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Seeds of Success: A National Seed Banking Program Working to Achieve Long-Term Conservation Goals

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ABSTRACT: Seeds of Success (SOS) is a national native seed collection program, led by the US Department of Interior Bureau of Land Management in partnership with numerous federal agencies and nonfederal organizations. The mission of the SOS is to collect wildland native seed for long-term germplasm conservation and for use in seed research, development of native plant materials, and ecosystem restoration. Each year about 50 SOS teams are stationed across the United States to make seed collections following a single technical protocol. SOS collections are divided into a long-term conservation storage collection, which is stored at multiple USDA Agricultural Research Service seed storage facilities, and a working collection, which is stored at partner institutions and made available for research. In addition to collecting and banking native species for future uses, SOS provides seed that can be increased to provide genetically appropriate plant materials for ecological restoration of disturbed lands. Seed collection is an efficient and cost-effective method for conserving the diversity of plant species into the future. Partners located throughout the United States are critical to the success of this program.

Index terms: Bureau of Land Management, ex situ conservation, Native Plant Materials Development Program, native plants, restoration, seed banking, Seeds of Success

INTRODUCTION

Healthy ecosystems provide the essential ecological services upon which all life depends, including our own (MEA 2003). Plants contain an astounding array of compounds important to medicine and cultural conditions (Balick and Cox 1996), and they are the basis of terrestrial food chains. Native plant communities are the foundation of ecosystems, supporting fish and wildlife, helping to stabilize soil and prevent erosion, buffer against floods, and minimize the effects of drought. Recent research has shown that, in order to maintain a high level of ecosystem services, a high diversity of plant species is needed to ensure services are provided over time and through changing conditions (Isbell et al. 2011). However, native plant communities are increasingly at risk from pressures such as urban expansion, energy development, recreation, invasive pests/plants, and climate change. According to Swaty et al. (2011), 52% of the land mass within the conterminous United States has been highly altered or converted to agriculture or urban land use. By 2000, over half of the approximately 4500 natural ecological communities defined at the time were at-risk, with 31% considered imperiled and another 26% vulnerable (Stein et al. 2000). Development continues with almost 43 million acres of land newly developed between 1982 and 2010, making more than 37% of developed land in United States (excluding Alaska) developed in those 28 years. (US Department of Agriculture 2013).

Thus the need to restore degraded ecosystems continues to increase. The Convention on Biological Diversity has called for 15% of degraded ecosystems to be restored by 2020 (CBD 2011). Across the United States, states are implementing State Wildlife Action Plans that focus on habitat-based conservation and restoration in order to conserve threatened wildlife (Stoms et al. 2010). Restoration of degraded habitats on a large scale requires the use of appropriately adapted seeds for a large number of species, which has made the development and production of native plant materials increasingly important (Smith et al. 2007). However, the commercial market does not currently supply the diversity or quantity of appropriately adapted native plants needed for restoring the American landscape (Borders et al. 2011). Because the scale and scope of restoration needs are so great, no single agency or organization can tackle it singlehandedly, requiring a coordinated, collaborative effort that brings together federal agencies and partners such as universities, botanic gardens, and native plant growers to achieve nationwide restoration goals.

Seed Banking: Meeting a Critical Conservation Need

The production of appropriately adapted native plant material for restoration efforts across the United States requires a foundation of plant material to carry out research, production, and seed increase efforts. One of the most effective means to ensure this foundational material is available to support restoration is via targeted seed collection and banking.

Seed banks are a critical component of any integrated conservation and restoration program, supporting the primary objective of retaining and restoring native plant diversity. Seed banking is widely accepted as a cost-effective, space-saving, and underutilized technique for ex situ conservation (Guerrant et al. 2004; Li and Pritchard 2009). In its most basic form, seed banking; (1) provides an insurance policy against the extinction of plant species in the wild, (2) serves as an emergency reserve in case of disasters such as fire or insect or disease outbreaks, and (3) complements in situ conservation by providing material for research and seed increase efforts.

Stored seeds, if dried and maintained at an appropriate low temperature and relative humidity, require little space and may remain viable for as long as a century or two, depending on the species. Seed banking efforts focus on species that produce orthodox seeds (i.e., seeds that are able to survive cold, dry storage at low relative humidity), which account for an estimated 88% of plant species globally (Hong et al. 1998). Seed collections that are banked for long-term conservation storage provide important information on contemporary species distributions and genetic composition. Climate change and unprecedented development make these banked samples more significant in the face of an uncertain future.

