Seeds of Success and the Millennium Seed Bank Project

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Abstract: The Bureau of Land Management (BLM) entered into an agreement with the Royal Botanic Gardens, Kew (RBG, Kew), to collect seeds from native plants in the Western United States. This program, initiated in 2000, is called "Seeds of Success." It is an offshoot of the international "Millennium Seed Bank" project. The goal of the Millennium Seed Bank project is to collect seed from 10 percent of the world's dryland flora and place it in long-term storage. For the BLM, this was an opportunity to evaluate additional native pant materials for restoration projects and to place seed in long-term storage for conservation. Collection targets included native species: of known forage or browse value, widespread regional endemics, wild relatives of cultivated or economically important species, species with significance to Tribes, monotypic species, relatives of rare species, relatives of nonnative invasive species, species of known pollinator importance, and flagship species such as State flowers and trees. RBG, Kew, and the BLM developed a seed collecting protocol at the population level. In 2002, the first collecting season, BLM gathered seed from 375 taxa in 11 States. Seed is currently in long-term storage at RBG, Kew, and the USDA National Seed Storage Laboratory in Fort Collins, CO.

Introduction

The Royal Botanic Gardens, Kew (RBG, Kew), has initiated a worldwide seed collection program called the "Millennium Seed Bank" project. It is a multiyear project funded by the United Kingdom Millennium Trust with a goal of collecting and conserving at least 10 percent of the world's flora (approximately 24,000 species) by the year 2010. Fourteen countries around the world are currently participating in the project. The Bureau of Land Management (BLM) participates with the RBG, Kew, and the Plant Conservation Alliance in an offshoot program named "Seeds of Success." The goal of Seeds of Success is multifold. Establishing a high-quality, accurately identified, and well-documented native seed collection at the USDA National Seed Storage Laboratory (NSSL) in Fort Collins, CO, with a backup collection at the Millennium Seed Bank, is a major objective. Additional, equally important objectives are to identify important native species for restoration of public lands, and to obtain information on the quality, viability, and germination requirements of those species.

The BLM was an obvious choice for RBG, Kew, to contact given the extensive arid regions the agency manages. The BLM and RBG, Kew, participate in the Seeds of Success program under the terms of a cooperative agreement signed by both parties in May 2000. The BLM agreed to collect seeds for the project and to grant access to the lands they manage for collection; to grant prior informed consent to RBG, Kew, for study and long-term storage of these seeds; and to send all seeds and vouchers to Kew. RBG, Kew, agreed to clean, process, test, and store all seed sent by the BLM; to return half of each collection to the United States for long-term storage; to provide the BLM with all testing results; to fund a fixed-term coordinator position in BLM to develop the collection program; and to provide training and advice to BLM during the project.

RBG, Kew, is interested in seed banking a range of species for long-term conservation of genetic material in support of the Convention on Biodiversity, and because their funding is partly provided by their ability to seed bank at the species level. Given that seeds from the majority of arid land plants in the United States are expected to survive conventional germplasm bank conditions (that is, drying to low moisture content and freezing at –20 °C), land managers can rely on conserved seed samples for use in plant conservation and restoration programs. As BLM collects seeds for restoration across the range of the species, they work with local seed growers to ensure that private businesses are given the opportunity to use and market native plant materials originating from the project.

As a multiple-use agency, the BLM has a need for native plant materials for many different programs. One of the goals set forth in the BLM's mission statement is to restore at-risk resources and to maintain or improve functioning ecosystems. In 1999 and 2000, wildfires burned more than 3 million acres, creating a demand that far exceeded the supply of native species. Fires often increase establishment of exotic, invasive species, and vast acreages are in need of restoration. Native seed is needed for BLM's fuels reduction program, for prescribed fire planning and implementation, and for the Great Basin Restoration Initiative. Wildlife enhancement programs, particularly those for threatened or endangered species, require native seed. Supplying energy is currently a priority activity for BLM, and native plant materials are needed for mitigation in mining reclamation and oil and gas exploration activities, and for nonenergy-related rights-of-way restoration such as communication lines and new roads. The newly designated national monuments have requirements for the use of native plant species

inside monument boundaries. Seeds of Success can help to successfully build a native plant materials program across the United States. It will also enhance the seed conservation capacity currently available within the United States, principally at the USDA NSSL in Fort Collins, CO.

