2008 Annual Report to the Bureau of Land Management on Conservation-Related Activities of The Berry Botanic Garden and Seed Bank Holdings

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I. Update on seed acquisition and germination reports for October 1, 2007 through September 30, 2008 for all species known to occur on BLM lands in Oregon.

Seed Acquisition and Curation

From October 1 2007 through September 30 2008, we acquired 1,688 seed accessions of 18 rare taxa (with one taxon new to the seed bank: *Arabis hastatula*, Hells Canyon rockcress), bringing the total collection size to more than 16,000 seed accessions of 347 rare plants. Of the more than 16,000 accessions, nearly three-quarters (or 11,300 accessions) contain seeds from plants on the BLM list of Oregon and Washington special status plants (Appendix I). Many seeds currently stored in the bank were collected from federally owned lands. More than 4,500 seed accessions of 160 rare taxa have been collected from BLM lands. Figure 1 summarizes numbers of accessions and taxa secured in the seed bank each year since 1983.

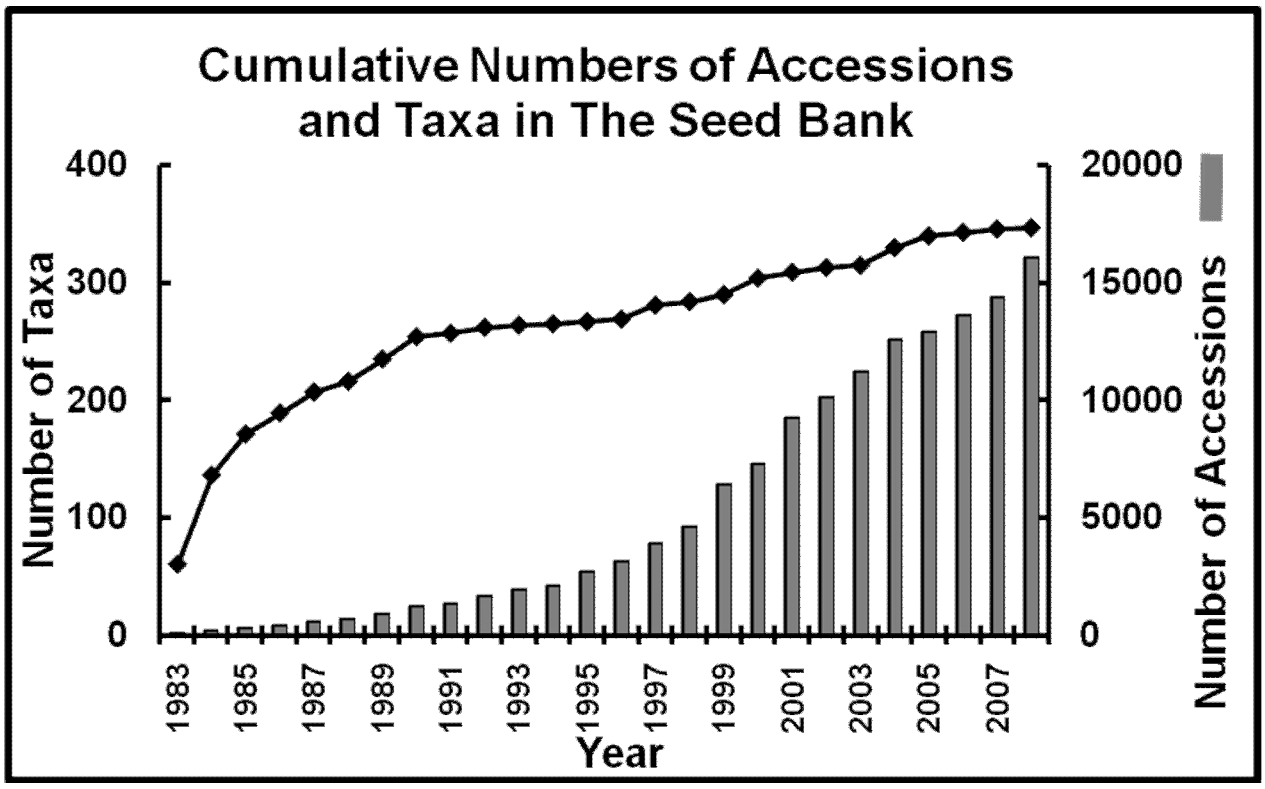

Figure 1. Total numbers of accessions (bars, right scale) and taxa (diamonds, left scale) stored in the bank since it was created in 1983. In the first year of the bank, we obtained 82 accessions of 60 different plants. To date, our cumulative total is 16,035 collections of 347 vulnerable plants.