Seed banking is not specifically mentioned in conservation or restoration policies of the United States government. However, the National Fish, Wildlife and Plants Climate Adaptation Strategy recognizes seed banking as a strategy to help manage species and habitats in a changing climate (NFWPCAP 2012). Seeds of Success (SOS), led by the US Department of the Interior's Bureau of Land Management (BLM), is the national native seed collection program. This unique collaboration engages federal and private partners across the country to collect and bank genetically diverse seed collections of important restoration species for long-term conservation and to support efforts to develop native plant material for restoration. Here, we describe the SOS history, goals and objectives, programmatic partnerships, successes, and opportunities and challenges for the future.

Program History

In 2000, the Millennium Seed Bank (MSB) Project was initiated by the Royal Botanic Gardens, Kew, United Kingdom (KEW) with the goal of collecting 10% of the world's dryland flora in 10 years. To achieve this goal, KEW relied heavily on partnerships around the world (Van Slageren 2003). In 2000, a Memorandum of Understanding (MOU) between the BLM and KEW formalized the agreement to cooperate in the collection, study, and conservation of seed of US native plants for restoration purposes. The first agreement was valid for 5 years; a second agreement extended the formal BLM and KEW partnership to 10 years. Targeted species lists were developed by BLM and KEW, and then species were assigned to collection teams. MSB had an original goal of one sample per species; however, SOS teams collected multiple samples and kept them in seedbanks in the United States. The formal agreement with KEW resulted in the collection of more than 3150 unique taxa, which represents more than 10% of the US flora.

The SOS program grew out of this agreement and began in 2001. Though an informal partnership with MSB continues today, the focus of SOS is on species of restoration value for disturbed lands to provide functioning native plant communities for wildlife habitat.

Simultaneously, the House of Representatives' FY 2001 Conference Report directed "the agencies to develop a long-term program to manage and supply native plant materials for various Federal land management restoration and rehabilitation needs," thus the BLM established the Native Plant Materials Development Program (USDI and USDA 2002). The mission of the Native Plant Materials Development Program (NPMDP) is to increase the quality and quantity of native plant materials, both seed and seedlings, available for restoring resistant and resilient ecosystems. Figure 1 shows the process that the BLM employs to develop native plant materials. The SOS program provides the foundation of wildland seed collections, which support other steps in the process.

In 2008, an agreement between the BLM and six nonfederal partners (Chicago Botanic Garden, Lady Bird Johnson Wildflower Center, New England Wildflower Society, New York Department of Parks and Recreation's Greenbelt Native Plant Center, North Carolina Botanical Garden, and Zoological Society of San Diego) formalized Seeds of Success as the national native seed collection program. With BLM's Plant Conservation Program as the lead, the BLM works with its partners to foster cooperation and coordination to increase collection of native seed for conservation and restoration across the United States.

Program Goals and Objectives

The primary goal of SOS is to collect and store native seed for long-term conservation. The program seeks to establish high quality, accurately identified, genetically representative, and well-documented native plant seed collections. During a 2009 SOS Partners' Meeting, the goal of safeguarding approximately 14,000 native plant species by banking seed of multiple populations was established. The focal species are those that produce orthodox seed that can be used for restoration. Rare, threatened, or endangered species are not collected by SOS, as these are under the purview of the Center for Plant Conservation.

In addition to banking species for long-term conservation storage, SOS establishes a working collection of native plant germplasm available for research. Research on seed transfer zones, plant propagation, seed harvest and storage methods, and production of large quantities of source-identified seed are appropriate uses of the SOS working collection material.

SOS has seven key objectives:

1. Further develop and maintain the SOS national cooperative seed banking effort.
2. Bank native seed to ensure the security of native plant germplasm.
3. Promote native seed research.
4. Centrally manage collection information through the SOS National Coordinating Office.

