower and Distributor
- Trillium Nursery – Private Native Plug and Bare-root Grower
- Buggy Crazy Bulb Nursery – Private Bulb Grower's Business

Support for these projects has largely come from these three partners:

- Bureau of Land Management
- City of Eugene
- The Nature Conservancy

ANNUAL REPORTS

(Interagency cooperative seed and plant increase and technology development projects)

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow
Jenny Freitag

December 30, 2008

THE 2008 BUREAU OF LAND MANAGEMENT ANNUAL REPORT:
WEST EUGENE WETLANDS

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into an agreement in the spring of 2002 with the Bureau of Land Management (BLM) to perform seed germination trials and seed increase of native wetland and wet prairie species. The West Eugene Wetlands (WEW) program has been collecting wild seed and sowing it in wetland restoration projects. Some species have been difficult to establish or have very high labor costs associated with hand collection. The PMC agreed to research and document seed propagation techniques for these species and to evaluate their potential for agronomic seed increase.

Figure 1. *Agoseris grandiflora* flowering in a weed fabric field at the Corvallis PMC, July 8, 2008.

In 2008, this agreement was renewed. One species from previous agreements was discontinued and two new species were brought to the PMC for seed increase. Seed increase was renewed on 33 of the species from the 2007 contract. This agreement will be amended and renewed through 2009.

Activities in 2008 included cleaning seed provided by the BLM, establishing and maintaining seed increase plantings, seed harvesting and seed cleaning.

II. Accessions Included in 2008 Agreement

Table 1. Accessions included in 2008 agreement with Eugene District of the BLM.

Species	Common name	Code	Accession #	Activity in 2008[1]
Agoseris grandiflora	bigflower agoseris	AGGR	9079571	pxn, sfp
Balsamorhiza deltoidea	deltoid balsamroot	BADE2	9079372	pxn, sfp
Carex feta	greensheath sedge	CAFE4	9079315	sfp
Carex languinosa	wooly sedge	CALA	9079304	pxn
Carex tumulicola	splitawn sedge	CATU3	9079291	sfp
Carex vesicaria	blister sedge	CAVE6	9079316	sfp
Castilleja tenuis	hairy Indian paintbrush	CATE26	9079254	pxn, sfp
Cicendia quadrangularis	Oregon timwort	CIQU3	9079254	pxn, sfp
Dichanthelium acuminatum	western panicgrass	DIACF	9079303	sfp
Deschampsia elongata	slender hairgrass	DEEL	9079375	sfp
Dodecatheon hendersonii	Henderson's shootingstar	DOHE	9079615	pxn
Downingia elegans	elegant calicoflower	DOEL	9079432	pxn, sfp
Downingia yina	Cascade calicoflower	DOYI	9079433	pxn, sfp
Eleocharis obtusa	blunt spikerush	ELOB2	9079434	pxn, sfp
Eleocharis palustris	common spikerush	ELPA3	9079435	pxn, sfp
Eryngium petiolatum	coyote thistle	ERPE	9079431	pxn, sfp
Galium trifidum	threepetal bedstraw	GATR2	9079317	pxn, sfp
Gentiana sceptrum	king's scepter gentian	GESC	9079311	sfp
Gratiola ebracteata	bractless hedgehyssop	GREB	9079436	pxn, sfp
Lasthenia glaberrima	smooth goldfields	LAGL3	9079293	pxn, sfp
Lotus formosissimus	seaside bird's-foot trefoil	LOFO2	9079294	pxn, sfp
Ludwigia palustris	marsh seedbox	LUPA	9079297	pxn, sfp
Lupinus bicolor	miniature lupine	LUBI	9079250	pxn, sfp
Madia glomerata	mountain tarweed	MAGL	9079437	pxn, sfp
Montia linearis	narrowleaf minerslettuce	MOLI4	9079295	pxn, sfp
Myosotis laxa	bay forget-me-not	MYLA	9079253	pxn, sfp
Navarretia intertexta	needleleaf navarretia	NAIN2	9079378	pxn, sfp
Nemophila menziesii	baby blue eyes	NEME	9079379	pxn, sfp

Table 1. Accessions included in 2008 agreement with Eugene District of BLM

Species	Common name	Code	Accession #	Activity in 2008[1]
Orthocarpus bracteosus	rosy owlclover	ORBR	9079502	pxn, sfp
Perideridia oregana	Oregon yampah	PEOR6	9079256	sfp
Phlox gracilis	slender phlox	PHGR	9079299	pxn, sfp
Pyrrocoma racemosa	clustered goldenweed	PYRA	9079496	pxn, sfp
Ranunculus alismaefolia	plantainleaf buttercup	RAAL	9079438	pxn, sfp
Rorippa curvisiliqua	curvepod yellowcress	ROCU	9079257	pxn, sfp
Saxifraga oregana	Oregon saxifrage	SAOR2	9079296	sfp
Sidalcea virgata	showy wild hollyhock	SIVI	9079305	sfp
Veronica peregrina	neckweed	VEPE2	9097439	pxn, sfp
Veronica scutellata	skullcap speedwell	VESC2	9079440	pxn, sfp

1- sfp= seed increase, pxn= container production,

III. Germination Trials

Two germination trials were performed in 2008. Seeds of *Agoseris grandiflora* were sown directly into three racks of stubby cone-tainers of moistened Sunshine #1 (a peat-based, soil-less media) amended with micronutrients and a slow-release fertilizer. Two racks were placed in a warm greenhouse (70°F day/ 55°F night), and one was placed outside and exposed to February temperatures. Seedlings emerged in the greenhouse within two weeks. The rack which had been placed outside was moved into the greenhouse and the seeds germinated. Seeds of *Dodecatheon hendersonii* were sown directly into plastic trays with 3.5 cubic inch round cells. The trays were covered with a polyethylene bag and placed in a walk-in cooler (34-38°F) for cold-moist stratification. After 90 days the trays were removed from the cooler and placed in a heated greenhouse. Seedlings emerged within two weeks. Each of the other species in this year's agreement have been successfully grown by the PMC in previous years. Treatments used to produce the plants for seed increase in 2008 are listed below.

Table 2. Plant production for the Eugene BLM WEW agreement at the Corvallis PMC in 2008.

Species	Amt used (g)	Number of cone-tainers produced	Treatment
Agoseris grandiflora	4	300	Heated greenhouse
Castilleja tenuis	1	400	90-days stratification
Cicendia quadrangularis	2	500	Unheated greenhouse
Dodecatheon hendersonii	3	312	90-days stratification
Downingia elegans	1	400	Unheated greenhouse
Downingia yina	1	400	Unheated greenhouse
Galium trifidum	1	100	Unheated greenhouse
Gratiola ebracteata	1	500	Unheated greenhouse
Lasthenia glaberrima	1	200	Unheated greenhouse

Table 2. Plant production for the Eugene BLM WEW agreement at the Corvallis PMC in 2008.

Species	Amt used (g)	Number of cone-tainers produced	Treatment
Lupinus bicolor	15	400	Scarification/inoculation
Madia glomerata	4	50	Heated greenhouse (80°F)
Montia linearis	2	300	Unheated greenhouse
Navarretia intertexta	2	400	Unheated greenhouse
Nemophila menziesii	6	400	Unheated greenhouse
Orthocarpus bracteosus	1	400	90-days stratification
Phlox gracilis	4	400	Unheated greenhouse
Rorippa curvisiliqua	1	300	Heated greenhouse
Veronica peregrina	1	200	Heated greenhouse

IV. Field Plantings

A *Sidalcea virgata* field planting was established in late spring of 2003. No weevils were detected on any of the seed heads. Plants did not seem affected by changes in soil environment due to the plastic woven weed barrier. Rodents have not damaged the plants, but some seeds were eaten.

Seed was collected weekly from June 26 to July 11th by hand-stripping mature seeds, and also by sweeping up ones that had shattered onto the ground cover. Collections were efficient and relatively little seed was lost. *S. virgata* racemes are less upright than other *Sidalceas*, which caused the seed to fall directly on the ground cover instead of on the plants' crown. The ground cover is a considerable aid in seed collection for the species and does not seem to be detrimental to plant growth or development. Ground cover needs to be cut back from the crowns of the *Sidalceas* as they expand. Harvested seed was collected in bags, dried in an open greenhouse and then placed in a small brush machine containing a scarifier (sandpaper) drum. Seed was further cleaned using an air screen machine.

Seed increase of many annual species was performed this year using weed fabric techniques. Two 15' X 170' sheets of weed fabric were stapled down onto a field that had been previously sprayed with glyphosate herbicide. Small squares were cut out of the weed fabric in order to transplant the cone-tainer plants. The squares were cut slightly larger than the size of the cones. Once transplanted, plants grew quickly, flowered, and set seed. As seed ripened, it shattered onto the weed fabric.

Figure 2. *Lotus formosissimus* flowers and immature seed pods in seed increase plot at the Corvallis Plant Materials Center, June 16, 2008.

Small, battery-powered hand vacuums were used to collect seed of *Montia linearis*, *Nemophila menziesii*, *Veronica peregrina*, *Veronica scutellata*, *Lasthenia glaberrima*, *Phlox gracilis*, *Lupinus bicolor*, *Lotus formosissimus* and *Rorippa curvisiliqua*. Twice a week, the weed fabric in the planting would be vacuumed and the material placed in paper bags in a greenhouse. The perennial plot of *Lotus formosissimus* was established this year. Seed collection was inefficient; many were blown away and the small black seeds were difficult to see against the black weed fabric. Next year the plants will be larger, hopefully producing more seeds and creating a wind block to hold the seeds on the fabric. Different methods for catching seeds will be experimented with.

The plot of *Galium trifidum* was harvested once. Plants covered the weed fabric completely and held the seeds on the fabric. The plot was vacuumed only when the plants had stopped producing seed; entire plants were removed and fed into a large brush machine.

The plot of *Madia glomerata* was harvested twice (Sept. 16 and Oct. 13). Some seeds were held on the plant and others dropped to the weed fabric. The entire plant was cut and fed through a hammermill. The seeds were then cleaned with a small air-screen machine. The plot was also vacuumed. Very little seed was produced this year due to a decrease in plot size. A combination of low germination rates and the damping off of germinants in the greenhouse resulted in 50 transplants to create the seed increase plot. Additionally, many plants died after transplanting.

Castilleja tenuis and *Orthocarpus bracteosus* were planted into field weed fabric plots this year along with a host plant. The *C. tenuis* was planted with *Downingia elegans*. Not all of the transplants survived, but those that did exhibited good vigor and seed production. Entire plants were cut as the seeds matured from June 30th through July 21st. Seeds were dried in an open greenhouse and cleaned with a small air-screen machine. *O.*

bracteosus was planted with *Lotus formosissimus*. Most of the transplants died and those that survived exhibited stunted growth and almost no seed production. Inclement weather (hail on the day of transplanting) and/or an inappropriate host could have contributed to the poor survival rate and low seed production of *O. bracteosus*.

Figure 3. *Castilleja tenuis* planted with *Downingia elegans* in seed increase plot at Corvallis PMC, May 26, 2008.

Some of the plants did not drop their seed. *Navarettia intertexta*, *Downingia elegans*, *Downingia yina*, and *Eryngium petiolatum* plants were cut out of the plots after all the plants had died, and were collected in large trash barrels. The plants were then fed into a large brush machine (each species was cleaned separately) equipped with a small mesh screen mantle. The brush machine opened the seed pods and separated the seeds from the larger pieces of plant material. The seed was cleaned using an air-screen machine.

A field plot of *Agoseris grandiflora* was established this year on weed fabric. Plants were vigorous and flowered profusely. When ripe, seed heads opened and were harvested individually by hand. Heads were harvested up to twice daily to prevent seeds from blowing away in the wind. Harvest extended from July 5th through September 5th. Seed collection for this species was very time consuming and somewhat inefficient as seeds were blown away by the wind.

Figure 4. Mature seed head of *Agoseris grandiflora* on weed fabric at Corvallis PMC, July 8, 2008.

V. Seed Increase Tubs

Some perennial species were maintained in tubs in the PMC shadehouse. Plants were monitored daily for disease and pests as well as seed maturity. Plantings were watered overhead as needed.

***Carex feta* (CAFE4)-** This tub was established with spring 2004-sown seedlings. In 2006, these plants were hearty and covered with flowering stems. In the fall of 2004, more CAFE plants were transplanted into an artificial pond at the PMC. These plants had a

100% survival rate and produced a moderate amount of seed. Seed heads were clipped just as they turned from green to yellow. Seeds shatter
when they still look green and immature. Seed from both tub planting and pond planting were combined. The planting in the pond is growing very well and produced the majority of this year's harvest.

***Carex tumulicola* (CATU3)-** This tub was established from cone-tainers seeded in 2003 that didn't germinate until spring of 2004. Seed heads were clipped when mature. When over 80% of seedheads were ripe at the same time, the entire tub was cut back and all the clippings were dried in a greenhouse on a tarp. Production was moderate.

***Carex vesicaria* (CAVE6)-** Seedlings that were sown in the spring of 2004 were used to establish this tub**.** Flowering in 2006 was fair, but no seed was produced. Seed production was better in 2007, but almost no seed was produced in 2008. There seemed to be much less filled seed than flowering. Most seed heads were empty.

Figure 5. *Carex vesicaria* seed increase tub at the Corvallis Plant Materials Center, July 1, 2007.

Dichanthelium acuminatum (DIAC)- A tub of plants was established in 2003. It flowered well in the summer of 2006. Seeds were collected by hand. A small plot was also planted into weed fabric. Seed production was good and seeds fell onto the weed fabric as they matured. Weed fabric was vacuumed twice in August with a hand-held vacuum. Seeds collected in the vacuum filter were emptied into collection bags. When flowering had subsided, seed was cleaned with an air-screen machine. This seed collection technique was very effective and efficient. The weed fabric plot yielded more seed than the tub because the weed fabric catches seeds as they mature and shatter.

***Gentiana sceptrum* (GESC)-** This tub was established from seedlings sown in winter of 2003. Plants were transplanted into the tub in late summer of 2004. Approximately 10 plants were also transplanted out into a field covered with plastic woven weed barrier. Field plants did not emerge in 2007. Plants in the tub flowered more, grew taller, and were more vigorous overall in previous years. Seeds were collected when capsules began to turn papery and tan. Some seed predation was exhibited in 2008.

Table 3. Recorded collection and cleaning times for seed increase tubs and plots.

Species	Harvest dates	Harvest time	Cleaning time	Amount of seed produced
Agoseris grandiflora	July 5- Sept 5	5 hours	1 hour	701 g
Carex feta	July 8- July 15	3 hours	30 min	490 g
Carex tumulicola	July 24	15 min	15 min	67 g
Castilleja tenuis	June 30- July 21	45 min	30 min	88 g
Carex vesicaria	July 25	15 min	15 min	<1 g
Cicendia quadrangularis	April 18- May31	3 hours	15 min	6 g
Downingia elegans	August 13	2 hours	2 hours	1.6 lbs
Downingia yina	July 25	2 hours	2 hours	1.5 lbs
Eleocharis obtusa	Jul 24 & Sept 15	2 hours	2 hours	1.2 lbs
Eryngium petiolatum	September 30	3 hours	2 hours	6.5 lbs
Galium trifidum	August 26	1 hour	1 hour	325 g
Gentiana sceptrum	Aug 26-Sept 12	2 hours	15 min	49 g
Gratiola ebracteata	May 29	15 min	30 min	109 g
Lasthenia glaberrima	May 5- July 8	4 hours	1 hour	1.4 lbs
Lotus formosissimus	July 10- Aug 11	3 hours	30 min	40 g
Lupinus bicolor	June 24- Aug 11	3 hours	30 min	2.5 lbs
Madia glomerata	Sept 16- Oct 13	15 min	15 min	22 g
Montia linearis	May 9- 22	2 hour	15 min	619 g
Navarretia intertexta	August 26	2 hours	2 hours	2.2 lbs
Nemophila menziesii	July 9- July 11	1 hour	30 min	20 g
Dichanthelium acuminatum	Aug 15- 26	1 hour	30 min	32 g
Orthocarpus bracteosus	June 30- July 14	15 min	5 min	1 g
Perideridia oregana	Aug 26- Oct 6	30 min	30 min	37 g
Phlox gracilis	June 20- July 29	2 hours	30 min	1.4 lbs
Pyrrocoma racemosa	Sept 5- Oct 28	30 min	1 hour	24 g
Ranunculus alismaefolia	June 13- July 1	30 min	5 min	19 g
Rorippa curvisiliqua	July 9- Aug 4	2 hours	1 hour	216 g
Saxifraga oregana	May 31- June 19	30 min	15 min	23 g
Sidalcea virgata	June 26- July 11	2 hours	30 min	1.9 lbs
Veronica peregrina	May 26- July 8	2 hours	1 hour	1 lbs
Veronica scutellata	July 10- Sept 12	30 min	1 hour	9 g

***Perideridia oregana* (PEOR6)-** This tub was established in 2003 from plants that were grown in 2002. A small plot was also planted into weed fabric in 2007. The weed fabric plot seems to be more vigorous and survival is higher. Entire umbels were cut from the stems when seeds turned grayish brown and felt dry and crumbly. Seeds were left in an open greenhouse to dry, then rubbed in a rubbing trough to break up seeds and stems. Seed was cleaned using an air-screen machine.

***Saxifraga oregana* (SAOR2)-** This tub was established in 2004. Plants flowered in early spring and seeds were collected by hand from May 31- June 19. Seed production increased this year, possibly due to later flowering and harvest dates.

***Eleocharis obtusa and Eleocharis palustris* (ELOB2), (ELPA3)-** This tub was established in 2008 from plants overwintered in 2007. ELPA and ELOB were planted in blocks next to each other in the same tub. The *Eleocharis obtusa* flowered profusely, was harvested July 24th, and then flowered again with the same vigor and was harvested on September 15th. The entire block was harvested by hand when at least half the seed heads exhibited ripe seeds that would disarticulate when touched. Seeds were dried in an open greenhouse, stripped from the heads in a large brush machine and then cleaned with a small air-screen machine. The *Eleocharis palustris* did not flower this year.

Figure 4. *Ranunculus alismaefolius* plants in the Corvallis Plant Materials Center shadehouse, June 16, 2008.

***Ranunculus alismaefolius* (RAAL)-** This tub was established in 2008 from plants overwintered in 2007. Plants flowered in the spring and seed was collected by hand from June 13th through July 1st. Seeds disarticulated from the seed head while still green. They were dried in an open greenhouse and cleaned by hand.

Additional 2008 Seed Increase Notes
Some species produced seed while they were in pots. *Pyrrocoma racemosa* plants were overwintered from 2006 and flowered profusely in 2007 and 2008. Seeds were collected by hand as they matured. Mouse predation of the seed heads was exhibited in 2008. *Gratiola ebracteata* flowered in their cone-tainers. Small battery-powered grass clippers were used to cut *G. ebracteata* like a mini- swather. Seeds were dried in an open greenhouse.

Mature *Cicendia quadrangularis* capsules were cut and placed in seed collection envelopes to dry. Seeds are tiny enough to slip out of paper bags. Capsules can be separated from the seed using handscreens.

The *Balsamorhiza deltoidea* was transplanted into the landscape and did not flower this year. The *Ludwigia palustris* did not overwinter; the plants failed to resprout and grow this spring.

VI. Plant Materials Delivery
Seed was requested for delivery in late August in order to be available for fall sowing on restoration sites. Some plantings were still producing seed at this time. Seeds from plantings that had completed seed production for the season were picked up by BLM staff

on August 22, 2008. All remaining seed lots are being stored at the PMC seed storage facilities until requested.

Table 4. Seed delivered to BLM staff in the fall of 2008.

Species	Amount of seed produced	Date delivered	Notes
Carex feta	1.7 lbs	22-Aug	
Carex tumulicola	67 g	22-Aug	
Castilleja tenuis	88 g	22-Aug	
Carex vesicaria	1 g	22-Aug	
Cicendia quadrangularis	6 g	22-Aug	
Dicanthelium acuminatum	136 g	22-Aug	Produced in 2006
Downingia elegans	1.6 lbs	22-Aug	
Downingia yina	1.5 lbs	22-Aug	
Eleocharis obtusa	35 g	22-Aug	Produced in 2007
Gratiola ebracteata	109 g	22-Aug	
Lasthenia glaberrima	1.4 lbs	22-Aug	
Lotus formosissimus	40 g	22-Aug	
Lupinus bicolor	2.5 lbs	22-Aug	
Madia glomerata	446 g	22-Aug	Produced in 2007
Montia linearis	1.4 lbs	22-Aug	
Nemophila menziesii	20 g	22-Aug	
Orthocarpus bracteosus	1 g	22-Aug	
Perideridia oregana	43 g	22-Aug	Produced in 2007
Phlox gracilis	1.4 lbs	22-Aug	
Pyrrocoma racemosa	38 g	22-Aug	Produced in 2007
Ranunculus alismaefolius	19 g	22-Aug	
Rorippa curvisiliqua	216 g	22-Aug	
Saxifraga oregana	23 g	22-Aug	
Sidalcea virgata	1.9 lbs	22-Aug	
Veronica peregrina	1.1 lbs	22-Aug	
Veronica scutellata	25 g	22-Aug	Produced in2007

Table 5. Seeds in storage at the Corvallis PMC.

Species	Weight	Year Produced
Agoseris grandiflora	1.5 lbs	2008
Dicanthelium acuminatum	32 g	2008
Eleocharis obtusa	552 g	2008
Eryngium petiolatum	6.5 lbs	2008
Galium trifidum	325 g	2008
Gentiana sceptrum	49 g	2008
Madia glomerata	22 g	2008
Navarretia intertexta	2.2 lbs	2008

Table 5. Seeds in storage at the Corvallis PMC

Species	**Weight**	**Year Produced**
Perideridia oregana	37 g	2008
Pyrrocoma racemosa	24 g	2008

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow
Jenny Freitag

December 30, 2009

THE 2009 BUREAU OF LAND MANAGEMENT ANNUAL REPORT:
WEST EUGENE WETLANDS

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into an agreement in the spring of 2002 with the Bureau of Land Management (BLM) to perform seed germination trials and seed increase of native wetland and wet prairie species. The West Eugene Wetlands (WEW) program has been collecting wild seed and sowing it in wetland restoration projects. Some species have been difficult to establish or have very high labor costs associated with hand collection. The PMC agreed to research and document seed propagation techniques for these species and to evaluate their potential for agronomic seed increase.

Figure 1. *Agoseris grandiflora* flowering in a weed fabric field at the Corvallis PMC, July 8, 2008.

In 2009, this agreement was renewed. Three species from previous agreements were discontinued. Seed increase was renewed on 35 of the species from the 2008 contract. This agreement will be amended and renewed through 2010.

Activities in 2009 included establishing and maintaining seed increase plantings, seed harvesting and seed cleaning.

II. Accessions Included in 2009 Agreement

Table 1. Accessions included in 2009 agreement with Eugene District of the BLM.

Species	Common name	Code	Accession #	Activity in 2009[1]
Agoseris grandiflora	bigflower agoseris	AGGR	9079571	sfp
Carex feta	greensheath sedge	CAFE4	9079315	sfp
Carex tumulicola	splitawn sedge	CATU3	9079291	sfp
Carex vesicaria	blister sedge	CAVE6	9079316	sfp
Castilleja tenuis	hairy Indian paintbrush	CATE26	9079254	pxn, sfp
Cicendia quadrangularis	Oregon timwort	CIQU3	9079254	pxn, sfp
Dichanthelium acuminatum	western panicgrass	DIACF	9079303	sfp
Deschampsia elongata	slender hairgrass	DEEL	9079375	sfp
Dodecatheon hendersonii	Henderson's shootingstar	DOHE	9079615	pxn
Downingia elegans	elegant calicoflower	DOEL	9079432	pxn, sfp
Downingia yina	Cascade calicoflower	DOYI	9079433	pxn, sfp
Eleocharis obtuse	blunt spikerush	ELOB2	9079434	sfp
Eleocharis palustris	common spikerush	ELPA3	9079435	sfp
Eryngium petiolatum	coyote thistle	ERPE	9079431	sfp
Galium trifidum	threepetal bedstraw	GATR2	9079317	pxn, sfp
Gentiana sceptrum	king's scepter gentian	GESC	9079311	sfp
Gratiola ebracteata	bractless hedgehyssop	GREB	9079436	pxn, sfp
Lasthenia glaberrima	smooth goldfields	LAGL3	9079293	pxn, sfp
Lotus formosissimus	seaside bird's-foot trefoil	LOFO2	9079294	pxn, sfp
Lupinus bicolor	miniature lupine	LUBI	9079250	pxn, sfp
Madia glomerata	mountain tarweed	MAGL	9079437	pxn, sfp
Montia linearis	narrowleaf minerslettuce	MOLI4	9079295	pxn, sfp
Myosotis laxa	bay forget-me-not	MYLA	9079253	pxn, sfp
Navarettia intertexta	needleleaf navarretia	NAIN2	9079378	pxn, sfp
Nemophila menziesii	baby blue eyes	NEME	9079379	pxn, sfp
Orthocarpus bracteosus	rosy owlclover	ORBR	9079502	pxn, sfp
Perideridia oregano	Oregon yampah	PEOR6	9079256	sfp
Phlox gracilis	slender phlox	PHGR	9079299	pxn, sfp
Pyrrocoma racemosa	clustered goldenweed	PYRA	9079496	sfp
Ranunculus alismaefolia	plantainleaf buttercup	RAAL	9079438	sfp
Rorippa curvisiliqua	curvepod yellowcress	ROCU	9079257	pxn, sfp

Table 1. Accessions included in 2009 agreement with Eugene District of the BLM (cont.).

Species	Common name	Code	Accession #	Activity in 2009[1]
Saxifraga oregano	Oregon saxifrage	SAOR2	9079296	sfp
Sidalcea virgata	showy wild hollyhock	SIVI	9079305	sfp
Veronica peregrine	neckweed	VEPE2	9097439	pxn, sfp
Veronica scutellata	skullcap speedwell	VESC2	9079440	sfp

1- sfp= seed increase, pxn= container production,

III. Germination Trials

Each of the species in this year's agreement has been successfully grown by the PMC in previous years. Treatments used to produce the plants for seed increase in 2009 are listed below.

Table 2. Plant production for the Eugene BLM WEW agreement at the Corvallis PMC in 2009.

Species	Amt used (g)	Number of cone-tainers produced	Treatment
Castilleja tenuis	1	400	90-days stratification, Heated greenhouse
Cicendia quadrangularis	1	500	Heated greenhouse
Downingia elegans	3	400	Heated greenhouse
Downingia yina	2	400	Heated greenhouse
Galium trifidum	1	100	Heated greenhouse
Gratiola ebracteata	2	500	Lathhouse
Lasthenia glaberrima	1	200	Heated greenhouse
Lupinus bicolor	29	400	Scarification/inoculation, Heated greenhouse
Madia glomerata	18	50	Heated greenhouse (80°F)
Montia linearis	2	300	Lathhouse
Myosotis laxa	5	400	Heated greenhouse
Navarretia intertexta	4	400	Lathhouse
Nemophila menziesii	11	400	Heated greenhouse
Orthocarpus bracteosus	1	400	90-days stratification
Phlox gracilis	4	400	Lathhouse
Rorippa curvisiliqua	2	300	Heated greenhouse
Veronica peregrina	1	200	Heated greenhouse

IV. Field Plantings

A *Sidalcea virgata* field planting was established in late spring of 2003. No weevils have been detected on any of the seed heads. Plants did not seem affected by changes in soil

environment due to the plastic woven weed barrier. Rodents have not damaged the plants, but some seeds were eaten.

Seed was collected twice (June 16 and June 26th) by hand-stripping mature seeds and by sweeping up ones that had shattered onto the ground cover. Collections were efficient and relatively little seed was lost. *S. virgata* racemes are less upright than other *Sidalceas*, which caused the seed to fall directly on the ground cover instead of on the plants' crown. The ground cover is a considerable aid in seed collection for the species and does not seem to be detrimental to plant growth or development. Ground cover needs to be cut back from the crowns of the *Sidalceas* as they expand. Harvested seed was collected in bags, dried in an open greenhouse and then placed in a small brush machine containing a scarifier (sandpaper) drum. Seed was further cleaned using an air screen machine.

Seed increase of many annual species was performed this year using weed fabric techniques. Two 15' X 170' sheets of weed fabric were stapled down onto a field that had been previously sprayed with glyphosate herbicide. Small squares were cut out of the weed fabric in order to transplant the cone-tainer plants. The squares were cut slightly larger than the size of the cones. The weed fabric is reused from year to year, and it is necessary to periodically move the site to a fresh field due to compaction and nutrient loss. The plot was moved this year and all of the annual species were moved with it. The perennials, *Lotus formosissimus* and *Eryngium petiolatum*, were left for one more year in the old plot location.

Shortly after all the annual species had been transplanted into the new field, 9 of the 13 began to decline simultaneously (*Montia linearis*, *Rorippa curvisiliqua*, *Myosotis laxa*, *Lupinus bicolor*, *Lasthenia glaberrima*, *Nemophila menziesii*, *Veronica peregrina*, *Madia glomerata*, and *Galium trifidum*). Three of those plots died out completely (*M. linearis*, *N. menziesii* and *R. curvisiliqua*) and the remaining 6 died out almost completely or the plants remained in a very weakened state. Smaller than usual harvests were collected from those 6 species. It is not known with certainty what caused the death in these 9 plots; damage from residual herbicide in the soil or as aerial drift was suspected. Cold damage was also suggested as a possible cause. Four species, *Phlox gracilis*, *Navarretia intertexta*, *Downingia elegans* and *Downingia yina* had close

Figure 2. *Downyngia elegans* flowers in seed increase plot at the Corvallis PMC, August, 2009.

to 100% survival, flowered, and produced seed. The *N. intertexta* and *P. gracilis* did at times exhibit irregular growth which may have been caused by the damage, but their seed production did not seem to be affected. Small, battery-powered hand vacuums were used to collect seed of *V. peregrina, L. glaberrima, P. gracilis, L. bicolor* ,and *L. formosissimus*. Twice a week, the weed fabric in the planting was vacuumed and the material placed in bags in an open greenhouse to dry.