Methods _____

The collecting focus for Seeds of Success is on species needed for ecological restoration of public lands, native plant material development, and conservation of widespread species. Target species lists were developed using The Nature Conservancy's ecoregions and included native species of known forage or browse value, widespread regional endemics, wild relatives of cultivated or economically important species, species with significance to Tribes, monotypic species, relatives of rare species, relatives of nonnative invasive species, species of known pollinator importance, and well-known species that the public can easily identify, such as State flowers and trees.

According to Brown and Marshall (1995), at least one copy of 95 percent of the alleles occurring in a population at frequencies of greater than 0.05 can be achieved by sampling from:

1. 30 randomly chosen individuals in a fully outbreeding sexual species, or

2. 59 randomly chosen individuals in a self-fertilizing species.

Because the reproductive biology of most target species has not been studied, and the capture of rarer alleles would require a markedly increased sample size, collectors are advised to sample from in excess of 50 individuals within a single population, and to look for populations with larger numbers of plants. For Seeds of Success, it was determined that an "ideal" collection would be from 100 to 500 individuals and contain 10,000 to 20,000 seeds. Each Western State was assigned a target number of species to collect during the first year. To help accomplish this, the Student Conservation Association (SCA) partnered with BLM and hired teams of three to four interns to work with botanists in five States, including California, Idaho, Oregon, Nevada, and Utah (fig. 1). The BLM also entered into a cooperative agreement with the Center for Plant Conservation to use their seed collection expertise in reaching BLM's goal of collecting 2,000 species over the next 10 years.

Once target species were identified, but before seed could be collected, potential sites were visited to assess the population size, collect a herbarium voucher for species verification (nomenclature follows Kartesz and Meacham 1999), evaluate presence of insect damage, and estimate seed production and maturation date. Seed collection protocols are as follows:

1. Carefully examine a small, representative sample of seeds using a cut test to estimate the frequency of empty or damaged seeds, and to confirm that the majority of seeds are mature. Repeat cut tests throughout the sampling to ensure seed quality across the population.

2. Collect mature, dry seeds into either cloth or brown paper bags. Large collections could be made using plastic buckets, for later transfer.

Figure 1—Student Conservation Association interns collecting seed in Idaho for the Bureau of Land Management Seeds of Success program.

3. If seeds can be liberated from their fruits quickly and easily, do so and record this on the data form. Cleaning should generally be left to RBG, Kew, staff.

4. Collect fleshy fruits into plastic bags and allow to aerate. Contact RBG, Kew, right away for specific advice on ripening and cleaning, as these fruits decompose rapidly and poor storage can lead to mold-infested seed.

5. Sample equally and randomly across the extent of the population, maintaining a record of the number of individuals sampled.

6. Collect no more than 20 percent of the viable seed available on the day of collection.

7. Collect from populations that allow removal of 10,000 to 20,000 viable seeds.

8. For each collection, estimate and record the viable seed production per fruit, per individual, and per population.

After collecting, seeds were kept in a cool, dry place prior to shipping to the seed bank. Voucher specimens and data forms were shipped with the seed to RBG, Kew, typically within a few days. Data recorded for each population included species name, collector name(s), location (narrative description plus latitude/longitude), elevation, habitat, landform, parent material, slope, soil texture, number of plants sampled, an estimate of the total population size and area, and the number of duplicate voucher specimens made. The location of each population was recorded with a Global Positioning System (GPS) unit, and digital photos of each species and its seed were taken. After cleaning and testing, half of each sample shipped to the RBG, Kew, seed bank will return to the United States for native plant materials development or long-term storage.

Results _____

Seed from 375 native taxa were collected in 2002, the first year of implementation for Seeds of Success (table 1). Taxa collected in more than one state are listed as such. Student Conservation Association intern teams assisted in five of the 11 States where collections were made, and

Table 1—Taxa and State of origin for 2002 native seed collections for the Bureau of Land Management's Seeds of Success program. Seed is currently in long-term storage at RBG, Kew, as part of the international Millennium Seed Bank project, or in the Bureu of Land Management's native plant materials development program.