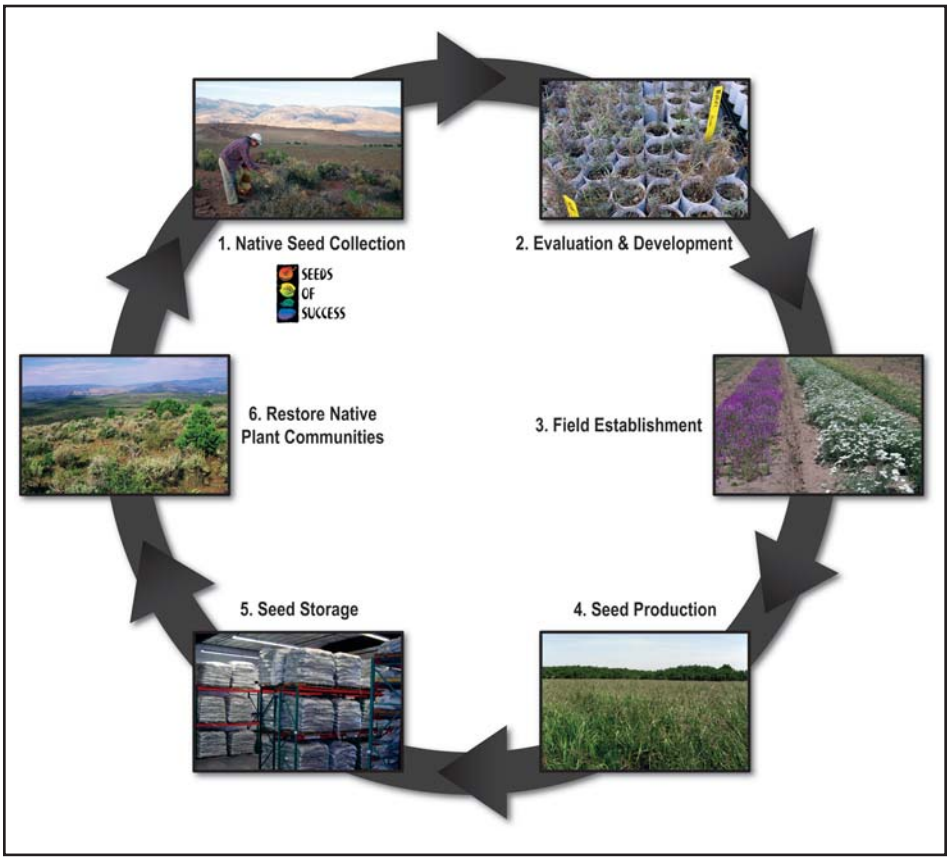

Figure 1. The BLM Native Plant Materials Development Process. There are many steps involved in the process of developing a reliable, stable crop from wild collected species.

5. Provide training for seed collection teams.
6. Collect, deposit, and curate voucher specimens of all SOS collections at one local herbarium and as part of the SOS Collection at the National Herbarium, Smithsonian Institute.
7. Promote the importance of appropriate native plant materials use for restoration.

Targeted Species

The SOS collection focus is species needed for restoration and rehabilitation of native plant communities across the United States. Teams may make multiple collections of a single species to capture diversity across the range. Collecting teams are encouraged to work with local federal land managers and the SOS National Coordinating Office to develop and implement collection of priority target species and populations. For example, many teams in the western United States are focused on collecting species for restoration of sage-grouse habitat and breeding areas, as this is a critical need for BLM. More than 2200 seed collections of 692 species have been made in the greater sage-grouse habitat areas.

To achieve the goal of banking seed from populations of 14,000 species of the US flora, SOS has established the following collection priorities:

- Species/populations of high restoration value.
- Species/populations most at risk from climate change and associated threats such as increased wildfire and the spread of invasive species.
- Species representative of key ecological communities.

SOS Technical Protocol and Training

The SOS Technical Protocol outlines the process and requirements of the SOS program (BLM 2012). It is the primary guidance document for all SOS collectors. The Protocol was initially developed by KEW, and later adapted by the BLM to meet the needs of a broader-focused program to collect multiple accessions of each species for conservation and restoration. The Protocol is a dynamic document that is updated every two years by the National Collection Curator with input from collection teams. The Protocol includes guidance on all factors that must be considered when making a wildland native seed collection, including permissions and permitting, sampling strategy, and seed collection methods for achieving SOS goals. Field documentation including landscape and locality information, photos, and herbarium vouchers is required for each SOS collection.

The SOS Protocol recommends a randomized sampling strategy with populations visited throughout the seed ripening process. SOS borrows from the more conservative rare plant collection methods and emphasizes that no more than 20% of the available seed on a given day shall be collected so that sustainable populations are maintained (Falk and Holsinger 1991). Each seed collection should include 10,000 to 20,000 seed from a minimum sample size of 50 plants (Brown and Marshall 1995). SOS recommends collection from at least 20 populations distributed throughout each species' range in order to maximize the genetic diversity obtained. SOS follows a broad sampling approach across geographic and ecological space to collect the highest proportion of alleles for targeted species (Hoban and Schlarbaum 2014).

To ensure that all SOS collecting teams are effectively trained in implementing the SOS Protocol, they are encouraged to attend SOS's Seed Collection for Conservation and Restoration course, which is offered each spring through the BLM National Training Center. The 2 1/2 day course covers the SOS Technical Protocol and management of native wildland seed collections. Course material includes field preparedness, native plant taxonomy, collection of herbarium voucher specimens, seed sampling strategies, and postcollection seed care. A field component reinforces classroom discussion topics. This course is supported by the BLM and a modest fee is required for all non-BLM participants.