Figure 3. *Navarretia intertexta* in seed increase plot at Corvallis PMC, August 2009.

The perennial plot of *Veronica scutellata* did not reemerge this year. The perennial plot of *L. formosissimus*, in its second year in the field, produced more than the previous year. Seed collection was more efficient this year: a rubber hose filled with water encircled the plot and prohibited many seeds from being blown off the weed fabric; the plants were larger and the seeds were caught by the foliage rather than being blown away.

The plot of *G. trifidum* was harvested once. Seeds were held on the fabric by the spreading stems. The plot was vacuumed only when the plants had stopped producing seed; entire plants were removed and fed into a large brush machine.

The plots of *M. glomerata* and *R. curvisiliqua* both failed in the new field. However, a small number of *R. curvisiliqua* and a large number of *M. glomerata* volunteered from second generation seed in the aisles of the old plot. After receiving permission from the Eugene BLM, we decided to treat the volunteers as our crop. The aisles were weeded and the plants were thinned so as to increase their productivity. The *R. curvisiliqua* plants were harvested once; the entire plant was cut and laid to dry in an open greenhouse. Plants were then fed through a small brush machine, followed by a small air-screen machine. Almost as much seed was produced this year as last year. The *M. glomerata* plants were harvested once; the entire plant was cut and laid to dry in an open greenhouse. Whole plants were fed through a hammermill and then the seeds were cleaned with a small air-screen machine. More seed was produced this year than in the past several years.

Experiments were performed on the *Castilleja tenuis* and *Orthocarpus bracteosus* crops this year. Last year, both species were planted into weed fabric fields with a host. There was low transplant survival in the plots and the seed harvest was time-consuming and inefficient. This year the plants were grown in several different conditions: cone-tainers in the greenhouse with no host; potted with a host (*Viola adunca*, *Eriophyllum lanatum*, or *Pyrrocoma racemosa*); and planted into bare soil tilled and untilled with a host (*Achillea millefolium* or various vegetable plants). The cone-tainers in the greenhouse grew, flowered well, set seed and were very easy to harvest. Those that were potted up with a host had variable growth. A few grew large and branched, but the majority were of a size comparable to the plants which had been left in cone-tainers. The plants transplanted into bare soil also had variable growth. Those in the tilled ground were watered by drip irrigation and many grew very bushy, especially those that were pruned. While some of these produced an abundance of seed, they were difficult to harvest because the seed ripening was extremely varied and the plants were difficult to find amidst the vegetables. Those planted into untilled ground died from irregular watering. Next year all production will be done in cone-tainers in the greenhouse. This method was the least time-consuming and more of the seed was recovered due to ease of monitoring. Experiments will be performed with pruning to stimulate branching.

Some of the plants did not drop their seed. *N. intertexta*, *D. elegans*, *D. yina*, and *E. petiolatum* were cut out of the plots after all the plants died, and were collected into large trash barrels. The plants were then fed through a large brush machine (each species was cleaned separately) equipped with a small mesh screen mantle. The brush machine opened the seed pods and separated the seeds from the larger pieces of plant material. The seed was cleaned using an air-screen machine.

Figure 4. Field of *Agoseris grandiflora* with mature seed heads at Corvallis PMC, July 2009.

The field plot of *Agoseris grandiflora* was vigorous and flowered profusely again this year. When ripe, seed heads opened and were harvested individually by hand. Heads were harvested up to twice daily to prevent seeds from blowing away in the wind. Harvest extended from June 24th through July 20th. Although harvest was easier this year due to more uniform ripening, seed collection for this species was very time consuming and somewhat inefficient as

seeds were blown away by the wind. The plot will be moved next year to a more convenient location and will possibly be surrounded by a wind fence to protect the seed heads. It was suspected that this species might be a biennial, but the majority of the plot reemerged in the winter following late summer dormancy.

In the spring of 2008 a small field of *Deschampsia elongata* was established using a precision cone seeder. As is normal for this species, it did not flower until its second summer in the field, 2009. The seeds ripened unevenly, with the outside edges maturing first, and because the seed shatters quickly the field was harvested in sections. The outside rows were harvested using a seed-stripper on June 11th, and the remainder of the field was harvested on June 18th.

Figure 5. Field of *Deschampsia elongata* at Corvallis PMC, June 2009.

Seeds were dried in an open shed and then fed through a brush machine and an air-screen machine. On the PMC farm *D. elongata* typically flowers the second year and then declines sharply, so it is not expected to produce next year.

V. Seed Increase Tubs

Some perennial species were maintained in tubs in the PMC shadehouse. Plants were monitored daily for disease and pests as well as seed maturity. Plantings were watered overhead as needed.

***Carex feta* (CAFE4)-** This tub was established with seedlings sown in the spring of 2004. In 2006, these plants were hearty and covered with flowering stems. In the fall of 2004, more *Carex feta* plants were transplanted into an artificial pond at the PMC. These plants had a 100% survival rate and produced a moderate amount of seed. Seed heads were clipped just as they turned from green to yellow. Seeds shatter when they still look green and immature. Seed from both the tub planting and pond planting were combined. The planting in the pond suffered heavy losses this year. The pond remained flooded through mid-May. As the plants began to emerge and grow in the spring the majority of them died. The remainder was harvested this year, but the yield was low. Next year the plot will be reestablished in another pond.

***Carex tumulicola* (CATU3)-** This tub was established from cone-tainers seeded in 2003 that didn't germinate until spring of 2004. Seed heads were clipped when mature. When

over 80% of seedheads were ripe at the same time, the entire tub was cut back and all the clippings were dried in a greenhouse on a tarp. Production was moderate.

***Carex vesicaria* (CAVE6)-** Seedlings that were sown in the spring of 2004 were used to establish this tub**.** Flowering in 2006 was fair, but no seed was produced. Seed production was better in 2007, but almost no seed was produced in 2008. Such a small amount of seed was produced in 2009 that it was not harvested. Most seed heads were empty.

Dichanthelium acuminatum (DIAC)- A small plot was planted into weed fabric. Seed production was good and seeds fell onto the weed fabric as they matured. Some seed was lost this year because it was blown off the fabric by wind. Weed fabric was vacuumed twice in August with a hand-held vacuum. Seeds collected in the vacuum filter were emptied into collection bags. When flowering had subsided, seed was cleaned with an air-screen machine. This seed collection technique was very effective and efficient. The weed fabric plot yielded more seed than the tub because the weed fabric catches seeds as they shatter. The tub that was established in 2003 was discontinued this year. Yields were low; the seed was difficult to collect because it fell into the tub.

***Gentiana sceptrum* (GESC)-** This tub was established from seedlings sown in winter of 2003. Plants were transplanted into the tub in late summer of 2004. Approximately 10 plants were also transplanted out into a field covered with a plastic woven weed barrier. Field plants did not emerge in 2007. Seeds from the tub were collected when capsules began to turn papery and tan. Some seed predation has been exhibited for the past several years, but not enough to seriously affect the harvest.

Table 3. Recorded collection and cleaning times for seed increase tubs and plots.

Species	Harvest dates	Harvest time	Cleaning time	Amount of seed produced
Agoseris grandiflora	June 24- July 20	5 hours	1 hour	795 g
Carex feta	July 8- July 15	1.5 hours	30 min	117 g
Carex tumulicola	July 6	15 min	15 min	34 g
Castilleja tenuis	June 9- Sept 1	45 min	30 min	57 g
Cicendia quadrangularis	May 13 - May31	1 hour	15 min	30 g
Deschampsia elongata	Jun 11 & Jun 18	30 min	2 hours	11 lbs
Downingia elegans	August 31	2 hours	2 hours	667 g
Downingia yina	August 31	2 hours	2 hours	783 g
Eleocharis obtusa	Jul 24 & Sept 21	1 hours	2 hours	672 g
Eleocharis palustris	July 15	15 min	1 hour	4 g
Eryngium petiolatum	September 14	2 hours	2 hours	3.15 lbs
Galium trifidum	Spetember 28	1 hour	1 hour	61 g
Gentiana sceptrum	Aug 24-Sept 14	2 hours	45 min	45 g
Gratiola ebracteata	May 13	15 min	30 min	45 g
Lasthenia glaberrima	June 9- July 20	3 hours	1 hour	81 g

Lotus formosissimus	June 16 – July 7	5 hours	1 hour	152 g
Lupinus bicolor	June 30- July 24	2 hours	30 min	266 g

Table 3. Recorded collection and cleaning times for seed increase tubs and plots (cont).

Species	Harvest dates	Harvest time	Cleaning time	Amount of seed produced
Madia glomerata	Oct 12	4 hours	4 hours	4.5 lbs
Navarretia intertexta	August 24	2 hours	2 hours	4.5 lbs
Dichanthelium acuminatum	Aug 15- 26	1 hour	1 hour	48 g
Orthocarpus bracteosus	June 13- Sept 1	1 hour	15 min	20 g
Perideridia oregana	Sept 24- Oct 6	30 min	30 min	73 g
Phlox gracilis	June 25- July 6	2 hours	1.5 hours	4.7 lbs
Pyrrocoma racemosa	Aug 31- Sept 28	30 min	1 hour	49 g
Ranunculus alismaefolia	June 13- June 29	30 min	5 min	1 g
Rorippa curvisiliqua	July 1	1 hour	1 hour	206 g
Saxifraga oregana	June 3- June 9	30 min	15 min	27 g
Sidalcea virgata	June 16- June 26	2 hours	1 hour	481 g
Veronica peregrina	June 17- July 20	2 hours	1 hour	314 g

***Perideridia oregana* (PEOR6)-** This tub was established in 2003 from plants that were grown in 2002. A small plot was also planted into weed fabric in 2007. The weed fabric plot seems to be more vigorous and survival is higher. Entire umbels were cut from the stems when seeds turned grayish brown and felt dry and crumbly. Seeds were left in an open greenhouse to dry, then run through a small brush machine to break up seeds and stems. Seed was cleaned using an air-screen machine.

***Saxifraga oregana* (SAOR2)-** This tub was established in 2004. Plants flowered in early spring and seeds were collected by hand from June 3 through June 9. Seed production increased this year, possibly due to later flowering and harvest dates.

***Eleocharis obtusa and Eleocharis palustris* (ELOB2), (ELPA3)-** This tub was established in 2008 from plants overwintered in 2007. ELPA and ELOB were planted in blocks next to each other in the same tub. The *Eleocharis obtusa* flowered profusely, was harvested in July and then flowered again with the same vigor and was harvested in September. The entire block was harvested by hand when at least half the seed heads exhibited ripe seeds that would disarticulate when touched. The timing of harvest for this crop is difficult: when the earliest seeds begin to disarticulate, most of the heads are still flowering. Each head does not mature

Figure 6. *Elocharis obtusa* heads simultaneously flowering and disarticulating mature seed in seed increase tub at the Corvallis Plant Materials Center, July 2009

evenly, so the bottom seeds of a particular head will be disarticulating while the top is still flowering. Seeds were dried in an open greenhouse, stripped from the heads in a large brush machine and then cleaned with a small air-screen machine. The *Eleocharis palustris* flowered for the first time this year and seeds were harvested in July. The plants were very healthy and dense, but only four grams of seed was produced; the majority of the tub was filled with vegetative growth.

***Ranunculus alismaefolius* (RAAL)-** This tub was established in 2008 from plants overwintered in 2007. In 2009, only about one quarter of the plants emerged in the spring. Flowering and seed set was very poor. Plants flowered in the spring and seed was collected by hand from June 13th through June 29th. Seeds disarticulated from the seed head while still green. They were dried in an open greenhouse and cleaned by hand.

Additional 2009 Seed Increase Notes

Some species produced seed while they were in pots. *Pyrrocoma racemosa* plants were overwintered from 2006 and have flowered profusely every year.
Seeds were collected by hand as they matured. Mouse predation of the seed heads was observed in 2008, but not in 2009. *Gratiola ebracteata* flowered in their cone-tainers. Small battery-powered grass clippers were used to cut *G. ebracteata* like a mini-swather. Seeds were dried in an open greenhouse.

Mature *Cicendia quadrangularis* capsules were cut and placed in seed collection envelopes to dry. The seeds are tiny enough to slip out of the corners, so the envelopes were reinforced with tape. Capsules can be separated from the seed using handscreens.

VI. Plant Materials Delivery

Seed was requested for delivery in late September in order to be available for fall sowing on restoration sites. Some plantings were still producing seed at this time. Seeds from plantings that had completed seed production for the season were picked up by BLM staff on September 21, 2009. All remaining seed lots are being stored at the PMC seed storage facilities until requested.

Table 4. Seed delivered to BLM staff in the fall of 2009.

Species	Amount of seed produced	Date delivered	Notes
Agoseris grandiflora	701 g	21-Sept	Produced in 2008
Agoseris grandiflora	795 g	21-Sept	
Carex feta	117 g	21-Sept	
Carex tumulicola	34 g	21-Sept	
Castilleja tenuis	57 g	21-Sept	
Carex vesicaria	1 g	21-Sept	
Cicendia quadrangularis	30 g	21-Sept	
Deschampsia elongata	11 lbs	21-Sept	

Table 4. Seed delivered to BLM staff in the fall of 2009 (cont).

Species	Amount of seed produced	Date delivered	Notes
Dicanthelium acuminatum	32 g	21-Sept	Produced in 2008
Dicanthelium acuminatum	48 g	21-Sept	
Downingia elegans	667 g	21-Sept	
Downingia yina	783 g	21-Sept	
Eleocharis obtusa	552 g	21-Sept	Produced in 2008
Eleocharis palustris	4 g	21-Sept	
Eryngium petiolatum	6.5 lbs	21-Sept	Produced in 2008
Eryngium petiolatum	3.2 lbs	21-Sept	
Galium trifidum	325 g	21-Sept	Produced in 2008
Gentiana sceptrum	49 g	21-Sept	Produced in 2008
Gentiana sceptrum	45 g	21-Sept	
Gratiola ebracteata	45 g	21-Sept	
Lasthenia glaberrima	81 g	21-Sept	
Lotus formosissimus	152 g	21-Sept	
Lupinus bicolor	266 g	21-Sept	
Madia glomerata	22 g	21-Sept	Produced in 2008
Navarretia intertexta	2.2 lbs	21-Sept	Produced in 2008
Navarretia intertexta	4.5 lbs	21-Sept	
Orthocarpus bracteosus	20 g	21-Sept	
Perideridia oregana	37 g	21-Sept	Produced in 2008
Phlox gracilis	4.7 lbs	21-Sept	
Pyrrocoma racemosa	24 g	21-Sept	Produced in 2008
Ranunculus alismaefolius	1 g	21-Sept	
Rorippa curvisiliqua	206 g	21-Sept	
Saxifraga oregana	27 g	21-Sept	
Sidalcea virgata	481 g	21-Sept	
Veronica peregrina	314 g	21-Sept	

Table 5. Seeds in storage at the Corvallis PMC.

Species	Weight	Year Produced
Eleocharis obtusa	672 g	2009
Galium trifidum	61 g	2009
Madia glomerata	4.5 lbs	2009
Perideridia oregana	73 g	2009
Pyrrocoma racemosa	49 g	2009

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

November 30, 2008

THE 2008 BUREAU OF LAND MANAGEMENT ANNUAL REPORT:
Medford District

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the Medford District of the Bureau of Land Management (BLM) in 2004 to provide native plant materials for ecological restoration. The agreement was continued in 2008. It was agreed that the PMC would maintain seed increase fields of two grasses, one legume, and six forbs; and continue germination trials and containerized production of two forbs

Figure 1. *Poa secunda* seed increase field, Corvallis Plant Materials Center, June 12, 2007.

II. Accessions Involved

Accessions included for the Medford District BLM in 2008 are listed in Table 1. This table also displays activities performed by PMC staff.

Table 1. Accessions involved for Medford District BLM cooperative agreement with Corvallis Plant Materials Center in 2008.

Species	Common name	Code	Accession #	Activity in 2008[1]
Achnatherum lemmonii	Lemmon's needlegrass	ACLE8	9079398	sfp
Clarkia rhomboidea	diamond clarkia	CLRH	9079595	sfp
Eriogonum umbellatum	sulfur-flowered buckwheat	ERUM	9079425	sfp
Festuca roemerii	Roemer's fescue	FERO	9079395	sfp
Iris douglasiana	Douglas Iris	IRDO	9079417	trl, pxn
Lupinus adsurgens	Drew's silky lupine	LUAD	9079426	sfp
Penstemon roezlii	Roezl's penstemon	PERO12	9079419	pxn, sfp
Poa secunda	Sandberg blue grass	POSE	9079394	sfp
Polemonium carneum	royal Jaccob's ladder	POCA4	9079424	pxn
Potentilla glandulosa	sticky cinquefoil	POGL9	9079427	pxn, sfp
Rupertia physoides	forest scurf peas	RUPH3	9079323	pxn
Sisyrincium bellum	western blue-eyed grass	SIBE	9079420	trl, pxn, sfp
Tritilia hyacinthina	white hyacinth	TRHY3	9079421	pxn

1- sfp= seed increase, trl= germination research trials, pxn=plant production, dlv=plant materials delivery

III. Experimental Propagation

Germination trials were preformed on *Iris douglasiana* in the winter of 2008. Sets of 100 seeds were counted and placed in plastic germination boxes with moistened germination paper. Three replications were made for each of the four treatments. Boxes that needed cold-moist (c/m) stratification were placed in walk in cooler with an average temperature of 35 degrees (F). Frozen treatments were placed in the freezer compartment of a refrigerator with an average temperature of 30 degrees (F). After being removed from stratification or freezing, boxes were moved to lab and remained at room temperature. Boxes were checked weekly for germination for six weeks.

Table 2. Iris douglasiana germination trial at the PMC in 2008.

Treatment	Average germination per treatment
3 months cold moist stratification	7%
1 week frozen + 3 months c/m stratification	7%
2 months frozen+ 1 month c/m stratification	1%
Alternating weeks of frozen and c/m stratification for 3 months.	0%

IV. Field Seed Increase

Field notes 2008:
Weed control in the forb and legume seed increase fields was performed mainly by hand weeding and rouging. Borders were cultivated. Most fields were spot-sprayed with glyphosate using a shielded backpack sprayer to control exotic bentgrasses and other rhizomatous weeds. The two grass fields were sprayed with Banvel in the spring to control broadleaf weeds and were fertilized in October 2007 with 25 lbs/ac nitrogen (N) and in February 2008 with 50 lbs/ac N plus 15 lbs/ac sulfur (S). Grass fields were burned using drip torches following harvest. In mid October, Outlook (a non-selective pre-emergent herbicide) was applied to the grass fields.

Figure 2. Field burning at the PMC. Burning reduces thatch, stimulates new growth, and helps reduce pests and diseases.

The PMC did not establish any new fields from seed in 2008. The existing *Poa secunda* field was burned in the fall of 2007 and a pre-emergent herbicide, Outlook, was applied. Once the fall rains began the field greened up and grew nicely. Outlook provided excellent control of annual grass weeds. This field flowered heavily in May and produced an amazing amount of seed despite very cool May and June temperatures.

The *Eriogonum umbellatum* plants flowered heartily in 2008. *Penstemon roezlii* plants flowered and set seed this year, but were less vigorous than in 2007. The *Potentilla glandulosa* field was expanded in 2008 with transplants that were grown in 2007. Only the established plants flowered in 2008. *Lupinus adsurgens* did not perform as well this year as it did last year. Some plants did not emerge in the spring and overall flowering seemed to be reduced from last year. Plots of *Sisyrinchium bellum* and *Iris douglasiana*

were established in March of 2008 using transplants that were grown in 2007. The iris did not flower, but the *S. bellum* did. All of these small forb plots were hand harvested multiple times during the harvest season.

Table 3. Yields from seed increase fields at the Corvallis Plant Materials Center in 2008.

Species	Accession #	Harvest date	Method	Field size	Yield
Achnatherum lemmonii	9079398	6/23	hand	< 0.1	180 g
Eriogonum umbellatum	9079425	7/7-7/11	hand	<0.1	8 lbs
Festuca roemerii	9079395	7/3	seed stripper	0.25	45
Lupinus adsurgens	9079426	7/15	hand	<0.1	225 g
Penstemon roezlii	9079419	9/25	hand	<0.1	0.5
Poa secunda	9079394	6/18	seed stripper	0.35	n/a
Polemonium carneum	9079424		hand	n/a	5g
Potentilla glandulosa	9079427	7/3-7/9	hand	<0.1	295 g
Sisyrinchium bellum	9079420	626-7/7	hand	<0.1	65 g

A new field of *Clarkia rhomboidea* was sown in the fall of 2008. A 0.02 acre field was sown using a cone-seeder. The sowing rate was approximately 4.5lbs/acre. Seedlings appeared within three weeks of sowing and remained very small throughout the winter.

V. Container Plant Production.

Containers of *Polemonium carneum* were kept in the PMC shadehouse throughout the growing season. They flowered and a minimal amount of seed was collected from them.

In the fall of 2008, containers of *Rupertia physoides* and *L. adsurgens* were sown. These plants will be used to create new, larger fields of the legumes in March of 2009.

Table 4. Containerized plant production at the Corvallis PMC in 2007 for the BLM Medford District.

Species			Amt of seed used	# of Containers grown	pre-planting treatment
Lupinus adsurgens	LUAD	9079426	40 g	1470	scarified + innoculant
Rupertia physoides	RUPH3	9079323	35 g	1470	lightly scarified

VI. Delivery of Plant Materials

Doug Kendig visited the PMC on September 26, 2008 and picked up many older, large seed lots that had been stored in the PMC seed storage facilities.

Table 5. Seed picked up by BLM staff on September 26, 2008

Species	Code	Origin	Seed lot	Weight
Eriogonum umbellatum	ERUM	Grizzely Peak	SG1-07-MB425	2.7 lbs
Eriogonum umbellatum	ERUM	Grizzely Peak	SG1-08-MB425	8.3 lbs
Penstemon roezlii	PERO	Box O	SG1-07-MB419	8 lbs
Bromus lavipes	BRLA	Sprignette Butte	SG1-06-MB396	22 lbs
Poa secunda	POSC	Hyatt lake	SG1-07-MB394	16 lbs
Festuca roemerii	FERO	Round top	SG1-07-MB395	9.5 lbs
Bromus carinatus	BRCA	Pleasant	SG1-05-MB397	6.5 lbs
Festuca californica	FECA	Anatuvak	SG1-06-MB399	34 lbs

Some seed still remains at the PMC and will stored in the seed cooler until requested by the BLM.

Table 6. Current seed in storage at Corvallis Plant Materials Center, November 30, 2008.

				Seed in storage	
Scientific Name	**Code**	**Accession #**	**Origin**	**Produced by PMC**	**Provided by BLM**
Lupinus albifrons	**LUAL4**	9079322	Sprignette Butte	29 g	
Rupertia physoides	**RUPH3**	9079323	E Evans Creek	3 lb	
Lomatium macrocarpum	**LOMA3**	9079325	Pelton Rd		129 g
Festuca romerii	**FERO**	9079326	Indigo Creek	339 g	
Melica harfordii	**MEHA2**	9079328	Flat cr	6 lbs	
Xerophyllum tenax	**XETE**	9079385	35-9-11 Biscuit		226 g
Scirpus microcarpus	**SCMI2**	9079386	Parsnip lakes		33 g
Juncus tenuis	**JUTE**	9079388	Obenchain Rd	1 g	13 g
Cimicifuga elata	**CIEL**	9079390	Grizzley Mt		14 g
Darlingtonia californica	**DACA5**	9079391	Biscuit fire		6 g
Poa secunda	**POSE**	9079394	Hyatt lake	100 lbs (est)	
Festuca roemerii	**FERO**	9079395	Round top	45 lbs	803 g
Bromus lavipes	**BRLA3**	9079396	Sprignette Butte		64 g
Achnatherum lemmonii	**ACLE8**	9079398	Granite	48 g	
Festuca californica	**FECA**	9079399	Anatuvak		836 g
Iris douglasiana	**IRDO**	9079417	Box O		72 g
Juncus ensifolius	**JUEN**	9079418	Box O		2 g
Penstemon roezlii	**PERO12**	9079419	Box O	283 g	1 g
Sisyrincium bellum	**SIBE**	9079420	Box O	65g	8 g

Tritilia hyacinthina	**TRHY3**	9079421	Box O		8 g
Festuca elmeri	**FEEL2**	9079422	Gall's Creek	24 g	21 g
Polemonium carneum	**POCA4**	9079424	Grizzley Peak	5g	1 g
Eriogonum umbellatum	**ERUM**	9079425	Grizzely Peak		5 g
Lupinus adsurgens	**LUAD**	9079426	I-5 Merlin Exit	2.5 lbs	
Potentilla glandulosa	**POGL9**	9079427	Soda Mt	320g	1 g

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

January 30, 2010

THE 2009 BUREAU OF LAND MANAGEMENT ANNUAL REPORT:
Medford District

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the Medford District of the Bureau of Land Management (BLM) in 2004 to provide native plant materials for ecological restoration. The agreement was continued in 2009. It was agreed that the PMC would maintain seed increase fields of one grass, two legumes, and five forbs.

Figure 1. Diamond clarkia (*Clarkia rhomboidea)* seed increase field, Corvallis Plant Materials Center, June 12, 2009.

II. Accessions Involved

Accessions included for the Medford District BLM in 2009 are listed in Table 1. This table also displays activities performed by PMC staff.

Table 1. Accessions involved for Medford District BLM cooperative agreement with Corvallis Plant Materials Center in 2009.

Species	Common name	Code	Accession #	Activity in 2009[1]
Clarkia rhomboidea	diamond clarkia	CLRH	9079595	sfp
Eriogonum umbellatum	sulfur-flowered buckwheat	ERUM	9079425	sfp
Iris douglasiana	Douglas iris	IRDO	9079417	sfp
Lupinus adsurgens	Drew's silky lupine	LUAD	9079426	pxn,sfp
Poa secunda	Sandberg blue grass	POSE	9079394	sfp
Polemonium carneum	royal Jacob's ladder	POCA4	9079424	pxn
Potentilla glandulosa	sticky cinquefoil	POGL9	9079427	pxn, sfp
Rupertia physoides	forest scurf peas	RUPH3	9079323	pxn, sfp
Sisyrinchium bellum	western blue-eyed grass	SIBE	9079420	pxn, sfp
Tritilia hyacinthina	white hyacinth	TRHY3	9079421	sfp

1- sfp= seed increase, trl= germination research trials, pxn=plant production, dlv=plant materials delivery

III. Experimental Propagation

There was no experimental propagation this year for this project.

IV. Field Seed Increase

Container plants of *L. adsugens* and *R. physoides* that were grown in the winter of 2008/2009 were transplanted out into fields that had been covered with weed fabric in early March. Some of the lupines did not thrive after transplanting. It was not known if the plants died or went dormant. Holes in the weed fabric that do not have a plant in them will be sown with new seed in the spring of 2010. The *R. physoides* plants seemed slow to grow, but had a flush of new growth in the fall before going dormant. A few lupines flowered late in the year, but no seed was harvested. None of the *R. physoides* flowered, however, both fields should flower in 2010.

Field notes 2009:
Weed control in the forb and legume seed increase fields was performed mainly by hand weeding and roguing. Borders were cultivated. Most fields were spot-sprayed with glyphosate using a shielded backpack sprayer to control exotic bentgrasses and other rhizomatous weeds. The two grass fields were sprayed with Banvel in the spring to control broadleaf weeds and were fertilized in October 2008 with 25 lbs/ac nitrogen (N) and in February 2009 with 50 lbs/ac N plus 15 lbs/ac sulfur (S).

The *Poa secunda* field was very thick this year and the seed stripper was very effective at harvesting the seed. This field was taken out in the fall of 2009 because it was no longer needed.

Figure 2. Sticky cinquefoil (*Potentilla glanduosa*) seed increase field at the Corvallis Plant Materials Center, May 25, 2009.

The *Eriogonum umbellatum* plants flowered heartily in 2009. This field is over six years old and shows no sign of decline. The *Penstemon roezlii* plot finally had to be retired. It was also six years old and was showing signs of decline in 2008. The field was taken out in the spring of 2009. The *Potentilla glandulosa* field was expanded in 2008 with transplants that were grown in 2007. Both sectons of the fields flowered in 2009. Plots of *Sisyrinchium bellum* and *Iris douglasiana* were established in March of 2008 using transplants that were grown in 2007. The iris still did not flower in 2009, but the *S. bellum* did. Each of these small forb plots were hand harvested multiple times during the harvest season.

Table 3. Yields from seed increase fields at the Corvallis Plant Materials Center in 2009.

Species	Accession #	Harvest date	Method	Field size	Yield
Eriogonum umbellatum	9079425	July 9	seed stripper	<0.1	3.5
Poa secunda	9079394	June 15	seed stripper	0.35	108
Potentilla glandulosa	9079427	July 2	hand	<0.1	3 lbs
Sisyrinchium bellum	9079420	June 22	hand	<0.1	0.5 lbs
Clarkia rhomboidea	9079595	Aug 3	combine	<0.1	5.5

Figure3. Blue-eyed grass (*Sisyrinchium bellum*) seed increase field at the Corvallis Plant Materials Center, May 22, 2009.

A new field of *Clarkia rhomboidea* was sown in the fall of 2008. A 0.02 acre field was sown using a cone-seeder. The sowing rate was approximately 4.5lbs/acre. Seedlings appeared within three weeks of sowing and remained very small throughout the winter. The plot was weeded by hand twice during the spring and summer. This annual is hearty, easy to grow and free of pests and diseases. The seed maturity was relatively uniform, so the PMC staff decided to try direct combining the plot. BLM staff came up to watch the combining and tour the farm. The combining worked very well, however, the material was very wet and coated the inside of the combine. A fair amount of seed also stuck to the wet areas of the combine. It took many hours of scraping to remove all the clarkia seed and material from the belts, screens, and concave of the combine. It may have been easier to clean the combine using a powerwasher before the plant material had time to dry. This species has a lot of potential for seed increase, and should be considered for large growouts.

V. Container Plant Production.
Containers of *Polemonium carneum* were kept in the PMC shadehouse throughout the growing season. They flowered and a minimal amount of seed was collected from them.

