National Seed Strategy Progress Report

Seeding is a valuable tool to address land management needs of post-disaster response and site stabilization, invasive plant management, and habitat improvements for numerous species. But managers know from experience that poorly selected seed can result in project failure and wasted funds. Federal agencies and non-governmental partners developed the National Seed Strategy for Rehabilitation and Restoration 2015-2020 (Strategy) and released it August 17, 2015. The overall goal of the Strategy is to provide "the right seed at the right place at the right time."

This report identifies progress toward the four Strategy goals. The following sections outline advances in science and management by individual partners of the Plant Conservation Association and a range of projects highlighting partnerships among federal, state, local, and non-government partners.

The Strategy calls for coordinated networks of diverse partners to accelerate the pace and scale of restoration. Implementation of the Strategy at the "right scale" reflects the need to develop program, ecological, and financial efficiencies. Various ecoregional approaches used by agencies, conservation organizations, and seed growers overlap with Strategy topics, such as fire and fuel regimes, endangered species habitats, and genetic variation of plant species. Below, we provide highlights of work that is laying the foundation for a more comprehensive network of collecting, testing, and using native seed across the country.

Prairie Reconstruction Initiative

Objectives 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2

Many conservation organizations and landowners attempt prairie reconstruction—establishing prairie from seed. This process helps buffer or enlarge existing prairie remnants, build a semblance of historic prairie where it no longer exists, improve water quality, or create habitat. However, the results aren't always uniform: they range from highly diverse, functional prairies to disappointingly weedy places with few native species.

Why such a difference? The Eastern Tallgrass Prairie and Big Rivers LCC formed the Prairie Reconstruction Initiative (PRI) with more than 11 conservation organizations with the goal of achieving the best possible result from each diverse prairie reconstruction attempt.

The necessary information to systematically compare plantings is often missing. That's why the PRI developed a prototype database to record and preserve these data. Post-planting monitoring can demonstrate how closely the seed mix matches the developing plant community. Monitoring and database information can reveal the most important influences on the developing character of prairie plantings. The database includes simple routines that provide land managers instant feedback if appropriate monitoring data is recorded.

This database, soon available for wider use, could provide key insights about how to efficiently and consistently achieve highly diverse prairies.

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Status by Goal

Goal 1: Identify seed needs and ensure the reliable availability of genetically appropriate seed

This is where the subject matter experts or organizers of each goal would offer some insight on status of goal based on the entries in the table. For example, it looks like we're making some progress on seed needs assessments of federal agencies in the intermountain and southwest regions as well as tribal lands. However, we still need to complete analyses on these seed need assessments, and this makes sense as the analyses cannot be completed before the assessments have been submitted. Overall, a nice diversity of organizations and regions has already helped identify seed needs across the country.

Locally Sourced Seed for Coastal Restoration
Objective 1.3

Spartina alterniflora Loisel. Smooth cordgrass. Photo USDA-NRCS PLANTS Database

In 2016, the Prime Hook National Wildlife Refuge in Delaware seeded approximately 250 pounds of cleaned smooth cordgrass seed from the Cape May Plant Materials Center (PMC). This extensive marsh restoration project, made possible by a partnership between the PMC, the BLM and others, seeded smaller quantities of other tidal marsh species, too.

Because of their seed collection and banking efforts, the Cape May PMC was able to provide native, locally adapted seed for coastal restoration projects funded through the Supplemental Sandy Mitigation Fund. Ongoing seed collections target species found in the habitats most affected by Hurricane Sandy.

The Cape May PMC receives seed collections, then cleans, weighs, and tests the seed for germination and purity. They send a subset of cleaned seed to long-term germplasm storage for preservation, and the balance is used in designated restoration projects. Cape May PMC plans to make 1,400 seed collections over 2 seasons. Many of these seed lots will be used in Fish and Wildlife Refuges from southern New England to North Carolina to revegetate damaged areas from Superstorm Sandy. Some seed will be transferred to commercial growers to facilitate larger-scale production and commercial availability of these locally adapted native species.