Family	Genus	Species	State
Aceraceae	*Acer*	*negundo*	UT
Anacardiaceae	*Rhus*	*trilobata*	UT
Anacardiaceae	*Rhus*	*trilobata* v. *trilobata*	CO
Apiaceae	*Angelica*	*kingii*	NV
Apiaceae	*Cnidium*	*cnidiifolium*	AK
Apiaceae	*Heracleum*	*lanatum*	CA
Apiaceae	*Lomatium*	*dissectum*	ID
Apiaceae	*Lomatium*	*grayi*	ID
Apiaceae	*Lomatium*	*macrocarpum*	CA
Apiaceae	*Lomatium*	*nudicaule*	CA
Apiaceae	*Lomatium*	*nuttallii*	CO
Apiaceae	*Lomatium*	*triternatum*	CA
Apiaceae	*Osmorhiza*	*berteroi*	OR
Apiaceae	*Perideridia*	*bolanderi*	OR
Asclepiadaceae	*Asclepias*	*cryptoceras*	OR
Asclepiadaceae	*Asclepias*	*speciosa*	ID
Asteraceae	*Achillea*	*millefolium*	CA
Asteraceae	*Achillea*	*millefolium* v. *occidentalis*	OR
Asteraceae	*Agoseris*	*glauca* v. *glauca*	OR
Asteraceae	*Agoseris*	*heterophylla*	OR
Asteraceae	*Ambrosia*	*eriocentra*	NV
Asteraceae	*Antennaria*	*monocephala*	AK
Asteraceae	*Arnica*	*chamissonis* ssp. *foliosa*	CA
Asteraceae	*Arnica*	*cordifolia*	OR, UT
Asteraceae	*Arnica*	*lessingii* ssp. *lessengii*	AK
Asteraceae	*Arnica*	*longifolia*	UT
Asteraceae	*Artemisia*	*tridentata* v. *tridentata*	UT
Asteraceae	*Artemisia*	*arctica* ssp. *arctica*	AK
Asteraceae	*Artemisia*	*suksdorfii*	CA
Asteraceae	*Artemisia*	*tilesii* ssp. *elatior*	AK
Asteraceae	*Aster*	*pauciflorus*	NV
Asteraceae	*Baccharis*	*pilularis*	OR
Asteraceae	*Balsamorhiza*	*hookeri*	ID
Asteraceae	*Balsamorhiza*	*macrophylla*	UT
Asteraceae	*Balsamorhiza*	*sagittata*	CA, ID
Asteraceae	*Balsamorhiza*	*serrata*	OR
Asteraceae	*Bebbia*	*juncea*	NV
Asteraceae	*Blepharipappus*	*scaber*	CA, OR
Asteraceae	*Brickellia*	*incana*	NV
Asteraceae	*Brickellia*	*oblongifolia*	NV
Asteraceae	*Chaenactis*	*douglasii*	ID
Asteraceae	*Chrysothamnus*	*humilis*	OR
Asteraceae	*Cirsium*	*cymosum*	CA
Asteraceae	*Cirsium*	*mohavensis*	NV
Asteraceae	*Crepis*	*acuminata*	ID
Asteraceae	*Encelia*	*virginensis*	NV
Asteraceae	*Erigeron*	*bloomeri*	ID
Asteraceae	*Erigeron*	*disparipilus*	ID
Asteraceae	*Erigeron*	*glaucus*	CA
Asteraceae	*Erigeron*	*peregrinus*	AK
Asteraceae	*Erigeron*	*pumilus*	ID
Asteraceae	*Erigeron*	*speciosus*	UT
Asteraceae	*Eriophyllum*	*lanatum* v. *grandiflorum*	CA
Asteraceae	*Eriophyllum*	*lanatum* v. *integrifolium*	CA
Asteraceae	*Eriophyllum*	*staechadifolium*	CA
Asteraceae	*Eurybia*	*radulina*	OR
Asteraceae	*Eurybia*	*sibirica*	AK
Asteraceae	*Grindelia*	*squarrosa*	UT
Asteraceae	*Helianthella*	*uniflora*	UT
Asteraceae	*Heterotheca*	*villosa*	CO, UT
Asteraceae	*Hieracium*	*triste*	AK

(con.)

Table 1—(Con.)