VI. Delivery of Plant Materials

Doug Kendig visited the PMC on August 3, 2009 and picked up a four seed lots that had been stored in the PMC seed storage facilities.

Table 5. Seed picked up by BLM staff on August 3, 2009

Species	Code	Origin	Seed lot	Weight
Festuca roemerii	**FERO**	Roundtop	SCO-08-MB395	45 lbs
Festuca californica	**FECA**	Cabin Creek	SCO-05-MB327	7 lbs
Melica harfordii	**MEHA2**	Flat cr	SCO-06-MB328	6 lbs
Poa secunda	**POSE**	Hyatt lake	SCO-08-MB394	26 lbs

Some seed still remains at the PMC and will stored in the seed cooler until requested by the BLM. Our seed lot numbers describe the generation of the field (SG0 or SWC is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed, SCO indicates that we don't know the generation of seed that we initially recieved). The middle numbers of a seed lot notes which year the seed was produced in. The last portion of the seed lot describes which project the seed is for (MB is for Medford BLM) and the last three digits of the accession number that has been assigned to this species specifically for this project.

Table 6. Current seed in storage at Corvallis Plant Materials Center, December 30, 2009.

				Seed in storage	
Scientific Name	**Code**	**Accession #**	**Origin**	**Produced by PMC**	**Provided by BLM**
Lupinus albifrons	**LUAL4**	9079322	Sprignette Butte	29 g	
Rupertia physoides	**RUPH3**	9079323	E Evans Creek	0.5 lbs	
Lomatium macrocarpum	**LOMA3**	9079325	Pelton Rd		129 g
Festuca romerii	**FERO**	9079326	Indigo Creek	339 g	
Scirpus microcarpus	**SCMI2**	9079386	Parsnip lakes		226 g
Juncus tenuis	**JUTE**	9079388	Obenchain Rd	1 g	33 g
Cimicifuga elata	**CIEL**	9079390	Grizzley Mt		13 g
Darlingtonia californica	**DACA5**	9079391	Biscuit fire		14 g
Poa secunda	**POSE**	9079394	Hyatt lake	269 lbs	6 g
Achnatherum lemmonii	**ACLE8**	9079398	Granite	48 g	803 g
Festuca californica	**FECA**	9079399	Anatuvak		64 g
Juncus ensifolius	**JUEN**	9079418	Box O		836 g

Penstemon roezlii	**PERO12**	9079419	Box O	1 lb	72 g
Sisyrinchium bellum	**SIBE**	9079420	Box O	0.5 lbs	2 g
Tritilia hyacinthina	**TRHY3**	9079421	Box O		1 g
Festuca elmeri	**FEEL2**	9079422	Gall's Creek	24 g	8 g
Polemonium carneum	**POCA4**	9079424	Grizzley Peak		8 g
Eriogonum umbellatum	**ERUM**	9079425	Grizzely Peak	3.5 lbs	21 g
Lupinus adsurgens	**LUAD**	9079426	I-5 Merlin Exit	0.5 lbs	1 g
Potentilla glandulosa	**POGL9**	9079427	Soda Mt	3.5 lbs	5 g

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

November 20, 2008

THE 2008 BUREAU OF LAND MANAGEMENT ANNUAL REPORT:
Roseburg District

Figure 1. *Elymus elymoides* seed increase field at the Corvallis Plant Materials Center, June 14, 2008.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the Roseburg District of the Bureau of Land Management (BLM) in 2005 to provide native plant materials for ecological restoration. It was agreed that the PMC would establish and maintain seed increase fields of three grasses (four accessions) and one legume. In the fall of 2006, new species were added to this agreement including one grass, two legumes, and three forbs. No new species were added in 2007 or 2008. Seed increase fields were expanded using seed that was produced in 2007; no fields were expanded in 2008. Some seed was delivered in the fall of 2008.

II. Accessions Involved

Accessions included for the Roseburg District BLM in 2008 are listed in Table 1. This table also displays activities performed by PMC staff.

Table 1. Accessions involved for Roseburg District BLM cooperative agreement with Corvallis Plant Materials Center in 2008.

Species	**Common name**	**Symbol**	**Accession**	**Activity in 2008**[1]
Eriogonum nudum	barestem buckwheat	ERNU3	9079489	Sfp
Eriophyllum lanatum var achillaeoides	wooly sunflower	ERLAA	9079490	Sfp
Sisyrinchium bellum	blue-eyed grass	SIBE	9079491	Pxn, sfp
Lupinus albifrons	silver lupine	LUAL4	9079492	Sfp
Lotus micranthus	small-flowered deervetch	LOMI	9079493	Sfp, dlv
Festuca californica	California fescue	FECA	9079494	Sfp
Silene hookeri ssp hookeri	Hooker's silene	SIHO	9079495	Pxn, sfp, dlv
Danthonia california	California oatgrass	DACA	9079415(CY)	Sfp
Danthonia california	California oatgrass	DACA	9079428(YF)	Sfp
Elymus elymoides	bottle-brush squirreltail	ELEL5	9079416	Sfp
Lupinus rivularis	river lupine	LURI	9079430	Sfp, dlv
Achnathrum lemmonii	Lemmon's needlegrass	ACLE8	9079429	Sfp

1- sfp= seed increase, pxn=plant production, dlv=plant materials delivery

III. Field Seed Increase Activities

Forb fields that were sown in 2006 emerged in the spring of 2007. All three forb fields were patchy, but the stands were worth maintaining because plants will grow to fill in the gaps. In the spring of 2008, plants had filled in many of the gaps and the fields looked good. Containerized plants of *Danthonia californica*, *Achnatherum lemmonii*, *Silene hookeri*, and *Sisyrinchium bellum* that were grown in the fall of 2007 were used to expand small seed increase plots in the spring of 2008. The plants of all species were transplanted into fields in early March. Also in early March, seeds of *Lotus micranthus* were directly sown (by hand) into a field that had been covered with weed fabric. Holes had been cut in the fabric and seeds were planted into the holes.

Weed control in seed increase fields was performed mainly by hand in the forb fields. There was a considerable amount of clover present in the *Eriophyllum lanatum* field and

it was spot sprayed using glyphosate in a backpack sprayer. The pre-emergent herbicide Outlook was applied to the grass fields in the fall to control fall germinating weeds. The grass seed fields were also sprayed with Bronate® in late spring to remove broadleaf weeds. Fields borders were tilled. Medusahead rye was discovered in the *E. elymoides* field once it began to bloom in 2007. This invasive weed was rogued from the field as much as possible. A few plants were found in the field in 2008, these were removed by hand. The field was walked many times and appeared to have no medusahead rye by harvest time. Seed test results showed no presence of medusahead rye in the sample that was tested. It is believed that the weed was in the collection provided to the PMC. The two grasses look very similar and medusahead was most likely collected by mistake.

Figure 2. *Lupinus albifrons* seed increase plot at the Corvallis Plant Materials Center, May 20, 2008.

Most fields were hand harvested multiple times throughout the growing season. Only the small established plots produced seed this year, the large fields that were sown in the fall of 2007 did not flower this year. The smaller *D. californica* (Yampah Flats), *Festuca californica, Eriogonum nudum, S. bellum, Lupinus rivularis, Lupinus albifrons* and *A. lemmonii* fields were harvested by hand using rice knives. This is the best way to harvest these small plots. Although, the *E. nudum* field is a large field, and next year it will be harvested with the seed stripper. It was hand harvested this year due to its patchiness and the large amount of weeds present in the field.

Usually *L. rivularis* doesn't produce a lot of seed in its first growing season, but this year's field had enough pods to warrant harvesting them by hand. This left the stand intact and will vigorously flower in 2009.

The *L. micranthus* and *S. hookeri* fields were covered with weed fabric and the seeds were vacuumed or swept from the fabric a few times during the harvest season. This was very effective for the *L. micranthus*! The *Silene* plants were still growing and adjusting to the transplanting, so it was hard to tell how effective this harvest method will be.
The larger *D. californica* (Culvert yard) plot and the *E. lanatum* fields were harvested using the "moon rover" (a self-propelled swather). This is the best choice for the *E. lanatum*, but next year, the large field of *D. californica* will be harvested with the seed stripper. The *E. elymoides* field was swathed and then harvested with a small plot combine.

Figures 3 & 4. *Lotus micranthus* plants grew vigororously (top) and as seed pods matured, they shattered seed onto the weed fabric (bottom). Seeds were swept or vacuumed from the fabric twice during the harvest season.

Table 2. Seed yields for the Roseburg District BLM cooperative agreement with the Corvallis Plant Materials Center in 2008.

Species	Accession	Field size (ac)	Date harvested	Method	Yield
Eriogonum nudum	9079489	0.25	7/23	hand	26 lbs
Eriophyllum lanatum	9079490	0.25	7/29	moon rover	48 lbs
Sisyrichium bellum	9079491	0.001	8/4	hand	81 g
Lupinus albifrons	9079492	0.001	6/16- 7/20	hand	2.3 lbs
Lotus micranthus	9079493	0.1	7/20-9/17	sweep weed fabric	7.6 lbs
Festuca californica	9079494	0.001	6/23	hand	1.5 lbs
Silene hookeri	9079495	0.1	6/26-7/15	vac weed fabric	18 g
Danthonia california	9079415	0.05	6/31	moon rover	8 lbs
Danthonia california	9079428	0.02	7/3	hand	4 lbs
Elymus elymoides	9079416	0.35	7/21-7/25	swath/combine	55 lbs
Lupinus rivularis	9079430	0.48	7/3	hand	6 lbs
Achnathrum lemmonii	9079429	0.04	6/26	seed stripper	10 lbs

Figure 5. Harvesting *Elymus elymoides* at the Corvallis Plant Materials Center, July 24, 2008.

Following harvest, *E. elymoides* field was burned and all other fields (except for the *L. micranthus*, *S. bellum*, both Lupines, and *S. hookeri*) were mowed with a Brady chopper to remove residue. All established grass fields were sprayed in late October with Outlook®, a non-selective pre-emergent herbicide.

IV. Delivery of Plant Materials

Samples of seed lots that were larger than 5 lbs were sent to the OSU seed lab for purity and germination testing. Viability on most seed lots was determined by a TZ test, but the squirreltail sample was tested for germination.

Table 5. Seed test results from field produced seed in 2008.

Species	Accession	Bulk amt	Purity	Viability or Germination	PLS amount
Eriogonum nudum	9079489	26 lbs	96.92%	93%	23.4 lbs
Eriophyllum lanatum	9079490	48.5 lbs	89.89%	N/A	
Danthonia california	9079415	8 lbs	96.18%	96%	7.3 lbs
Elymus elymoides	9079416	55 lbs	99.15%	97%	53 lbs
Achnathrum lemmonii	9079429	10 lbs	99.37%	96%	9.5 lbs

Some seed was delivered to BLM staff on September 3, 2008. Remaining seed will be kept in a cooled/dehumidified seed storage facility at the PMC until requested by BLM staff.

Table 6. Seed delivered to BLM staff on September 3, 2008.

Species	Accession	Seed lot	Amount
Lotus micranthus	9079493	SG2-08-RB493	4.5 lbs
Silene hookeri	9079495	SG2-08-RB495	18 g
Lupinus rivularis	9079430	SG1-07-RB430	69 lbs

Table 7. Seeds in storage at the Corvallis Plant Materials Center for the Roseburg District BLM cooperative agreement with Corvallis Plant Materials Center in 2008.

Species	Lot number	Weight
Eriogonum nudum	SG1-08-RB489	26 lbs
Eriophyllum lanatum	SG1-08-RB490	48.5 lbs
Sisyrichium bellum	SG1-08-RB491	81g
Lotus micranthus	SG1-08-RB493	1.7 lbs
Festuca californica	SG1-08-RB494	1.5 lbs
Silene hookeri ssp hookeri	SG1-07-RB495	72 g
Danthonia california	SG2-07-RB415	100g
Danthonia california	SG2-08-RB415	8 lbs
Danthonia california	SG2-07-RB428	39 g
Danthonia california	SG2-08-RB428	4 lbs
Elymus elymoides	SG1-06-RB416	5 lbs
Elymus elymoides	SG1-07-RB416	12 lbs
Elymus elymoides	SG2-08-RB416	55 lbs
Lupinus rivularis	SG1-06-RB430	475 g
Lupinus rivularis	SG2-08-RB430	6 lbs
Achnathrum lemmonii	SG2-07-RB429	213 g
Achnathrum lemmonii	SG2-08-RB429	10 lbs

CORVALLIS PLANT MATERIALS CENTER
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Amy Bartow

January 20, 2010

THE 2009 BUREAU OF LAND MANAGEMENT ANNUAL REPORT:
Roseburg District

Figure 1**.** Silver leaf lupine **(***Lupinus albifrons)* seed increase plot at the Corvallis Plant Materials Center, May 20, 2009.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the Roseburg District of the Bureau of Land Management (BLM) in 2005 to provide native plant materials for ecological restoration. It was agreed that the PMC would establish and maintain seed increase fields of three grasses (four accessions) and one legume. In the fall of 2006, new species were added to this agreement including one grass, two legumes, and three forbs. No new species were added in 2009 and one forb was discontinued.

Activities in 2009 included maintenance and harvest of 11 seed increase fields and plant production of one forb. Three seed increase fields were expanded using seed that was produced in 2008 and 2009.

II. Accessions Involved

Accessions included for the Roseburg District of the BLM in 2009 are listed in Table 1. This table also displays activities performed by the PMC staff.

Table 1. Accessions involved for Roseburg District BLM cooperative agreement with Corvallis Plant Materials Center in 2009.

Species	Common name	Symbol	Accession	Activity in 2009[1]
Eriogonum nudum	barestem buckwheat	ERNU3	9079489	sfp
Eriophyllum lanatum var achillaeoides	wooly sunflower	ERLAA	9079490	sfp
Sisyrinchium bellum	blue-eyed grass	SIBE	9079491	pxn, sfp
Lupinus albifrons	silver lupine	LUAL4	9079492	sfp
Lotus micranthus	small-flowered deervetch	LOMI	9079493	sfp
Festuca californica	California fescue	FECA	9079494	sfp
Danthonia californica	California oatgrass	DACA	9079415	sfp
Danthonia californica	California oatgrass	DACA	9079428	sfp
Elymus elymoides	bottle-brush squirreltail	ELEL5	9079416	sfp
Lupinus rivularis	river lupine	LURI	9079430	sfp
Achnathrum lemmonii	Lemmon's needlegrass	ACLE8	9079429	sfp

1- sfp= seed increase, pxn=plant production, dlv=plant materials delivery

III. Field Seed Increase Activities

The *Danthonia californica* seed increase fields that were sown in the fall of 2007 flowered for the first time in 2009. These fields look fair. Plants are not incredibly vigorous, yet they appear healthy and flowered moderately. Various harvest techniques were tested on the fields this year. The smaller field was harvested using the seed stripper. This machine was effective at harvesting the seed, but the stems wrapped around the brushes and had to be cleaned out often. This harvest method did capture both the stem seeds as well as the florets. The larger field was too thick to seed strip so the combine was used. Instead of swathing the material, allowing it to dry, and then combining, we tried direct combining (combining standing material). This works well with material that already has low moisture content. Direct combining did a great job harvesting the seed in the florets, however, the stems seeds were left inside the stems and the stems came out of the back of the combine in piles across the field. A tractor-mounted rake was used to gather the stems into “swaths”, and after a week of drying, we combined the stems. This method concentrated the seed of the annual weeds with the stem seeds of the *Danthonia*.

The area of the *Achnathrum lemmonii* field that was sown in the fall of 2007 still did not flower this year. The plants look wispy and immature. Hopefully, in their third year (2010) they will flower. The plants that were started from plugs in 2006 are producing well and remain robust.

In early March, *Lotus micranthus* seeds were directly sown (by hand) into a field that had been covered with weed fabric. Holes had been cut in the fabric and seeds were planted into the holes. Over 80% of the holes contained flowering plants this year. Slugs can be a major problem when the seedlings begin to emerge. The field was hand weeded twice and harvested once at the end of September. Dead plants were pulled out and the seed on the fabric was swept and collected into barrels.

There was a considerable amount of clover present in the *Eriophyllum lanatum* field and it was spot sprayed using glyphosate in a backpack sprayer.Much of the clover was destroyed, but there is still clover in the field. Running the seed through an indent cylinder removes almost all of the clover seeds from the seed lot. However, spraying the clover is necessary to keep it from taking over the crop of *E. lanatum*. Progress is being made, and with each year there seems to be less clover. This field was weeded by hand twice in the growing season. It was harvested using the moon rover.

Figure 2. Oregon sunshine (*Eriophyllum lanatum)* seed increase field at the Corvallis Plant Materials Center, June 14, 2009.

Fields of *Sisyrinchium bellum* and *Lupinus albifrons* were hand harvested multiple times throughout the growing season. The *Festuca californica* and *Eriogonum nudum* fields were harvested by hand one time each. The *E. nudum* field was becoming very sparse and the field was very weedy. A new field was established in the fall of 2009.

The *Lupinus rivularis* field flowered this year. This species of lupine is great for seed increase because the pods ripen fairly evenly and don't shatter easily. Usually, a one-time harvest is inefficient for lupines because only a small portion of the seeds are mature at the same time. Due to our experience of working with this species, we felt confident that direct combining the lupines would be successful. Our Hege plot combine can handle a lot of material even if it is green (wet). The outer rows ripened first, and when 70% of the pods were black, we combined it. The combine was able to open green pods without damaging the seed. The field was combined at various times as it matured. After combining, the seed was spread out to dry on tarps in the sun. Many of the seeds were fully formed, but were green and swollen. Within two days the green seeds were hard and normal sized, but they remained green. The seed lot was tested for germination and was found to be 95% viable. A separate test was also run at the PMC on sets of yellow (normal) seed and green seeds. No significant difference in germination was found between the green and yellow seeds.

Table 2. Seed yields for the Roseburg District BLM cooperative agreement with the Corvallis Plant Materials Center in 2009.

Species	Accession	Field size (ac)	Date harvested	Method	Yield
Eriogonum nudum	9079489	0.25	July 25	hand	4 lbs
Eriophyllum lanatum var achillaeoides	9079490	0.25	July 29	moon rover	40 lbs
Sisyrichium bellum	9079491	0.001	June 27	hand	0.5 lbs
Lupinus albifrons	9079492	0.001	6/15- 6/20	hand	1 lb
Lotus micranthus	9079493	0.1	7/20-9/17	sweep weed fabric	10 lbs
Festuca californica	9079494	0.001	June 27	hand	1.5 lbs
Danthonia californica	9079415(CY)	0.45	June 10	combine	50 lbs
Danthonia californica	9079428(YF)	0.32	June 29	seed stripper	7.5 lbs
Elymus elymoides	9079416	0.35	7/15-7/20	swath/ combine	75 lbs
Lupinus rivularis	9079430	0.48	June 22	combine	180 lbs
Achnathrum lemmonii	9079429	0.04	June 20	seed stripper	6 lbs

The *E. elymoides* field was swathed and then harvested with a small plot combine. The field has been getting thicker every year, making the swaths larger. The PMC farm is very windy in the summer and the squirreltail seeds roll all over the farm after being swathed. The thicker swaths take longer to dry and the longer they sit on the field the more seed blows away. It is estimated that only 35% of the seed that the field produces is harvested. If the PMC has another opportunity to establish a field of squirreltail, it will be planted with a tall wheatgrass border to keep the seeds on the field.

Figure 5. Blue-eyed grass (*Sisyrinchium bellum*) at the Corvallis Plant Materials Center, June 20, 2009.

Following harvest, all grass fields were mowed with a Brady chopper to remove residue. All established grass fields were sprayed in late October with Outlook®, a non-selective pre-emergent herbicide. The *S. bellum, E. Nudum, F. californica,* and *L. albifrons* plots were all removed this fall due to age or location. Some small forb plots were the only plot left in a 2-3 acre range that was due to be taken out of production and put under a cover crop. Larger fields were established in new areas to replace the tiny plots.

Three new fields were direct sown this fall using seed that was produced in 2008 and 2009. In September and October, fields were sown using the PMC's precision cone-seeder. This type of seeder is calibrated to drill a programmed amount of seed over a programmed area. It is very precise and is a good choice for drilling limited amounts of seed.

Within two weeks the seedlings emerged. Many of the buckwheat seeds had germinated in the fall, unexpectedly. This species usually has a large percent of dormant seeds that will not germinate until spring. In early December, the PMC experienced very cold temperatures lasting more than two weeks. Soil probes at the OSU field lab (which is next door to the PMC) measured freezing temperatures as deep as 8" down in the soil. Whipping winds and temperatures in the teens created a harsh environment for the seedlings. When the cold ended, the seedlings were inundated with water from heavy rains. Surprisingly, the seedlings in the grass fields appeared unharmed, but the buckwheat seedlings were damaged, though. Hopefully, many new seedlings will emerge in the spring and fill in the rows. Slugs damaged many of the lupine seedlings, so a

slugicide was applied to the field. Seedlings germinate throughout the winter and the main flush of germinants will occur in the spring.The fescue field appears to be very healthy and unaffected by the weather or pests.

Table 3. Seed increase field establishment for the Roseburg BLM in 2009 at the Corvallis Plant Materials Center.

Species	Code	Accession	Rate	Field size
Eriogonum nudum	ERNU3	9079489	12 lbs/ac	0.5
Lupinus albifrons	LUAL4	9079492	10 lbs/ac	0.34
Festuca californica	FECA	9079494	9 lbs/ac	0.26

IV. Container Plant Production

The new *S. bellum* field will be established using transplants. On October 15th, 2009 seed was sown into plug trays filled with moistened media (Sunshine #1, a special peat-based soil-less mix) and lightly covered with fine vermiculite. Trays were placed outside in a lathhouse for natural stratification. This species appears to need natural stratification and outdoor winter conditions for germination. Large sheets of clear plastic were draped over the plugs so they weren't damaged by the pounding rain. Sheets were removed in late December when the seedlings began to germinate. Plugs will be transplanted into a field in early March.

V. Delivery of Plant Materials

Two seed lots were mailed to private seed growers who will be establishing large seed increase fields for the BLM. This arrangement reflects the purpose of the PMC. A very small amount of wild seed was initially collected and brought to the PMC. It was used to grow plugs that were transplanted into a seed increase field in 2006. These plants produced seed in 2007 and 2008. This seed was bulked and sent to private growers who can establish 1-5 acre fields. Remaining seed will be kept in a cooled/dehumidified seed storage facility at the PMC until requested by BLM staff.

Table 4. Seed Deliveries in 2009 for the Roseburg District BLM cooperative agreement with Corvallis Plant Materials Center.

Species	Lot number	Weight	Delivered to:
Elymus elymoides	SG2-08-RB416	55 lbs	Western Reclamation
Achnathrum lemmonii	SG2-08-RB429	10 lbs	Oregon Wholesale Seed

Table 5. Seeds in storage at the Corvallis Plant Materials Center for the Roseburg District BLM cooperative agreement in 2009.

Species	Lot number	Weight	Total per accession
Eriogonum nudum	SWC-06-RB489	99 g	
Eriogonum nudum	SG1-08-RB489	22 lbs	22 lbs
Eriophyllum lanatum var achillaeoides	SWC-06-RB490	234 g	
Eriophyllum lanatum var achillaeoides	SG1-08-RB490	48.5 lbs	
Eriophyllum lanatum var achillaeoides	SG1-09-RB490	40 lbs	98.5 lbs
Sisyrinchium bellum	SG1-08-RB491	81g	
Sisyrinchium bellum	SG1-09-RB491	0.5 lbs	0.5
Lotus micranthus	SWC-06-RB493	11 g	
Lotus micranthus	SG1-08-RB493	1.7 lbs	
Lotus micranthus	SG2-09-RB493	10 lbs	11.7 lbs
Festuca californica	SWC-06-RB494	4 g	4 g
Silene hookeri ssp hookeri	SWC-06-RB495	23 g	
Silene hookeri ssp hookeri	SG1-07-RB495	72 g	95 g
Danthonia californica	SG2-07-RB415	100g	
Danthonia californica	SG2-08-RB415	8 lbs	
Danthonia californica	SG3-09-RB415	50 lbs	58 lbs
Danthonia californica	SG2-07-RB428	39 g	
Danthonia californica	SG2-08-RB428	4 lbs	
Danthonia californica	SG3-09-RB428	7.5 lbs	11.5 lbs
Elymus elymoides	SG1-06-RB416	5 lbs	
Elymus elymoides	SG1-07-RB416	12 lbs	
Elymus elymoides	SG2-09-RB416	57 lbs	74 lbs
Lupinus rivularis	SG1-06-RB430	475 g	
Lupinus rivularis	SG2-08-RB430	6 lbs	
Lupinus rivularis	SG2-09-RB430	180 lbs	187 lbs
Achnathrum lemmonii	SG2-07-RB429	213 g	
Achnathrum lemmonii	SG3-09-RB429	6 lbs	6.5 lbs

Our seed lot numbers describe the generation of the field (SG0 or SWC is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed). The middle numbers of a seed lot notes which year the seed was produced in. The last portion of the seed lot describes which project the seed is for (RB is for Roseburg BLM) and the last three digits of the accession number that has been assigned to this species specifically for this project.

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

November 29, 2008

THE 2008 LASSEN VOLCANIC NATIONAL PARK ANNUAL REPORT:
Kings Creek Revegetation Project

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with Lassen Volcanic National Park in 2006 to provide native plant materials for revegetation in the King's Creek area. It was agreed that the PMC would produce a minimum of 3700 container plants including 700 legume plugs, 2500 sedge and rush plugs, 500 grass plugs and 1800 containers of one shrub species. Activities in 2008 included propagation and delivery of 3671 plants. PMC staff also traveled to the Park to collect more manzanita cuttings.

II. Accessions Involved

Table 1. Accessions involved in the Kings Creek Revegetation Project.

Species	Common name	Code	Accession	Activity in 2008[1]
Juncus balticus	Baltic rush	JUBA	9079507	Pxn, dlv
Carex abrupta	abruptbeak sedge	CAAB2	9079503	Pxn, dlv
Carex staminiformis	Shasta sedge	CAST7	9079506	Pxn, dlv
Lupinus obtusilobus	satin lupine	LUOB	9079501	Pxn, dlv
Deschampsia cespitosa	tufted hairgrass	DECE	9079500	Pxn, dlv
Arctostaphylos nevadensis	pinemat manzanita	ARNE	9079498	Pxn, dlv, col

1- pxn= plant production, dlv= delivered plant materials, col= collected plant materials

III. Experimental Propagation

There was no experimental propagation in 2008.

IV. Plant Propagation

Arctostaphylos nevadensis cuttings that were collected in the fall of 2007 were kept in a cooler until the end of January. On January 25, 2008, cuttings were removed from the coolers. Stems were stripped of lower leaves, re-cut, dipped in a 0.8% IBA powder, and stuck into 6" deep propagation flats filled with perlite. Flats were placed on heat mats set at 70° (F) in an unheated greenhouse. The flats did not get watered the first three days in the greenhouse and all cuttings desiccated and died. More cuttings were taken in the fall of 2008 and will be grown (and watered!) in 2009.

On December 18, 2007, 32 racks of Ray Leach "stubby" cone-tainers filled with moistened media (Sunshine #4, a special peat-based soil-less mix) were sown with seeds of *Carex abrupta*, *Carex staminiformis*, and *Juncus balticus* and lightly covered with fine vermiculite. Seeded flats were placed in polyethylene bags and moved into a walk-in cooler (36-38° F) for four months. After stratification, they were moved to a heated greenhouse. Seedlings emerged within two to four weeks. *C. abrupta* seeds had lower than expected germination (about 30%). The other species had expected germination rates (about 60-80%).

Figure 1. PMC staff member, Vanessa East, taking cuttings at Lassen Volcanic National Park, October 16, 2008.

On May 15, 2008, 15 racks of Ray Leach "stubby" cone-tainers filled with moistened media (Sunshine #4, a special peat-based soil-less mix) were sown with seeds of *Lupinus obtusilobus* and *Deschampsia caespitosa*. Before sowing, lupine seeds were lightly scarified by rubbing them on sandpaper and then were inoculated with a Lupine specific rhizobium. Flats were placed in a heated greenhouse. On June 1, 2008 all plants were moved from the greenhouse to a shadehouse. Plants were watered overhead daily or as needed and were monitored for pests and diseases. In late August, plants were watered less to prepare them for delivery and transplanting.

Some pots of manzanita that were produced last year were returned to the PMC after delivery to the park in the fall of 2007. These plants were placed in a walk-in cooler throughout the winter and then were moved to a covered shed in early May. Keeping the

plants drier and relatively cool (to prevent root rot) was of high concern. When spring rains had let up, plants were moved to a lathhouse. These plants were also delivered to the park in the fall of 2008.

VI. Delivery of Plant Materials.

On September 3, 2008, PMC staff traveled to the park to deliver the plants. Plants were unloaded at a high elevation horse corral near the planting site.

Table 2. Plants that were delivered to the park on September 3, 2008.

Species	Code	Accession	Amount Delivered	Size
Juncus balticus	JUBA	9079507	1273	7" plugs
Carex abrupta	CAAB2	9079503	601	7" plugs
Carex staminiformis	CAST7	9079506	469	7" plugs
Lupinus obtusilobus	LUOB	9079501	646	7" plugs
Deschampsia cespitosa	DECE	9079500	556	7" plugs
Arctostaphylos nevadensis	ARNE	9079498	126	40 cc D40

CORVALLIS PLANT MATERIALS CENTER
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December 2, 2008

THE 2008 LASSEN VOLCANIC NATIONAL PARK ANNUAL REPORT:
Visitors' Center Landscape Project

Figure 1. PMC staff members, Jenny Freitag and Vanessa East, pose in front of the new Visitors' Center, Lassen Volcanic National Park, October 16, 2008 (photo by Kathy Pendergrass).

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with Lassen Volcanic National Park in 2007 to provide native plant materials for planting around the new visitors' center. It was agreed that the PMC would produce a minimum of 6200 container plants including: 2000 grass plugs, 1000 sedge and rush plugs, and 3200 containers of shrubs. In the original contract, containers of red fir, mountain hemlock and chinquapin were ordered, but due to lack of seed, these species were replaced by an appropriate number of forb containers. Activities in 2008 included collection and vegetative propagation of two shrubs and production of five sedges and rushes, two shrubs, two grasses, one legume, and three forbs.