Contact:
Website: www.nrcs.usda.gov/wps/portal/nrcs/main/plantmaterials/pmc/northeast/njpmc/

Conservation of *Penstemon penlandii*, a Rare Colorado Endemic
Objective 1.3

Penstemon penlandii, a rare Colorado endemic, is listed under the Endangered Species Act. This species has been found in only two places: one on BLM land near Kremmling, Colo., and the other less than 2 miles north, on private property. A partnership between the Denver Botanic Gardens (Gardens), the Bureau of Land Management (BLM), and the private landowner helps conserve this rare plant.

Seed has been collected six times from the BLM population from 1988-2015. The population on the private property had not been assessed for many years, but in 2015 the landowner granted permission to take tissue samples. Through a genetic analysis, Gardens researchers discovered that the two populations are genetically distinct. With these results, staff determined it was necessary to collect seed from the private property population to capture all of the genetic diversity present in the species. In August 2017, the landowner again allowed access to his property to collect seed. On this trip, researchers discovered a large, robust population with ample amounts of seed.

Gardens will continue to collect seed and research this species to ensure adequate *ex situ* conservation, both through seed banking and plantings in the Gardens' living collections.

Contact:
Website:

Goal 2: Identify research needs and conduct research to provide genetically appropriate seed and to improve technology for native seed production and ecosystem restoration

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Genotyping Desert Plantain for the Mojave Desert Native Plant Program (MDNPP): Landscape Genomics to Inform Seed Transfer Zones
Objective 2.1

Desert plantain in Death Valley in the Mojave Desert. Photo by L. Washburn.

A growing human presence brings significant ecological changes to the Mojave Desert. Non-native grasses introduced by humans allow wildfires to spread quickly between widely spaced native shrubs. The fires destroy food and shelter plants that the native, endangered desert tortoise (*Gopherus agassizii*) depends on. For example, desert tortoise favor the desert plantain, *Plantago ovata* var. *fastigiata,* for food in the spring. So land managers need an ample supply of locally sourced, genetically appropriate seed to restore areas after fire or other disturbances.

The Conservation Program at Rancho Santa Ana Botanic Garden (RSABG), in collaboration with the BLM and USGS, is helping the effort by studying genetic variation of the desert plantain. Field botanists collected leaves from 12-15 plants from each of 66 locations throughout the Mojave Desert. Then they extracted DNA from the leaves to generate genotypes using RADSeq, a Next Generation sequencing method that reveals patterns of variation in the DNA sequence. When analyzed in the context of environmental variables, such as elevation, precipitation, and temperature, these genetic data will identify species-specific seed transfer zones – areas where collected seed can be planted back without negative impact on the gene pools of established plant populations.

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Plant Development in the Pacific Northwest Aids in Habitat Restoration for Endangered Species
Objectives 2.1, 2.2, 2.3

Golden paintbrush. Photo USFWS.

The Corvallis Plant Materials Center (PMC) worked with more than 20 native plant species to aid the endangered Oregon Silverspot Butterfly's recovery. Working with federal partners and private landowners, quality habitat for this butterfly has doubled. Additionally, the Corvallis PMC provided seed to high schools, prisons, private growers, nurseries, and Soil & Water Conservation Districts to encourage planting these important species.

In another project, the Corvallis PMC helped recover Willamette Valley threatened and endangered plant species. Seed increase and plant production of all seven of the listed plant species in the Willamette Valley have provided federal, state, and local government and private conservation partners with appropriate plant material for restoration and recovery efforts. Several areas in the Willamette Valley now meet local recovery targets for some species, with others close behind. In fact, golden paintbrush, which was extirpated from Oregon, is on track to for delisting within the next three years.

This work, in addition to agreements with BLM, USFS, and USFWS, provided the Corvallis PMC with more than 50 native plant species. The information acquired from this work is included in the Native Seed Production Manual for the Pacific Northwest and numerous plant propagation protocols.
Contact:
Website:

Goal 3: Develop tools that enable managers to make timely, informed seeding decisions for ecological restoration

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Conveyor belt at the Smithsonian's National Museum of Natural History.

Specimen Digitization Objective 3.2

The Smithsonian's National Museum of Natural History Botany Department's digitization conveyor project continues to run full speed ahead. Herbarium specimens in the plant groups Pteridophytes (ferns and fern allies), Onagraceae, and Asteraceae were processed through the conveyor. All specimens in those groups have been fully digitized. By the end of 2016, Fabaceae will also be partially completed. In addition, through Picturae (the Dutch-based digitization company), labels from the digitized botanical specimens have been transcribed and are ready to import to the museum's specimen data catalog.