Family	Genus	Species	State
Asteraceae	*Hymenoxys*	*cooperi*	NV
Asteraceae	*Isocoma*	*drummondii*	UT
Asteraceae	*Iva*	*acerosa*	UT
Asteraceae	*Microseris*	*troximoides*	ID, OR
Asteraceae	*Petasites*	*hyperboreus*	AK
Asteraceae	*Peucephyllum*	*schottii*	CA, NV
Asteraceae	*Psilocarphus*	*oregonus*	CA
Asteraceae	*Rudbeckia*	*laciniata* v. *ampla*	CO
Asteraceae	*Rudbeckia*	*occidentalis*	UT
Asteraceae	*Senecio*	*atratus*	CO
Asteraceae	*Senecio*	*spartioides* v. *spartioides*	NV
Asteraceae	*Solidago*	*canadensis*	UT
Asteraceae	*Solidago*	*multiradiata* v. *multiradiata*	AK
Asteraceae	*Solidago*	*spathulata* v. *spathulata*	CA
Asteraceae	*Stephanomeria*	*exigua*	OR
Asteraceae	*Stephanomeria*	*pauciflora*	NV
Asteraceae	*Symphyotrichum*	*spathulatum*	ID
Asteraceae	*Taraxacum*	species not yet determined	AK
Asteraceae	*Tetradymia*	*canescens*	ID
Asteraceae	*Tetradymia*	*spinosa*	ID
Asteraceae	*Townsendia*	*florifer*	ID
Asteraceae	*Tripleurospermum*	*maritimum* ssp. *phaeocephalum*	AK
Asteraceae	*Wyethia*	*amplexicaulis*	ID
Asteraceae	*Wyethia*	*mollis*	CA
Asteraceae	*Wyethia*	*scabra*	UT
Asteraceae	*Xylorhiza*	*tortifolia*	NV
Berberidaceae	*Mahonia*	*aquifolium* ssp. *aquifolium*	OR
Betulaceae	*Betula*	*occidentalis*	UT
Bignoniaceae	*Chilopsis*	*linearis*	NV
Boraginaceae	*Cryptantha*	*circumscissa*	ID
Boraginaceae	*Heliotropium*	*curassavicum*	NV, OR
Boraginaceae	*Lithospermum*	*ruderale*	ID
Boraginaceae	*Mertensia*	*ciliata*	UT
Brassicaceae	*Draba*	*verna*	ID
Brassicaceae	*Lepidium*	*dictyotum*	CA
Brassicaceae	*Polyctenium*	*fremontii*	OR
Brassicaceae	*Stanleya*	*pinnata*	NV
Cactaceae	*Opuntia*	*whipplei*	NV
Campanulaceae	*Downingia*	*bacigalupii*	CA
Campanulaceae	*Downingia*	*bicornuta*	OR
Campanulaceae	*Downingia*	*insignis*	CA
Caprifoliaceae	*Lonicera*	*hispidula*	OR
Caprifoliaceae	*Lonicera*	*involucrata*	UT
Caprifoliaceae	*Symphoricarpos*	*oreophilus*	UT
Chenopodiaceae	*Atriplex*	*canescens*	NV
Chenopodiaceae	*Atriplex*	*confertifolia*	NV
Chenopodiaceae	*Grayia*	*spinosa*	CA
Chenopodiaceae	*Nitrophila*	*occidentalis*	NV
Chenopodiaceae	*Suaeda*	*torreyana*	NV
Cornaceae	*Cornus*	*nuttallii*	OR
Cornaceae	*Cornus*	*sericea*	CO
Crassulaceae	*Sedum*	*spathulifolium*	OR
Cupressaceae	*Juniperus*	*communis*	NV
Cupressaceae	*Juniperus*	*osteosperma*	NV
Cupressaceae	*Juniperus*	*occidentalis*	ID
Cucurbitaceae	*Cucurbita*	*palmata*	NV
Cyperaceae	*Carex*	*alma*	NV
Cyperaceae	*Carex*	*aurea*	NV
Cyperaceae	*Carex*	*interior*	UT
Cyperaceae	*Carex*	*microptera*	NV
Cyperaceae	*Carex*	*nebrascensis*	UT
Cyperaceae	*Carex*	*pellita*	UT
Cyperaceae	*Carex*	*praegracilis*	NV, UT

(con.)