II. Accessions Involved

Table 1. Accessions involved in the Visitors Center Landscape Project in 2008.

Species	Common name	Code	Accession Number	Activity in 2008[1]
Elymus glaucus	blue wildrye	ELGL	9079530	Pxn, dlv
Bromus carinatus	California brome	BRCA5	9079531	Pxn, dlv
Holodiscus microphyllus	oceanspray	HOMI3	9079548	Pxn, dlv
Ceanothus cordulatus	whitethorn ceanothus	CECO	9079553	Pxn, dlv
Arctostaphylos nevadensis	pine mat manzanita	ARNE	9079554	Pxn, dlv, col
Senecio triangularis	arrowleaf ragwort	SETR	9079545	Pxn, dlv
Anaphalis margaritacea	pearly everlasting	ANMA	9079547	Pxn, dlv
Carex jonesii	jones's sedge	CAJO	9079541	Pxn, dlv
Carex microptera	smallwing sedge	CAMI7	9079543	Pxn, dlv
Juncus balticus	baltic rush	JUBA	9079555	Pxn, dlv
Juncus ensifolius	swordleaf rush	JUEN	9079549	Pxn, dlv
Wyethia mollis	woolly mules-ears	WYMO	9079546	Pxn, dlv
Ribes sp	currant	RIBES	9079572	Pxn, dlv
Eriogonum sp	buckwheat	ERIOG	9079573	Pxn, dlv
Potentilla sp	cinquefoil	POTEN	9079574	Pxn, dlv
Lupinus arbustus	longspur lupine	LUAR6	9079551	Pxn, dlv

1-pxn=produced plants, dlv=delivered plant materials, col= collected plant materials

III. Experimental Propagation

The PMC is to provide 100 containers of *Ceanothus cordulatus* for this agreement. This species has not been propagated previously at the PMC. Seeds were collected by park staff and delivered to the PMC. Seed was cleaned and placed in hot water (180°F) and left to cool/soak for 24 hours. Seeds were then mixed with moistened peat-based media in a plastic zip-lock bag and placed in a walk-in cooler. Seeds were monitored weekly for germination (no germination was observed). After 60 days in the cooler, media and seeds were spread out in a shallow flat and placed in the greenhouse. Within two weeks, seedlings began to germinate. Seedlings were transplanted into 7” stubby cells. Stem cuttings were also collected at the park by PMC staff on October 23-24, 2007. Target materials were stems that were at least six inches long, current season’s growth, and free of diseases. Cuttings were packed with moistened vermiculite and stored in a walk-in cooler (38°F). In February, cuttings were prepared for rooting by stripping the leaves from the lower 4 inches, making a fresh basal cut, dipping them in an 0.8% IBA rooting powder, and sticking them into moist perlite in 4” deep propagation flats. Flats were placed on heat mats set at 70° F in an unheated greenhouse and lightly watered weekly or as needed. A small percent of the cuttings did form roots (approximately 40%), but survival after being transplanted into pots was extremely low (less than 10%).

Table 2. Results of germination trials of select species for the Visitors' Center agreement at the PMC in 2008.

Species	Treatment	Average germination per treatment
Carex jonesii	Warm	56
	45 day cold moist stratification	61
	90 day cold-moist stratification	45
Carex microptera	Warm	86
	45 day cold moist stratification	86
	90 day cold-moist stratification	82
Wyethia mollis	Warm	35
	45 day cold moist stratification	40
	90 day cold-moist stratification	44
Potentilla sp	Warm	35
	90 day cold-moist stratification	71

Informal germination tests were set up on *Juncus* and *Carex* species that have never been propagated at the Corvallis PMC. For each species, nine sets of 100 seeds were counted, weighed and placed in plastic germination boxes on moistened germination paper and stored in a growth chamber set at 8°(C) days and 4°(C) nights with 8 hours of light. Treatments include 45 or 90 days cold-moist stratification or no cold-moist stratification. Each treatment contained three replications per species.

Figure 2. Juncus plants growing in the PMC greenhouse.

Cuttings of a *Ribes* species were also collected from the Park in October of 2007. Only 10 cuttings were taken. They were packed and processed the same way as the *C. cordulatus* cuttings except that they were rooted in moistened vermiculite and were not placed on heat mats. All ten cuttings rooted and were transplanted into 1-gallon pots. Shrubs were almost 3 ft tall at delivery time. This species was very successful (100% survival) and easy to work with.

IV. Plant Propagation

Figure 3. *Arctostaphylos nevadensis* growing in the PMC greenhouse.

Arctostaphylos nevadensis cuttings were collected at the Park by PMC staff on October 23-24, 2007. Collection area was defined by the Park as the south entrance sign north to the visitors' center. Staff collected 4000 cuttings from this area. Target material were stems that were at least six inches long, non-branching, this season's growth, free of diseases. Cuttings were packed with moistened vermiculite and stored in a walk-in cooler (38°F) until December 20, 2007. Half of the cuttings (approximately 2000) were prepared for rooting by stripping the leaves from the lower 4 inches, making a fresh basal cut, dipping them in an 0.8% IBA rooting powder, and sticking them into moist perlite in 4" deep propagation flats. Flats were placed on heat mats set at 70° F in an unheated greenhouse and lightly watered weekly or as needed. Due to space limitations on the heat mats, cuttings were propagated in two rounds. The second round of cuttings was started in early February. Rooting success was lower this year compared to last year. After cuttings were sufficiently rooted, they were transplanted into D40 cone-tainers filled with moistened media (Sunshine #4, a special peat-based soil-less mix amended with a balanced slow-release fertilizer and micronutrients) and placed in a heated greenhouse. The rooted cuttings grew slowly at first, and then in late May began to send out many new leaves. Due to a sudden hot spell (100° F), plants were moved out of the greenhouse and into a shadehouse. After a week of unusually hot spring temperatures, the weather turned to unusually wet and cool. Days did not reach 65° F for at least four weeks and most days were rainy. The cool wet weather seemed to affect the manzanita plants. In July and August many plants began to yellow and die. About half of the plants were lost and the ones that did survive were weak and small. More manzanita plants will be produced in 2009 to fulfill the needs of the contract.

On December 18, 2007, racks of Ray Leach "stubby" cone-tainers filled with moistened media (Sunshine #4, a special peat-based soil-less mix) were sown with seeds of three *Carex* sp, an *Erigognum* sp, a *Potentila* sp, *Wyethia mollis*, *Holodiscus discolor*, and *Juncus balticus* and lightly covered with fine vermiculite. Seeded flats were placed in polyethylene bags and moved into a walk-in cooler (36-38° F) for four months. After stratification, they were moved to a heated greenhouse. Seedlings emerged within two to four weeks.

On May 15, 2008, 15 racks of Ray Leach "stubby" cone-tainers filled with moistened media (Sunshine #4, a special peat-based soil-less mix) were sown with seeds of *Bromus carinatus*, *Senecio triangularis*, *Juncus ensifolius*, a *Lupine* sp, *Anaphalis margaritacea*, and *Elymus glaucus*. Before sowing, lupine seeds were lightly scarified by hand by rubbing them on sandpaper and then were inoculated with a Lupine specific rhizobium. Flats were placed in a heated greenhouse.

On June 1, 2008 all plants were moved from the greenhouse to a shadehouse. Plants were watered overhead daily or as needed and were monitored for pests and diseases. In July, 100 *H. discolor* plants were transplanted into larger D40 cone-tainers. In late August, plants were watered less to prepare them for delivery and transplanting.

V. Delivery of Plant Materials

Figure 4. Plants produced by the PMC in 2008 delivered to the new Visitor's Center.

On September 3, 2008, PMC staff traveled to the park to deliver the plants. The plants were unloaded at the planting site at the visitors' center.

Table 3. Plants Delivered to Lassen Volcanic National Park, September 3, 2008, for the Visitors' Center agreement.

Species	Code	Accession Number	Amount Delivered	Amount ordered
Elymus glaucus	ELGL	9079530	1171	1000
Bromus carinatus	BRCA5	9079531	1086	1000
Holodiscus microphyllus	HOMI3	9079548	486	100
Ceanothus cordulatus	CECO	9079553	20	100
Arctostaphylos nevadensis	ARNE	9079554	579	2800
Senecio triangularis	SETR	9079545	172	100
Anaphalis margaritacea	ANMA	9079547	196	150
Carex jonesii	CAJO	9079541	287	100
Carex microptera	CAMI7	9079543	680	400
Juncus balticus	JUBA	9079555	488	400
Juncus ensifolius	JUEN	9079549	53	100
Wyethia mollis	WYMO	9079546	269	250
Eriogonum sp	ERIOG	9079573	6	0
Potentilla sp	POTEN	9079574	46	0
Ribes sp	RIBES	9079572	10	0
Lupinus arbustus	LUAR6	9079551	60	60

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December 2, 2009

THE 2009 LASSEN VOLCANIC NATIONAL PARK ANNUAL REPORT:
Visitors' Center Landscape and Disturbed Lands Project

Figure 1**.** Plants produced by the PMC in 2009 and delivered to the new Visitors' Center.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with Lassen Volcanic National Park in 2009 to provide additional native plant materials for planting around the new Visitors' Center and in the restoration of historically disturbed lands in the park. It was agreed that the PMC would produce a minimum of 16,875 container plants including: 1000 grass plugs, 3700 sedge and rush plugs, 4100 trees, and 7575 containers of shrubs. Three small deliveries of plants will occur in 2009, 2010 and 2011 to spread out the labor of planting nearly17,000 containers. The optimal transplanting conditions at the Park exist in late September and early October. With this limited time to transplant, staggering the deliveries over three years will make the project more successful. Activities in 2009 included the collection and vegetative propagation of one shrub species and production (by seed) of one tree and three other shrub species.

II. Accessions Involved

Table 1. Accessions involved in the Visitors Center Landscape Project in 2009.

Species	Common name	Code	Accession Number	Activity in 2009[1]
Ceanothus cordulatus	whitethorn ceanothus	CECO	9079553	pxn, dlv, trl
Arctostaphylos nevadensis	pinemat manzanita	ARNE	9079554	pxn, dlv, col
Alnus incana	grey alder	ALIN	9079603	pxn, dlv
Pinus jefferyi	Jeffrey pine	PIJE	9079583	pxn, dlv

1-pxn=produced plants, dlv=delivered plant materials, col= collected plant materials, trl=conducted trials

III. Experimental Propagation

The PMC is to provide 1000 containers of *Ceanothus cordulatus* for this agreement. This species has been propagated previously at the PMC and severe mold issues occur on the seed while it is in stratification. This year, trials using Zero-tol (concentrated hydrogen peroxide) were conducted in different concentrations and at various times during the stratification process. Seed of all treatments was cleaned and placed in hot water (180°F) and left to cool/soak for 24 hours. Before going into stratification, seeds were rinsed with a 1% dilute solution of Zero-tol, a concentrate solution, or water (treatment 1).Seeds were then spread out on moistened germination paper in plastic germination boxes and placed in a walk-in cooler. Seeds were monitored weekly for germination; no germination was observed. After 60 days in the cooler, seeds were rinsed again (treatment 2) and then transferred back into germination boxes. The boxes were moved to a growth chamber set at 70° (F) days/ 50° (F) nights and 12 hours of day light. Within a few days, seeds began to germinate. Seedlings were counted and transplanted into 7” stubby cells. Washing with the dilute solution used (treatment 1) followed by a water or soap wash (treatment 2) seemed to produce the highest germination. Mold was still present in most boxes, except for the boxes that were treated with concentrate both times.

Table 2. Results of germination trials using Zero-tol for mold control on stratified *Ceanothus cordulata* seed for the Visitors’ Center agreement at the PMC in 2009.

Treatment 1	Treatment 2	Average germination
Water wash	Water wash	15%
Water wash	Soap wash	9%
Dilute	Soap wash	21%
Dilute	Dilute	17%
Concentrate	Soap wash	6%
Concentrate	concentrate	4%

IV. Plant Propagation

Arctostaphylos nevadensis cuttings were collected at the Park by PMC staff on October 13-14, 2008. Collection area was defined by the Park as the south entrance sign north to the visitors’ center. Staff collected 4000 cuttings from this area. Target material were stems that were at least six inches long, non-branching, this season’s growth, and free of

diseases. Cuttings were packed with moistened vermiculite and stored in a walk-in cooler (38°F) until January 3, 2009. Half of the cuttings (approximately 2000) were prepared for rooting by stripping the leaves from the lower 4 inches, making a fresh basal cut, dipping the base in an 0.8% IBA rooting powder, and sticking them into moist perlite in 4" deep propagation flats. Flats were placed on heat mats set at 70° F in an unheated greenhouse and lightly watered weekly or as needed. Due to space limitations on the heat mats, cuttings were propagated in two rounds. The second round of cuttings was started in early March. After cuttings were sufficiently rooted, they were transplanted into D40 cone-tainers filled with moistened media (Sunshine #4, a special peat-based soil-less mix amended with a balanced slow-release fertilizer and micronutrients) and placed in a heated greenhouse. The rooted cuttings grew slowly at first, and then in late May began to send out many new leaves. In July, some manazanita plants turned yellow and looked very choloratic. An iron chelate solution fortified with micronutrients and a small amount of fertilizer was applied to the yellowing plants. Within a week, they were much greener. The iron chelate solution was applied every two weeks in July and August.

Figure 3. *Pinus jeffreyi* growing in the PMC greenhouse.

On November 27th, 2008, seeds of Jeffrey pine were spread out on moistened germination paper in plastic germination boxes and placed in a walk-in cooler. Seeds were monitored weekly for germination; no germination was observed. After 30 days in the cooler, the boxes were moved to a growth chamber set at 70° (F) days/ 50° (F) nights and 12 hours of day light. Within a few days, seeds began to germinate. Germinating seeds were transplanted into racks of D40 cone-tainers filled with moistened media (Sunshine #4, a special peat-based soil-less mix amended with a balanced slow-release fertilizer and

micronutrients) and placed in a greenhouse set at moderate temperatures (70° (F) days/ 50° (F) nights).

In early May of 2009 two racks of Ray Leach "stubby" cone-tainers filled with moistened media (Sunshine #4, a special peat-based soil-less mix amended with a balanced slow-release fertilizer and micronutrients) were sown with seeds of *Alnus incana*. Flats were placed in a heated greenhouse. This species of alder doesn't need any stratification to germinate, but does need very warm temperatures (80° (F) or higher) and plenty of water. When the alder seedlings' roots had filled their cone-tainers, they were transplanted into D40 cones.

Ceanothus seedlings from the Zero-tol trials were transplanted into "stubby" cone-tainers filled with moistened media (Sunshine #4, a special peat-based soil-less mix amended with a balanced slow-release fertilizer and micronutrients). When the seedlings' roots had filled their cone-tainers, they were transplanted into D40 cones.

On June 1, 2009 all plants were moved from the greenhouse to a shadehouse. Plants were watered overhead daily or as needed and were monitored for pests and diseases.

V. Delivery of Plant Materials

On September 4, 2009, PMC staff traveled to the park to deliver the plants. The Manzanita, alders and ceanothus were unloaded at the planting site at the Visitors' Center and the pines were delivered to the Manzanita Lake area.

Table 3. Plants Delivered to Lassen Volcanic National Park, September 4, 2009, for the Visitors' Center agreement.

Species	Code	Accession #	Size	Number delivered
Ceanothus cordulatus	CECO	9079553	D-40	362
Ceanothus cordulatus	CECO	9079553	stubby cones	830
Arctostaphylos nevadensis	ARNE	9079554	D-40	1414
Alnus incana	ALIN	9079603	D-40	160
Alnus incana	ALIN	9079603	stubby cones	25
Pinus jeffreyi	PIJE	9079583	D-40	2880
			total	5671

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

November 20, 2008

THE 2008 MOUNT RAINIER NATIONAL PARK ANNUAL REPORT:
Steven's Canyon Road Revegetation Project

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the National Park Service (NPS) in 2007 to provide native plant materials for ecological restoration along Steven's Canyon Road following road construction. It was agreed that the PMC would establish and maintain seed increase fields of three grasses (five accessions). The PMC will deliver 195 lbs (PLS) of upper elevation grasses and 135 lbs (PLS) of lower elevation grasses. This project is expected to be complete in 2009. All seed is planned to be delivered in the fall of 2009. Activities in 2008 included wild seed collection and seed increase field establishment of high and low elevation ecotypes of three grasses.

II. Accessions Involved

Accessions included for the Steven's Canyon Road revegetation project in 2008 are listed in Table 1. This table also displays activities performed by PMC staff.

Table 1. Accessions involved for the Steven's Canyon Road revegetation project in 2008.

Species	Common Name	Code	Accession Number	Activity in 2008[1]
Upper Elevation				
Elymus glaucus	blue wildrye	ELGL	9079518	Col, sfp
Festuca rubra	red fescue	FERU	9079519	Col, sfp
Bromus carinatus	California brome	BRCA5	9079531	Col, sfp
Lower Elevation				
Elymus glaucus	blue wildrye	ELGL	9079520	Sfp
Festuca rubra	red fescue	FERU	9079521	Sfp

1- sfp= seed increase, col= collected plant materials

III. Wild Seed Collection

PMC staff was responsible for collecting seed from the park to establish the seed increase fields. Collection boundaries were determined by park staff. The upper collection zone was the intersection of Steven's Canyon Rd. and Paradise Rd. down to the intersection of

Steven's Creek and Steven's Canyon Rd. The lower collection zone was defined as the intersection of Backbone Ridge and Steven's Canyon Rd. down to the entrance station near the intersection of Steven's Canyon Rd. and SR 123. The dominant *Bromus* species along the upper section of the road was determined to be *Bromus inermis* (a non-native plant). This species was not collected by PMC staff. Few plants of *Bromus carinatus* were found along the upper roadsides, but it was very limited.

Table 2. Wild collections for the Steven's Canyon Road revegetation project in 2008.

Species	Accession Number	Collection dates	Amount Collected
Upper Elevation			
Elymus glaucus	9079518	August 26-28	152 g
Festuca rubra	9079519	August 26-28	1052 g
Bromus carinatus	9079531	August 26-28	10 g

Seeds were brought back to the PMC greenhouses to dry. Seed was cleaned and then informal germination tests were performed on both high and low ecotypes of *Elymus glaucus* and *Festuca rubra* prior to sowing.

IV. Field Seed Increase Activities

All of the fields that were seeded in the fall of 2007 emerged well and grew vigorously. Only the low elevation ecotypes of *E. glaucus*, *F. rubra*, and the high elevation ecotype of *B. carinatus* flowered and set seed in summer of 2008. All three fields were harvested using a seed stripper.

Table 3. Seed Harvested for Steven's Canyon Road Revegetation Project at Corvallis Plant Materials Center in 2008.

Species	Accession Number	Field size	Harvest date	Method	Yield
Upper Elevation					
Bromus carinatus	9079531	0.001	July 10-15	seed stripper	2.2 lbs
Lower Elevation					
Elymus glaucus	9079520	0.2	July 7	seed stripper	30 lbs
Festuca rubra	9079521	0.37	July 5	seed stripper	6.6 lbs

2008 Field Seed Production Notes:

All fields were fertilized in October 2008 with 25 lbs/ac nitrogen (N), and in February 2008 with 50 lbs/ac N plus 15 lbs/ac sulfur (S). Weed control within the plots was mainly performed by hand-hoeing and rouging, and broadleaf herbicides. Field borders were cultivated periodically throughout the year. After harvest, fields were burned using

drip torches. In mid October of 2008, a pre-emergent herbicide, Outlook®, was applied to all fields.

Figure 1. The PMC's new precision cone-seeder equipped with a carbon-banding unit.

In September and October, fields were sown using the PMC's new precision cone-seeder. This type of seeder is calibrated to drill a programmed amount of seed over a programmed area. The PMC staff set the seeder for intervals of 24ft. Pre-weighed packets were fed into the seed drill at 24 ft intervals. It is very precise and is a good choice for drilling limited amounts of wild-collected seed. This new seeder is a huge improvement over the old Plantet Jr seeder.

Table 4. Seed increase field establishment in the fall of 2008 for the Steven's Canyon Road revegetation project.

Species	Accession Number	Date	Seeding method	Bulk Seeding rate	Area sown
Upper Elevation					
Elymus glaucus	9079518	23-Oct	cone seeder	10 lbs/ac	0.15
Festuca rubra	9079519	14-Oct	cone seeder	5 lbs/ac	0.2
Bromus carinatus	9079531	8-Oct	cone seeder	15 lbs/ ac	0.16

V. Container Plant Production.

No containerized production occurred for this project in 2008.

VI. Delivery of Plant Materials.

No materials were delivered in 2008. Seed that was produced in 2008 will be kept in the seed storage facilities at the PMC. Only the blue wild rye seed was tested for purity and germination. It was found to be 98.68 % pure and has a germination of 68%.

Table 5. Seed currently in storage as of February 10, 2008 for the Steven's Canyon Rd revegetation project at the PMC.

Species	**Code**	**Accession Number**	**Amount in Storage**
Lower Elevation			
Elymus glaucus	ELGL	9079520	30 lbs
Festuca rubra	FERU	9079521	6 lbs

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NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

December 20, 2009

THE 2009 MOUNT RAINIER NATIONAL PARK ANNUAL REPORT:
Steven's Canyon Road Revegetation Project

I. Brief Background of Project

Figure 1. PMC staff members looking for perennial grass weeds in the red fescue (*Festuca rubra*) seed increase field for the Steven's Canyon Road revegetation project in 2009.

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the National Park Service (NPS) in 2007 to provide native plant materials for ecological restoration along Steven's Canyon Road following road construction. It was agreed that the PMC would establish and maintain seed increase fields of three grasses (five accessions). The PMC will deliver 195 lbs (PLS) of upper elevation grasses and 135 lbs (PLS) of lower elevation grasses. This project was expected to be complete in 2009, but construction has been delayed until 2011.The project should be completed by the fall of 2011 and all seed will be delivered to the park then. Activities in 2009 included maintenance and harvest of five seed increase fields of high and low elevation ecotypes of three grasses. All seed production goals were exceeded for this contract except for the high elevation blue wild rye. This field will be harvested again in 2010.

II. Accessions Involved

Accessions included for the Steven's Canyon Road revegetation project in 2009 are listed in Table 1. This table also displays activities performed by PMC staff.

Table 1. Accessions involved for the Steven's Canyon Road revegetation project in 2009.

Species	Common Name	Code	Accession Number	Activity in 2009[1]
Upper Elevation				
Elymus glaucus	blue wildrye	ELGL	9079518	sfp
Festuca rubra	red fescue	FERU	9079519	sfp
Bromus carinatus	california brome	BRCA5	9079531	sfp
Lower Elevation				
Elymus glaucus	blue wildrye	ELGL	9079520	sfp
Festuca rubra	red fescue	FERU	9079521	sfp

1- sfp= seed increase, col= collected plant materials

III. Field Seed Increase Activities

All of the fields that were seeded in the fall of 2008 emerged well and grew vigorously. All five seed increase fields flowered this year. The lower elevation blue wildrye field had very even ripening this year, so it was also swathed and combined.

Figure 2. Blue wild rye (*Elymus glaucus*) seed increase field at the Corvallis Plant Materials Center.

The upper and lower elevation fescue fields were very tall and thick with seed. The seed heads were so dense that the seed stripper could not be used. Both fields were swathed

and then combined. The brome field did not mature evenly this year. The seed on the outside rows were shattering while the seed on the inside rows was still very green and soft. The seed stripper was used on the perimeter of the field to collect the early ripening seed. The field was swathed a couple of days later, and then combined when fully dried. Using this combination of harvest methods maximized genetic diversity and boosted seed yields. The high elevation blue wildrye field is located at another research farm that is about five miles from the PMC's main farm. Moving equipment between the farms can be complicated and time consuming so, this year, the blue wildrye was harvested using the "moon rover". It is a self-propelled swather with a conveyor belt to move cut material up off the field to be stuffed into large collection bags. It is a small machine that can be loaded onto a trailer and driven over to the other farm. This is much easier than trying to drive a swather and a combine across town. Harvesting with the moon rover means that all the collected material has to be laid on tarps in a shed to dry. Once dry, the material was pitch-forked into a stationary combine.

Table 3. Seed Harvested for Steven's Canyon Road Revegetation Project at Corvallis Plant Materials Center in 2009.

Species	**Accession Number**	**Field size**	**Harvest date**	**Method**	**Yield**
Upper Elevation					
Elymus glaucus	9079518	0.3	July 1	moon rover	14 lbs
Festuca rubra	9079519	0.46	June 22-July 7	swath/combine	134 lbs
Bromus carinatus	9079531	0.17	June 24 – July 7	seed strip swath/combine	142 lbs
Lower Elevation					
Elymus glaucus	9079520	0.2	June 28-July 8	swath/combine	129 lbs
Festuca rubra	9079521	0.37	June 20-June 26	swath/combine	186 lbs

2009 Field Seed Production Notes:
All fields were fertilized in October 2008 with 25 lbs/ac nitrogen (N), and in February 2009 with 50 lbs/ac N plus 15 lbs/ac sulfur (S). Weed control within the plots was mainly performed by hand-hoeing and rouging, and broadleaf herbicides. Field borders were cultivated periodically throughout the year. The high elevation blue wildrye field was mowed with a flail chopper after harvest.

V. Container Plant Production.
No containierized production occurred for this project in 2009.

VI. Delivery of Plant Materials.

No materials were delivered in 2009. Seed that was produced in 2008 and 2009 will be kept in the seed storage facilities at the PMC.

Table 5. Seed currently in storage as of December 30, 2009 for the Steven's Canyon Rd revegetation project at the PMC.

Species	**Code**	**Seed lot**	**Bulk Amount in Storage**
Lower Elevation			
Elymus glaucus	ELGL	SG1-08-MR520	30 lbs
	ELGL	SG1-09-MR520	129 lbs
Festuca rubra	FERU	SG1-08-MR521	6 lbs
	FERU	SG1-09-MR521	186 lbs
Upper Elevation			
Elymus glaucus	ELGL	SG1-09-MR518	14 lbs
Festuca rubra	FERU	SG1-09-MR519	134 lbs
Bromus carinatus	BRCA5	SG2-09-MR531	142 lbs

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

February 10, 2009

THE 2008 MOUNT RAINIER NATIONAL PARK ANNUAL REPORT:
Nisqually Entrance Revegetation Project

I. Brief Background of Project

Figure 1. Red fescue seed increase field for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center, December 28, 2008.

The Corvallis Plant Materials Center (PMC) entered into a new agreement with Mount Rainier National Park in 2008 to provide native plant materials for the ecological restoration of the Nisqually Entrance road construction area. It was agreed that the PMC would produce a minimum of 120 lbs (PLS) of *Elymus glaucus*, 200 lbs (PLS) of *Bromus carinatus*, and 35 lbs (PLS) of *Festuca rubra*. The project is expected to be completed in 2011.

Activities in 2008 included collection and seed cleaning of three grasses as well as establishment of two grass seed increase fields (one by plugs and one by direct seeding).

II. Accessions Involved

Accessions included for the Nisqually Entrance are listed in Table 1. This table also displays activities performed by PMC staff in 2008.

Table 1. Accessions involved for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center in 2008.

Species	Common name	Symbol	Accession number	2008 Activity[1]
Elymus glaucus	blue wildrye	ELGL	9079593	Col
Bromus carinatus	California brome	BRCA5	9079592	Col, pxn
Festuca rubra	red fescue	FERU	9079594	Col, sfp

1- col=wild seed collection, pxn= plant production sfp= seed field production,

III. Wild Seed Collection

Park staff was responsible for collecting seed from the park to establish the seed increase fields. Collection boundaries were determined by park staff as along roadsides of the Nisqually Entrance to Paradise Rd. Few plants of *Bromus carinatus* were found along the roadsides so seed collection was limited.

Table 2. Wild seed collections performed for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center in 2008.

Species	Code	Accession #	Amount collected
Elymus glaucus	ELGL	9079593	1275 g
Bromus carinatus	BRCA5	9079592	15 g
Festuca rubra	FERU	9079594	499 g

IV. Plant Production

Only a small amount of *B. carinatus* seed was collected in 2008. In order to meet contract goals, the seed increase field will be established using plugs. On October 20, 2008, 15 g grams of seed were sown in 9800 cone-tainers filled with moistened media (Sunshine #1, a special peat-based soil-less mix) amended with a balanced slow-release fertilizer and micronutrients. Plants were grown in a greenhouse throughout the winter.

V. Seed Increase

In October, *Festuca rubra* field was sown using the PMC's new precision cone-seeder. This field was established in the fall of 2008 because it will not produce seed until 2010. The blue wildrye field will be established in the spring of 2009. *B. carinatus* plugs that were grown in the fall of 2008 will be transplanted into a seed increase field in March of 2009.

Table 3. Field establishment in 2008 for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center.

Species	Accession Number	Date seeded	Seeding rate	Field Size (ac)
Bromus carinatus	9079592	30-Oct	sown in containers	0.01
Festuca rubra	9079594	14-Oct	4 lbs/ac	0.2

VI. Delivery of Plant Materials

There were no deliveries made in 2008.

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NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
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December 10, 2009

THE 2009 MOUNT RAINIER NATIONAL PARK ANNUAL REPORT:
Nisqually Entrance Revegetation Project

I. Brief Background of Project

Figure 1. Blue wildrye (*Elymus glaucus*) increase field for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center, May 5, 2009.

The Corvallis Plant Materials Center (PMC) entered into a new agreement with Mount Rainier National Park in 2008 to provide native plant materials for the ecological restoration of the Nisqually Entrance road construction area. It was agreed that the PMC would produce a minimum of 120 lbs (PLS) of *Elymus glaucus*, 200 lbs (PLS) of *Bromus carinatus*, and 35 lbs (PLS) of *Festuca rubra*. The project is expected to be completed in 2011.

Activities in 2009 included maintenance and harvest of two seed increase fields as well as establishment of a blue wildrye seed increase field and expansion of the brome seed increase field.

II. Accessions Involved

Accessions included for the Nisqually Entrance are listed in Table 1. This table also displays activities performed by PMC staff in 2009.