After the Fabaceae, the herbarium will focus on the Gymnosperms, Cyperaceae, and possibly the Rubiaceae (funds permitting). The goal is to find funding to completely digitize the 4.5 million specimens in the U.S. National Herbarium – a lofty goal, indeed, but well worth the effort. The botanical specimens have many stories to tell, and with open access to the data and images, the collections can be queried and analyzed in ways not previously possible.

Contact:
Website:

not be completed before the assessments have been submitted. Overall, a nice diversity of organizations and regions has already helped identify seed needs across the country.

Goal 4: Develop strategies for internal and external communication

This is where the subject matter experts or organizers of each goal would offer some insight on status of goal based on the entries in the table. For example, it looks like we're making some progress on seed needs assessments of federal agencies in the intermountain and southwest regions as well as tribal lands. However, we still need to complete analyses on these seed need assessments, and this makes sense as the analyses cannot be completed before the assessments have been submitted. Overall, a nice diversity of organizations and regions has already helped identify seed needs across the country.

Way forward

In February 2017, more than xx plant and seed conservation professionals met in Washington, D.C., for the National Seed Conference. During this conference, 12 task forces, aligned by Seed Strategy Goals and Objectives, formed to identify initial tasks for the coming year. These groups will address several topics:

Policy and Funding

- Develop ways to incorporate seed needs in ecological restoration as an adaptation mechanism and insurance policy in response to wildfires, hurricanes, and other extreme weather events
- Identify existing Federal seed and restoration policies and guidance
- Explore opportunities to use USDA programs to fund native plant research and development for ecological restoration and rehabilitation

Research and Tools

- Incorporate soil-related research needs and decision tools into seed production and revegetation

- Plan, implement, and help publicize native plant demonstration sites in different ecoregions across the U.S.
- Develop basic guidance and communication for land managers who may not yet be accustomed to taking native species into account
- Develop consistency for seed collections across the U.S.
- Identify gaps between training courses offered and training needs to increase the understanding of restoration principles and the use of native seed across multiple agencies (Federal, state, tribal, and local), nongovernmental organizations, private sector industries, and universities

Communication

- Identify various deliverables of the Strategy and provide recommendations on mechanisms and opportunities for communicating and disseminating information in a coordinated way
- Develop ways to use momentum behind wildlife species to support the use and development of native plant materials in habitat management decisions
- Bring together public and private sector land managers with private sector seed growers to learn how to improve seed development partnerships that can serve all parties' needs

Appendix 1: Progress Summary Tables

Goal 1: Identify seed needs and ensure the reliable availability of genetically appropriate seed reserves

Objective 1.1: Assess the plant production needs and capacity of federal agencies

Action	Agency/Org	Progress
1.1.1 Conduct a needs and capacity assessment for all Federal agencies and their offices that provide or use seed.	Southwest Seed Partnership (SWSP)	Initial target lists developed for 3 NM and AZ ecoregions and under review. Multiple public (USFS, BLM, NM DoT, NRCS, etc.) and private seed users have provided input to lists. A restoration "seed needs" survey has been developed and is ready for distribution. A species selection subcommittee will continue to refine these lists.
	USFS – Intermountain region	USFS R4 identified 80 pollinator friendly native plant species as high priority for seed production. This core list of native forbs and shrubs is suitable for enhancing existing pollinator habitat as well as improving pollinator habitat in disturbed areas during revegetation activities.
1.1.2 Identify and inventory agency and private sector seed collections, nurseries, and storage capacity.	Chicago Botanic Garden	Compiled a database of all native plant sellers in the US and the species they sell; data shared with USFS and FHA to support the new FHWA revegetation manual and species selection tool. A paper summarizing the state of the US native plant industry and species availability is in preparation for submission to *Restoration Ecology*.
	Botanic Gardens Conservation International US	Compiled a directory of wild plant seed conservation expertise in the US, including individuals in the federal government. Compiled a list of seed banks in the US and determined which ones hold native plant species, including seed banks maintained by the federal government.
1.1.3 Identify existing Federal seed and restoration policies.		
1.1.4 Analyze results of needs and capacity assessment (Fed)		
1.1.5 Analyze results of policy and guidance assessment and develop restoration program		