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Family	Genus	Species	State
Cyperaceae	*Cladium*	*californicum*	NV
Cyperaceae	*Eleocharis*	*palustris*	ID
Cyperaceae	*Eleocharis*	*parishii*	NV
Cyperaceae	*Eleocharis*	*rostellata*	UT
Cyperaceae	*Fimbristylis*	*thermalis*	NV
Cyperaceae	*Schoenoplectus*	*acutus*	UT
Cyperaceae	*Schoenoplectus*	*americanus*	NV, UT
Cyperaceae	*Schoenoplectus*	*maritimus*	NV
Cyperaceae	*Schoenoplectus*	*pungens* v. *longispicatus*	UT
Cyperaceae	*Schoenoplectus*	*tabernaemontani*	NV
Cyperaceae	*Schoenus*	*nigricans*	NV
Cyperaceae	*Scirpus*	*microcarpus*	OR
Cyperaceae	*Trichophorum*	*alpinum*	AK
Elaeagnaceae	*Shepherdia*	*argentea*	UT
Ephedraceae	*Ephedra*	*californica*	CA
Ericaceae	*Arctostaphylos*	*canescens* ssp. *canescens*	OR
Ericaceae	*Arctostaphylos*	*columbiana*	OR
Ericaceae	*Arctostaphylos*	*patula*	OR
Ericaceae	*Harrimanella*	*stelleriana*	AK
Ericaceae	*Phyllodoce*	*glanduliflora*	AK
Ericaceae	*Rhododendron*	*camtschaticum* ssp. *spathulata*	AK
Ericaceae	*Vaccinium*	*ovatum*	CA, OR
Ericaceae	*Vaccinium*	*parvifolium*	OR
Fabaceae	*Acacia*	*greggii*	NV
Fabaceae	*Astragalus*	*alpinus*	AK
Fabaceae	*Astragalus*	*filipes*	ID
Fabaceae	*Astragalus*	*lentiginosus*	CA
Fabaceae	*Astragalus*	*lentiginosus* v . *floribundis*	CA
Fabaceae	*Astragalus*	*obscurus*	ID
Fabaceae	*Astragalus*	*preussii* ssp. *preussii*	UT
Fabaceae	*Astragalus*	*purshii* ssp. *purshii*	CA
Fabaceae	*Astragalus*	*utahensis*	UT
Fabaceae	*Astragalus*	*whitneyi*	CA
Fabaceae	*Cercis*	*orbiculata*	NV
Fabaceae	*Glycyrrhiza*	*lepidota*	UT
Fabaceae	*Hedysarum*	*alpinum*	AK
Fabaceae	*Lathyrus*	*littoralis*	CA
Fabaceae	*Lupinus*	*arbustus*	CA
Fabaceae	*Lupinus*	*argenteus*	CA, UT
Fabaceae	*Prosopis*	*gladulosa*	NV
Fabaceae	*Prosopis*	*gladulosa* v. *torreyana*	NV
Fabaceae	*Prosopis*	*pubescens*	NV
Fabaceae	*Prosopis*	*velutina*	AZ
Fabaceae	*Sophora*	*stenophylla*	UT
Fabaceae	*Thermopsis*	*californica* v. *argentea*	CA
Garryaceae	*Garrya*	*elliptica*	OR
Gentianaceae	*Gentiana*	*glauca*	AK
Grossulariaceae	*Ribes*	*cereum* v. *cereum*	CA
Grossulariaceae	*Ribes*	*cruentum* v. *cruentum*	OR
Grossulariaceae	*Ribes*	*sanguineum* v. *glutinosum*	CA
Grossulariaceae	*Ribes*	*sanguineum* v. *sanguineum*	OR
Hydrangeaceae	*Whipplea*	*modesta*	OR
Hydrophyllaceae	*Eriodictyon*	*angustifolium*	NV
Hydrophyllaceae	*Phacelia*	*capitata*	OR
Hydrophyllaceae	*Phacelia*	*humilis* ssp. *humilis*	CA
Iridaceae	*Iris*	*douglasiana*	CA
Iridaceae	*Iris*	*missouriensis*	CA, CO
Iridaceae	*Sisyrinchium*	*demissum*	UT
Iridaceae	*Sisyrinchium*	*halophilum*	NV
Iridaceae	*Sisyrinchium*	species not yet determrined	NV
Juncaceae	*Juncus*	*alpinus*	UT
Juncaceae	*Juncus*	*balticus*	ID, NV, UT
Juncaceae	*Juncus*	*breweri*	CA

(con.)

Table 1—(Con.)

