

CORVALLIS PLANT MATERIALS CENTER
NATURAL RESOURCES CONSERVATION SERVICE
CORVALLIS, OREGON
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THE 2006 OLYMPIC NATIONAL PARK ANNUAL REPORT:
Elwha River Ecosystem and Fisheries Restoration

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 staff as restoration plans are finalized.



Figure 1. Elwha River, Olympic National Park, August 10, 2006.

Activities in 2006 included collecting seed of 18 species; establishment and maintenance of seed production fields including five grasses, seven forbs, four rushes, two legumes, and two sedges; containerized stock production of eight species; maintenance of cutting blocks of nine shrubs and one forb. Details are provided below.

II. Accessions Involved

Table1. Accessions involved and activities performed in 2006 for Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis Plant Materials Center.

Species	Common name	Symbol	Accession number	2006 Activity ¹
<i>Achillea millefolium</i>	common yarrow	ACMI2	9079349	Sfp, Col
<i>Agrostis exarata</i>	spiked bentgrass	AGEX	9079401	Sfp, Col
<i>Anaphalis margaritacea</i>	pearly everlasting	ANMA	9079350	Sfp, Col
<i>Artemisia suksdorfii</i>	coastal wormwood	ARSU4	9079400	Sfp
<i>Aruncus dioicus</i>	goatsbeard	ARDI8	9079370	Sfp
<i>Bromus complex</i>	Brome complex	BR sp	9079332	Sfp, Col
<i>Bromus vulgaris</i>	Columbia brome	BRVU	9079333	Sfp, Col
<i>Carex deweyana</i>	dewey sedge	CADE9	9079330	Sfp Pxn
<i>Carex hendersonii</i>	Henderson's sedge	CAHE7	9079331	Sfp,Pxn
<i>Carex pachystachya</i>	thick-headed sedge	CAPA14	9079329	Sfp Pxn Col
<i>Collomia grandiflora</i>	Grand collomia	COGR	9079355	Pxn, Col
<i>Deschampsia elongata</i>	slender hairgrass	DEEL	9079335	Sfp Col
<i>Elymus glaucus</i>	blue wildrye	ELGL	9079334	Sfp Col
<i>Epilobium angustifolium</i>	tall fireweed	EPAN	9079345	Sfp Col
<i>Epilobium ciliatum</i>	fringed willowherb	EPCI	9079346	Col
<i>Eriophyllum lanatum</i>	wooly sunflower	ERLA	9079441	Pxn Col
<i>Gaultheria shallon</i>	salal	GASH	9079340	Pxn
<i>Juncus bolanderi</i>	Bolander's rush	JUBO	9079371	Pxn Col
<i>Juncus effusus</i>	common rush	JUEF	9079348	Pxn, Col
<i>Lonicera ciliosa</i>	orange honeysuckle	LOCI3	9079364	Cb
<i>Lonicera involucrata</i>	honeysuckle	LOIN	9079363	Cb
<i>Lupinus latifolius var. latifolius</i>	broadleaf lupine	LULA4	9079336	Pxn, Sfp, Col
<i>Luzula comosa</i>	Pacific woodrush	LUCO	9079444	Pxn, Sfp Col
<i>Luzula parviflora</i>	smallflowered woodrush	LUPA4	9079337	Pxn, Sfp Col
<i>Populus balsamifera ssp. trichocarpa</i>	black cottowood	POBAT	9079369	Cb
<i>Prunella vulgaris ssp. Lanceolata</i>	lance selfheal	PRVUL2	9079483	Sfp, Col
<i>Ribes divaricatum</i>	spreading gooseberry	RIDI	9079365	Cb
<i>Ribes lacustre</i>	prickly currant	RILA	9079366	Cb
<i>Rosa nutkana</i>	nutka rose	RONU	9079338	Cb
<i>Rubus spectabilis</i>	salmonberry	RUSPS	9079362	Cb

Species	Common name	Symbol	Accession number	2006 Activity ¹
<i>Salix lucida</i> var. <i>lasiandra</i>	Pacific willow	SALUL	9079368	Cb
<i>Salix sitchensis</i>	Sitka willow	SASI2	9079361	Cb
<i>Sambucus racemosa</i>	red elderberry	SARA2	9079367	Cb
<i>Symphoricarpos albus</i>	common snowberry	SYAL	9079339	Cb
<i>Vicia americana</i>	American vetch	VIAM	9079341	Pxn Col

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

III. Native Seed and Plant Collections

Five separate trips were conducted in July and August 2006; approximately 368 hours were spent performing collections. Seed collections were made all over the Elwha watershed (below 1000ft elevation) throughout the growing season. A total of 20 lbs of clean seed of 18 species were collected in 2006.