SOS Partners and Collecting Teams

As the lead of SOS, the BLM Plant Conservation Program serves as the National Coordinating Office and manages the training of and communication with SOS collection teams. The National Collection Curator is the primary contact for SOS and interacts with all collection teams and interagency partners involved in seed cleaning and storage. The SOS website (www.blm.gov/SOS) is the central hub for all information related to the program. Programmatic updates and correspondence with collection teams are conducted through monthly conference calls. The SOS discussion list provides conference call notes, seed related news articles, references to academic publications, and job announcements for the SOS community.

BLM collection teams supported by the agency are the primary workforce of SOS. In addition to the BLM collection teams, there are seven primary regional collection partners. Six of these partners have signed the SOS Memorandum of Understanding with BLM and support their own seed collection and cleaning activities. These partners hold seed banking and plant conservation as a keystone of their organizational missions and are highlighted in Table 1.

BLM has agreements with other federal and nonfederal partners to clean and store SOS collections, provide training for SOS team members, as well as to curate the material at storage facilities. For example, the USDA Forest Service Bend Seed Extractory (BSE) is a critical partner for SOS. Most SOS seed collections are sent to the Extractory to be cleaned prior to storage. In addition to cleaning, the Extractory provides the following in house tests: percent moisture content, seeds per pound, percent purity, and percent seed fill. It is the goal of BSE to clean all seedlots to a 90% purity, 90% fill standard. In addition to these tests, the Extractory evaluates collection quality and advises the National Coordinating Office of inadequate number of seeds or if insect damage, disease, or any other seed handling practices may have reduced seed quality. Nonfederal partners clean seed collections at their institutions, often with the help of volunteers and interns.

The Agricultural Research Service (ARS) is an essential partner in the curation of the SOS National Collection. They receive, store, and curate the SOS National Collection. Seed collections are sent to ARS's Western Regional Plant Introduction Station (WRPIS) in Pullman, Washington, where the seed enters the National Plant Germplasm System and the collection data is entered into the Germplasm Resources Information Network (GRIN). Accessions are subdivided for -20 ^{0}C backup storage at WRPIS and the National Center for Genetic Resources Preservation (NCGRP) in Fort Collins, Colorado. If seed quantity is sufficient, a distribution component is included in the 4 ^{0}C working collection. The NCGRP also provides seed lot viability testing services. For nondormant orthodox seeds, seed lot viability is determined using standard germination protocols. Species with dormancy breaking requirements are assessed for viability using tetrazolium tests. Small quantities of seed may be requested for research, but ARS does not distribute seed for personal or garden use when commercial seed is readily available. Any SOS collections that are available to researchers through this collection can be found by searching the GRIN website (www.ars-grin.gov/npgs/orders.html). The criteria used for dividing SOS collections into long-term and working collections are provided in Table 2.

SOS collections made in Alaska follow a slightly different cleaning and storage regime, as they are cleaned and stored at the ARS's Arctic and Subarctic Plant Gene Bank in Palmer, Alaska, as well as entered into GRIN. A portion of each of these collections is then sent to NCGRP for backup storage. The Alaska Natural Heritage Program partners with BLM in making the most northerly collections for SOS. This partnership is a great model for engaging State Natural Heritage Programs and preserving the genetics at the edge of the range of multiple species.

The Chicago Botanic Garden's Conservation and Land Management Internship Program (CLM) is another important partner to SOS. This internship program for natural resource graduates has been instrumental in getting trained staff on the ground as part of SOS collecting teams. Since 2001, the program has successfully placed over 900 interns at the BLM, National Park Service, Forest Service, US Fish and Wildlife Service, and other federal agencies. CLM internships help train the next generation of land managers by providing field experience in botany and plant ecology, including native seed collection. These interns work directly with mentors at field offices, and many assist in making SOS collections, providing needed additional capacity for seed collecting on federal land across the western United States.

The Cyclic Nature of SOS

In general, SOS teams spend their winter identifying priority taxa and potential collection locations. During the growing season, herbarium vouchers are collected on scouting trips to populations that will be revisited when seed has matured. These voucher specimens are sent to the National Herbarium at the Smithsonian Institution and to smaller herbaria throughout the United States.

The overall availability of seed depends on the weather for the preceding months. Abnormally dry, wet, warm, or cold years can interrupt successful development of seed, resulting in poor seed set. In the western United States, 2012 was an especially difficult year for seed collecting as a record low snowpack and an exceptionally dry spring contributed to near-record acres burned by wildfires. These environmental disturbances illustrate the need to preserve our natural heritage and collect material from native plant populations before they are impacted.

Seed collecting begins as early as January and February in the southwestern United States, and continues into late fall for many SOS teams (Figure 2). By the end of field season, SOS collecting teams have made on average about 1500 new seed collections. All SOS collecting teams compile their annual reports and submit their collection data to the National Coordinating Office for entry into the SOS national collection database. SOS uses BG-BASE Collection

Table 1. Seeds of Success (SOS) partner institutions and their work.