On-Going Germination and Propagation Research on Rare Plants

We conducted two germination trials using seeds of rare taxa in 2008. In the first trial, we focused on obtaining baseline information on germination requirements for species we have not attempted to germinate previously. We subjected 24 taxa to six standard temperature treatments: placement into either a steady 20°C germination chamber or a chamber with alternating temperatures (10°C during the dark cycle and 20°C during the light cycle) following either no cold stratification, eight weeks of cold stratification or 16 weeks of stratification. To date, seeds from 17 of the 24 taxa have germinated in one or more of the treatments (Table 1). Two of the rare species we tested in the first germination trial are annuals and we have been successful in growing them to a flowering stage: *Eschscholzia caespitosa* (tufted poppy) and *Plagiobothrys figuratus* ssp. *corallicarpus* (fragrant popcorn flower). This germination trial is still being monitored.

In the second trial, we re-moistened seeds used in previous germination trials in order to examine the possibility that previously ungerminated seeds remain viable. We used ungerminated seeds from 42 taxa that were firm at the end of their initial germination trials. We allowed them to dry completely (dishes with ungerminated seeds were stored in the drying vault for three years). Table 2 summarizes the taxa examined in the second trial and the results to date. So far, we have observed germination for 16 of the 42 rare taxa. The results of this trial indicate that seeds of those 16 taxa have the ability to remain viable during repeated moist and dry conditions. This is good news for propagation of rare plants: seeds that do not germinate when first subjected to appropriate conditions should not be discarded, as germination could be successful at a later time. This germination trial is still being monitored and additional germination could be observed.

One notable success story in the second trial has been germination of *Sisyrinchium sarmentosum* (pale blue-eyed grass). Previous attempts to germinate pale blue-eyed grass seeds have not been successful and we are thrilled to now have a pot of a half dozen seedlings growing in the greenhouse. We hope to ultimately place pale blue-eyed grass plants out in the Garden for public display.

Table 1. Rare taxa subjected to six baseline temperature treatments in 2008 germination trials. We have not attempted to germinate seeds from these taxa before this trial. An "x" in the middle column indicates that one or more seeds have germinated so far. An "x" in the right column indicates that seedlings from this trial have grown to flowering size. The trial is still in process.

Taxa	Germination Observed	Grown to Flowering
Allium bolanderi var. *mirabile*	x	
Allotropa virgata		
Astragalus anserinus		
Calochortus marcrocarpus var. *maculosus*	x	
Carex serratodens	x	
Castilleja brevilobata	x	
Castilleja schizotricha		
Eleocharis bolanderi		
Epilobium siskiyouense	x	
Epipactis gigantea		
Eschscholzia caespitosa	x	x
Gentiana newberryi	x	
Kalmiopsis fragrans	x	
Lilium bolanderi	x	
Lilium humboldtii	x	
Lloydia serotina	x	
Lomatium rollinsii	x	
Navarretia tagetina	x	
Orthocarpus bracteosus	x	
Physaria didymocarpa var. *lyrata*		
Plagiobothrys figuratus ssp. *corallicarpus*	x	x
Silene grayi		
Symphyotrichum jessicae (formerly *Aster*)	x	
Trifolium douglasii	x	

Table 2. Taxa re-moistened for 2008 germination trials. Seeds of these taxa were tested in previous germination trials but did not germinate. An "x" in the second or fourth column indicates that one or more seeds of the taxon listed to the left have germinated so far. The trial is still in process.

Taxa	Germination Observed	Taxa	Germination Observed
Agoseris elata		*Hastingsia bracteosa* var. *bracteosa*	
Arabis macdonaldiana	x	*Kalmiopsis leachiana*	
Astragalus applegatei		*Lathyrus holochlorus*	x
Astragalus cusickii var. *packardiae*	x	*Lepidium davisii*	
Astragalus peckii		*Lilium occidentale*	x
Astragalus tegetarioides		*Lilium pardalinum* ssp. *vollmeri*	
Calochortus coxii		*Lobelia dortmanna*	x
Calochortus howellii	x	*Lomatium cookii*	
Calochortus umpquaensis		*Lomatium watsonii*	
Carex gigas	x	*Lupinus aridus* ssp. *ashlandensis*	x
Cimicifuga elata		*Mirabilis macfarlanei*	
Corydalis aquae-gelidae		*Oenothera wolfii*	
Delphinium pavonaceum		*Penstemon davidsonii* var. *praeteri*	x
Draba howellii var. *carnosula*		*Phacelia argentea*	
Erigeron decumbens		*Sedum moranii*	
Eriogonum cusickii		*Sedum oblanceolatum*	
Eryngium petiolatum	x	*Sidalcea hirtipes*	x
Fritillaria camschatcensis		*Sidalcea nelsoniana*	x
Fritillaria recurva	x	*Sisyrinchium sarmentosum*	x
Frasera umpquaensis		*Streptanthus howellii*	
Hastingsia bracteosa var. *atropurpurea*	x	*Suksdorfia violacea*	x

Germination Research on Non-Rare Species: Seed Germination and Storage Research for Plants Native to Western U.S. Areas Impacted by Fire

The Bureau of Land Management is developing a long-term program to supply and manage native plant materials for use in restoration and rehabilitation efforts on public lands, with a focus on areas subjected to periodic fire. As one part of this larger effort, The Berry Botanic Garden is investigating seed germination behavior and storage protocols for 26 populations of 19 taxa.