Table 2. Native Seed and Plant Collection in the Elwha Watershed in 2006 for Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis Plant Materials Center.

Species		Amt collected	Dates
<i>Achillea millefolium</i>	ACMI2	108 g	8/7-8/22
<i>Agrostis exarata</i>	AGEX	242 g	7/10-7/25
<i>Anaphalis margaritacea</i>	ANMA	61 g	8/20-8/24
<i>Bromus complex</i>	BR sp	2158 g	7/10-7/25
<i>Bromus vulgaris</i>	BRVU	1316 g	7/20-8/10
<i>Collomia grandiflora</i>	COGR	21 g	8/7-8/20
<i>Deschampsia elongata</i>	DEEL	230 g	7/10-7/25
<i>Elymus glaucus</i>	ELGL	10 lbs	7/20-8/24
<i>Epilobium angustifolium</i>	EPAN	70 g	8/20-8/24
<i>Epilobium ciliatum</i>	EPCI	50 g	8/20-8/24
<i>Eriophyllum lanatum</i>	ERLA	35 g	8/20-8/24
<i>Juncus bolanderi</i>	JUBO	49 g	8/20-8/24
<i>Juncus effusus</i>	JUEF	61 g	8/20-8/24
<i>Lupinus latifolius</i> var. <i>latifolius</i>	LULA4	70 g	7/20-8/24
<i>Luzula comosa</i>	LUCO	6 g	7/10-7/25
<i>Luzula parviflora</i>	LUPA4	16 g	7/10-7/25
<i>Prunella vulgaris</i> ssp. <i>Lanceolata</i>	PRVUL2	283 g	7/25-8-10
<i>Vicia americana</i>	VIAM	16 g	8/7-8/24

IV. Experimental Propagation

Most species involved in this project have been propagated successfully at the PMC. Two new species were added in 2006 (*Collomia grandiflora* and *Prunella vulgaris* spp)

lanceolata) and informal propagation trials were performed. Seeds of COGR and PRVU were placed in plastic germination boxes on moistened germination paper and stored in a walk-in cooler both species exhibited germinated within two weeks while remaining in the cooler and both had germination rates between 84-89%. It is inferred that these species will germinate best if fall sown or sown in early spring while temperatures are still cool.

V. Cutting Block Maintenance.

The base of all willows and elderberry shrubs were wrapped with aluminum foil to prevent damage from rodents. Individuals that had died the previous fall were replaced with healthy cuttings from other plants within the cutting blocks. All cutting blocks were fertilized with a slow release fertilizer in March.

VI. Field Production Activities

Containerize plants that were produced in the fall of 2005 were transplanted into fields in January 2006. Fields of LUCA, CAHE, LULA, ARDI, were established using transplants. LULA and ARDI plugs were transplanted into weed fabric that had been stapled down over the field. The ANMA field was augmented using transplants in to fill in empty places within the rows. JUBO and JUEF were planted into simulated ponds in January 2006. After planting, the ponds were flooded by heavy rain; plants were under four feet of water. Almost all of the JUEF and about ¾ of the JUBO died. New plants were grown in the fall of 2006 and will be transplanted into the ponds in early spring of 2007.



Figure 2. *Luzula campestris* transplants in a seed increase field at the Corvallis Plant Materials Center, May 15, 2006.

Plants of ERLA and LUPA were not vigorous enough in early spring to be transplanted out into fields. It was decided to keep these plants in containers throughout the 2006 growing season and transplant them out into fields in the fall.

Plants grown in the summer of 2006 were used to expand and fill in the CAPA and CADE fields.

Spring seeding:

The ACMI field that was sown in the spring of 2005 was planted with rows that were 1 ft apart. The plants grew so vigorously that it wasn't feasible to use a cultivator between the rows without severely damaging every other row in the field. A new field was sown in May 4, 2006. Using seed that was collected in the summer of 2004, ACMI was sown using

a six-row Planet Jr. equipped with a carbon banding unit. The planter was set up to only plant every other row, creating three rows that were 2 ft apart, instead of six rows that were 1 ft apart (as with the previous field). The field was sprayed with Karmex (a non-

selective pre-emergent herbicide) prior to planting. Spotty rain came within two days and no irrigation was set up for the plot. Most seedlings emerged within 2-3 weeks after planting, and stand establishment and vigor was rated high for all species.