Dixon National Tallgrass Prairie Seed Bank, Chicago Botanic Garden, Glencoe, IL The tallgrass prairie is one of the earth's most endangered habitats, having lost 96% of its land to agricultural and other human activities. To preserve the species found in the region, the Dixon National Tallgrass Prairie Seed Bank is focused on increasing collections from species that are integral to the tallgrass prairie biome of the Midwestern United States. This includes flora of the tallgrass prairie and connected ecosystems such as forests, plus species of importance to the conservation and restoration of the tallgrass prairie habitat. Another goal is collection of multiple samples of over 500 species selected for their importance for
Lady Bird Johnson Wildflower Center, Austin, TX The Lady Bird Johnson Wildflower Center has partnered with SOS to establish localized seed banking programs across Texas to restore regional native plant communities and "keep common species common." One important initiative trains citizen scientists to collect and bank seed of all ash species in Texas prior to the arrival of the emerald ash borer. Additionally, for the past two years the Center has partnered with the Texas Forest Service to grow approximately 300,000 loblolly pine trees from seed to help restore the Bastrop Lost Pines forest, which was decimated by forest fires in 2011.
Mid-Atlantic Regional Seed Bank at the Greenbelt Native Plant Center, Department of Parks, New York City, NY Launched in the winter of 2012 by the New York City Parks Department's Greenbelt Native Plant Center, the Mid-Atlantic Regional Seed Bank is a cooperative conservation effort that serves as the Mid-Atlantic coordinating body of SOS. The two primary goals of the Seed Bank are to assist SOS in the long-term conservation banking of the flora of the United States and to meet regional and local needs for ecotypic seed for land management and restoration. The Mid-Atlantic region covers New York, New Jersey, Pennsylvania, eastern Ohio, West Virginia, Virginia, Maryland and Delaware. There are 15 Level III Ecoregions in this area and, as part of its long-term goal, the Seed Bank intends to work with local organizations and governmental agencies to develop ecotypic seed mixes for restoration in each of these regions. Seed collections made by the
New England Wildflower Society, Framingham, MA The New England Wildflower Society has partnered with SOS to collect seed from common species in the northeastern United States. The Society's role in seed collection of common species for SOS has been limited. Attempts to procure funding for seed collection through a collaboration of eastern botanical gardens are just beginning. The Society recently partnered with the Chicago Botanic Garden and the US Forest Service Region 9 on a native seed collection project. This project focuses on collecting seeds of the Alpine Garden Research Natural Area and other common
North Carolina Botanical Garden, Chapel Hill, NC The North Carolina Botanical Garden has partnered with SOS to collect and store seeds of the Piedmont savanna, which is a heavily disturbed ecosystem that once extended from Maryland south to central Alabama. SOS seed bank and conservation seed programs work with many local and regional partners in North Carolina and surrounding states. The Botanical Garden seed program works with SOS on the collection, storage, and recovery of common plants. Projects of note include: 1) Department of Defense: operational-scale demonstration of propagation protocols; 2) US Forest Service: contracted seed collections on national forest lands in North Carolina and pine barren sandreed (*Calamovilfa brevipilis* (Torr.) Scribn.) seed collection and seed increase plots; and 3) The Nature Conservancy, Mansboro Island, NC: seed collection and rehabilitation.
Native Seed Bank, San Diego Zoo, San Diego, CA San Diego County, California, is a global biodiversity hotspot. Although the county includes only 4% of the state's land area, it supports 26% of the state's native flora, more than 1500 native species. The Institute for Conservation Research's Native Seed Bank, part of San Diego Zoo Global, was established in 2005 to help conserve the rich plant biodiversity of San Diego County. The Native Seed Bank seeks to have at least one seed collection for each native species in the county. To date, more than 628 collections have been added to the Native Seed Bank. SOS has been a valued partner for the Native Seed Bank for many years, and facilitated the expansion of efforts and focus on acquiring multiple collections from native species identified as important for restoration efforts. Through this effort, 106 collections have been made from public lands in San Diego County.

Table 2. Seeds of Success germplasm proportioning for long-term backup and working collection samples.

SOS accession seed quantity	Portion of sample to long-term storage at NCGRP (-20 ^{0}C)	Portion of sample to long-term storage at WRPIS (-20 ^{0}C)	Portion of sample to working collection (4 ^{0}C)
<6000	1/2	1/2	0
6000-7500	2/5	2/5	1/5
7500-30000	1/3	1/3	1/3
30000 +	2/5	2/5	1/5

Management Software, a system designed for managing botanical collections (www.bg-base.com). These data are used to assess and evaluate the SOS National Collection, thus informing geographic gaps in collections for specific species or populations and assisting in planning for the next collection season.