Table 1. Accessions involved for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center in 2009.

Species	Common name	Symbol	Accession number	2009 Activity[1]
Elymus glaucus	blue wildrye	ELGL	9079593	sfp
Bromus carinatus	California brome	BRCA5	9079592	sfp
Festuca rubra	red fescue	FERU	9079594	sfp

1- col=wild seed collection, pxn= plant production sfp= seed field production,

III. Seed Increase

In early April, 2009, the blue wildrye field was sown using the PMC's new precision cone-seeder. The seeds germinated and emerged within two weeks and the stand was very vigorous and thick. The field was irrigated every two weeks through July as needed. The field flowered which is rare for a first year, spring-sown field. Upon close inspection, it was found that almost all of the seeds were empty. It is unknown if the irrigation affected pollination of the flowers. The field wasn't harvested.

The fescue and brome fields that were sown in the fall of 2008 both flowered in 2009. The brome field flowered profusely and was very vigorous. Even though the field was very small it was swathed and combined. The field was going to reach peak maturity over the 4th of July weekend, so it was swathed to keep the seed from shattering over the long weekend. This seemed to be a good choice because the very small field produced 17.5 lbs! Only about 5% of plants in the fescue field flowered this year. This is typical, since most plants don't flower until their second year.

Table 2. Seed Harvested for the Nisqually Entrance Revegetation Project at Corvallis Plant Materials Center in 2009.

Species	Accession Number	Field Size (ac)	Harvest date	Method	Yield
Bromus carinatus	9079592	0.01	July2/July 15	swath/combine	17.5 lbs
Festuca rubra	9079594	0.2	July 20	seed strip	5 lbs

Wild seed collections weren't sufficient to plant a 0.5 acre field of brome. Wild collections were supplemented with the seed that was produced from the brome field in 2009. On October 5th, using the cone seeder, the field was expanded to 0.5 acres. Heavy fall rains lasted about four days after sowing. Seedlings had emerged and were looking very healthy within two weeks.

Table 3. Field establishment in 2009 for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center.

Species	Accession Number	Date seeded	Seeding rate	Field Size (ac)
Bromus carinatus	9079592	Oct 4	9 lbs/ac	0.5
Elymus glaucus	9079593	April 4	10 lbs/ac	0.3

All fields were fertilized in October 2009 (except new brome seedlings) with 25 lbs/ac nitrogen. Weed control within the plots was mainly performed by hand-hoeing and rouging, and using broadleaf herbicides. Field borders were cultivated periodically throughout the year. After harvest, the fescue field was burned using drip torches, and the brome and blue wildrye fields were mowed using a flail chopper.

VI. Delivery of Plant Materials

There were no deliveries made in 2009. Seed that was produced this year will remain in storage until requested.

Table 4. Seed in storage in 2009 for the Nisqually Entrance Revegetation Project with Corvallis Plant Materials Center.

Species	Seed lot	Amt
Bromus carinatus	SG1-09-MR592	13 lbs
Festuca rubra	SG1-09-MR594	5 lbs

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NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
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November 20, 2008

THE 2008 MOUNT RAINIER NATIONAL PARK ANNUAL REPORT:
State Road 123 Revegetation Project

Figure 1. California brome seed increase field.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with Mount Rainier National Park in 2004 to provide native plant materials for the ecological restoration of the State Road 123 construction area. It was agreed that the PMC would produce a minimum of 25 lbs (PLS) of *Elymus glaucus*, 50 lbs (PLS) of *Bromus carinatus*, and 25 lbs (PLS) of *Festuca rubra*. A final seed delivery was scheduled for the fall of 2007. The construction project was delayed and final delivery occurred in 2008.

Activities in 2008 included maintenance, harvest and seed cleaning of three grass seed increase fields.

II. Accessions Involved

Accessions included for State Road 123 are listed in Table 1. This table also displays activities performed by PMC staff in 2008.

Table 1. Accessions involved for State Road 123 Revegetation Project with Corvallis Plant Materials Center in 2008.

Scientific Name	Common Name	Symbol	Accession #	2008 Activity[1]
Bromus carinatus	California brome	BRCA5	9079309	Sfp, dlv
Elymus glaucus	blue wildrye	ELGL	9079310	Dlv
Festuca rubra	red fescue	FERU	9079348	Sfp, dlv

1- sfp= seed field production, dlv= delivery.

III. Experimental Propagation

There was no experimental propagation in 2008.

IV. Seed Increase

The older sections of the *Bromus carinatus* and *Festuca rubra* fields looked fair after winter. The new sections of the *B. carinatus* and *F. rubra* fields were growing quite slowly in the spring, but once the temperatures reached 65° (F) the plants grew vigorously. The *F. rubra* fields were very thick and covered with seed heads. The *B. carinatus* fields weren't very tall, but seed production was very high.

Table 2. Seed Harvested for State Road 123 Revegetation Project at Corvallis Plant Materials Center in 2008.

Scientific Name	Accession #	Size of field (ac)	Harvest Date	Method	Yield
Bromus carinatus	9079309	0.18	6/25, 6/30	seed stripper	145 lbs
Festuca rubra	9079348	0.2	6/25, 7/8	swath/ combine	127 lbs

2008 Field Seed Production Notes:

All fields were fertilized in October 2007 with 25 lbs/ac nitrogen (N), and in February 2008 with 50 lbs/ac N plus 15 lbs/ac sulfur (S). Weed control within the plots was mainly performed by hand-hoeing and rouging, and broadleaf herbicides. Field borders were cultivated periodically throughout the year. After harvest, fields were burned using drip torches. In mid October of 2007, a pre-emergent herbicide, Outlook®, was applied to all fields. The herbicide didn't cause any injury to the established plants and fields were very clean. The PMC will continue to use this herbicide as a weed control method on second year fields. It may not be necessary to use it every year on the fields. More

research on timing of applications will be performed on other grass seed increase fields at the PMC.

V. Delivery of Plant Materials

Seed production was so high in 2008 that the Park couldn't use all of the seed in 2008. Approximately 100 lbs of brome seed and 102 lbs of fescue seed was left at the PMC to be used in 2009 or 2010 in areas that didn't establish well from the initial seeding. Seed will remain in the PMC seed storage facilities until requested.

Table 4. Seed delivered on September 24, 2008 to Mount Rainier National Park.

Scientific Name	Symbol	Accession #	Seed lot	Bulk weight (lbs)	PLS weight (lbs)
Bromus carinatus	BRCA5	9079309	SG1-07-MR309	55	50
Bromus carinatus	BRCA5	9079309	SG1-08-MR309	54	42
Elymus glaucus	ELGL	9079310	SG1-05-MR310	81	76
Elymus glaucus	ELGL	9079310	SG1-06-MR310	62	59
Festuca rubra	FERU	9079348	SG1-07-MR485	53	45
Festuca rubra	FERU	9079348	SG1-08-MR485	25.5	23
				330.5	295

CORVALLIS PLANT MATERIALS CENTER
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November 30, 2008

THE 2008 OLYMPIC NATIONAL PARK ANNUAL REPORT:
Elwha River Ecosystem and Fisheries Restoration

Figure 1. *Eriophyllum lanatum* seedlings growing in the Corvallis PMC greenhouse, February 15, 2009.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with Olympic National Park in 2004 to provide native plant materials for the ecological restoration of Lake Mills and Lake Aldwell following the removal of two high head dams on the Elwha River. It was agreed that the PMC would propagate a minimum of 4000 lbs of grass and forb seed. A more detailed production list will be determined by PMC and NPS staffs as restoration plans are finalized. Current plans estimate that the dams might be removed in 2012. Most of the fields that were in production would not survive until 2012 and the seed that is produced from the existing fields (and from previous years) will not be viable in 2012. Possible exceptions are the sedges and legumes. These plants and seeds are long-

lived. Seed production on these species will continue in 2009 and future years. Production on all other species will be halted until dam removal plans have been finalized and demolition has begun.

Activities in 2008 included collecting wild seed of *Bromus carinatus, Elymus glaucus and Eriophyllum lanatum*, germination trials on one legume, and establishment and maintenance of seed production fields including two forbs and two sedges. Details are provided below.

II. Accessions Involved

Table1. Accessions involved and activities performed in 2008 for Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis Plant Materials Center.

Species	Common name	Symbol	Accession number	2008 Activity[1]
Artemisia suksdorfii	coastal wormwood	ARSU4	9079400	Sfp
Carex deweyana	dewey sedge	CADE9	9079330	Sfp, pxn
Carex pachystachya	thick-headed sedge	CAPA14	9079329	Sfp
Eriophyllum lanatum	wooly sunflower	ERLA	9079441	Pxn, col
Elymus glaucus	blue wildrye	ELGL	9079334	Col
Bromus complex	Brome complex	BR sp	9079332	Col
Lathryus polyphyllus	leafy peavine	LAPO	9079517	Trl

1- sfp= seed increase, trl= production research trial, pxn= plant production, col= collected plant materials from park,

III. Native Seed and Plant Collections

Two trips were made to the Elwha River this year. *Bromus* seed was collected on July 16-18th and *E. glaucus* seed was collected on August 6-8th. NPS staff collected *E. lanatum* seed on August 30th and mailed it to the PMC. The grass seed will remain in storage until dam removal is finalized and seed production is set to begin. The *E. lanatum* seed will be used to establish a seed increase field in spring of 2009.

IV. Experimental Propagation

NPS staff collected seeds of *Lathyrus polyphyllus* in 2007. Informal germination tests were set up for this species since it had never been propagated at the Corvallis PMC. Nine sets of 100 seeds were counted, weighed and placed in plastic germination boxes on moistened germination paper and stored in a growth chamber set at 8°(C) days and 4°(C) nights with 8 hours of light. After stratification, boxes were moved to a tabletop near a sunny window and were exposed to natural room temperatures (average 21° (C) days and 13° (C) nights). Treatments include 45 or 90 days cold-moist stratification or no cold-moist stratification (warm). Each treatment contained three replications per species.

Table 2. Results of *Lathryus polyphyllus* germination trials at the Corvallis PMC.

Treatment	Average germination
Warm	15%
45-day cold-moist stratification	65%
90-day cold-moist stratification	68%

V. Cutting Block Maintenance

The cutting blocks were removed in 2008 due to pests and project changes. Willows were severely damaged in 2007 by a stem borer, and only a few plants survived.

VI. Field Production Activities

All seed increase fields were removed except the *Carex pachystachya*, *Carex deweyana*, and *Artemisia suksdorfii* fields. The carexes have long lived seeds that will still be viable when the seed is needed for restoration and the fields have been created using transplants. These fields have been time consuming to create and will be continued. The *A. suksdorfii* field is large and harvest techniques are still being experimented with.

Figure 1. A lab-sized gravity table was added to the PMC's seed cleaning facilities this year.

Weed seeds are often a problem when farming native plants. Some weeds cannot easily be removed from the field or be avoided during harvest. Some of these weed seeds can be removed with seed cleaning machines. In 2008, the PMC acquired a gravity table. This machine is able to separate weeds seeds such as *Poa annua* from the sedge seed lots.

Field Production Notes for 2008:
Weed control in sedge and sage fields was primarily performed by hand (mainly to remove exotic perennial grasses) and by spot-spraying with glyphosate. Borders were tilled. Broadleaf herbicides (Bison and Banvel) were applied

to sedge fields in February and May.

Harvest Notes for 2008:

The "moon rover" was used this year on the *C. pachystachya* field. The field is entering its peak production years. The plants were very vigorous in 2008. The "moon rover" swathed the material, then it was moved to an open shed on tarps to dry. Once dry, material was run through a stationary Winterstieger plot combine. Although labor intensive, this method produced 58 lbs of seed.

C. deweyana plants flowered this year, but these plants are still young and have not reached full maturity. Seeds were hand harvested, which was very labor intensive. The moon rover would be a good choice for this field as the plants get larger. When the field is at least 0.25 acres, swathing and combining will be an efficient harvest method. This field will be retained and expanded.

Fall rain started later than usual in 2008 and this seemed to assist in the seed maturation of the *A. suksdorfii* field. The plants are large and healthy and this year they were covered with blooms in late August. The seed stripper was used to harvest a small section of the field in mid Septmeber. It stripped the seeds from the plants without removing too much plant material. It seemed to be a good choice of harvest method.

Table 3. Seed harvest in 2008 for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis PMC.

Species	Field size (ac)	Date(s)	Method	Yield	Comments
Carex deweyana	0.02	June 24	hand	2 lbs	small stand, high vigor
Carex pachystachya	0.22	June 29	moon rover	58 lbs	good stand, medium vigor
Artemisia suksdorfii	0.01	Sept 17	seed stripper	1 lb	good stand, high vigor

VII. Container Plant Production

A small amount of *E. lanatum* seed was collected in 2008 and sown into 2450 containers filled with moistened media (Sunshine #1, a peat-based soil-less media) amended with micronutrients (MicroMax) and a balanced slow-release fertilizer. Trays were placed in a walk-in cooler and were removed late December. Plants will be transplanted into a field in spring of 2009.

VIII. Delivery of Plant Materials

No seed deliveries were made in 2008. All seed is being held at the PMC in cold storage until requested.

Table 4. Seed in storage at the Corvallis PMC, December 5, 2008.

Scientific name	Common name	Amount in storage
Forbs		
Achillea millefolium	yarrow	120 lbs
Anaphalis margaritacea	pearly everlasting	0.5 lbs
Artemisia suksdorfii	coastal wormwood	2 lbs
Epilobium ciliatum	fringed willowherb	26 lbs
Epilobium angustifolium	tall fireweed	0.5 lbs
Aruncus dioceous	goastbeard	0.5 lbs
Grasses, sedge, and rushes		
Agrostis exerata	spiked bentgrass	18 lbs
Bromus complex	brome species	309 lbs
Bromus vulgaris	Columbia brome	10 lbs
Carex deweyana	Dewey's sedge	8 lbs
Carex hendersonii	Henderson's sedge	0.1 lbs
Carex pachystachya	thick-headed sedge	80.4
Deschampsia elongata	slender hairgrass	192 lbs
Elymus glaucus	blue wildrye	214.5 lbs
Juncus bolanderi	Bolander's rush	0.2 lbs
Luzula parviflora	Many-flowered woodrush	0.1 lbs
Luzula comosa	common woodrush	0.2 lbs

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

January 30, 2010

THE 2009 OLYMPIC NATIONAL PARK ANNUAL REPORT:
Elwha River Ecosystem and Fisheries Restoration

Figure 1.Oregon sunshine (*Eriophyllum lanatum)* seed increase field at the Corvallis PMC, June 30, 2009.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with Olympic National Park in 2004 to provide native plant materials for the ecological restoration of Lake Mills and Lake Aldwell following the removal of two high head dams on the Elwha River. Current plans estimate that the dams will be removed in 2012. The PMC has agreed to produce 4355 lbs of four grass species, 450 lbs of two sedge species, and 430 lbs of three forbs.

Activities in 2009 included collecting wild seed of four grasses and one forb and establishment, maintenance, and harvest of seed production fields including two grasses, two forbs and two sedges. Details are provided below.

II. Accessions Involved

Table1. Accessions involved and activities performed in 2009 for Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis Plant Materials Center.

Species	Common name	Symbol	Accession number	2009 Activity[1]
Artemisia suksdorfii	coastal wormwood	ARSU4	9079400	Sfp
Carex deweyana	dewey sedge	CADE9	9079330	Sfp
Carex pachystachya	thick-headed sedge	CAPA14	9079329	Sfp
Eriophyllum lanatum	wooly sunflower	ERLA	9079441	Pxn, Col
Elymus glaucus	blue wildrye	ELGL	9079334	Sfp,Col
Bromus complex	Brome complex	BR sp	9079332	Sfp,Col
Deschampsia elongata	slender hairgrass	DEEL	9079335	Col
Agrostis exerata	spike bentgrass	AGEX	9079401	Col

1- sfp= seed increase, trl= production research trial, pxn= plant production, col= collected plant materials from park,

III. Native Seed and Plant Collections

Two trips were made to the Elwha River this year. *Bromus* seed was collected on July 15-17th and *Elymus glaucus*, *Deschampsia elongata*, and *Agrostis exerata* seed was collected on August 5-7th. NPS staff collected *E. lanatum* seed on August 30th and mailed it to the PMC. The collected grass seed was bulked with collections from previous years.

Table 2. Native seed collections performed in 2009 or Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis Plant Materials Center.

Species	Symbol	Accession number	Dates	Amount
Eriophyllum lanatum	ERLA	9079441	8-24 9-30	15 g
Elymus glaucus	ELGL	9079334	August 5-7	2.5 lbs
Bromus complex	BR sp	9079332	July 15-17	4 lbs
Deschampsia elongata	DEEL	9079335	August 5-7	1 lb
Agrostis exerata	AGEX	9079401	August 5-7	0.5 lbs

IV. Experimental Propagation

There was no experimental propagation in 2009.

V. Field Production Activities

Various methods of combining were experimented with this summer. The PMC's Hege plot combine was equipped with a header that allowed fields to be directly combined. This was not very effective for the *Carex pachystachya*. The *C. pachystachya* was not dry

enough and it was difficult to remove all the seeds from the stems. The field was then swathed and three days later, combined using a Wintersteger combine fitted with a pickup belt. The few days of drying made quite a difference in how easily the seeds would come off the stems. This method seemed to work well and was not labor intensive. Some shattering occurred when the plants were swathed. Yields were lower this year compared to last year, this could be due to the amount of seed that was shattered during the swathing process. The PMC will try the moon rover again in 2010 and see if yields are comparable to the 2008 harvest (when the moon rover was used and yields were high).

Many of the original *C. deweyana* plants did not emerge this spring. The plants were four years old and it was concluded that they died of old age. Two year old plants in the field looked healthy and had high survival. Seeds from these plants were harvested by hand.

The *A. suksdorfii* field was harvested using the seed stripper. The field was getting very weedy and the plants appeared to be less vigorous this year. Yields were also down. The field was plowed under in the fall. A new field will be started in 2010.

A field of *E. lanatum* was established in February of 2009 using greenhouse grown transplants. The transplants were incredibly vigorous and flowered in the summer. This is uncommon for *E. lanatum*. The field was directly combined using the Hege plot combine. This method of harvest was very efficient. The plants from the Elwha population have seed that shatters more readily than other populations grown at the PMC. Swathing before combining would shatter a lot of seed.

Table 3. Seed harvest in 2009 for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis PMC.

Species	**Area Harvested**	**Date(s)**	**Method**	**Yield**	**Comments**
Artemisia suksdorfii	0.1	Aug 27	Seed stripper	800 g	most of field was very weedy and low in vigor
Carex deweyana	0.001	July 3	Hand	26 g	spotty field, low vigor. New plants look great
Carex pachystachya	0.22	June 30/ July 2	swath/ combine	20 lbs	nice, established field
Eriophyllum lanatum	0.15	Sept 14	direct combine	19 lbs	very vigorous

Field Production Notes for 2009:

Weed control in all fields was primarily performed by hand (mainly to remove exotic perennial grasses) and by spot-spraying with glyphosate. Borders were tilled. Broadleaf herbicides (Bison and Banvel) were applied to sedge fields in February and May. The sedge fields were also fertilized in February. After harvest, the sage and Oregon sunshine fields were mowed and the sedge field was burned using drip torches.

In the fall, some of the large grass fields were established. Three acre fields of Brome and blue wildrye are needed for this project. The PMC has been saving wild collected seed from previous years to sow these large fields. In early October, fields were sown using the PMC's precision cone seeder. This was a very slow way to plant three acres, but the planter is extremely accurate and seed is not wasted. In addition to the two grass fields, the Oregon sunshine field was also expanded. Within two weeks the seedlings had

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Figure 2. Blue wildrye (*Elymus glaucus*) seed increase field at the Corvallis Plant Materials Center for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement, December 30, 2009.

Table 4. Seed increase field establishment for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis PMC, October 2009

Species	**Accession Number**	**Date seeded**	**Seeding rate**	**Field Size (ac)**
Elymus glaucus	9079334	2-Oct	10 lbs/ ac	2.2
Bromus complex	9079332	3-Oct	8 lbs/ ac	1.6
Eriophyllum lanatum	9079441	4-Oct	5 lbs/ ac	0.3
				4.1

emerged. Unexpectedly, many of the Oregon sunshine seeds germinated in the fall. This species usually has a large percent of dormant seeds that will not germinate until spring.

In early December, the PMC was hit with very cold temperatures lasting more than two weeks. Soil probes at the OSU field lab (next door to the PMC) measured freezing temperatures as deep as 8” down in the soil. Whipping winds and temperatures in the teens were very hard on the seedlings. When the cold ended, the seedlings were inundated with water from heavy rains. Surprisingly, the seedlings in the grass fields appear unharmed. The Oregon sunshine seedlings were damaged, though. Hopefully, many new seedlings will emerge in the spring and fill in the rows.

VI. Container Plant Production

There was no container plant production for this project in 2009.

VII. Delivery of Plant Materials

Two seed deliveries occurred in 2009. In July, some grass and forb seed from 2005 was delivered to the park. In November, park employees attended an Open House at the PMC and picked up older wild collections of species that are going to be grown at the park’s propagation facilities rather than at the PMC.

Table 4. Seed Delivered to the Park by the Corvallis PMC in 2009.

Scientific name	Common name	Seed lot	Amount
Forbs			
Achillea millefolium	yarrow	SG1-05-ER349	70 lbs
Anaphalis margaritacea	pearly everlasting	SG1-06-ER350	0.5 lb
Epilobium ciliatum	fringed willowherb	SG1-05-ER346	26 lbs
Epilobium angustifolium	tall fireweed	SG1-06-ER345	0.5 lb
Aruncus dioceous	goatsbeard	SNC-05-ER370	0.2 lb
Aruncus dioceous	goatsbeard	SG1-07-ER370	0.3 lb
Grasses, sedge, and rushes			
Bromus complex	brome species	SG1-05-ER332	38 lbs
Bromus vulgaris	Columbia brome	SG1-05-ER333	6 lbs
Bromus vulgaris	Columbia brome	SG1-06-ER333	0.5 lb
Carex hendersonii	Henderson's sedge	SG1-05-ER331	0.1 lb
Deschampsia elongata	slender hairgrass	SG1-05-ER335	61 lbs
Elymus glaucus	blue wildrye	SG1-05-ER334	10.5 lbs
Juncus bolanderi	Bolander's rush	SNC-05-ER371	0.1 lb
Juncus bolanderi	Bolander's rush	SG1-07-ER371	0.1 lb
Luzula parviflora	Many-flowered woodrush	SG1-07-ER337	0.1 lb
Luzula comosa	common woodrush	SG1-06-ER444	0.1 lb
Luzula comosa	common woodrush	SG1-07-ER444	0.1 lb

Table 5. Seed in storage at the Corvallis PMC, December 5, 2009.

Scientific name	Common name	Seed lot	Amount
Forbs			
Achillea millefolium	yarrow	SG1-06-ER349	50 lbs
Artemisia suksdorfii	coastal wormwood	SG1-08-ER400	2 lbs
Artemisia suksdorfii	coastal wormwood	SG1-09-ER400	2 lbs
Eriophyllum lanatum	Oregon sunshine	SG1-09-ER441	17 lbs
Grasses, sedge, and rushes			
Agrostis exerata	spike bentgrass	SG1-07-ER401	18 lbs
Bromus complex	brome species	SG1-06-ER332	195 lbs
Bromus complex	brome species	SG1-07-ER332	71 lbs
Carex deweyana	Dewey's sedge	SG1-06-ER330	0.5 lbs
Carex deweyana	Dewey's sedge	SG1-07-ER330	1 lb
Carex deweyana	Dewey's sedge	SG1-08-ER330	2 lbs
Carex deweyana	Dewey's sedge	SG1-09-ER330	26 g
Carex pachystachya	thick-headed sedge	SG1-05-ER329.	1 lb
Carex pachystachya	thick-headed sedge	SG1-06-ER329	6.5 lbs
Carex pachystachya	thick-headed sedge	SG1-07-ER329	12 lbs
Carex pachystachya	thick-headed sedge	SG1-08-ER329	59 lbs
Carex pachystachya	thick-headed sedge	SG1-09-ER329	22 lbs
Deschampsia elongata	slender hairgrass	SG1-05-ER335	21 lbs
Deschampsia elongata	slender hairgrass	SG1-06-ER335	90 lbs
Deschampsia elongata	slender hairgrass	SG1-07-ER335	20 lbs
Elymus glaucus	blue wildrye	SG1-06-ER334	52 lbs
Elymus glaucus	blue wildrye	SG1-07-ER334	142 lbs

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NATURAL RESOURCES CONSERVATION SERVICE
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December 30, 2009

THE 2009 GOLDEN GATE NATIONAL PARK ANNUAL REPORT:
Marin Headlands Revegetation Project

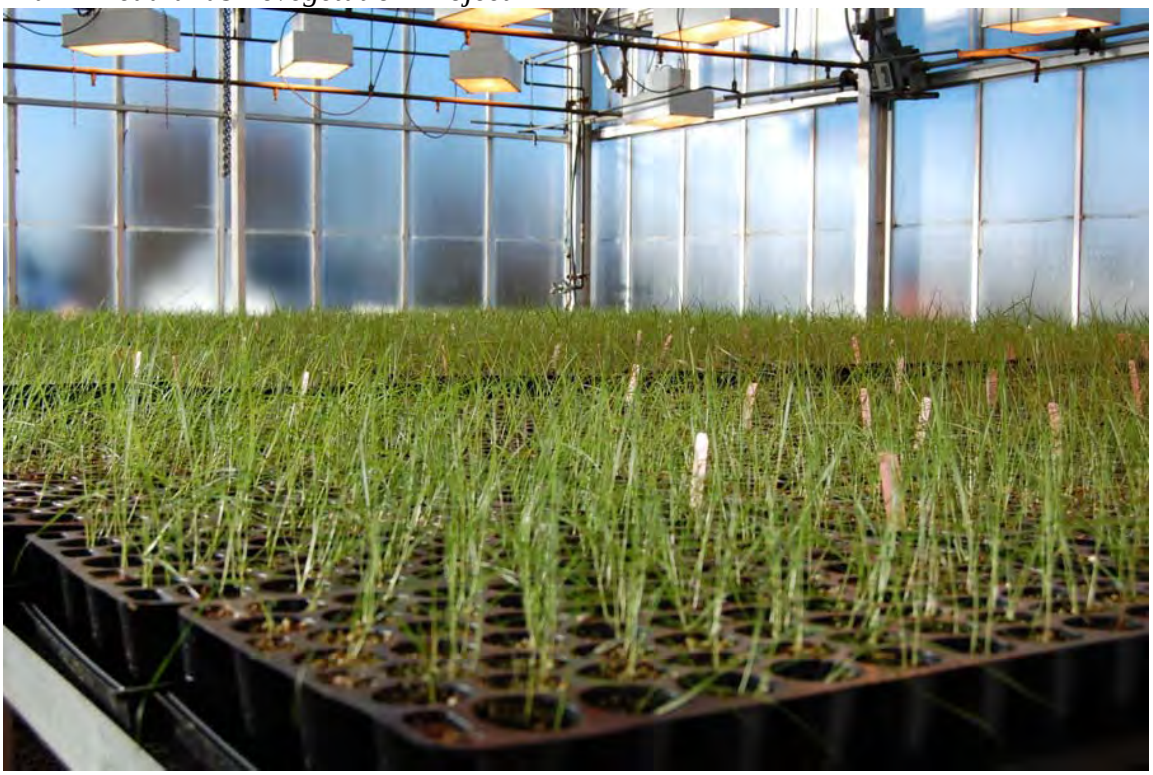

Figure 1. Foothills needlegrass (*Nassella lepida*) seedlings in the PMC greenhouse, December 30, 2009.

I. Brief Background of Project

In 2009, The Corvallis Plant Materials Center (PMC) entered into a new agreement with Golden Gate National Park to provide native plant materials for ecological restoration following road construction in the Marin Headlands. The PMC has agreed to produce 250 lbs of two grasses.

Activities in 2009 included cleaning wild seed that was provided by the park and containerized production of 22,000 grasses.

II. Accessions Involved

Accessions included for the restoration of Marin Headlands are listed in Table 1. This table also displays activities performed by PMC staff in 2009.

Table 1. Accessions involved for the restoration in the Marin Headlands project with the Corvallis Plant Materials Center in 2009.

Species	Common name	Code	Accession	Activity in 2009[1]
Danthonia californica	California oatgrass	DACA	9079621	pxn
Nassella lepida	Foothill's needlegrass	NALE	9079622	pxn

1- col=wild seed collection, pxn= plant production sfp= seed field production,

III. Container Plant Production

Seed was delivered to the PMC on December 1, 2009. Seed was cleaned by PMC and then sown into plugs trays filled with Sunshine #1 (a sterilized peat-based soil-less media) amended with micronutrients (Micromax) and a balanced slow release fertilizer. Trays of *Nassella lepida* were placed in a cold frame and trays of *Danthonia californica* were placed in a warm greenhouse. Both species germinated in their respective places within two weeks. After two weeks in the cold frame, the *N. lepida* was moved into the warm greenhouse.

Plants will be transplanted out into seed increase fields in March.

Table 2. Container plant production for the Marin Headlands project with the Corvallis Plant Materials Center in 2009.

Species	Amt of clean seed	# of containers produced
Danthonia californica	350 g	16,352
Nassella lepida	43g	6500

VI. Delivery of Plant Materials

There were no deliveries made in 2009.

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
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December 30, 2009

THE 2009 SAN JUAN ISLANDS NATIONAL HISTORICAL PARK ANNUAL REPORT: *American Camp Prairie Restoration Project*

I. Brief Background of Project

Figure 1. Sitka brome (*Bromus sitchensis*) seed increase field for the American Camp Prairie Restoration Project with Corvallis Plant Materials Center, December 20, 2009.

The Corvallis Plant Materials Center (PMC) entered into a new agreement with San Juan Islands National Historical Park in 2009 to provide native plant materials for the restoration of the American Camp Prairie. It was agreed that the PMC would produce a minimum of 900 lbs (PLS) of *Elymus glaucus*, 900 lbs (PLS) of *Bromus sitchensis*, and 440 lbs (PLS) of *Festuca roemerii*. The project is expected to be completed in 2013.