Objective 1.2: Assess capacity and needs of tribes, states, private sector seed producers, nurseries, and other partners

Action	Agency/Org	Progress
1.2.1 Conduct a needs and capacity assessment of tribal, state, local, private sector, and nonprofit seed storage and distribution facilities.	Southwest Seed Partnership (SWSP)	Grower outreach/presentations at multiple venues (i.e., NMSU Northern Pueblos Ag Day, State Seedsman Association, community farm board meetings, & CPNPP) with 5 individual farm visits to assess capacity and expertise. More than 10 SW producers (2 tribal nurseries, 3 commercial producers, and several small scale farmers) have expressed an interest in participating in the program. A grower survey has been developed and is ready for distribution. Coordinating continues with NM and AZ tribes, agency tribal liaisons, and watershed councils to further facilitate tribal farms in native species production.

Action	Agency/Org	Progress
1.2.1 Conduct a needs and capacity assessment of tribal, state, local, private sector, and nonprofit seed storage and distribution facilities.	USFS	Rocky Mountain Research Station writing nearly 300 native plant propagation protocols requested by different tribes.
	USFS	Co-organized the 16th Annual Intertribal Nursery Council workshop in Buffalo, NY.
	Navajo Natural Heritage Program – Navajo Fish and Wildlife	Acquired funding for interns to conduct a needs assessment survey targeting Navajo agencies involved in ecological restoration to get a baseline understanding of native plant needs for buyers on Navajo. Interns will also conduct community outreach at 15 chapters throughout the Nation to gauge interest in a native plants program. Survey results will be compiled into a report that will be used to guide future decisions about the scope and direction of the Navajo native plants program.
	Botanic Gardens Conservation International US	Compiled a directory of wild plant seed conservation expertise in the US. Compiled a list of seed banks in the US and determined which ones hold native plant species.
1.2.2 Work with partners to leverage strengths and address deficiencies in distribution and availability of genetically appropriate seed.	Golden Gate National Parks Conservancy	Multi-agency seed collection projects underway that involve collaboration of several federal, state, and local agencies and non-profit partners in the San Francisco Bay area.
	Green Ribbon Initiative	Administered an assessment of 10-year capacity and needs of regional partners.
1.2.3 Analyze results of needs and capacity assessment.	Green Ribbon Initiative	Creating regional priority species propagation list and will assign targets to partners according to capacity and expertise.

Objective 1.3: Increase the supply and reliable availability of genetically appropriate seed

Action	Agency/Org	Progress
1.3.1 Expand and improve facilities and plant production capacity.	Southwest Seed Partnership	Funding secured for 4-8 production fields in NM and AZ. First production fields will be contracted in 2017. A harvest is anticipated in 2018-19 (annual species).
	USFS – Coeur d'Alene Nursery	More than 72,000 containers were distributed to Region 1, 2, 4, and 6 and to Montana BLM. There were 66 native plant species including shrubs, forbs, grasses, and grass-like plants. These include pollinator friendly plants as well as riparian and upland plants.
	USFS – Intermountain region	Collaborated with Great Basin Research Center-UDWR to bulk up seed quantity for 5 sage grouse and pollinator friendly forb species sources collected from the Colorado Plateau Ecoregion.
	Golden Gate National Parks Conservancy	Invested in and completed facility improvements to follow BMP for plant pathogen control. Upgrades include new protocols, footbaths, soil steamer, and more.
1.3.2 Improve capability to plan for seed needs by seed zone.	USFS – Northern region	Seed zones under development for 4 species including 2 pollinator-friendly species. Bluebunch wheatgrass seed is available for forest and grassland use. A common garden study was established for Sandberg's bluegrass. There are 13 species being tested for delivery to specific ranges using genetic and morphological traits.
	NRCS	Several NRCS Plant Materials Centers have interagency agreement with the National Park Service to propagate and increase native seed and plants for NPS units.
1.3.3 Assess and implement alternative seed production methods for "workhorse" shrub species.		
1.3.4 Expand collection, conservation, and assessment of native plant genetic resources through programs such as SOS.	Southwest Seed Partnership (SWSP)	Seed collection crews covered 6 ecoregions (AZ NM Mountains, AZ NM Plateau, S. Rocky Mountains, Chihuahuan Desert, SW Tablelands, and Colorado Plateau). Collections were made in the Madrean Archipelago in 2015. The 2016 seed collections were represented by 21 families, 54 genera, and 79 unique species and collections were made from over 200 populations. Half of the total collections were from forb species. Seed is being cleaned and placed in cold storage until ample diversity is available to deliver to seed producers.