ACCOMPLISHMENTS

Today, the SOS National Collection contains more than 15,000 native seed collections. Figure 3 illustrates the annual collection totals, which show steady growth since 2000. The near-doubling of collections in 2010 is due to an infusion of $1.25 million of American Recovery and Reinvestment Act (ARRA) funding. Although SOS is a national program, a majority of the collections are made in the western United States (Figure 4), corresponding to public land managed by BLM. Additional information about the geographic distribution of SOS collections, seed collection totals, and collection teams can be found in Table 3.

The SOS National Collection contains nearly 5000 unique taxa, representing 172 families. The most frequently collected species include Sandberg's bluegrass (*Poa secunda* J. Presl), Indian ricegrass (*Achnatherum hymenoides* [Roem. & Schult.] Barkworth), squirreltail (*Elymus elymoides* Swezey), needle and thread (*Hesperostipa comata* [Trin. & Rupr.] Barkworth), and basin wildrye (*Leymus cinereus* [Scribn. and Merr.] Á. Löve), which are species commonly found on BLM lands and used for restoration and rehabilitation projects. The Asteraceae and Poaceae, two of the largest plant families, make up 21% and 20% of the SOS National Collection, respectively.

In addition to long-term conservation storage, SOS material has been used in hundreds of projects ranging from germination studies to common garden trials. More than 2100 SOS seed samples have been distributed through the USDA ARS National Plant Germplasm System to researchers around the world.

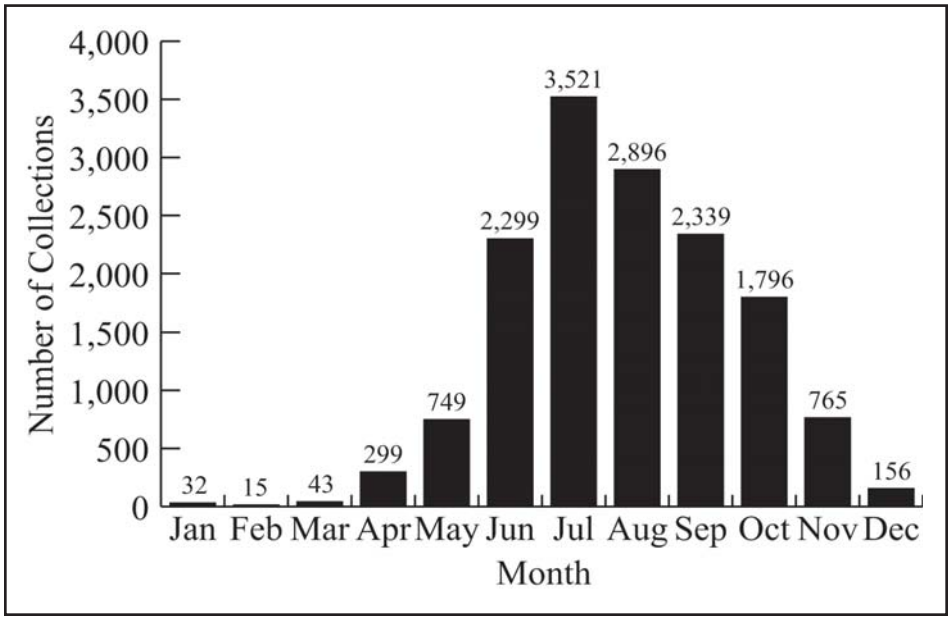

Figure 2. Monthly distribution of SOS collections from 2001 to 2013.

Challenges and Opportunities

While seed banking is a cost-effective conservation tool in comparison to other conservation tools, such as purchasing land for habitat preservation, there are costs associated with it. The most expensive part of seed banking is the seed collection itself. Locating healthy populations of the target plant species is just the beginning of the process. Returning to the population throughout the field season is necessary to ensure seed collection is made at the correct time in the seed ripening process.

Limited funding is the major challenge for most plant conservation activities and Seeds of Success is no different. Because the majority of funds for Seeds of Success come through the Bureau of Land Management's congressional appropriations, the majority of collections have been made in the western United States. The Bureau of Land Management is responsible for more than 245 million acres of land within the United States, primarily in the West. The SOS collections largely mirror the public lands managed by BLM in the West.