Activities in 2009 included establishment and maintenance of three seed increase fields as well as additional expansion in the fall of 2009 of the fescue seed increase field.

II. Accessions Involved

Accessions included for the restoration of American Camp prairie are listed in Table 1. This table also displays activities performed by PMC staff in 2009.

Table 1. Accessions involved for the restoration of American Camp prairie project with Corvallis Plant Materials Center in 2009.

Species	Common name	Code	Accession	Activity in 2009[1]
Elymus glaucus	blue wildrye	ELGL	9079607	sfp
Bromus sitchensis	sitka brome	BRSI	9079606	sfp
Festuca roemerii	Roemer's fescue	FERU	9079605	sfp

1- col=wild seed collection, pxn= plant production sfp= seed field production,

III. Seed Increase

The PMC usually sows seed in the fall rather than in the spring, however, this project came to the PMC too late in the fall to sow the seed into the fields. The PMC decided to spring sow the fields rather than wait for the fall of 2009. In early April 2009, the blue wildrye, brome and fescue fields were sown using the PMC's new precision cone-seeder. The seeds germinated and emerged within two weeks. The fields were irrigated every two weeks through July as needed.

Park staff collected more fescue seed in the summer of 2009 and sent it to the PMC for cleaning and fall sowing. The fescue field was expanded to 0.25 acres in early October.

All fields were fertilized in October 2009 with 25 lbs/ac nitrogen. Weed control within the plots was mainly performed by hand-hoeing, and roguing, and using broadleaf herbicides. Field borders were cultivated periodically throughout the year. In the fall, fields were mowed with a flail chopper.

Table 2. Field establishment in 2009 for the restoration of American Camp prairie project with the Corvallis Plant Materials Center.

Species	Accession	Date	Seeding rate	Field Size
Elymus glaucus	9079607	April 15	8 lbs/ acre	0.25 ac
Bromus sitchensis	9079606	April 15	8 lbs/ acre	0.62 ac
Festuca roemerii	9079605	April 20	3 lbs/ acre	0.07 ac
Festuca roemerii	9079605	Oct 26	5 lbs/ acre	0.25 ac

VI. Delivery of Plant Materials

There were no deliveries made in 2009.

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December 2, 2008

THE 2008 US FISH AND WILDLIFE ANNUAL REPORT:
Willamette Valley Seed Increase Project

Figure 1. *Ranunculus occidentalis* seed increase field at the Corvallis PMC, May 14, 2008.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with US Fish and Wildlife (USFW) in 2007 to increase seed of Willamette Valley forbs to be used in Wetland Reserve Program (WRP) restoration sites. The Native Seed Network (NSN) collected seed from remnant wet prairies across the Willamette Valley in 2005, 2006, and 2007 to create composite collections to be released to growers for seed increase. Traditional agronomic seed increase techniques were not successful for some species; these species were brought to the PMC for research and development. Wild collected seed was very limited for a few species; these species were also brought to the PMC. Small common gardens were established at the PMC for many species that were selected for the Willamette Valley Seed Increase Project. Information from these studies will be used to establish seed transfer guidelines. Activities in 2008 included establishing a seed increase field of one forb, and harvest and maintenance of seed increase fields of six forbs and one rush.

II. Accessions Involved

The following table lists the accessions involved in the Willamette Valley Seed Increase Project at the Corvallis Plant Materials Center in 2008.

Table 1. Accessions in the Willamette Valley Seed Increase Project at the Corvallis Plant Materials Center in 2008.

Species	Common name	Code	Accession #	Activity in 2008[1]
Sidalcea virgata	rose checkermallow	SIVI	9079536	Sfp, dlv
Eriophyllum lanatum	Oregon sunshine	ERLA	9079538	Sfp, dlv
Ranunculus occidentalis	western buttercup	RAOC	9079564	Sfp, dlv
Juncus tenuis	poverty rush	JUTE	9079535	Sfp, dlv
Saxifraga oregana	Oregon saxifrage	SAOR	9079537	Sfp, dlv
Achillea millefolium	western yarrow	ACMI	9079539	Sfp, dlv
Symphyotricum hallii	Hall's aster	SYHA	9079540	Pxn, sfp, dlv

1- sfp= seed increase,, pxn=plant production, dlv= delivered plant materials

III. Container Plant Production

In January, *Symphyotricum hallii* seeds were sown into Ray Leach "stubby" cone-tainers (7-cubic inch cones) filled with moistened media (a soil-less media amended with a slow release fertilizer and micronutrients) and placed in a heated greenhouse. Plants grew fast and were ready for transplanting in April. Plants were moved to a lathhouse the last week in March to acclimate to outdoor temperatures and then were transplanted into the seed increase field on April 11, 2008.

Figure 2. *Symphyotricum hallii* plants growing in the PMC greenhouse, March 20, 2008.

Table 2. Plug production of Hall's aster in 2008.

Bulked Population	Number of cone-tainers planted	Amount of seed used
SYHA- South Large-07	686	1 g
SYHA- South Small-07	784	2 g
SYHA- North Large-07	784	1 g
SYHA- North Small-07	686	1 g

IV. Seed Increase

In mid October, 2007 *Eriophyllum lanatum* and *Ranunculus occidentalis* fields were directly sown into seed increase fields. The buttercup emerged within five weeks of sowing and rows were filled in nicely and plants grew slowly throughout the winter. The field was weeded by hand twice during the spring. Plants began to flower in early May and were harvested in late June. Blocks were harvested on different days due to a slight difference in maturation.

The seedlings in the *E. lanatum* field did not emerge until late February. The field had become quite weedy by this time and seedlings were difficult to locate. Attempts were made at hand weeding the field, but PMC staff worried about destroying the small seedlings that were amongst the weeds. The areas in between the rows of seedlings were weeded once in March, but new weeds quickly became established in the field. The majority of the weeds were spring germinating annuals. Very few plants flowered in 2008 and the seed from these plants were harvested by hand in late August.

Table 3. Seed harvest in 2008 at the Corvallis Plant Materials Center.

Species	Accession	Field size (ac)	Date harvested	Method	Yield
Sidalcea virgata	9079536	0.25	August 12	moon rover, sweep fabric	8 lbs
Eriophyllum lanatum	9079538	0.3	August 26	hand	162 g
Ranunculus occidentalis	9079564	0.15	June 13- June 26	seed stripper	11 lbs
Juncus tenuis	9079535	0.15	July 14	moon rover	2.2 lbs
Saxifraga oregana	9079537	0.15	July 3-July 20	hand	0.3 lbs
Symphyotricum hallii	9079540	0.2	Sept 5- Oct 25	vacuum	2 lbs

Achillea millefolium seed increase field was established on May 17, 2008. It was seeded using the PMC's precision cone seeder. The field was irrigated two weeks after sowing and seedlings began to emerge. Plants did not get very large in 2008 and did not flower.

Most of the fields that are in production for this agreement were established by plugs. Plugs were grown in the fall of 2007 and transplanted out into seed increase fields in the winter of 2007 and spring of 2008. *Symphyotricum hallii* field was not established until April of 2008. The field became covered with a weedy annual *Epilobium* sp. Instead of attempting to weed or spot spray the field, a Hiniker Flail Mower/Shredder was used to mow down the field. This piece of equipment cuts and "vacuums" all residue laying on the ground surface. Residue is shot out into a wagon that is pulled behind the mower and can be dumped offsite. This form of "weed control" was chosen because the annual weeds would be killed or completely reduced to 2" tall, and all the seeds that were about to be produced by the weeds were removed from the field. The aster plants were mowed also, but were not harmed by the cutting. The field was mowed twice in late summer and early fall to remove the weeds. Aster plants looked very healthy heading into winter and almost all the weeds had been killed by the mowing. Before the mowing it appeared that the asters were not going to flower, but incase they were going to flower (and flowers would have been mowed off), PMC staff harvested seeds from the *S. hallii* common garden in lieu of the harvesting the seed increase field. Seeds were vacuumed from plants three times a week throughout the end of September and all of October.

Figure 3. *Juncus tenuis* seed increase field at the Corvallis Plant Materials Center, May 24, 2008.

Other fields that were established by plugs flowered in 2008. Some of the species were not expected to flower in their first growing season (*Saxifraga oregana* and *Juncus*

tenuis). Plants quickly established after transplanting and flowered in June. *S. oregana* plants were harvested by hand as they matured. After being harvested, material was laid on tarps inside in open greenhouse to dry. *J. tenuis* plants were harvested by a self-propelled swather, nick-named the "moon rover". This machine cuts and sends all material up a conveyor belt where it can be collected into large bags. After being harvested, material was laid on tarps inside in open greenhouse to dry. The *Sidalcea virgata* field flowered in June and seeds shattered on the weed fabric. A lot of seed remained in the inflorescences, so the moon rover was used to cut down all the flowering stems, and the weed fabric was also swept to remove all the seeds that had shattered.

Seed cleaning:

Harvest methods greatly determine the process for cleaning each seed lot. The *R. occidentalis* seeds were harvested with a seed stripper, which removes seeds and very little plant material. These seeds were cleaned using an air-screen machine. Since entire heads of *S. oregana*, *J. tenuis*, *S. virgata* and *E. lanatum* were harvested, seeds needed to be removed from the heads. A small lab-sized brush machine was used to "thresh" the seeds, except *S. virgata* seeds were placed in a large brush machine, and then they were cleaned using an air-screen machine. The aster seeds were very fluffy and needed to have the pappas removed before they could be cleaned with an air-screen machine. A lab-sized brush machine fitted with a sandpaper drum was used to break up the pappas. A fan was set up at the front of the machine where the seeds and pappas were coming out. The fan helped blow some of the pappas away from the seeds. An air-screen machine was used for final cleaning.

Figure 4. *Sidalcea virgata* seed increase field at the Corvallis Plant Materials Center, June 10, 2008.

Post harvest field management:

Fields that hadn't been previously cut down during harvest were mowed with the Hiniker Flail Mower (*E. lanatum* and *R. occidentallis*). This mowing helped clean up weeds and weed seeds in the

E. lanatum field. By late October, both of these fields as well as the *S. virgata* and *S. oregana* fields had come out of fall dormancy and were growing vigorously. The weed fabric in the checkermallow and saxifrage fields was cut back from the crown of each plant to allow room for growth.

V. Delivery of Materials

All seed that was produced in 2008 was delivered to the Native Seed Network. Two deliveries were made, one on September 15, 2008 and another on October 30, 2008. Seed lots that were over two pounds were sampled and sent to the Oregon State University Seed Lab for purity and germination testing.

Table . Seed delivery amounts and purity and germination tests results.

Species	Seed lot	Bulk Amount	Purity	Germination
Sidalcea virgata	SG1-08-NS536	8 lbs	94.95%	73%
Eriophyllum lanatum	SG1-08-NS538	162 g	n/a	n/a
Ranunculus occidentalis	SG1-08-NS564	11 lbs	98.81%	16%
Juncus tenuis	SG1-08-NS535	2.2 lbs	99.72%	91%
Saxifraga oregana	SG1-08-NS537	0.32 lbs	n/a	n/a
Symphyotricum hallii	SG1-08-NS540	2 lbs	n/a	n/a

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

January 20, 2010

THE 2009 US FISH AND WILDLIFE ANNUAL REPORT:
Willamette Valley Seed Increase Project

Figure 1. Rose checkermallow (*Sidalcea virgata*) seed increase field at the Plant Materials Center, May 20, 2009.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with US Fish and Wildlife (USFW) in 2007 to increase seed of Willamette Valley forbs to be used in Wetland Reserve Program (WRP) and Wetland Reserve Enhancement Program (WREP) restoration sites. The Native Seed Network (NSN) collected seed from remnant wet prairies across the Willamette Valley in 2005, 2006, and 2007 to create composite collections to be released to growers for seed increase. Traditional agronomic seed increase techniques were not successful for some species; these species were brought to the PMC for research and development. Wild collected seed was very limited for a few species; these species were also brought to the PMC. Small common gardens were established at the PMC for many species that were selected for the Willamette Valley Seed Increase Project. Information from these studies will be used to establish seed transfer guidelines. Activities in 2009 included harvest and maintenance of seed increase fields of six forbs and one rush.

II. Accessions Involved

The following table lists the accessions involved in the Willamette Valley Seed Increase Project at the Corvallis Plant Materials Center in 2009.

Table 1. Accessions in the Willamette Valley Seed Increase Project at the Corvallis Plant Materials Center in 2009.

Species	Common name	Code	Accession #	Activity in 2009[1]
Sidalcea virgata	rose checkermallow	SIVI	9079536	sfp
Eriophyllum lanatum	Oregon sunshine	ERLA	9079538	sfp
Ranunculus occidentalis	western buttercup	RAOC	9079564	sfp
Juncus tenuis	poverty rush	JUTE	9079535	sfp
Saxifraga oregana	Oregon saxifrage	SAOR	9079537	sfp
Achillea millefolium	western yarrow	ACMI	9079539	sfp
Symphyotricum hallii	Hall's aster	SYHA	9079540	sfp

1- sfp= seed increase,, pxn=plant production, dlv= delivered plant materials

III. Seed Increase

Figure 2. Oregon saxifrage (*Saxifraga oregana*) seed increase field at the Corvallis Plant Materials Center, May 15, 2009

Juncus tenuis plants were harvested by a self-propelled swather, nick-named the “moon rover”. This machine cuts and sends all material up a conveyor belt where it can be collected into large bags. The *J. tenuis* plants are planted in to weed fabric which was also vacuumed, as it was covered with seed. The weed fabric is a huge aid in weed control and this year it also caught a large amount of shattering seed. It is estimated that two pounds of the total harvest was recovered from the weed fabric. After being harvested, material was laid on tarps inside in open greenhouse to dry.

The *Saxifraga oregana* field is also covered with weed fabric. It is quite helpful in weed control, but if the holes are not re-cut early in the fall it can impede the saxifrage’s growth. This species goes dormant in the summer and emerges again in the fall, usually after a couple of rain storms. The optimal time to enlarge the holes is just before they start growing in

the fall. This is also a very busy time at the PMC: seed is still being harvested; all the seed that had to be delivered in the fall is still being cleaned; new fields have to be sown; plants are being delivered; and end of the fiscal year summaries have to be reported. In 2008, the fabric did not get cut in time and some new growth on the saxifrage plants were stuck under the fabric. PMC staff tried cutting the fabric in the spring, but it seemed to be hurting more than helping. The effort was abandoned with the knowledge that it must be done in the fall. In the fall of 2009, the fabric was cut as the plants were emerging and this worked well. It gave the plants room to grow, but it didn't leave a lot of space for weed seeds to establish. The field flowered profusely in 2009. Seed maturity was quite variable, so it was harvested by hand multiple times. The fabric was also vacuumed. The fabric captures all of the early maturing seed that has shattered and the hand harvesting collects all of the mid to late maturing seed. The combination of these methods increases yields as well as diversity.

Eriophyllum lanatum and *Ranunculus occidentalis* fields were hand weeded many times during the growing season. Trefoil became a serious weed in the buttercup field. It was very dense among the buttercup plants and was almost as tall as the seedheads. The buttercup was harvested using the seed stripper (once on each block at different times); this removed the seed, but did not collect any mature trefoil seeds, since the plants were still in bloom. Once the buttercup plants went dormant in late summer, the field was sprayed with a broadleaf herbicide to remove the trefoil. This technique appeared tobe very effective. The trefoil died in the fall and no new or resprouting plants have been observed.

Figure 3. Oregon sunshine (*Eriophyllum lanatum)* seed increase field at the Corvallis Plant Materials Center. The color difference in the north and south diversity blocks can be seen in this picture.

The *E. lanatum* field was harvested by swathing and combining. PMC staff tried direct combining which cuts and combines the material at the same time, but the plant material was not brittle enough to be adequately threshed by the combine. It was swathed, left to dry for a week, and then combined. This field flowered moderately, but plants looked a bit wispy. They are not thick and spreading like other *E. lanatum* fields at the PMC. This field also has the lowest lbs/acre yield of the three current *E. lanatum* fields at the PMC.

Table 3. Seed harvest in 2009 at the Corvallis Plant Materials Center.

Species	Accession	Field size (ac)	Date harvested	Method	Yield
Sidalcea virgata	9079536	0.25	June 30	direct combine, seed stripper	22 lbs
Eriophyllum lanatum	9079538	0.3	Sept 14	direct combine	20 lbs
Ranunculus occidentalis	9079564	0.15	June 10	seed stripper	11 lbs
Juncus tenuis	9079535	0.15	June 30	moon rover	17 lbs
Saxifraga oregana	9079537	0.15	6/10-6/15	hand, vaccum	8 lbs
Symphyotricum hallii	9079540	0.2	9/15-10/12	seed stripper	13 lbs

The *Symphyotricum hallii* field was established in April of 2008 and the field became covered with a weedy annual *Epilobium* sp. Instead of attempting to weed or spot spray the field, a Hiniker Flail Mower/Shredder was used to mow down the field. This piece of equipment cuts and "vacuums" all residue laying on the ground surface. Residue is shot out into a wagon that is pulled behind the mower and can be dumped offsite. This form of "weed control" was chosen because the annual weeds would be killed or completely reduced to 2" tall, and all of the seeds that were about to be produced by the weeds were removed from the field. The aster plants were mowed also, but were not harmed by the cutting. The field was mowed twice in late summer and early fall to remove the weeds. Aster plants looked very healthy heading into winter and almost all the weeds had been killed by the mowing. This weed control method was quite effective at removing the large amount of weed seed that would have been germinating in the spring of 2009. The field was slightly weedy in the spring, but was easily hoed out, afterwards, the field was very clean with little to no summer germinating weeds. The plants were planted on wide spacing. Plants are 2 feet apart and rows are 3 feet apart. Originally, this was done with the expectation that the plants would spread at a rapid rate, and would close the gap in three years. We compared our field to a private grower's field which was sown a year earlier using the same seed lot, but with tighter spacing. The plants in the field with tighter spacing are taller, flower later and usually don't set seed until November. Upon comparing fields, it was agreed that the extra space was important for this species. The seed stripper was used on this field. It had to be modified with a screen over the air vents on the top of the hopper to keep the seed from flying out. The field was harvested multiple times with this machine, even though it drives over the plants. Seeds could be harvested even when damp, which is important for this late blooming species. Piles of fluff and seed were emptied from the hopper of the seed stripper and placed on tarps in an open greenhouse. Piles were turned often to let the material dry and to prevent molding.

Cleaning seed of the species that have a lot of pappus can be difficult and time consuming. Having a large brush machine makes cleaning these species much easier. For each of the fluffy-seeded species (pearly everlasting, goldenrods, and aster) the material was run through the brush machine to break everything up. The result was a mass of fine fluff. For the largest field, the aster, this pile of fluff filled a 30 gallon garbage barrel. It was then put into a large air-screen machine. The "Crippen" is a two-screen machine that uses rubber balls inside of trays under the screens to help the material flow down the screens. We adjust the number of balls in the tray depending on what type of seed we are cleaning: very few or no balls to clean easy flowing seeds like lupine, lots of balls for hard to sift seed lots. Using a lot of balls helps break up the fuzzballs and sift the seeds out of the fluff. After one run through the Crippen, the 30 gallons of fluff and aster seed was reduced to about 2 cubic feet of fine sticks, seed, and chaff. A small air-screen machine was used for fine cleaning.

Figure 4. Western buttercup (*Ranuculus occidentalis)* seed increase field at the Corvallis Plant Materials Center, May 10, 2009. Differences in the flowering times of the north and south blocks can be seen in this picture.

The *Sidalcea virgata* field flowered in June and the seeds shattered on the weed fabric. Many different harvest techniques were used this year. First, we tried to direct combine the field. The flower stalks were very dry and combining was easy. The combine shoots all "trash" out the back of the machine. This left a lot of chopped up material all over the

weed fabric and there was still a lot of seed on the weed fabric. The field was raked and pitch forked to remove all of the large stems, then the seed stripper was used to pick up all the seeds on the weed fabric. The seed stripper acted like a street sweeper. It took a lot of coordination between the tractor operator and two people on either side of the seed stripper to make sure that the brushes were close to the ground, but that the edges of the machine were not touching the fabric, so as not to cut it.

Post harvest field management:
Fields that hadn't been previously cut down during harvest (*E. lanatum* and *R. occidentallis*) were mowed with the Hiniker Flail Mower. By late October, both of these fields as well as the *S. virgata* and *S. oregana* fields had come out of fall dormancy and were growing vigorously. The weed fabric in the checkermallow and saxifrage fields were cut back from the crown of each plant to allow room for growth.

IV. Delivery of Materials

All seed that was produced in 2009 except for the aster was delivered to the Native Seed Network.

Table3 . Seed delivery amounts and purity and germination tests results.

Species	Seed lot	Bulk Amount	Purity	TZ
Sidalcea virgata	B40-9-N18SV02	21 lbs	96.24%	87%
Eriophyllum lanatum	B40-9-N17EL03	29 lbs	86.09%	41%
Ranunculus occidentalis	B40-9-N17RC02	10 lbs	97.74%	92%
Juncus tenuis	SG1-09-NS535	17 lbs	94.44%	25%
Saxifraga oregana	SG1-09-NS537	8 lbs	90.36%	51%

CORVALLIS PLANT MATERIALS CENTER
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December 28, 2008

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Figure 1. Sand fescue (*Festuca ammobia*) seed increase plot at the Corvallis Plant Materials Center, June 15, 2008.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with US Fish and Wildlife (USFW) in 2005 to increase seed of early blue violet (*Viola adunca*) for use in recovery efforts for the Oregon silverspot butterfly (*Speyeria zerene hippolyta*). In 2007, the Siuslaw District of the United States Forest Service (USFS) became a new partner in the agreement with USFW. The butterfly has become threatened due to the degradation and loss of its coastal meadow habitat. The early blue violet is the obligate host to the silverspot caterpillars and has also been negatively impacted in its coastal meadow ranges by the encroachment of tall, spreading exotic plants. Coastal red fescue, (recently renamed sand fescue, *Festuca amobia*) is included in this agreement as a matrix

species in the coastal meadows. All other forbs included in this project are nectar sources for the adult butterflies.

Activities in 2008 included establishing five forb seed increase plots, maintaining, and harvesting two forb and one grass seed increase plots, wild seed collection and seed cleaning of nectar species.

II. Accessions Involved

The following table lists the accessions involved in this project.

Table 1. Accessions in the USFW Oregon Silverspot seed increase project.

Species	**Common name**	**Symbol**	**Accession**	**Activity in 2008**[1]
Achillea millefolium	common yarrow	ACMI2	9079448	Sfp
Anaphalis margaritacea	pearly everlasting	ANMA	9079451	Col, Sfp
Aster chiliensis	pacific aster	ASCH2	9079449	Col, Sfp
Soildago canadensis	goldenrod	SOCA6	9079497	Col, Sfp
Festuca rubra	red fescue	FERU	9079450	Sfp
Viola adunca	early blue violet	VIAD	9079406	Sfp
Solidago spathulata	dune goldenrod	SOSP	9079561	Sfp
Tanacetum camphoratum	camphore tansy	TACA	9079559	Sfp
Artemisia suksdorfii	coastal wormwood	ARSU	9079560	Sfp

1- sfp= seed increase, col= wild seed collection, pxn=plant production, dlv=delivered plant materials

III. Seed Increase

A small seed increase plot of *V. adunca* was established using plants that were collected from the Rock Creek area in 2004. A sheet of weed fabric was stapled down over the field, then holes were cut in the fabric and plants were transplanted into the ground through the holes. As the violet plants grew, they spread out onto the weed fabric. When they flowered and seed pods matured, the pods released the seed onto the weed fabric. The seeds were then vacuumed up using battery-powered, handheld vacuums. Pods were collected also, by hand when feasible. Violet pods turn upright when they are mature, which makes determining seed ripeness simple. This plot was expanded in 2007 using plants grown from the seed that was harvested in 2006.

Table 2. Yields in 2008 for the USFW Oregon Silverspot seed increase project.

Species	Code	Area	Harvest Date	Yield
Achillea millefolium	ACMI2	0.15	8/19/2008	7 lbs
Viola adunca	VIAD	0.001	May 22- Sept	3 lbs
Tanacetum camphoratum	TACA	0.001	25-Sep	15 g

The *Achillea millefolium* field was hand weeded many times throughout the winter and spring of 2008. This year, the seed stripper was used to harvest the field. This method brushes the seed from the plant and collects it in a hopper. Very little plant material is

collected this way. Seed and chaff was dumped onto a tarp and placed in a shed to dry. Once, dry the seed was cleaned using an air-screen machine.

F. amobia seed collected by USFS in the summer of 2007 was used to sow a large seed increase field. Heavy rain in September and October limited the amount of land that the PMC could prepare for fall sowing. Not all of the seed was sown. The rest of the seed was used to expand the field in the spring of 2008. This will also provide a comparison between fall and spring planting. Neither section flowered in 2008.

Seed increase plots of nectar species were also established this year using the PMC's precision cone-seeder. The aster established well using this method, but the *A. margaritacea* and the *S. canadensis* fields were very spotty. The aster field has thick rows of plants and was the most successful species of the three that were directly sown.

Tanacetum camphoratum and *Solidago spathulata* fields were established using greenhouse grown transplants because of the small amount of seed that was collected. The plants were transplanted outside on April 5, 2008. The tansy flowered and produced seed in 2008. A few of the *S. spathulata* plants flowered in late October, but rain prevented any seed from being produced.

Figure 2. Dune tansy (*Tanacetum camphoratum*) seed increase plot at the Corvallis PlantMaterials Center, August 10, 2008.

IV. Container Plant Production.
On January 19, 2008 20g of *V. adunca* seed were sown into 4410 Ray Leach "stubby" cone-tainers filled with moistened media (Sunshine #1, a special peat-based soil-less mix) and lightly covered with fine vermiculite. Seeded flats of violets were placed in polyethylene bags and moved into a walk-in cooler (36-38° F) for four months. After stratification, they were moved outside to a lathhouse. In early August, all plants were moved to a shadehouse. Other growers provided USFW with violet plants for outplanting, so the PMC kept the violet plants that were grown in 2008 and will use them to establish a large seed increase field.

Plugs of nectar species were also grown in the fall of 2008. These plants will be used to expand or establish seed increase fields.

Species	Accession	Number of plants	Grams of seed used
Anaphalis margaritacea	9079451	990	2
Aster chiliensis	9079449	990	7
Viola adunca	9079406	4410	20
Soildago canadensis	9079497	990	5

V. Native Seed Collection

USFW staff was able to collect seed in fall of 2008. This seed will be used to expand the current seed increase plots in the spring of 2009.

VI. Delivery of Materials
Violet plants that had been left over from previous year's production were potted up into 5" pots and have remained in the PMC shadehouse for the past few years. Seed has been collected from these plants, but now that the seed increase field will be established in 2009, these plants were no longer needed. They were given to USFW on October 21 and December 5, 2008.

A half of a pound of violet seed was also delivered to USFW. All other seed will remain in PMC seed storage facilities until requested.

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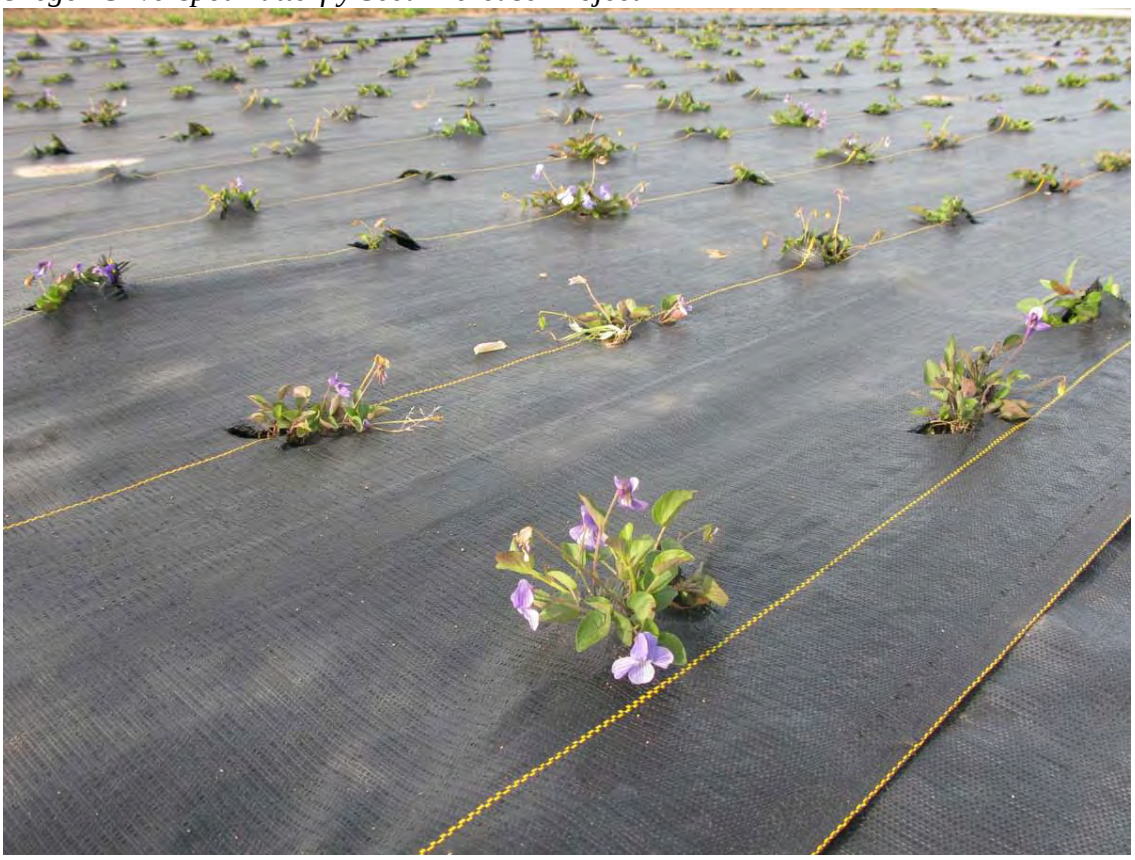

Figure 1. Early blue violet (*Viola adunca*) seed increase field at the Corvallis Plant Materials Center, April 15, 2009.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with US Fish and Wildlife (USFW) in 2005 to increase seed of early blue violet (*Viola adunca*) for use in recovery efforts for the Oregon silverspot butterfly (*Speyeria zerene hippolyta*). In 2007, the Siuslaw District of the United States Forest Service (USFS) became a new partner in the agreement with USFW. The butterfly has become threatened due to the degradation and loss of its coastal meadow habitat. The early blue violet is the obligate host to the silverspot caterpillars and has also been negatively impacted in its coastal meadow ranges by the encroachment of tall, spreading exotic plants. Coastal red fescue, (recently renamed sand fescue, *Festuca ammobia*) is included in this agreement as a matrix species in the coastal meadows. Most of the forbs included in this project are nectar sources for the adult butterflies.