In 2007 and 2008, we conducted germination studies to examine seed viability following four years of either cool, dry storage or frozen storage. Previous trials examined germination following one and two years of storage. For each germination trial, we used the "best" germination temperature treatment for each species, as determined by results of original baseline trials. Data following four years of storage have been collected and partially analyzed and a final report is due by the end of the year. This germination research is projected to occur over a total of 16 years (we are four years into the project). Comparisons of germination behavior through time will lead to recommendations for storage protocols and guidelines for stockpiling in anticipation of future needs for restoration of public lands.

This work is being funded by the National Office of the BLM, via the Center for Plant Conservation, as part of a larger Memorandum of Understanding between the two organizations.

II. Update on Berry Botanic Garden and Center for Plant Conservation activities with plants sponsored by the BLM in Oregon, Washington and Idaho, or occurring on BLM lands.

A. *Arabis koehleri* var. *koehleri* Experimental Reintroduction on Roseburg District

We continue work on a population augmentation of Koehler's rock cress (*Arabis koehleri* var. *koehleri*) in southern Oregon at the North Bank Habitat Area of Critical Environmental Concern. This research was designed not only to increase population size and vigor but also to evaluate the effectiveness of using different reintroduction methods. We are investigating the use of seeds vs. plants, impact of parentage and impact of microhabitat within the site. A first set of seeds and plants was placed at the site in 2001. Due to unusually hot and dry weather following planting and subsequent heavy plant mortality, Ed Guerrant and Berry Garden volunteers placed a second set of seeds and plants (768 additional propagules) at the site in the fall of 2007. We collected data on germination, growth, and survival of introduced Koehler's rock cress plants in the spring and fall of 2008.

Ed Guerrant submitted a 48-page report in 2008 summarizing results for the first seven years of this work, titled "Reintroduction (Augmentation) of Koehler's rockcress (*Arabis koehleri* var. *koehleri)* at the BLM North Bank Habitat Management Area: Survival and Growth During the First Six Years After Planting (2001 through 2007)." This rare plant reintroduction has been funded through challenge cost-shares with the Roseburg District.

B. *Lilium occidentale* Experimental Reintroductions on Coos Bay District

We are conducting work on two western lily (*Lilium occidentale*) projects, both occurring on New River Area of Critical Environmental Concern (ACEC). The first project was initiated in 1994, with study plots established and both seeds and plants introduced to the site in 1996. Previously, there had been no western lily plants at the immediate study site. This first research project was designed to examine the success of possible reintroduction methods: use of different propagule types (new seeds, older seeds and small bulbs), differences in substrate surface (intact cover vs. bare ground) and differences in the propagule source population. Study plots have been monitored each year since 1996 (including 2008) and Ed Guerrant has submitted annual summary reports. In March of 2008, Ed submitted a summary report on research conducted through 2007, titled "Experimental Reintroduction of Western Lily (*Lilium occidentale*) at the New River ACEC: Results of the First Eleven Years of Growth."

A second project was initiated in 2008, which is focused on a naturally occurring population near Muddy Lake. The ultimate goal of this project is to increase the current population size. This work began with the establishment of a long-term demographic study (25 plants known), along with detailed mapping of the site and vegetation, and with the installation of two ground water level monitoring wells. Ultimately, this project may involve active augmentation, using either seeds gathered on site (the default choice if sufficient numbers available) or seeds brought in from another site (most likely a privately owned site that is closer to New River than any other available source material.) We will use information gleaned from the first project to improve any augmentation work conducted at Muddy Lake.

The CBS National Evening News filmed Ed and a Berry intern during one visit to the site and reported on this project, as part of a piece on seed banking in their climate change series. The report aired on September 24, 2007 and can be viewed on-line at
http://www.cbsnews.com/stories/2007/09/24/eveningnews/main3292567.shtml

Both of these western lily reintroduction projects have been funded through challenge cost-shares with the Coos Bay District.