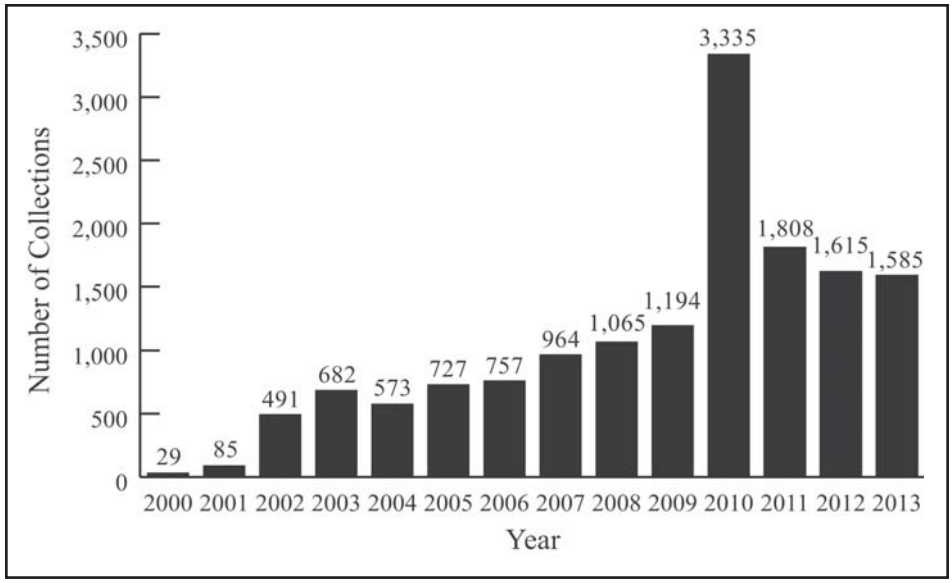

Figure 3. Seeds of Success annual collection totals, 2000 to 2013. The 2010 spike in collection numbers resulted from an infusion of $1.25 million of American Recovery and Reinvestment Act funding.

Though consistent funding has been limited, there was an infusion of funds that directly resulted in doubling the annual collections for SOS. In 2010, the BLM Plant Conservation Program received $1.25 million in American Recovery and Restoration Act (ARRA) funds for 26 teams of Conservation and Land Management interns to collect native seeds following the Seeds of Success Protocol. ARRA-funded interns made a total of 2127 collections, representing 1081 species in 2010 and 2011. More funding can result in more collections but it can also lead to more successful restoration projects with genetically appropriate local seed.

In 2014, BLM received a $3.5 million grant from the Department of Interior's Hurricane Sandy Relief Fund to develop a Seeds of Success project for restoration projects in the eastern states affected by Hurricane Sandy. New York City Parks and Recreation Department's Greenbelt Native Plant Center, New England Wild Flower Society, and North Carolina Botanical Garden will be working with BLM to build the foundation for Seeds of Success in the eastern United States. Funding will be an ongoing challenge unless other federal agencies, state agencies, and conservation organizations support Seeds of Success in ensuring that the genetic diversity of eastern native plants is conserved into the future and made available for restoration in a changing climate.

It is not sufficient to simply bank seed. In order to be useful, plant materials must be developed for restoration use. This entails research to delineate seed transfer zones (geographic areas in which seed can be used without danger of maladaptation), devising guidelines for agricultural seed production of grasses and forbs (e.g., seed germination, stand establishment, seed harvesting and storage), and engagement of the private sector to grow out large quantities of seed. SOS serves as the foundation of the native plant materials development process by continuing to expand the National Collection and making it available to scientists and ultimately for use in restoration projects.

As the program moves forward, there will be a focus on increasing the genetic diversity in the National Collection and strategically filling in gaps in both species and geography. New partners, such as other federal agencies, state agencies, land trusts, and other organizations can assist in expanding the SOS National Collection.

In 2014, the BLM led an effort to develop an Interagency Seed Strategy. This collaboration will guide the development, availability, and use of seed needed for timely and effective restoration. The Strategy will include four goals with associated objectives and initial actions to improve seed supplies for restoring healthy and productive native plant communities. The Strategy will also serve as an opportunity for federal agencies to become more engaged in the native plant materials development process and support wildland seed collection efforts, such as SOS.

Seeds of Success provides a means of preserving species in a cost-effective and space-efficient manner. As disturbances to native plant communities increase, the demand for restoration material also increases. Although there is more to do in plant conservation and native community restoration, programs like SOS play a key role in safeguarding the diversity of native plant species now. Seed banking and other plant research, such as developing seed transfer zones, maximizing seed storage, and increasing germination success, requires consistent funding and substantial effort from both the public and private sector. In a changing climate, Seeds of Success is critical to ensure that resilient native plant communities continue to provide ecosystem services and wildlife habitat into the future.

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Megan Haidet is National Collection Curator for Seeds of Success. She supports native seed collection teams on a day-to-day basis, trains collectors, manages and analyzes collections data, provides guidance regarding the SOS Protocol, and works with Bureau of Land Management and SOS partners to prioritize and distribute collections.