AGEX field that had been sown in fall of 2006 had very low emergence and seedlings looked very weak. There was a high amount annual bluegrass (*Poa annua*) within the rows which heavily competed with the AGEX the field was sprayed out and re-sown in the spring. Using a precision cone-seeder, a new field was established on April 24, 2006. The field was not irrigated. Seedlings germinated and remained small throughout the growing season.

Table 3. Spring seeding at the Corvallis Plant Materials Center in 2006 for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement.

Species/Ac	amt seeded	germ	approximate seeding rate	seeds/lb
ACMI				
0.2 acres or 24 180' rows 24" btwn rows	400 g	58%	4 lbs/acre (bulk) 2lbs/acre (PLS) 372 PLS/ft-row	3,117,200
AGEX				
0.1 acres or 12 160' rows 12" btwn rows	20 g	75%	0.5 lbs/acre (bulk) 0.4 lbs/acre (PLS) 20 PLS/ft-row	7,153,000

Field Production Notes for 2006:

Weed control in grass fields was primarily performed by hand (mainly to remove exotic perennial grasses) and spraying borders and spot-spraying with glyphosate. Broadleaf herbicides (Bison and Banvel) were applied to grass fields in February and May.



Figure 3. *Artemisia suksdorfii* seed increase field at the Corvallis Plant Materials Center, September 15, 2006.

EPAN, ARLU, CAPA, and ANMA fields were hand weeded monthly through May. All forb fields grew vigorously and flowered in the summer. Fields were rouged before harvest to remove any seed-bearing weeds. CAPA and ARLU fields were sprayed with glyphosate in late February before Carex seedlings had emerged.

BRVU and AGEX (fall-sown) fields had very low emergence rates and were severely

damaged by freezing or submerged conditions in the winter and spring. Both fields were sprayed out. BRVU is not performing well under dry, sunny conditions. The plants seem to act as annuals in the Corvallis climate and produce little seed. It will be more productive to collect seed from the park and use the wild seed to be used in the restoration. Production fields will not be continued with this species.

EPCI field became crowded with volunteers and was sprayed out. It will be re-established in the spring of 2007 and will be treated as an annual crop in the following years.

Harvest Notes for 2005:

Fields were harvested by hand with rice knives, swathing and combining, seed stripper or the new “moon rover”. DEEL field was swathed and combined again this year. It was swathed at a greener stage than last year. It seems that this species does not after-ripen. Germination, seed size, and overall yields were much lower in the 2006 harvest. Next year, the seed stripper and moon rover will be experimented with.



Figure 4. *Deschampsia elongata* seed increase field at the Corvallis Plant Material Center, May 15, 2006.

ACMI field was harvested this year using a Woodward Flail-vac seed stripper. It uses a high speed brush to strip seed off the heads of grasses and dry flower stalks of forbs. It is mounted like the bucket on a front end loader. The unit has proven to be effective for harvesting several species. It was moderately effective for the yarrow. It didn't remove all of the seed, so multiple passes were needed. Also, many low-growing weeds were present in the field at harvest time. Flail-vac harvesters are adjustable in height and can be set to harvest seed off the plants at 1ft off the ground, preventing low-growing weeds and seeds from being harvested.

ELGL and BRsp were both harvested using a “moon rover.” It is a hand-built, self-propelled swather. It has a conveyor belt that moves all material that has been cut and loads it into bags. Two people operate it; one person drives and the other helps feed

the material into bags. The moon rover has all the benefits of hand harvesting but greatly reduces the labor involved. Once material was bagged, it was placed onto tarps to dry and cure. It was then fed through a plot thresher and cleaned as usual. The moon rover produced higher yields than swathing/combining and less weeds were present in the seed tests of seed lots that had been harvested with moon rover. It is a great harvest tool for fields that are less than half acre. Larger fields would require a lot of drying space.



Figure 5. PMC staff harvesting California brome with the “moon rover,” June 16 2006.

Table 4. Seed harvest in 2006 for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis PMC.