Action	Agency/Org	Progress
1.3.4 Expand collection, conservation, and assessment of native plant genetic resources through programs such as SOS.	USFS – Northern region	More than 40 grass and forb species in bulk seed production. Many are pollinator friendly, and new plots were established to increase production. Additions include Western showy aster (*Aster conspicuus*). Couer d'Alene Nursery provides storage for native grass seed until ready for use by forests and grasslands.
	SBR	A portion of each seed collection from the SBR is donated to Seeds of Success for long term germplasm storage for preservation. The balance will be available for use in designated restoration projects. Fish and Wildlife Refuges from southern New England to North Carolina will use this to revegetate damaged areas from Superstorm Sandy. In 2016, the Prime Hook National Wildlife Refuge in Delaware seeded approximately 250 pounds of cleaned smooth cordgrass seed from the PMC. Some of the seed will also be transferred to commercial growers to help facilitate larger-scale production and commercial availability of these locally adapted native species.
	National Lab for Genetic Resources Preservation	Provides long term backup storage for SOS accessions within the USDA's National Plant Germplasm System. Seed quality is assessed prior to storage.
	Navajo Natural Heritage Program – Navajo Fish and Wildlife	Collecting seed for target species on Navajo lands.
	Santa Barbara Botanic Garden	Made 18 SOS collections representing 13 unique taxa at Carrizo Plain National Monument in 2017. Made 26 conservation seed bank collections representing 20 unique taxa from Carrizo Plain National Monument, Fort Ord National Monument, and Clear Creek Management Area.
	Missouri Botanical Garden Seed Bank	MBG Seed Bank is working on a project to collect examples of Missouri's entire flora. Small amounts of seed are available for request for a variety of uses including research and education.
	Green Ribbon Initiative	Piloting a regional (Oak Openings of MI/OH) cryobanking program, with submissions to Chicago Botanic Garden.
	NRCS	The NRCS Cape May Plant Materials partners with Seeds of Success-East under an interagency agreement to clean and test seed collections in NJ and NY. Seed is then used to restore coastal environments impacted by Hurricane Sandy. A sample of seed is also sent for preservation.
1.3.5 Engage Federal procurement specialists to assess contracting regulations and practices; correct deficiencies.		

Goal 2: Identify research needs and conduct research to provide genetically appropriate seed and to improve technology for native seed production and ecosystem restoration

Objective 2.1: Characterize genetic variation of restoration species to delineate seed zones, and provide seed transfer guidelines for current and projected future environmental conditions

Action	Agency/Org	Progress
2.1.1 Conduct genetic research to develop seed zones for key restoration species.	USFS – Intermountain region	Collaborated with Rocky Mountain Research Station on contract production of 3 provisional seed zone sources of thickleaf penstemon (*Penstemon pachyphyllus*).

Action	Agency/Org	Progress
2.1.1 Conduct genetic research to develop seed zones for key restoration species.	Rancho Santa Ana Botanic Garden	Collaborated with Rocky Mountain Research. RSABG is working in partnership with BLM and USGS by studying genetic variation of a common desert annual in the Mojave. Field collectors made tissue collections of nearly 1,000 individuals of *Plantago ovata* (desert plantain) from 66 populations throughout the Mojave Desert. The goal is to understand the geographic patterns of genetic diversity in desert plantain.
	Chicago Botanic Garden	Conducting common garden research on 5 priority restoration forbs collected from multiple populations in the Colorado Plateau and comparing them with available germplasm from outside the region.
2.1.2 Develop predictive models of climate change effects.	Missouri Botanical Garden	Developed phenotype and species distribution models to predict how climate change affects the future size and distribution of big bluestem (*Andropogon gerardii*), a dominant C4 grass of Midwestern grasslands. Results have important implications for seed sourcing for restoration and grassland reconstructions. Paper published in *Global Change Biology* 23: 4365–4375.