Activities in 2009 included expansion of five forb seed increase plots, maintaining, and harvesting one grass and seven forb increase plots, and plug production of eight forbs.

II. Accessions Involved

The following table lists the accessions involved in this project.

Table 1. Accessions in the USFW Oregon Silverspot seed increase project.

Species	Common name	Symbol	Accession	Activity in 2009[1]
Achillea millefolium	common yarrow	ACMI2	9079448	Sfp
Anaphalis margaritacea	pearly everlasting	ANMA	9079451	Sfp,Pnx
Aster chilensis	pacific aster	ASCH2	9079449	Sfp,Pxn
Soildago canadensis	goldenrod	SOCA6	9079497	Sfp, Pxn
Festuca ammobia	sand fescue	FERU	9079450	Sfp, Dlv
Viola adunca	early blue violet	VIAD	9079406	Sfp, Pxn, Dlv
Solidago simplex spp simplex var spathulata	dune goldenrod	SOSISP	9079561	Sfp,Pxn
Tanacetum camphoratum	camphor tansy	TACA2	9079559	Sfp
Artemisia suksdorfii	coastal wormwood	ARSU	9079560	Pxn
Trifolium wormskijoldii	sand clover	TRWO	9079619	Pxn
Cirsium edule	edible thistle	CIED	9079620	Pxn

1- sfp= seed increase, col= wild seed collection, pxn=plant production, dlv=delivered plant materials

III. Seed Increase

A large seed increase plot of *V. adunca* was established using 4200 plants that were produced in 2008. A sheet of weed fabric was stapled down over the field, then holes were cut in the fabric and plants were transplanted into the ground through the holes. As the violet plants grew, they spread out onto the weed fabric. When they flowered and seed pods matured, the pods released the seed onto the weed fabric. Normally, PMC staff would sweep or vacuum the seeds off the weed fabric a couple times per season. This year, however, a flock of pigeons were often seen on the weed fabric and were thought to be eating seed off the fabric. The violets did not flower abundantly, but there still seemed to be a lot less seed on the fabric than what was expected. PMC staff decided it was most effective to hand pick the pods once a week to prevent seeds from being eaten by the birds or blowing off the weed fabric. In 2010, bird deterrents (pinwheels, noisy flagging, ect) and a “wind fence” will be implemented. Hopefully, these additions will aid in seed remaining on the fabric and the fabric can be swept rather than hand-picking the seeds.

Three seed increase plots were sown in the late spring of 2008 (*Aster chilensis*, *Anaphalis margaritacea*, *Solidago canadensis*). The aster looked great in the spring of 2009, but the rows of pearly everlasting and the goldenrod were spotty. Pearly everlasting plants continued to germinate through the spring of 2009, but were quickly becoming smothered by the quick-growing spring weeds. New plugs of aster, pearly everlasting and goldenrod were grown in the winter of 2008/2009 and planted out in March 2009. The areas that

were directly sown were compared to the areas that were planted with plugs and it was clear that plugs were a better way to start a seed increase field for the goldenrod and the pearly everlasting. The area that contained plants that were started as plugs flowered their first year, were relatively weed free, and were very vigorous. The aster field looked great whether it was directly sown or if it was made from plugs.

Table 2. Yields in 2009 for the USFW Oregon Silverspot seed increase project.

Species	**Code**	**method**	**Harvest Date**	**Area**	**Yield (bulk lbs)**
Achillea millefolium	ACMI2	seed stripper	Aug 17, Aug 24	0.15	8
Viola adunca	VIAD	hand	May 22- Sept 15	0.2	3
Tanacetum camphoratum	TACA2	combine	Sept 2	0.04	23
Anaphalis margaritacea	ANMA	hand	Aug 22- Sept 30	0.04	0.5
Aster chilensis	ASCH	seed stripper	Aug 25- Oct 14	0.08	8
Soildago canadensis	SOCA	hand	Sept 7-Oct 20	0.04	1.4
Festuca ammobia	FEAM	swath/combine	July 1, July 10	0.36	133
Solidago simplex var spathulata	SOSP	hand	Sept 23- Oct 30	0.04	2

The *Achillea millefolium* field was spot-sprayed with glyphosate in spring and hand weeded twice in the summer of 2009. This year, the seed stripper was used to harvest the field. This method brushes the seed from the plant and collects it in a hopper. Very little plant material is collected this way. Seed and chaff were dumped onto a tarp and placed in a shed to dry. Once dry, the seed was cleaned using an air-screen machine.

F. ammobia field was infested with non-native bentgrass and ryegrass. The field was hand weeded many times and herbicide “canes” filled with glyphosate were used to control weeds. The field was very vigorous and flowered well. A huge thunderstorm hit the PMC on June 10th during peak flowering of the field. Seed production may have been affected by this weather, but seed fill was decent across this field. The field was swathed and combined. After the field was swathed, a heavy rainstorm moved through the Willamette Valley, knocking seed out of the heads and onto the ground. The field still produced 133 lbs of seed even with these untimely weather events.

The tansy field isn’t large, but it was covered with flowers this year! Normally, the “moon rover” would be used to harvest the field and then the material would have to be run through a thresher to break the seeds away from the flower receptacle. PMC staff was experimented with direct combining different forbs this summer. Most material that is combined has first been swathed (cut) and dried before attempting to run it though a combine. Some of the forbs at the PMC are dry enough at harvest time or not so leafy that they can be direct combined. This technique was tried on the tansy and it was very successful. The field is very small, but it still was a timesaver to not have to handle the material twice- the combine cut and threshed the material. Seeds and chaff were spread out on a tarp to dry more before running it through an air screen machine for final

cleaning. This species has a lot of potential for seed increase because it can be direct combined. Cleaning this seed is a challenge though, because it is very difficult to determine which seeds are viable. Seeds are heavy and the weight of a small filled seed can be the same as a large unfilled seed. Seed lots of this species will have low purity and low germ but will be large. Make sure to pay attention to the difference between bulk pounds and PLS (pure live seed) pounds for this species.

Figure 2. Camphor tansy (*Tanacetum camphoratum*) seed increase field at the Corvallis Plant Materials Center, May 15, 2009

Both goldenrods and the pearly everlasting fields were weeded by hand multiple times during the growing season. Fields flowered in late summer and were hand-harvested twice a week in late August through October. The pearly everlasting field was sometimes harvested three times a week during peak maturity. The dune goldenrod was the latest to mature and peak harvest was in the last week of October. This fall was warm and dry which greatly helped seed production. On warm days in late September, pollinators flocked to these late blooming fields.

The aster field was weeded by hand multiple times during the growing season. When the field began to set seed, a leaf-blower (used in reverse as a vacuum) was used to harvest the field. A third of the field was vacuumed every day for the first three weeks of harvest (the last week in August and the first two weeks in September). Once the field was covered in puffy seedheads, the flail-vac seed stripper was used. Sometimes, the seed stripper can damage plants, flowers, and unripe seed heads. PMC staff waited until later in the season to try the seed stripper in case the harvester damaged the plants. If the harvester damaged the plants, at least some seed would have been harvested from the

field. Luckily, the seed stripper worked very well. Even plants that were run over by the tractor, popped back up and continued producing seed. The field was harvested three times in late September and early October. This harvest method works even when the seeds are damp, which will be important in other years when we are not as fortunate to have so many dry days. Piles of fluff and seed were emptied from the hopper of the seed stripper and placed on tarps in greenhouse. Piles were turned often to let the material dry and to prevent molding.

Figure 3. Aster (*Aster chilensis*) seed increase field at the Corvallis Plant Materials Center, September 9, 2009.

Cleaning seed of the species that have a lot of pappas can be difficult and time consuming. Having a large brush machine makes cleaning these species much easier.

For each of the fluffy-seeded species (pearly everlasting, goldenrods, and aster) the material was run through the brush machine to break everything up. The result was a mass of fine fluff. For the largest field, the aster, this pile of fluff filled a 30 gallon garbage barrel. It was then put into a large air-screen machine. The “Crippen” is a two-screen machine that uses rubber balls inside of trays under the screens to help the material flow down the screens. We adjust the number of balls in the tray depending on what type of seed we are cleaning: very few or no balls to clean easy flowing seeds like lupine, lots of balls for hard to sift seed lots. Using a lot of balls helps break up the fuzzballs and sift the seeds out of the fluff. After one run through the Crippen, the 30 gallons of fluff and aster seed was reduced to about 2 cubic feet of fine sticks, seed, and chaff. A small air-screen machine was used for fine cleaning.

In the summer of 2009, plugs of aster, coastal wormwood, pearly and both goldenrod species were grown. These plugs were used to expand the current fields in early fall. A mechanical transplanter was used to plant a large number of plugs in a very short amount of time. The mechanical transplanter is very useful for establishing large fields from plugs. It works best when soils are dry, which, unfortunately, is not the best time to be

setting out plants. Irrigation is usually needed after planting. Transplanting occurred in the first week of October and irrigation was applied twice a week for two weeks, then consistent rain began for the winter and irrigation was no longer needed.

Table 3. Establishment of seed increase fields at the Corvallis Plant Materials Center for the USFW Oregon Silverspot seed increase project.

Species	Common name	Symbol	Accession #	Field size at the end of 2009
Achillea millefolium	common yarrow	ACMI2	9079448	0.15
Anaphalis margaritacea	pearly everlasting	ANMA	9079451	0.2
Aster chilensis	pacific aster	ASCH2	9079449	0.3
Soildago canadensis	goldenrod	SOCA6	9079497	0.2
Festuca ammobia	sand fescue	FERU	9079450	0.51
Viola adunca	early blue violet	VIAD	9079406	0.15
Tanacetum camphoratum	camphor tansy	TACA2	9079559	0.08
Artemisia suksdorfii	coastal wormwood	ARSU	9079560	0.1
Trifolium wormskijoldii	sand clover	TRWO	9079619	0.2
Cirsium edule	edible thistle	CIED	9079620	0.2
Solidago simplex spp simplex var spathulata	dune goldenrod	SOSISP	9079561	0.1

IV. Container Plant Production.

On January 12, 2009 24g of *V. adunca* seed were sown into 4410 Ray Leach "stubby" cone-tainers filled with moistened media (Sunshine #1, a special peat-based soil-less mix) and lightly covered with fine vermiculite. Seeded flats of violets were placed in polyethylene bags and moved into a walk-in cooler (36-38° F) for four months. After stratification, they were moved outside to a shadehouse. Germination was lower than in previous years. The same seed lot has been used to grow 4000 violets annually since 2006. The seed lot is from 2005. Seed viability may be declining as the seeds age. Germination tests will be repeated in the fall/winter of 2009 to get a better idea of how long these seeds will remain viable in storage.

V. Native Seed Collection

USFS staff was able to collect seed of two new species: sand clover, *Trifolium wormskijoldii* and edible thistle, *Circium edule* in fall of 2009. This seed was cleaned and used to start 4000 plugs of each species. Both of these species do not exhibit seed dormancy, seed readily germinated in a warm greenhouse. Plugs will be transplanted out into seed increase fields in early spring of 2010.

VI. Delivery of Materials

3500 Violet plants were picked up by USFWS staff on October 13, 2009. A propagation meeting was held at the PMC in early November to inform horticulturalists at the Oregon Zoo and the Oregon Coast Aquarium about how the PMC produces violet plants. Seed was also distributed to the various growers for 2010 plant production. Fescue and violet seed was also given to USFWS and USFS staff to use in replanting areas that had been covered with weed fabric for two years (to remove existing vegetation).

Table 4. Seed delivered in 2009 for the Oregon Silverspot seed increase project.

Species	Code	Seed lot	Amount delivered	Recipient
Viola adunca	VIAD	SG1-06-OS406	2 lb	Anne Walker USFW
Achillea millefolium	ACMI2	SWC-07-OS448	2g	Oregon Zoo
Viola adunca	VIAD	SG1-07-OS406	100 g	Oregon Zoo
Tanacetum camphoratum	TACA2	SG1-09-OS559	2 g	Oregon Zoo
Anaphalis margaritacea	ANMA	SG1-09-OS559	2g	Oregon Zoo
Aster chilensis	ASCH	SG1-09-OS449	2g	Oregon Zoo
Soildago canadensis	SOCA	SG1-09-OS497	2g	Oregon Zoo
Solidago simplex var spathulata	SOSP	SG1-09-OS450	2g	Oregon Zoo
Achillea millefolium	ACMI2	SWC-07-OS448	5g	Peoria Gardens
Anaphalis margaritacea	ANMA	SG1-09-OS559	5g	Peoria Gardens
Aster chilensis	ASCH	SG1-09-OS449	5g	Peoria Gardens
Soildago canadensis	SOCA	SG1-09-OS497	5g	Peoria Gardens
Viola adunca	VIAD	SG1-05-OS406	0.5 lb	USFS
Festuca ammobia	FEAM	SG1-09-OS450	34 lbs	USFS

All seed that has been produced for this project and has not been delivered will remain in the PMC seed storage facilities until requested. Samples of seed produced from the PMC fields were sent to the Oregon State University Seed Lab for purity and germination testing. This information is important for calculating pure live seed amounts (pls) for each seed lot.

Many of these species are difficult to clean, resulting in very impure seed lots. When calculating how many live seeds are actually being sown out on a restoration site, purity (how much of the seed lot is actually seed) and germination (how much of the seed is viable?) are needed. The table below shows that the tansy seed lot weighs 23 lbs. But purity testing shows that only 58.39% of the 23 lbs is seed, and of that seed, only 37% of

them are germinable. These results reflect the level of cleaning a seed lot received. The more cleaning a seed lot receives the more seed is lost. In order to retain the most seed possible, the seed lots were not cleaned to high purity. To find the pure live seed amount for a given seed lot multiply the purity (as a percent) times the bulk amount of seed, then take that amount and multiply it by the germination percent.

Table 5. Purity and germination test results for select seed lots for the Oregon Silverspot seed increase project

Species	Seed lot	Yield (bulk lbs)	Purity %	Germination %	PLS weight
Achillea millefolium	SG1-08-OS448	7	87.72	94	5.77 lbs
Achillea millefolium	SG1-07-OS448	6	57.55	91	3.14 lbs
Tanacetum camphoratum	SG1-09-OS559	23	58.39	37	5 lbs
Aster chiliensis	SG1-09-OS449	8	61.99	58	2.87 lbs
Soildago canadensis	SG1-09-OS497	1.4	65.75	53	0.48 lbs
Festuca ammobia	SG1-09-OS450	131	98.88	94	121 lbs

Our seed lot numbers describe the generation of the field (SG0 or SWC is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed). The middle numbers of a seed lot indicates which year the seed was produced in. The last portion of the seed lot describes which project the seed is for (OS is for the Oregon Silverspot butterfly) and the last three digits of the accession number that has been assigned to this species specifically for this project.

Table 6. Seed in storage at the Corvallis Plant Materials Center for the Oregon Silverspot seed increase project

Species	Code	Seed lot	Yield (bulk lbs)
Achillea millefolium	ACMI2	SG1-09-OS448	8
Achillea millefolium	ACMI2	SG1-08-OS448	7
Achillea millefolium	ACMI2	SG1-07-OS448	6
Achillea millefolium	ACMI2	SWC-07-OS448	0.5
Viola adunca	VIAD	SG1-09-OS406	3
Viola adunca	VIAD	SG1-08-OS406	1.5
Tanacetum camphoratum	TACA2	SG1-09-OS559	23
Anaphalis margaritacea	ANMA	SG1-09-OS451	0.5
Aster chilensis	ASCH	SG1-09-OS449	8
Soildago canadensis	SOCA	SG1-09-OS497	1.4
Festuca ammobia	FEAM	SG1-09-OS450	131

Solidago simplex var spathulata	SOSP	SG1-09-OS561	2

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NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
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February 10, 2010

THE 2009 US ARMY/USFWS ANNUAL REPORT:
North Coast Oregon Silverspot Butterfly Seed Increase Project

Figure 1. *Viola adunca* plants growing in the PMC greenhouse, February 12, 2009.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the US Army (specifically with the Oregon Military Department (OMD)) in 2007 to increase seed of early blue violet (*Viola adunca*) for use in recovery efforts for the Oregon silverspot butterfly (*Speyeria zerene hippolyta*). The butterfly is thought to be extirpated from Camp Rilea due to the loss of disturbance in its coastal meadow habitat. The early blue violet is the obligate host to the silverspot caterpillars and has also been negatively impacted in its coastal meadow ranges by the encroachment of tall, spreading exotic plants. Seed increase on the violets will provide a source for future seedling grow-outs which can then be transplanted back into areas of Oregon silverspot butterfly habitat enhancement and restoration. Production of nectar plants or other matrix species will be added to this agreement if seeds and funds become available. The United States Fish and Wildlife Service (USFWS) in Washington also became a partner in this agreement in 2009. Seed sources will be shared between the two agencies.

II. Accessions Involved

The table below lists the accessions involved in this project. Activities in 2009 included seed collection, seed cleaning of two species, plant production of a forb and a sedge, and establishment of two seed increase fields.

Table 1. Accessions in the North Coast Oregon Silverspot Butterfly Seed Increase Project in 2009.

Species	Common name	Symbol	Accession	Activity in 2009[1]
Viola adunca	early blue violet	VIAD	9079558	pxn, sfp, dlv
Viola adunca (white)	early blue violet	VIAD	9079616	pxn, sfp, dlv
Solidago spathulata	dune goldenrod	SOSP	9079532	-
Carex pansa	dune sedge	CAPA16	9079563	pxn, sfp
Festuca rubra	red fescue	FERU	9079617	sfp

1- col= wild seed collection, pxn=plant production, sfp= seed production

III. Seed Collections

Throughout the summer of 2009, staff from many groups (OMD, USFWS, North Coast Land Conservancy, ect) collected red fescue seed. Barbara Wilson, a local fescue expert, traveled to the North Coast area and trained collectors on native fescue identification. Seeds were bulked by population and populations were kept separate. This seed was used to sow a seed increase field in the fall of 2009.

IV. Seed Production

Fifty violet plants in 5” pots remained at the PMC in the fall of 2008 for seed increase plants in the 2009 growing season. Seed pods were hand collected twice a week from May until September. Seed pods were also collected from white-flowered violets throughout the growing season. Pods were collected almost everyday. The white flowered plants appeared to produce less pods than typical first year purple-colored violet

plants. At the PMC, plants that are kept in 5” pots in the shadehouse produce a large amount of flowers and pods once in the spring and once again in the fall. Throughout the summer, very few flowers are observed, yet the plants continue to produce a lot of seed pods, which must be cliestogamous (clonal). The white-flowered plants appeared to produce less of these clonal seeds.

The PMC agreed to establish a seed increase field of *Carex pansa*. Transplants were grown over the fall and winter of 2008/2009. On March 12, 2009 plants were placed on two feet apart and rows were planted three feet apart. The transplants grew well over the summer but no plants flowered. This species is very rhizomatous and should quickly fill in the spaces between the plants. Hopefully, it will produce seed in 2010. The field was hand weeded twice during the summer to remove grasses from the plot. The field was also sprayed with broadleaf herbicide in late fall to kill clover, thistle and other perennial broadleaf weeds.

Table 2. Seed Produced at the Corvallis Plant Material Center for the North Coast Oregon Silverspot Butterfly Seed Increase Project in 2009.

Species	**Accession**	**Method**	**Date**	**Amount**
Viola adunca	9079558	hand	May-September	1 lb
Viola adunca (W)	9079616	hand	March- September	130 g

In March of 2009, the PMC received, from the Judy Landor with the USFWS, approximately 600 plugs of red fescue to be used to establish a seed increase field. The plants were transplanted out into a field in late March and grew moderately well, but only two of the plants flowered.

Figure 3. Red fescue (*Festuca rubra*) field grown from transplants, December 30, 2009.

Using the seed that was collected from the wild in the summer of 2009, a seed increase field of red fescue was established. On October 3, 2009 the field was sown using the PMC's new precision cone-seeder. This type of seeder is calibrated to drill a programmed amount of seed over a programmed area. The PMC staff set the seeder for intervals of 24 ft. Pre-weighed packets were fed into the seed drill at 24 ft intervals. It is very precise and is a good choice for drilling limited amounts of wild-collected seed. The seed had been collected from four different populations and the populations were planted in separate rows in the same field, so the populations have the opportunity to interbreed. They were planted separately in the event that non-native fescues were collected in some populations, it will be easier to weed out non-native plants in some rows rather than all of them. Also, identification of the fescues is very difficult. If some populations are later identified as the wrong species, it is easier to take out a block within the field, rather than the entire field. Approximately 0.15 acres were sown in the fall.

V. Experimental Propagation

Previous germination trials with *C. pansa* have shown that higher germination rates can be achieved by dehulling the seed. These trials were performed under moderate temperatures (approximately 65° (F) days). Trials were performed this year using various dehulling techniques. Seeds are very difficult to dehull, but the PMC's belt-thresher was able to dehull about 30% of the seed when run through once. The belt thresher is a machine that has two rough rubber belts running in the same direction, but at different speeds. This creates a rolling, grinding action on the material that is fed into it. Two batches of seed were fed into the belt thresher, one set was run through once and another set was run through twice. A set of seed was also dehulled by rubbing two sandpaper blocks together, this was the roughest treatment. Three sets of 50 seeds were counted for each treatment and were placed on moistened germination paper in plastic germination boxes. Boxes were placed in a growth chamber set at 80°(F) days and 55° (F) night. The growth chamber was malfunctioning during the study and the temperature reached 100° (F) on a few occasions. The sedge responded well to the heat. Comparing this study with the one from previous years, it seems that heat is much more important than scarification to obtain the highest germination percentages.

Table. 2. *Carex pansa* germination trials using various levels of scarification.

Treatment	Rep	Germ Week 1	Week 2	Week 3	Total	% Germ
Control	1	9	13	5	27	**54**
Control	2	9	9	5	23	**46**
Control	3	11	6	5	22	**44**
Belt thresher 1 X	1	6	1	6	13	**26**
Belt thresher 1 X	2	14	5	2	21	**41**
Belt thresher 1 X	3	19	6	6	31	**62**
Belt thresher 2 X	1	16	3	3	22	**44**
Belt thresher 2 X	2	20	1	3	24	**48**
Belt thresher 2 X	3	21	5	4	30	**60**
Sandpaper rub	1	17	0	5	23	**46**
Sandpaper rub	2	13	0	2	15	**30**
Sandpaper rub	3	9	2	3	14	**28**

V1. Container Plant Production

On August 15, 2008 *C. pansa* seeds were dehulled by rubbing two sandpaper blocks together. Seeds were then sown into plastic trays with 3.5 cubic inch round cells. Trays were placed outside in a shadehouse and seedlings emerged within four weeks. In mid October, trays were moved into a greenhouse. Seedlings remained there until January 2009, and then were moved outside to acclimate to outdoor temperatures before being transplanted into a field in March.

Table 2. Plants produced for the North Coast Oregon Silverspot Butterfly Seed Increase Project in 2009.

Species	Code	Accession number	Number produced	Treatment	Start date
Viola adunca	VIAD	9079558	5509	120 days cold strat	12-Jan
Carex pansa	CAPA16	9079563	6000	scarification	15-Aug

Throughout the summer of 2008, OMD staff collected more violet seed. Seeds from white-flowered and lavender-flowered violets were targeted. In September, seeds were placed in germination boxes with moistened germination paper and left in a walk-in cooler for 120 days. The seeds were removed from the cooler in mid January 2009. These plants were grown in the greenhouse through the winter and assessed for flower color. Many of the plants had white flowers, some were purple and some were lavender. White-flowered plants were selected and re-potted in 5” square pots. These plants remained in the greenhouse until April, then were placed in a shadehouse.

Figure 3. Dune sedge (*Carex pansa)* plug production in the PMC shadehouse.

On January 12, 2009, 30 grams of the seed produced from the greenhouse plants was used to grow violets for fall outplanting at Camp Rilea. Seeds were sown in 5800 cone-tainers filled with moistened media (Sunshine #1, a special peat-based soil-less mix) amended with a balanced slow-release fertilizer and micronutrients. Flats of cone-tainers were placed in polyethylene bags and left in a walk-in cooler for 120 days. After being removed from the cooler, flats were placed in a shadehouse.

VII. Delivery of Materials

Table 3. Plants picked up by OMC staff on October 23, 2009.

Species	Code	Accession number	Size	Number delivered
Viola adunca	VIAD	9079558	Cone-tainers	5509
Viola adunca	VIAD	9079558	5" pots	47
Viola adunca (white)	VIAD	9079616	5" pots	64

Our seed lot numbers describe the generation of the field (SG0 is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed).

The middle numbers of a seed lot indicates which year the seed was produced in. The last portion of the seed lot describes which project the seed is for (or an abbreviation for the seed source) and the last three digits of the accession number that has been assigned to this species specifically for this project.

Table 4. Seeds in storage for the North Coast Oregon Silverspot Butterfly Seed Increase Project.

Species	**Seed lot**	**Amount**
Viola adunca	SG1-08-UA558	20 g
Viola adunca	SG1-09-UA558	1 lb
Viola adunca (w)	SG1-09-UA616	130 g
Solidago spathula	SG0-07-UA532	104 g
Carex pansa	SG0-07-UA563	350 g

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THE 2008 US ARMY/OREGON MILITARY DEPARTMENT ANNUAL REPORT:
Camp Rilea Seed Increase Project

Figure 1. *Viola adunca* plants growing in the PMC greenhouse, April 12, 2008.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the US Army, specifically with the Oregon Military Department (OMD), in 2007 to increase seed of early blue violet (*Viola adunca*) for use in recovery efforts for the Oregon silverspot butterfly (*Speyeria zerene hippolyta*). The butterfly is now extirpated from Camp Rilea due to the loss of disturbance in its coastal meadow habitat. The early blue violet is the obligate host to the silverspot caterpillars and has also been negatively impacted in its coastal meadow ranges by the encroachment of tall, spreading exotic plants. Seed increase on the violets will provide a source for future seedling grow-outs which can then be transplanted back into areas of Oregon silverspot butterfly habitat enhancement and restoration. In 2008, two species were added to this agreement. Seed

production of *Carex pansa* and plant production of *Solidago simplex ssp simplex var spathulata* were started in 2008.

II. Accessions Involved

The table below lists the accessions involved in this project. Activities in 2008 included seed collection and cleaning of three species, production of violets, and germination trials.

Table 1. Accessions in the Camp Rilea seed increase project.

Species	Common name	Symbol	Accession	Activity in 2008[1]
Viola adunca	early blue violet	VIAD	9079558	Col, pxn, sfp, dlv
Carex pansa	dune sedge	CAPA16	9079563	Pdx, trl
Solidago simplex ssp simplex var spathulata	dune goldenrod	SOSIS4	9079558	Pdx, dlv

1- trl= germination trials, col= wild seed collection, pxn=plant production, dlv= delivery of plant materials

III. Seed Collections

Throughout the summer, OMD staff collected additional violet seed to increase the diversity of the seed increase plants. Seeds from white-flowered and lavender-flowered violets were targeted. In September, seeds were placed in germination boxes with moistened germination paper and left in a walk-in cooler for 120 days. The seeds will come out of the cooler in mid January. These plants will be grown in the greenhouse through the winter and assessed for flower color.

IV. Seed Production

Plants that were produced in the winter of 2007 flowered in the greenhouse in December of 2007. Fifty plants were transplanted into 5” pots and were kept as seed increase plants. Seed pods were hand collected daily throughout January- March. All the seed that had been collected by mid-March was cleaned and used to grow violets for fall delivery. Plants remained in the greenhouse until late spring. PMC staff continued to collect seed pods off the violets throughout the growing season. The plants produced a total of 123g. A small portion of this (23g) was used to produce violets for outplanting.

The PMC agreed to establish a seed increase field of *Carex pansa* in 2008. Land was rented on a farm owned by Oregon State University. The seeds were sown using a precision cone-seeder on May 14, 2008. When the PMC rented this land, irrigation was available, but after the seeds were sown, the well ran dry and no irrigation could be applied to the field. Seeds did not germinate. The seed increase field will be established using transplants.

V. Container Plant Production

Of the plants that were produced in the winter of 2007, 50 were kept as seed production plants. The other 845 plants were picked up by OMD staff on March 26, 2008 and planted out at Camp Rilea.

On March 12, 2008 23 grams of the seed produced from the greenhouse plants was used to grow violets for outplanting at Camp Rilea. Seeds were sown into 4800 cone-tainers filled with moistened media (Sunshine #1, a special peat-based soil-less mix) amended with a balanced slow-release fertilizer and micronutrients. Flats of cone-tainers were placed in polyethylene bags and left in a walk-in cooler for 120 days. After being removed from the cooler, flats were placed in a lathhouse. Flats were moved to a shadehouse in late September.

Figure 2. Carex pansa seedlings growing in the Corvallis Plant Materials Center greenhouse, December 2, 2008

Plants were also produced for the North Coast Land Conservancy. Plants were used to establish a butterfly demonstration garden for use in public awareness activities concerning the butterfly. Seeds were sown on May 20, 2008 into cone-tainers. After sowing, flats of cone-tainers were moved to a lathhouse. Seedlings of all species were thinned down to two seedlings per cone. In early October watering was reduced to harden the plants to prepare them for outplanting.