Species	Ac.	Date(s)	Method	Yield	Comments
ACMI	0.25	18-Aug	seed stripper	50 lbs	Excellent stand, high vigor
ANMA	0.1	Aug 10- Sept 4	Hand	255 g	Good stand, high vigor
BR sp.	0.42	15-Jun	moon rover	195 lbs	Excellent stand, high vigor
BRVU	0.1	5-Jul	Hand	124 g	very poor stand, low vigor
CADE	0.02	20-Jun	Hand	216 g	small stand, high vigor
CAPA	0.22		Hand	6.4 lbs	good stand, medium vigor
DEEL	0.43	June 16/ June 23	swathed/ combined	90 lbs	Excellent stand, medium vigor
ELGL	0.56	26-Jul	moon rover	52 lbs	Excellent stand, medium vigor
EPAN	0.1	July 5- Aug 15	Hand	252g	fair stand, high vigor
LULA	0.1	12-Jun	Hand	2 g	good stand, high vigor
LUCO	0.01	May 15- June 30	Hand	65 g	small stand, high vigor

Following harvest, BRsp, ELGL, CAPA, DEEL, fields were all burned using drip torches. ACMI would not burn, so it was mowed and raked. EPAN and EPCI fields were cut using a sickle bar mower. Residue was left on the field to hold down the weed fabric

over winter, the fields will be cleaned up in spring before plants begin to emerge. ARSU, ANMA, and LULA plants were cut back by hand in late winter to remove previous season's growth.



Figure 6. Burning an *Elymus glaucus* seed increase field at the Corvallis Plant Materials Center. Burning removes thatch, stimulates new growth, and reduces pests and diseases.

Days before the rain began in the fall, a new pre-emergent herbicide Outlook was applied to burned fields to control volunteer seedlings and weedy annuals. Results look very promising. Fields are very clean and established plants do not appear damaged.

Fall 2006 Establishment of Seed Increase Fields:

All seed collected in 2005 was cleaned and informal germination tests were performed on most of the seed lots prior to planting. Only two grasses, one rush, and two forbs were selected for fall seeding, other forbs will be seeded in the spring of 2006 after spring germinating weeds have been sprayed out of the fields. After planting, Corvallis experienced heavy rain for 31 consecutive days totaling 15". Seedlings of the grass species emerged and grew very slowly. Diuron provided fair weed control. Seedlings were still too small to receive an application of broadleaf herbicide in mid-winter. It will be applied when the seedlings are large enough in the spring. ERLA and LUPA are expected to emerge in February of 2007 and hopefully were not damaged by the winter weather. They will be evaluated in the spring.



Figure 7. *Carex pachystachya* seedlings emerging in spring at the Corvallis Plant Materials Center, May 15, 2006.

Table 5. Establishment information for new seed increase fields for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement at the Corvallis PMC in 2006.

Species/Ac	Amt seeded	Germ	Approximate seeding rate	Seeds/lb
DEEL				
0.35 acres or 84 181' rows 12" btwn rows	176 g	81%	4 lbs/acre (bulk) lbs/acre (PLS) PLS/ft-row	1,200,000
PRVU				
0.11 acres or 36 135' rows 12" btwn rows	75 g	87%	lbs/acre (bulk) lbs/acre (PLS) PLS/ft-row	906,000
AGEX				
0.20 acres or 48 180' rows 12" btwn rows	234 g	98%	3 lbs/acre (bulk) 3 lbs/acre (PLS) PLS/ft-row	2,700,000
ERLA				
0.025 acres or 5 185' rows 18" btwn rows	23 g	88%	2 lbs/acre (bulk) 1.8 lbs/acre (PLS) PLS/ft-row	
LUPA				
0.017 acres or 3 185' rows 18" btwn rows	16 g	75%	2 lbs/acre (bulk) 1.6 lbs/acre (PLS) PLS/ft-row	

Even though a large amount of seed was collected of ELGL and BRsp in 2006, it was not planted into fields. Dam removal has been delayed again; therefore major production will be delayed until two years before planting is expected to occur. The Corvallis PMC will create large fields in the fall of 2007 using the seed that was collected in 2006 and 2007.