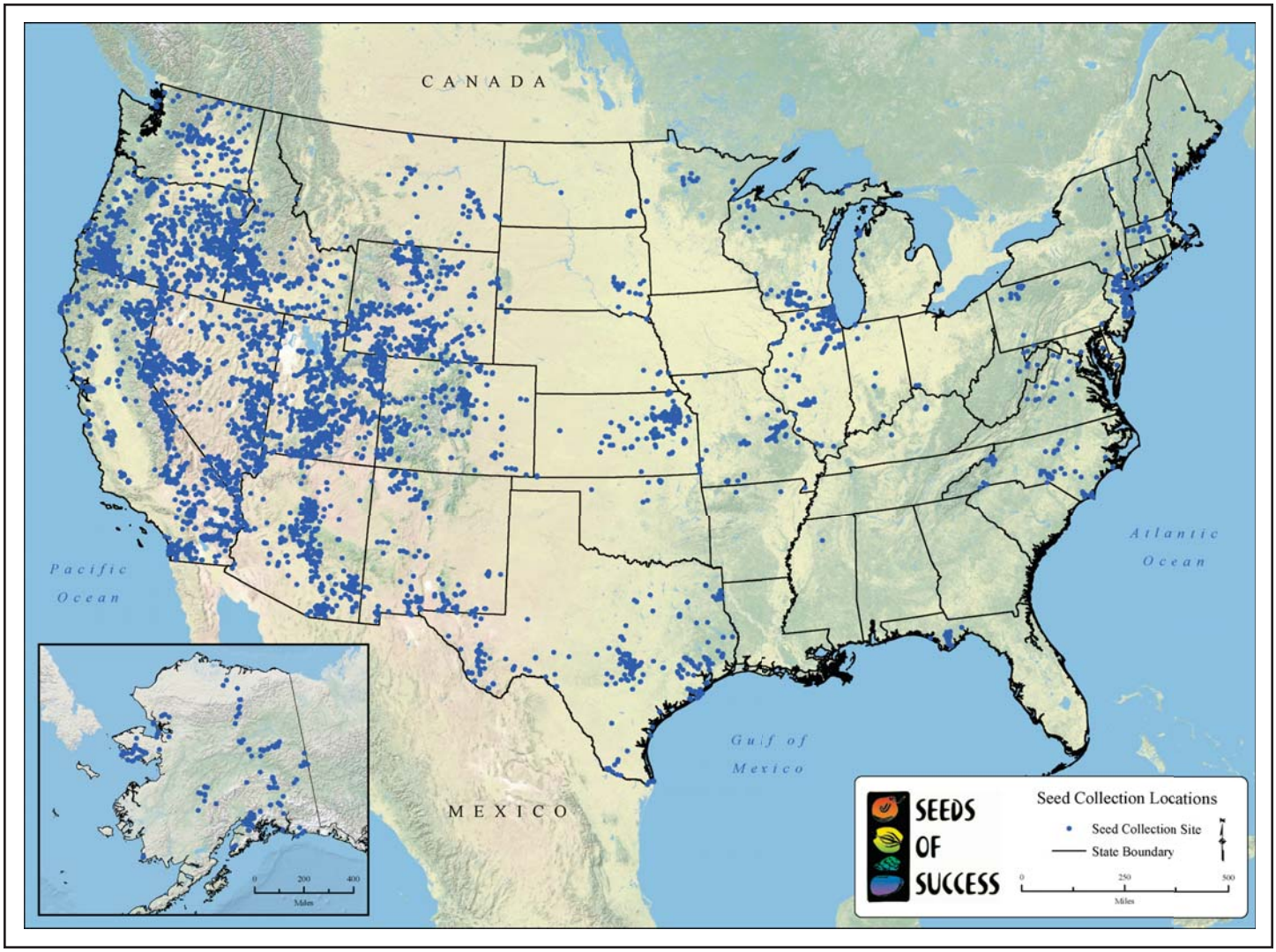

Figure 4. Map of SOS collection sites throughout the United States, 2000 to 2013.

Table 3. Seeds of Success collection summary as of 2014.

	Number
Total number of SOS collections	15,123
Number of families represented	172
Number of unique taxa represented	4948
Average number of collections made per year	1080
Species with at least 20 collections	85
Number of states represented in SOS collections	43
Number of Omernik Level III ecoregions represented	79
Number of collectors trained in use of the SOS Technical Protocol	600+
Number of SOS collection teams (over time)	111

Peggy Olwell is Plant Conservation Program Lead for the Bureau of Land Management and Chair of the Plant Conservation Alliance Federal Committee. She has worked in plant conservation for more than 25 years and is instrumental in leading and developing the Native Plant Materials Development Program, including Seeds of Success.

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