Family	Genus	Species	State
Juncaceae	*Juncus*	*castaneus*	AK
Juncaceae	*Juncus*	*cooperi*	NV
Juncaceae	*Juncus*	*drummondii*	AK
Juncaceae	*Juncus*	*effusus* v. *brunneus*	OR
Juncaceae	*Juncus*	*longistylis*	UT
Juncaceae	*Juncus*	*mertensianus*	AK
Juncaceae	*Juncus*	*nodosus*	NV, UT
Juncaceae	*Juncus*	*saximontanus*	UT
Juncaceae	*Juncus*	*torreyi*	UT
Juncaceae	*Luzula*	*parviflora*	AK
Juncaginaceae	*Triglochin*	*concinna*	NV
Juncaginaceae	*Triglochin*	*maritimum*	UT
Lamiaceae	*Agastache*	*urticifolia*	CA, UT
Lamiaceae	*Hedeoma*	*nana*	NV
Lamiaceae	*Lepechinia*	*calycina*	CA
Lamiaceae	*Mentha*	*arvensis*	UT
Lamiaceae	*Monardella*	*odoratissima*	CA, UT
Lamiaceae	*Salvia*	*sonomensis*	CA
Lamiaceae	*Stachys*	*ajugoides* v. *rigida*	CA
Lamiaceae	*Stachys*	*palustris*	UT
Liliaceae	*Allium*	*acuminatum*	ID, OR, UT
Liliaceae	*Calochortus*	*macrocarpus*	OR
Liliaceae	*Camassia*	*leichtlinii*	OR
Liliaceae	*Camassia*	*quamash*	OR
Liliaceae	*Lilium*	*columbianum*	OR
Liliaceae	*Lilium*	*pardalinum* ssp. *pardalinum*	OR
Liliaceae	*Maianthemum*	*stellatum*	NV
Lillaceae	*Veratrum*	*viride*	AK
Lillaceae	*Zigadenus*	*elegans*	AK
Lillaceae	*Zigadenus*	*venenosus* v. *venenosus*	CA
Loasaceae	*Eucnide*	*urens*	NV
Loasaceae	*Mentzelia*	*albicaulis*	ID
Loasaceae	*Mentzelia*	*lacinata*	NV
Malvaceae	*Sphaeralcea*	*grossulariifolia*	ID
Malvaceae	*Sphaeralcea*	*munroana*	UT
Malvaceae	*Sphaeralcea*	*parviflora*	UT
Myricaceae	*Morella*	*californica*	OR
Nyctaginaceae	*Abronia*	*latifolia*	OR
Oleaceae	*Fraxinus*	*velutina*	NV
Onagraceae	*Clarkia*	*gracilis*	CA
Onagraceae	*Epilobium*	*ciliatum*	UT
Onagraceae	*Epilobium*	species not yet determined	AK
Orchidaceae	*Epipactis*	*gigantea*	NV
Orchidaceae	*Platanthera*	*dilatata*	AK
Papaveraceae	*Argemone*	*hispida*	CO
Plumbaginaceae	*Armeria*	*maritima* v. *californica*	CA
Poaceae	*Achnatherum*	*hymenoides*	UT
Poaceae	*Achnatherum*	*nelsonii*	CA
Poaceae	*Achnatherum*	*thurberianum*	CA, ID
Poaceae	*Andropogon*	*glomeratus*	NV
Poaceae	*Aristida*	*purpurea*	UT
Poaceae	*Bromus*	*carinatus*	OR
Poaceae	*Bromus*	*marginatus*	CA
Poaceae	*Bromus*	*vulgaris*	OR
Poaceae	*Calamagrostis*	*nutkaensis*	CA
Poaceae	*Danthonia*	*californica*	CA, OR
Poaceae	*Distichlis*	*spicata*	NV
Poaceae	*Elymus*	*spicata*	CA
Poaceae	*Festuca*	*californica*	CA, OR
Poaceae	*Melica*	*californica*	CA
Poaceae	*Muhlenbergia*	*asperifolia*	NV, UT
Poaceae	*Muhlenbergia*	*rigens*	NV
Poaceae	*Panicum*	*virgatum*	NV

(con.)

Table 1—(Con.)