C. *Sidalcea nelsoniana* Research on Salem District

In 1997, The Berry Botanic Garden began monitoring three populations of Nelson's checker-mallow, *Sidalcea nelsoniana*, in order to determine plant number trends. Two of the populations, Neverstill and South Maguire, had been created by CH2M Hill as experimental reintroductions. The third population, Walker Flat, is a wild population. Berry Garden staff and interns monitored the three populations in 1997, 1998, 2003 and 2006. No field activities related to this work occurred in 2008. Ed Guerrant will work with Salem District botanists to monitor the population again in 2010. This project has been funded through challenge cost-shares with the Salem District BLM.

D. Seeds of Success Program

In 2007 and 2008, we obtained seeds of eight native plant species as part of the Seeds of Success Program (SOS), a partnership between The Royal Botanic Garden at Kew (England), the Bureau of Land Management, The Center for Plant Conservation and many other organizations. The ultimate goal of the program is to collect, conserve, and develop native plant materials for stabilizing, rehabilitating and restoring lands in the United States. In 2007, we hired Christa von Behren to collect seeds and send them to Kew for storage in the Millennium Seed Bank or to the Bend Seed Extractory for local use and research. The species Christa and I have collected so far (2007 and 2008) include *Agoseris aurantiaca* (orange goat chicory), *Arnica discoidea* (rayless leopardbane), *Cornus unalaschkensis* (western bunchberry), *Lomatium martindalei* (Cascade desert parsley), *Nemophila parviflora* (small flowered nemophila), *Osmorhiza purpurea* (purple sweet-root), *Ranunculus aquatilis* (white water crowfoot) and *Romanzoffia sitchensis* (Sitka mistmaiden). It is possible that one or more additional species will be collected this year. We have received funding for work in 2009 and we anticipate collecting from a greater number of plant species next year.

III. List of seed received from BLM botanists between October 1, 2007 and December 1, 2008.

The following is a list of seed collected by Oregon and Washington BLM botanists between October 1, 2007 and December 1, 2008. The list includes the following data for each seed collection: Berry Botanic Garden accession number, scientific name, collection location: county and state, collection date, numbers of good and apparently "bad" seeds, and element occurrence number (when known). We did not receive seeds of rare plants from any Oregon or Washington BLM botanists in 2008.

Eugene District OR, collected by Cheshire Mayrsohn:

Accession #	Taxon	County	State	Collection Date	# Good	# Bad	EO#
SB2007-0733	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	78	39	22
SB2007-0734	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	81	23	22
SB2007-0735	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	7	23	22
SB2007-0736	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	37	9	22
SB2007-0737	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	31	21	22
SB2007-0738	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	12	10	22
SB2007-0739	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	35	23	22
SB2007-0740	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	112	34	22
SB2007-0741	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	58	13	22
SB2007-0742	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	50	37	22
SB2007-0743	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	104	35	22
SB2007-0744	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	62	33	22
SB2007-0745	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	49	23	22
SB2007-0746	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	59	21	22
SB2007-0747	*Eucephalus (Aster) vialis*	Lane	OR	7-Sept-07	81	12	22

Acknowledgments

Ed Guerrant provided information and digital images related to his work with the Bureau of Land Management. Christa von Behren provided information related to her work with the Seeds of Success Project. The following interns and volunteers assisted with processing of special status seeds and germination trials in 2008: Ricky Boun, Jane Burleigh, Madelon Case, Daphne Cissell, Moira Curns, Mary Dondlinger, Jen Goff, Kristin Hanley, Heather Hodges, Shannon Kelsey, Gina Megson, Dana Mylees, Mick Ollison, Olivia Poblacion, Donna Prock, Jean Quinsey, Christopher Randolph, Jill Richardson, John Richardson, Sonja Rosas, Mark Rosas, Nicole Shores, Elizabeth Stanek, Eileen Unowsky, Christa von Behren and Sarah Wheeler. Special thanks to Rachel Witmer, who spent many hours entering and updating our seed bank documentation.

List of Images

Cover Images: Timberline penstemon (*Penstemon davidsonii* var. praeteritus) seedling in the Berry greenhouse, top image; Thickleaf penstemon (*Penstemon pachyphyllus* var. *congestus*) seeds germinating, lower right image; Christa von Behren collecting *Lomatium martindalei* seeds from North Bank ACEC in the fall of 2008, lower left image. Photographer: Andrea Raven.

Image on page 2: Pale blue-eyed grass (*Sisyrinchium sarmentosum*) seedlings in the Berry greenhouse. Photographer: Andrea Raven.

Image on page 3: Gold poppy or tufted poppy (*Eschscholzia caespitosa*) germinated in 2008 and grown to flowering size. Photographer: Andrea Raven.

Image on page 6: Western lily (*Lilium occidentale*) flower. Photographer: Ed Guerrant.

Image on page 7: Nelson's checkermallow (*Sidalcea nelsoniana*) flowers. Photographer: Ed Guerrant.

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