On August 15, 2008 *C. pansa* seeds were dehulled by rubbing them between two sandpaper blocks. Seeds were then sown into plastic trays with 3.5 cubic inch round cells. Trays were placed outside in a shadehouse and seedlings emerged within four weeks. In mid October, trays were moved into a greenhouse. Seedlings will remain there until

January when they will be moved outside to get acclimated to outdoor temperatures before being transplanted into a field in March.

Figure 3. *Viola adunca* plug production in the PMC shadehouse.

Table 2. Plants produced for the Camp Rilea seed increase project.

Species	**Code**	**Accession number**	**Amt**	**Treatment**	**Start date**
Viola adunca	VIAD	9079558	4530	120 days cold-moist stratification	March 12
Carex pansa	CAPA16	9079563	159	scarification	May 20
Solidago spathulata	SOSIS4	9079558	1467	no treatment	May 20
Anaphalis margaritacea	ANMA	9079451	126	no treatment	May 20
Tanacetum douglasi	TADO	9079559	7	no treatment	May 20
Soildago canadensis	SOCA	9079497	71	no treatment	May 20
Artemisia suksdorfii	ARSU	9079560	137	no treatment	May 20
Achillea millefolium	ACMI	9079448	132	no treatment	May 20
Aster suspicata	ASCH	9079449	103	no treatment	May 20
Fesctuca amobia	FEAM	9079450	388	no treatment	May 20
Carex pansa	CAPA16	9079563	4680	dehull prior to	August 14

				sowing	

VI. Delivery of Materials

Two deliveries occurred in 2008. The first one, on March 26, 2008 consisted of 845 violet plugs. OMD staff picked up the plants from the PMC. The second delivery occurred on October 20, 2008. Plants for Camp Rilea as well as the North Coast Land Conservancy were picked up by OMD staff. Seed produced under this agreement will remain in the PMC seed storage facilities until needed.

Table 3. Plants picked up by OMC staff on October 20, 2008.

Species	**Code**	**Accession number**	**Number delivered**
Viola adunca	VIAD	9079558	5375
Carex pansa	CAPA16	9079563	159
Solidago simplex ssp simplex var spathulata	SOSIS4	9079558	1467
Anaphalis margaritacea	ANMA	9079451	126
Tanacetum douglasi	TADO	9079559	7
Soildago canadensis	SOCA	9079497	71
Artemisia suksdorfii	ARSU	9079560	137
Achillea millefolium	ACMI	9079448	132
Aster suspicata/chilliensis	ASCH	9079449	103
Fesctuca amobia	FEAM	9079450	388

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
Amy Bartow

November 20, 2008

THE 2008 FEDERAL HIGHWAY ADMINISTRATION ANNUAL REPORT:
Fort Hill Nelson's Checkermallow *(Sidalcea nelsoniana)* Seed Increase

Figure 1. *Sidalcea nelsoniana* seed increase field at the Corvallis Plant Materials Center, June 20, 2008.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the Federal Highway Administration in 2007 to provide temporary refuge for Nelson's checkermallow plants that will be impacted by road construction. Plants will be housed at the PMC until a mitigation site is established in 2010. While the plants are at the PMC, seeds will be collected from them. The seed will be used to grow containerized plants. At the conclusion of this project, the impacted plants, the seed they produced, and container plants (grown from the seed) will all be planted at the mitigation site.

II. Accessions Involved

Accession included in the Fort Hill Nelson's checkermallow project is presented below.

Table 1. Accessions involved for the Fort Hill Nelson's checkermallow project at the Corvallis Plant Materials Center in 2008.

Species	Common name	Symbol	Accession	Activity in 2008[1]
Sidalcea nelsoniana	Nelson's checkermallow	SINE	9079516	sfp

1- sfp= seed increase

III. Field Seed Increase Activities

Plants began to grow vigorously in early March. The weed fabric was cut back from each plant and rhizomes were pulled up on top of the fabric. The plants were very large by June and were covered with flowers. No seed weevils were detected.

Seed maturity was fairly even across the field this year. On July 29, 2008, the field was harvested using a self-propelled swather equipped with a conveyor belt to help bag all the cut material. All plant material was laid out on tarps in a shed to dry. Seed was also swept up from the weed fabric. After drying, plant material was fed through a small Winterstieger plot combine. This separated the seeds from the plants and blew out some chaff. Seed was cleaned using a large brush machine (to try to remove some of the hulls) and an air screen machine. The *Sidalcea* field is near a field of bottle-brush squirreltail (*Elymus elymoides*) and the squirreltail seeds had blown or rolled 100 ft or more and ended up on the weed fabric of the *Sidalcea* field. This seed was swept up with the sidalcea seed. An indent cylinder machine was used to separate the *Sidalcea* seed from the squirreltail field; this was very effective. The field produced 38 lbs pounds of seed. Gophers had moved into the south end of the field and many traps were set in the area. By fall, three gophers had been trapped. Gophers did not appear to be damaging plants in early fall, but PMC staff had concerns that as winter set in, gophers might eat the underground tubers and rhizomes of the plants. Areas around the plot were tilled to discourage gophers from residing there. Rabbits and voles are both a problem in the plot. Some of the plants were severely damaged in late winter, but those plants survived. The damaged plants outgrew the herbivory, exhibiting abundant new growth and high seed production. Other than keeping field borders tilled and adding a raptor perch near the plot, control measures will not be taken to reduce rabbit or vole herbivory on the plants.

III. Plant Production

No plant production occurred in 2008 for this project.

IV. Delivery of Plant Materials

Two seed deliveries were made this year. The seed that was produced in 2007 was delivered to the Native Seed Network on September 30, 2008 and a portion of the seed produced in 2008 was picked up by United States Fish and Wildlife staff on October 15, 2008. The remaining 21.5 lbs of seed will be kept in the PMC seed storage facilities until requested.

Table 2. Seed delivery for the Fort Hill Nelson's Checkermallow project in 2008.

Species	Seed lot	Amount Delivered	Date
Sidalcea nelsoniana	SG1-07-GR516	9 lbs	9/30/2008
Sidalcea nelsoniana	SG1-08-GR516	16.5 lbs	10/15/2008

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NATURAL RESOURCES CONSERVATION SERVICE
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THE 2008 UNITED STATES FOREST SERVICE ANNUAL REPORT:
Umatilla District

Figure 1. *Penstemon fruticosus* trial seed increase plot at the Corvallis Plant Materials Center, July 20, 2008.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the Umatilla District of the United States Forest Service (USFS) in 2007 to provide native plant materials for ecological restoration. It was agreed that the PMC would establish and maintain seed increase fields of two forbs and research and establish test plots of another three forbs and one legume. Activities in 2008 included establishment and maintenance of seed increase fields and trial plots, harvest and seed cleaning.

II. Accessions Involved

Accessions included for the Umatilla District USFS in 2008 are listed in Table 1. This table also displays activities performed by PMC staff.

Table 1. Accessions involved for the Umatilla District USFS cooperative agreement with Corvallis Plant Materials Center in 2008.

Scientific Name	Common name	Code	Accession #	Activity in 2008[1]
Eriogonum heracleoides	parsnipflower buckwheat	ERHE2	9079523	Trl, sfp
Penstemon fruticosus	bush penstemon	PEFR3	9079524	Trl
Monardella odoratissima	mountain monardella	MOOD	9079525	Trl
Penstemon procerus	littleflower penstemon	PEPR2	9079526	Trl
Hellianthella uniflora	oneflower hellianthella	HEUN	9079527	Trl, sfp
Trifolium eriocephalum	woollyhead clover	TRER	9079522	Trl

1- sfp= seed increase, trl=germination trials

III. Field Seed Increase Activities

The seedlings that were produced during the germination trials were grown in a greenhouse and transplanted out into seed increase plots in mid-March. Each plot contains between 400 and 500 plants. These plots will demonstrate the species ability to survive under the growing conditions at the PMC. Weed control in the plots was performed by hand. All of the species grew vigorously after transplanting, except for the *Trifolium eriocephalum*, it went dormant. Hopefully it will emerge in the spring of 2009. Both *Penstemon sp*. had a few individuals that flowered in 2008. The *Monardella ordoratissima* plot flowered profusely and seedheads were collected by hand when they were mature. The small plot produced 18g seed. The other plots did not flower.

The *T. eriocephalum* plants were small and the leaves looked slightly stunted. Only 100 plants were transplanted out into a trial plot. The rest of the plants were held over in the lathhouse for the growing season. None of the plants were inoculated with a rhizobium at planting time. Some species greatly benefit from inoculation, others receive a small benefit, but rarely does the PMC encounter a species that will die in cultivation if not properly inoculated. As the clover plants grew in the lathhouse over the summer the plants began to look less vigorous and new leaves were very small. The PMC didn't have any clover innoculant, so weedy clover plants that persist on the farm were dug up and their root nodules were crushed. A slurry of crushed roots was made and poured over two flats of the *T. eriocephalum* plants. One flat wasn't treated (control). No major difference in growth was observed following the root slurry treatment. All the clover plants soon went dormant in their containers. They will be evaluated again in the spring.

The larger direct-sown fields of *Eriogonum hercleoides* and *Hellianthella uniflora* became very weedy in late summer. Rows of plants were very sparse in the *E. heracleoides* plot and it may not be worth maintaining. Field will be re-evaluated in the spring of 2009. The *H. uniflora* field had visible rows of seedlings, but weed cover made it difficult to evaluate the overall establishment of the field. It will be evaluated in the spring of 2009. In the spring/summer of 2008, plants were still very small and it was decided that the fields would not be weeded by hand so the plants wouldn't be damaged by weeding. Instead of attempting to weed or spot spray the field, a Hiniker Flail Mower/Shredder was used to mow down the field. This piece of equipment cuts and "vacuums" all residue laying on the ground surface. Residue is shot out into a wagon that is pulled behind the mower and can be dumped offsite. This form of "weed control" was chosen because the annual weeds would be killed or completely reduced to 2" tall, and all the seeds that were about to be produced by the weeds were removed from the field.

Figure 2. *Monardella ordoratissima* trial seed increase plot at the Corvallis Plant Materials Center, July 20, 2008.

IV. Delivery of Plant Materials.

No materials were delivered in 2008.

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
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January 20, 2009

THE 2009 UNITED STATES FOREST SERVICE ANNUAL REPORT:
Umatilla District

Figure 1.Littleflower penstemon (*Penstemon procerus)*(left) and bush penstemon *(Penstemon fruticosus)*(right) trial seed increase plot at the Corvallis Plant Materials Center, June 20, 2009.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) entered into a new agreement with the Umatilla District of the United States Forest Service (USFS) in 2007 to provide native plant materials for ecological restoration. It was agreed that the PMC would establish and maintain seed increase fields of two forbs and research and establish test plots of another three forbs and one legume. Activities in 2009 included maintenance of seed increase fields and trial plots, harvest, and seed cleaning.

II. Accessions Involved

Accessions included for the Umatilla District USFS in 2009 are listed in Table 1. This table also displays activities performed by PMC staff.

Table 1. Accessions involved for the Umatilla District USFS cooperative agreement with Corvallis Plant Materials Center in 2009.

Scientific Name	Common name	Code	Accession #	Activity in 2009[1]
Eriogonum heracleoides	parsnipflower buckwheat	ERHE2	9079523	sfp
Penstemon fruticosus	bush penstemon	PEFR3	9079524	sfp
Monardella odoratissima	mountain monardella	MOOD	9079525	sfp
Penstemon procerus	littleflower penstemon	PEPR2	9079526	sfp
Hellianthella uniflora	oneflower hellianthella	HEUN	9079527	sfp
Trifolium ericephalum	woollyhead clover	TRER	9079522	trl

1- sfp= seed increase, trl=germination trials

III. Field Seed Increase Activities

All of the species in this agreement, except for the *Hellianthella*, flowered in 2009 which was the second growing season for these plants. The *T. eriocephalum* plants were still in their cone-tainers as of the spring of 2009. The plants were small and the leaves looked slightly stunted, but some plants did flower. None of the plants were inoculated with a rhizobium at planting time. Some species greatly benefit from inoculation, others receive a small benefit, but rarely does the PMC encounter a species that will die in cultivation if not properly inoculated. As the clover plants grew in the lathhouse over the summer of 2008 the plants began to look less vigorous and new leaves were very small. The PMC didn't have any clover innoculant, so weedy clover plants that persist on the farm were dug up and their root nodules were crushed. A slurry of crushed roots was made and poured over two flats of the *T. eriocephalum* plants. One flat wasn't treated (control). No major difference in growth was observed following the root slurry treatment in 2008. All the clover plants soon went dormant in their containers. The plants emerged in early spring and a difference was observed between the plants that had been "inoculated" and the ones that hadn't. The ones that had received the slurry had larger leaves and flowered in their cone-tainers. If grown in containers, this species must be sown with an innoculant. It may not be mandatory to sow it with innoculant in a field because it may be present in the soil, but for added insurance, sow with an innoculant.

The *Monardella odoratissima* plot flowered again this year. It did not produce more seed than it did last year. The two-year old field looked similar (regarding the amount of flowers) to the one-year old field. Only 35g of seed was harvested from the very small PMC plot. This plant could be harvested with a combine which would recover the

majority of the seed produced. The seed does not shatter easily and plants within the plot appeared to mature evenly. The plants go dormant in the winter with almost all of their leaves disappearing. This opens up a window to use broad-spectrum herbicides on the field while the plants are dormant. *M. odoratissima* doesn't produce as much seed as the penstemons studied in this project, but it does produce seed its first year.

Figure 2. Littleflower penstemon (*Penstemon procerus)* trial seed increase plot at the Corvallis Plant Materials Center, June 30, 2009.

The PMC staff was shocked at the amount of seed the small plot of *Penstemon procerus* produced this year! The plants were fully mature in their second growing season and flowered profusely. Stalks were hand harvested on two occasions. This species holds onto its seeds relatively well. Compared to other penstemons, the capsules of *P. procerus* shatter more readily. This issue is greatly compensated for by the amount of seeds these plants can produce. This species could easily be combined and produces heartily on its second year, making it a good candidate for large scale seed increase.

The *Penstemon fruticosus* plants appeared to not have reached their peak flowering year. The third growing season will probably be the year that the field reaches maturity. The capsules do not shatter easily, but are very low to the ground, making mechanized harvest difficult. If plants were sown on tight row spacing, it might force the plants to grow taller more therefore cause the seedheads to be higher too.

Table 2. Seed Increase Field Yields at the Corvallis Plant Materials Center for the Umatilla National Forest in 2009.

Species	Harvest date	Method	Yield	Projected lbs/acre (year 2 plants)	Notes
Eriogonum heracleoides	July 20	hand	194 g	40	peak flowering will probably occur in year 3
Penstemon fruticosus	June 29	hand	88 g	20	peak flowering will probably occur in year 3
Monardella odoratissima	July 20	hand	34 g	10	could get higher yields with large field that was combined
Penstemon procerus	July 7	hand	5 lbs	500	peak flowering occurred this year

Figure 3. Creamy buckwheat (Eriogonum hercleoides) seed increase plot at the Corvallis Plant Materials Center, June 30, 2009.

The larger direct-sown fields of *Eriogonum hercleoides* did not emerge in the spring of 2009. However, the plot that was created from plugs, looked great, had high survival and many of the plants flowered. The plants have not reached their peak flowering year. The third growing season will probably be the year that the field reaches maturity. Seeds were harvested by hand, but for a large field, using a combine or a seed stripper would be very effective.

The larger direct-sown *Hellianthella uniflora* field was relatively weed free this year, but no plants flowered. This species appears to be low maintenance and has a long dormant period in which some broad spectrum herbicides could be used. It will hopefully flower next year (its third growing season), but it may not reach its peak production until its fourth growing season. These plots are on an Oregon State University (OSU) research farm located about five miles from the main PMC farm. The OSU farm manager highly recommended that we

remove the trial plots this fall due to encroachment of Canada thistle. The infestation was severe and several bouts of hand weeding per year were just exacerbating the problem. Sadly, the plots were removed in the fall. The larger field of Hellianthella was kept; it was thistle free, and PMC staff felt that this plot needs to be continued to obtain harvest information from it.

IV. Delivery of Plant Materials.

No materials were delivered in 2009. Seed that has been produced for this project will remain in the PMC's seed storage facilities until requested by the USFS.

Table 3. Seeds in storage at the Corvallis Plant Material Center for the Umatilla National Forest in 2009.

Species	Seed lot	Amount
Eriogonum heracleoides	***SG0-06-UM523***	130 g
Eriogonum heracleoides	***SG1-09-UM523***	194 g
Monardella odoratissima	***SG0-06-UM525***	65 g
Monardella odoratissima	***SG1-08-UM525***	34 g
Penstemon fruticosus	***SG0-07-UM524***	260 g
Penstemon fruticosus	***SG1-09-UM524***	88 g
Penstemon procerus	***SG0-07-UM526***	230 g
Penstemon procerus	***SG1-09-UM526***	5 lbs
Trifolium eriocephalum	***SG0-04-UM522***	80 g

Our seed lot numbers describe the generation of the field (SG0 is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed). The middle numbers of a seed lot notes which year the seed was produced in. The last portion of the seed lot describes which project the seed is for (UM is for Umatilla National Forest) and the last three digits of the accession number that has been assigned to this species specifically for this project.

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
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February 20, 2010

THE 2009 SEED INCREASE OF THREATENED AND ENDANGERED SPECIES ANNUAL REPORT

Figure 1. Combining a Nelson's checkermallow *(Sidalcea nelsoniana)* seed increase field at the Corvallis Plant Materials Center, July 22, 2009.

I. Brief Background of Project

The Corvallis Plant Materials Center (PMC) has entered into agreements with various agencies that need seed and plants of threatened and endangered species. One agreement with Federal Highway Administration began in 2007 to provide temporary refuge for Nelson's checkermallow plants that will be impacted by road construction. Plants will be housed at the PMC until a mitigation site is established in 2010. While the plants are at the PMC, seeds will be collected from them. The seed will be used to grow containerized plants. At the conclusion of this project, the impacted plants, the seed they produced, and the container plants (grown from the seed) will all be planted at the mitigation site. Another project involving two more seed increase fields of Nelson's checkermallow began in 2009. This project, in partnership with the Institute for Applied Ecology (IAE),

will help reach recovery goals by producing seeds, plants, and rhizome pieces to be planted out in various restoration projects on protected sites. Also, in partnership with IAE, the PMC is researching seed increase techniques for Kincaid's lupine and Willamette Valley daisy. New in 2010, is an agreement with IAE and USFWS to produce seeds and plants of golden paintbrush. This plant is thought to have been extirpated from Oregon and the products of this project will be used to establish new populations in Oregon according to recovery goals.

II. Accessions Involved

Table 1. Accessions involved in the Threatened and Endangered Species Seed Increase project at the Corvallis Plant Materials Center in 2009.

Species	Common name	Population Source	Accession #	Activity in 2009[1]
Erigeron decumbens var. *decumbens*	Willamette valley daisy	Allan & Allan Farm	9079508	sfp, dlv
Erigeron decumbens var. *decumbens*	Willamette valley daisy	Baskett Butte	9079509	sfp
Lupinus oreganus var. *kincaidii*	Kincaid's lupine	Lupine meadows	9079514	sfp, dlv
Lupinus oreganus var. *kincaidii*	Kincaid's lupine	Piercy farm	9079515	sfp,dlv
Sidalcea nelsoniana	Nelson's checkermallow	Salem West	9079600	sfp, pxn, dlv
Sidalcea nelsoniana	Nelson's checkermallow	Corvallis West	9079597	sfp, pxn,dlv
Sidalcea nelsoniana	Nelson's checkermallow	Ft. Hill	9079516	sfp,dlv
Castilleja levisecta	golden paintbrush	Rocky Prairie	9079627	pxn
Castilleja levisecta	golden paintbrush	Nass, Ft. Casey, Ebey's landing, Rocky Prairie	9079625	pxn

1- sfp= seed increase, pxn= plant production, dlv= delivery of plant materials

III. Plant Production

On October 15, 2008 seeds of the SW and CW Nelson's checkermallow were provided by IAE. Collections were made over the summers of 2008 and 2009 by IAE staff. Seeds from populations were grouped into four metapopulations for each recovery zone (seed increase field). Seeds were scarified by rubbing them between two pieces of sandpaper and then sown into Ray Leach stubby "cone-tainers" filled with Sunshine #1 (a sterile soil-less, peat-based media) amended with micronutrients and a balanced slow release fertilizer. Racks of cones were wrapped in plastic bags and placed in a walk-in cooler for four months for stratification. After coming out of the cooler, racks were placed in a greenhouse set at moderate temperatures (65 days/ 50 degree nights). Seedlings emerged within two weeks after being removed from the cooler (some seedlings had germinated in

the cooler). Cones that had more than two seedlings were thinned and extra seedlings were transplanted into empty cones. After two months, the plants were transplanted out into the seed increase fields. A few of the populations had low germination and not enough plants were produced. A second round of plant production was repeated in the fall of 2009 to produce the desired number of plants from each population.

Table 2. Plant Production in 2009 for the Threatened and Endangered Species Seed Increase project at the Corvallis Plant Materials Center.

Species	**Source**	**Treatment**	**Amount Produced**
Sidalcea nelsoniana	Salem West	Scarify, 16 weeks cold	200
Sidalcea nelsoniana	Corvallis West	Scarify, 16 weeks cold	600
Castilleja levisecta	Rocky Prairie	7 weeks cold	700
Castilleja levisecta	Nass,	7 weeks cold	1000
Castilleja levisecta	Ft. Casey	7 weeks cold	800
Castilleja levisecta	Ebey's landing	7 weeks cold	850

Seeds of *Castilleja levisecta* were provided by IAE in the fall of 2009. Collections were made over the summer of 2009 by various groups in Washington. Germination tests were performed on each of the populations. Sets of 50 seeds were counted and placed on moistened germination paper in plastic germination boxes. They were placed in a walk-in cooler for six weeks, and then placed in a growth chamber (70 degree days 55 degree nights). A quick flush of germination occurred within five days and then ceased in the growth chamber. On November 19, 2009 the remaining seed was placed on moistened germination paper in plastic germination boxes placed in a walk-in cooler. Instead of taking the boxes out of the cooler after six weeks, they were left in the cooler. Seeds began to germinate at seven weeks and continued to germinate for three weeks more. The boxes that were left to germinate in the cooler appeared to have a higher germination rate than the boxes that were placed in the warm growth chamber after six weeks.When the seeds first began to germinate, they were carefully removed by hand using tweezers and transplanted into Ray Leach stubby “cone-tainers” filled with Sunshine #1 (a sterile soil-less, peat-based media) amended with micronutrients and a balanced slow release fertilizer. Racks of cones were placed in a greenhouse set at moderate temperatures.

In the spring of 2010, 1500 plugs will be delivered to IAE for outplanting, and the remaining 1500 plugs will be used to establish seed increase plots at the PMC. This species is known to be hemi-parasitic and will thrive if planted with a host. Seeds of sand fescue (*Festuca ammobia*) will be sown in the cone-tainers of paintbrush that will be used for seed increase plots. Golden paintbrush does not appear to be host specific, therefore sand fescue was chosen mostly for convenience in PMC field planning.

IV. Field Seed Increase Activities

Kincaid’s lupine- this was the third growing season for both of the lupine plots. In early March the plants emerged from dormancy and began to grow vigorously. Some plants in the Lupine meadows plot did not emerge in the spring. This plot is on heavier soils than the Piercy plot, which has had 100% survival over the three growing seasons. Both plots

were weeded by hand and field borders were tilled. The plants flowered more abundantly than last year and were often covered with bumblebees. When seed pods turned light tan they were collected by hand and placed inside a tarp "taco" in an open greenhouse.

Figure 2. Kincaid's lupine (*Lupinus oreganus var kincaidii*) seed increase plot at the Corvallis Plant Material Center May 30, 2009.

Willamette Valley Daisy- this was the third growing season for both of the daisy plots. In late January the plants emerged from dormancy and began to grow vigorously. Both plots were weeded by hand and field borders were tilled. The Allen and Allen plot was excessively weedy and some plants were damaged during the weeding process. Seeds were harvested using a portable battery-powered vacuum. The plots were harvested three times a week for three weeks during July and August.

Ft. Hill Nelson's checkermallow- Vole and rabbit predation is high on this plot in the winter. Plants grow rapidly and overcome the predation in mid spring. This spring leaves of 80% of the plants had yellow spots on them. The cause was unknown and was not pursued. The plants with the spots did not appear any less vigorous than the plants without the spots. However, the seed production of this field was far less than it was last year. No other *Sidalcea* field at the PMC had plants with any spotted leaves; it was only seen on the Ft. Hill population. It is not known if the spots were rust or other signs of disease and if it affected the seed production. During peak flowering of this field, a huge thunder storm ripped across the PMC, damaging a lot of plants and ruining seed production of two fescue fields that were in peak anthesis. It is likely that many flowers were damaged in the storm. The two other Nelson's checkermallow fields were not in bloom during the storm since they were first year plants and did not flower until later in

Figure 3. Willamette Valley daisy (*Erigeron decumbens var decumbens*) seed increase plot at the Corvallis Plant Materials Center, June 15, 2009

the summer. If the yellow spots are seen again, leaves will be taken to the pathology lab for diagnosis. In late February, the weed fabric was cut back from each plant and rhizomes were pulled up on top of the fabric. The field was weeded twice by hand and the borders of the field were sprayed with glyphosate.

Seed maturity was fairly even across the field this year. The plot was harvested using the PMC's Hege plot combine. This method was very efficient and effective.

Salem West (SW) and Corvallis West (CW) Nelson's checkermallows- These fields were established in mid March of this year using plugs that were grown over the winter. Plants from each of the metapopulations were distributed across the fields to reduce the chances of an entire metapopulation being lost due to damage to the fields (flood, pest attack, gophers, mowing or spraying accident, ect). This arrangement also increases the opportunity for cross-pollination between the metapopulations. The two seed increase fields were isolated from each other by being planted on separate farms (three miles apart). Since the wild population of the Ft. Hill checkermallows are included in the SW recovery zone, the SW seed increase field was located about 500 ft from the Ft. Hill checkermallow seed increase field; it is suspected that these fields could interbreed.

Weed fabric was installed on the SW field but not on the CW field. Originally, it was planned that both fields would have weed fabric, but the CW field had a large amount of glass, sharp rocks, and other debris that could make crawling around on weed fabric dangerous for PMC employees. Also, having a checkermallow field without weed fabric gives the PMC an opportunity to compare the seed increase fields. The CW field was weeded by hand twice during the growing season and the field borders were tilled. The

SW field was weeded once by hand and the borders of the field were sprayed with glyphosate.

Figure 4. Corvallis West Nelson's checkermallow (*Sidalcea nelsoniana*) seed increase field at the Corvallis Plant Materials Center, June 22, 2009.

Both the SW and CW seed increase fields matured at approximately the same time. The CW field was combined a week sooner because it did not have weed fabric. The weed fabric catches all the early maturing seed as it shatters, which means that the field can be combined when the latest maturing seeds are ripe. Without the weed fabric, the field has to be carefully assessed to figure out when the largest percent of seed is mature but hasn't shattered (because it will fall to the ground).

Table 3. Harvest Information for the Threatened and Endangered Species Seed Increase project at the Corvallis Plant Materials Center in 2009.

Species	Accession	Field size (ac)	Date harvested	Method	Yield
Erigeron decumbens var. *decumbens*	Allan & Allan	0.006	July 12- 20	vacuum	48 g
Erigeron decumbens var. *decumbens*	Baskett Butte	0.006	July 12- 20	vacuum	64 g
Lupinus oreganus var. *kincaidii*	Lupine meadows	0.008	June18-25	hand	1 lb
Lupinus oreganus var. *kincaidii*	Piercy farm	0.008	June20-27	hand	2.2 lbs
Sidalcea nelsoniana	Salem West	0.3	July 27	combine	51 lbs
Sidalcea nelsoniana	Corvallis West	0.2	July 22	combine	34.5 lbs
Sidalcea nelsoniana	Ft. Hill	0.08	July 27	combine	6 lbs

V. Delivery of Plant Materials

Seed was delivered in the fall to IAE and USFWS staff. The remaining seed will be kept in the PMC seed storage facilities until requested.

Table 4. Seed delivered for the Seed Increase of Threatened and Endangered Species project in 2009.

Species	Source	Seed lot	Amt	Germ	Purity
Erigeron decumbens var. *decumbens*	Allan & Allan	SG1-08-AA508	175 g	N/A	N/A
Lupinus oreganus var. *kincaidii*	Lupine meadows	SG1-08-LM514	1 lb	N/A	N/A
Lupinus oreganus var. *kincaidii*	Lupine meadows	SG1-09-LM514	1 lb	N/A	N/A
Lupinus oreganus var. *kincaidii*	Piercy farm	SG1-08-PE515	2 lbs	N/A	N/A
Lupinus oreganus var. *kincaidii*	Piercy farm	SG1-09-PE516	2.2 lbs	N/A	N/A
Sidalcea nelsoniana	Salem West	SG1-09-SW600	21 lbs	41%	99.57%
Sidalcea nelsoniana	Corvallis West	SG1-09-CW597	1.5 lbs	59%	99.9%
Sidalcea nelsoniana	Ft. Hill	SG1-08-GR516	19 lbs	85%	97.42%
Sidalcea nelsoniana	Ft. Hill	SG1-09-GR516	6 lbs	89%	94.72%

Our seed lot numbers describe the generation of the field (SG0 is wild collected seed, SG1 is seed that is produced from the plants that were grown using wild collected seed). The middle numbers of a seed lot indicates which year the seed was produced in. The letters in the last portion of the seed lot describes which project the seed is for (or an abbreviation for the seed source) and the numbers are the last three digits of the accession number that has been assigned to this species specifically for this population source.

Table 5. Seed in storage for Seed Increase of Threatened and Endangered Species project in 2009.

Species	Source	Seed lot	Amt
Erigeron decumbens var. *decumbens*	Allan & Allan Farm	SG1-09-AA508	48 g
Erigeron decumbens var. *decumbens*	Baskett Butte	SG1-09-BB509	64 g
Erigeron decumbens var. *decumbens*	Baskett Butte	SG1-08-BB509	33 g
Sidalcea nelsoniana	Salem West	SG1-09-SW600	30 lbs
Sidalcea nelsoniana	Corvallis West	SG1-09-CW597	33 lbs