Family	Genus	Species	State
Poaceae	*Pluchea*	*sericea*	NV, UT
Poaceae	*Poa*	*fendleriana*	NV
Poaceae	*Poa*	*macrantha*	CA
Poaceae	*Poa*	*secunda*	NV
Poaceae	*Sporobolus*	*airoides*	NV, UT
Poaceae	*Stipa*	*comata*	UT
Poaceae	*Stipa*	*lettermanii*	CO
Polemoniaceae	*Collomia*	*grandiflora*	CA
Polemoniaceae	*Polemonium*	*foliosissimus*	UT
Polygonaceae	*Eriogonum*	*bifurcatum*	NV
Polygonaceae	*Eriogonum*	*caespitosum*	CA
Polygonaceae	*Eriogonum*	*corymbosum*	NV
Polygonaceae	*Eriogonum*	*latifolium*	CA
Polygonaceae	*Eriogonum*	*lobbii*	NV
Polygonaceae	*Eriogonum*	*niveum*	WA
Polygonaceae	*Eriogonum*	*nudum* v. *auriculatum*	OR
Polygonaceae	*Eriogonum*	*racemosum*	UT
Polygonaceae	*Eriogonum*	*sphaerocephalum* v. *halimioides*	CA
Polygonaceae	*Eriogonum*	*umbellatum* ssp. *nevadense*	CA
Polygonaceae	*Eriogonum*	*umbellatum* v. *polyanthum*	CA
Polygonaceae	*Oxyria*	*digyna*	AK
Polygonaceae	*Rumex*	*arcticus*	AK
Portulacaceae	*Lewisia*	*rediviva*	ID
Primulaceae	*Dodecatheon*	*redolens*	NV, UT
Primulaceae	*Primula*	*parryi*	WY
Primulaceae	*Samolus*	*ebracteatus*	NV
Ranunculaceae	*Aconitum*	*columbianum*	UT
Ranunculaceae	*Aconitum*	*delphiniifolium* ssp. *delphiniifolium*	AK
Ranunculaceae	*Anemone*	*parviflora*	AK
Ranunculaceae	*Aquilegia*	*formosa*	CA
Ranunculaceae	*Caltha*	*leptosepala*	UT
Ranunculaceae	*Clematis*	*ligusticifolia*	UT
Ranunculaceae	*Thalictrum*	*fendleri*	UT
Rhamnaceae	*Rhamnus*	*betulifolia*	NV
Rosaceae	*Amelanchier*	*alnifolia*	ID
Rosaceae	*Cercocarpus*	*ledifolius* v. *intermontanus*	NV
Rosaceae	*Cercocarpus*	*ledifolius*	UT
Rosaceae	*Cercocarpus*	*montanus*	CO
Rosaceae	*Dryas*	*drummondii*	AK
Rosaceae	*Dryas*	*octopetala* ssp. *octopetala*	AK
Rosaceae	*Fallugia*	*paradoxa*	UT
Rosaceae	*Geum*	*rossii*	AK
Rosaceae	*Geum*	*triflorum*	CA
Rosaceae	*Luetkea*	*pectinata*	AK
Rosaceae	*Potentilla*	*gracilis*	CA
Rosaceae	*Potentilla*	*uniflora*	AK
Rosaceae	*Prunus*	*virginiana*	ID
Rosaceae	*Purshia*	*glandulosa*	NV
Rosaceae	*Purshia*	*mexicana*	UT
Rosaceae	*Purshia*	*tridentata*	UT
Rosaceae	*Rosa*	*pisocarpa*	OR
Rosaceae	*Rosa*	*woodsii*	CO
Rosaceae	*Rubus*	*parviflorus*	CA
Rosaceae	*Sanguisorba*	*canadensis*	AK
Rosaceae	*Spiraea*	*douglasii*	OR
Rosaceae	*Spiraea*	*stevenii*	AK
Rutiaceae	*Thamnosma*	*montana*	NV
Salicaceae	*Populus*	*angustifolia*	UT
Salicaceae	*Salix*	*exigua*	ID, UT
Salicaceae	*Salix*	*lemmonii*	ID
Salicaceae	*Salix*	*lucida*	UT
Salicaceae	*Salix*	*lutea*	ID, UT
Santalaceae	*Commandra*	*umbellatum*	NV

(con.)

Table 1—(Con.)