VII. Container Plant Production

Some of the seed lots collected from the Elwha watershed were too small or valuable to be seeded with machines. These seeds were planted into containers filled with moistened media (Sunshine #1, a peat-based soil-less media) amended with micronutrients (MicroMax) and a balanced slow-release fertilizer and will be transplanted into a field when appropriate. Trays of CAPA, CADE, JUBO, JUEF, LUCO and ERLA were placed in polyethylene bags and moved into a walk-in cooler after sowing. LUCO trays were removed after three weeks, and all others were removed after five weeks. Upon removal from the cooler, trays were placed in a greenhouse or an outdoor lathhouse to germinate.

Table 6. Container Plant Production in 2006 at the Corvallis PMC for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement.

Species	Code	Amt of seed used	date planted	Number of plants produced
<i>Carex deweyana</i>	CAPA14	7g	5/14/2006	1500
<i>Carex pachystachya</i>	CADE	9g	5/14/2006	1300
<i>Eriophyllum lanatum</i>	ERLA	2g	9/16/2006	1500
<i>Juncus bolanderi</i>	JUBO	1 g	10/15/2006	400
<i>Lupinus latifolius</i> var. <i>latifolius</i>	LULA4	70g	9/16/2006	700
<i>Luzula comosa</i>	LUCO	6 g	7/20/2006	400
<i>Vicia americana</i>	VIAM	16 g	9/16/2006	400

Field Production for 2006:

Most fields that were planted in the fall of 2006 will produce seed in 2007. *Deschampsia elongata* and *Bromus vulgaris* fields look less vigorous in fall of 2005 than they did in fall of 2004. These fields may have decreased production on year two and may need to be treated as annuals. Most other fields will have higher yields in 2006 than in 2005. Sedge, rush, and legume fields did not produce seed the first year (except sedge transplants), these fields should flower and set seed in 2006.



Figure 8. PMC greenhouse with containerized plants for the Elwha River Ecosystem and Fisheries Restoration.

After planting in the fall of 2006, there are almost four acres of seed increase fields at the PMC for this project. Total amount of seed in storage at the PMC is listed in Table 8.

Table 7. Acres in Production Per Species at the Corvallis Plant Materials Center for the Elwha River Ecosystem and Fisheries Restoration Cooperative Agreement in 2006.

Species	Seed Yielding area in 06	Seed Yield for 2006	Total acres in production in fall 2006	Total PMC produced seed in storage	Total wild collected seed in storage
ACMI	0.25	50 lbs	0.7	112 lbs	108 g
ANMA	0.1	255 g	0.1	0.5 lb	61 g
ARSU	0	-	0.25	0	236 g
AGEX	0	-	0.35		5 g
BR sp.	0.42	195 lbs	0.42	233 lbs	5 lbs
BRVU	0.66	124 g	0	6 lbs	3 lbs
CADE	0.2	216 g	0.1	0.5 lb	376 g
CAPA	0.085	6.4 lbs	0.22	7 lbs	128 g
DEEL	0.43	90 lbs	0.43	172 lbs	2 g
ELGL	0.56	52 lbs	0.56	62 lbs	12 lbs
EPAN	0.1	252 g	0.1	0.5 lb	65 g
EPCI	0	-	0.1	26 lbs	
ERLA	0	-	0.1	0	0
JUBO	0	-	0.03	0	63 g
JUEF	0	-	0.03	0	135 g
LUCO	0.01	65 g	0.01	65 g	0
LULA	0	2 g	0.1	2 g	0
LUPA	0	-	0.1	0	0
PRVU	0	-	0.11	0	163 g
VIAM	0	-	0.01	0	0
	total	396 lbs	3.82	619.5 lbs	

VIII. Seed Test Results/Delivery of Plant Materials

No deliveries were made in 2006. All seed is being held at the PMC in cold storage until requested.

All lots of seed that were produced at the Corvallis PMC were sent to the Oregon State University seed lab for germination and purity tests. Tests were conducted in December of 2005. Results are listed below.

Table 8. Germination and purity test results conducted on seed lots produced at the Corvallis Plant Materials Center.

Species	Yield	Germ	Purity	PLS amt
ACMI ¹	50 lbs	n/a	n/a	n/a
BR sp.	195 lbs	95%	96.08%	178 lbs
CAPA	6.4 lbs			
DEEL (old field)	16 lbs	66%	83.92%	9 lbs
DEEL (new field)	74 lbs	79%	98.41%	57 lbs
ELGL	52 lbs	88%	96.25%	44 lbs

¹- test results were not available at reporting time