Family	Genus	Species	State
Saururaceae	*Anemopsis*	*californica*	CA, NV
Saxifragaceae	*Boykinia*	*occidentalis*	OR
Saxifragaceae	*Parnassia*	*kotzebuei*	AK
Saxifragaceae	*Saxifraga*	*bronchialis*	AK
Saxifragaceae	*Saxifraga*	*lyallii*	AK
Saxifragaceae	*Saxifraga*	*odontoloma*	UT
Saxifragaceae	*Tellima*	*grandiflora*	OR
Saxifragaceae	*Tiarella*	*trifoliata* ssp. *unifoliata*	OR
Scrophulariaceae	*Castilleja*	*applegatei* ssp. *pinetorum*	CA
Scrophulariaceae	*Castilleja*	*linariifolia*	CA, UT
Scrophulariaceae	*Castilleja*	*minor* ssp. *minor*	UT
Scrophulariaceae	*Castilleja*	*pruinosa*	OR
Scrophulariaceae	*Castilleja*	*unalaschcensis*	AK
Scrophulariaceae	*Lagotis*	*minor*	AK
Scrophulariaceae	*Mimulus*	*aurantiacus*	CA
Scrophulariaceae	*Mimulus*	*guttatus*	CA, UT
Scrophulariaceae	*Penstemon*	*acuminatus*	ID
Scrophulariaceae	*Penstemon*	*albomarginatus*	NV
Scrophulariaceae	*Penstemon*	*cyananthus*	UT
Scrophulariaceae	*Penstemon*	*cyaneus*	ID
Scrophulariaceae	*Penstemon*	*deustus*	ID
Scrophulariaceae	*Penstemon*	*fruticiformis*	NV
Scrophulariaceae	*Penstemon*	*fruticosus*	ID
Scrophulariaceae	*Penstemon*	*laevis*	UT
Scrophulariaceae	*Penstemon*	*palmeri*	UT
Scrophulariaceae	*Penstemon*	*platyphyllus*	UT
Scrophulariaceae	*Penstemon*	*roezlii*	CA
Scrophulariaceae	*Scrophularia*	*californica*	CA
Scrophulariaceae	*Veronica*	*peregrina* ssp. *xalapensis*	CA
Scrophulariaceae	*Veronica*	*wormskjoldii*	AK
Typhaceae	*Typha*	*angustifolia*	UT
Valerianaceae	*Valeriana*	*sitchensis*	AK
Zygophyllaceae	*Larrea*	*tridentata*	NV

Center for Plant Conservation botanists collected in two States. Table 2 includes both target and the actual number of taxa collected by State. In general, where interns or other assistance was provided, targets were exceeded, as the additional workload was difficult to accomplish otherwise. Drought conditions in the Western United States limited seed production for some species; however, because flexibility is built into the program, alternate species could usually be identified for collection.

Seed collecting protocols, shipping forms, proposed species lists, and a database of collected taxa are available at http://www.nps.gov/plants/sos and http://www.rbgkew.org.uk/seedbank. Digital photographs of each species and its seed were also taken in 2002. These photographs are housed at RBG, Kew, and each participating BLM office, and may eventually be available online.

Table 2—2002 targeted and actual number of taxa collected by the Bureau of Land Management for the Millenium Seed Bank project and Seeds of Success program.

State	Number of species targeted	Number of species collected
AK	20	45
AZ	25	1
CA[a]	50	73
CO	25	11
ID[a]	50	37
MT	20	0
NV[a]	50	77
NM	20	0
OR[a]	50	52
UT[a]	50	79
WY	30	0
Total	**390**	**375**

[a]States that had Student Conservation Association intern teams.

Conclusions

In 2002, in partnership with RBG, Kew, and as part of the international Millennium Seed Bank project, the Bureau of Land Management implemented a native seed collecting program deemed "Seeds of Success." Seed from 414 populations representing 375 taxa were collected for long-term storage at RBG, Kew, and the USDA National Seed Storage Laboratory in Fort Collins, CO, and for use in native plant materials development. As a multiple-use agency, the BLM has a need for native plant materials for many different programs in order to meet its goal of restoring at-risk

resources and maintaining or improving functioning ecosystems. The Seeds of Success program facilitates development of native plant materials from local genetic sources, and provides valuable information on germination and viability of native plant species that are currently in short supply. Additional information on Seeds of Success and the Millennium Seed Bank project is available at http://www.nps.gov/plants/sos and http://www.rbgkew.org.uk/seedbank.

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