Objective 2.2: Conduct species-specific research to provide seed technology, storage, and production protocols for restoration species

Action	Agency/Org	Progress
2.2.1 Conduct seed germination studies and develop seed testing protocols for key restoration species.	USFS – Intermountain region	Regions 4 and 1 implementing the 2017 Sage-Grouse Habitat Seed Transfer Zone Study project. The project will ensure appropriate plant material is available and in quantities needed to improve sage grouse habitat following wildfire and other disturbances.
	Chicago Botanic Garden	Conducted research on seed germination requirements of multiple populations of 8 priority restoration forb species in the Colorado Plateau, with a manuscript accepted for publication in Plos ONE.
	Rancho Santa Ana Botanic Garden	Rancho Santa Ana Botanic Garden is currently running several germination experiments to develop germination protocols for *Juniperus californica.*
	Botanic Gardens Conservation International US	Collaborating with Cincinnati Zoo and Botanical Garden on developing an Exceptional Plant Conservation Network to focus on species that cannot be seed banked using conventional methods. Refining a list of North American exceptional species.
2.2.2 Develop storage guidelines for key restoration species to improve maintenance of seed viability.		
2.2.3 Develop species-specific protocols for seed and seedling production practices to maintain genetic diversity.	Golden Gate National Parks Conservancy	In addition to published *Nursery Manual*, created database to record and analyze collection and propagation data. Also implemented new BMPs based on recommendations from the regional Phytophthora working group.
	USFS and Chicago Botanic Garden	Initiated research to assess changes in neutral and potentially adaptive genetic variation in multi-source seed production and use of *Penstemon pachyphyllus.*
	Green Ribbon Initiative	Secured funding for a scholar to collate literature searches on and distribute propagation protocols for regionally rare and difficult to produce species.

Objective 2.3: Conduct research on plant establishment, species interactions, and ecological restoration

Action	Agency/Org	Progress
2.3.1 Develop site preparation and seeding and transplanting strategies that improve plant establishment and diversity.		
2.3.2 Within seed zones, examine capacity of native plants to establish and persist.	University of Arizona - School of Natural Resources & the Environment	Developing experiments to investigate relationships between drought tolerant traits and restoration capacity in the southwestern US.
	Missouri Botanical Garden	Conducted germination and seedling establishment trials in the field and greenhouse with 6 common native woodland herbs to determine which species were most suitable for revegetating burn pile scars in restored woodlands of the Ozark plateau. Draft manuscript available; currently preparing for submission to peer-reviewed journal.
2.3.3 Advance investigations to diversify depleted native communities.	USFS – Rocky Mountain region	Bessey Nursery collected, cleaned, stratified and grew seeds of the endangered blowout penstemon restricted to stabilized sand dunes in NE and WY. Planting them in their preferred habitat provides benefits for pollination and wildlife habitat as a whole.
	Missouri Botanical Garden	Developing and trialing native woodland seed mixes for restoring woodlands after the removal of invasive shrubs in the Ozark plateau.
2.3.4 Assess soil degradation, and develop treatments, soil amendments, and other site preparation techniques.		

Objective 2.4: Develop or modify monitoring techniques and investigate long-term restoration impacts and outcomes

Action	Agency/Org	Progress
2.4.1 Analyze new and existing monitoring methodologies to evaluate restoration outcomes.	Green Ribbon Initiative	A regional rapid assessment method for planted restoration sites is under development and will be vetted against FQAI.
2.4.2 Quantify ecological and economic costs/benefits of planting native and nonnative plants on public lands.		
2.4.3 Study selected native plant restoration projects to evaluate short-and long-term responses.	Chicago Botanic Garden	Analyzing data from the Colorado Plateau Restoration Outcomes Database for publication and have shared the data with USGS and grad students at NAU and CU-Boulder.
	Missouri Botanical Garden	Analyzing long-term changes (decade) in woodland plant communities of the Ozark plateau following the reintroduction of fire and removal of invasive woody plants.

Goal 3: Develop tools that enable managers to make timely, informed seeding decisions for ecological restoration

Objective 3.1: Develop training programs for practitioners, producers, and stakeholders on the use of genetically appropriate seed for restoration

Action	Agency/Org	Progress
3.1.1 Develop a cadre of experts, and work with partners to establish a restoration certification program.	USFS – Pacific Northwest region	The R6 Restoration Services Team provided revegetation consultations and trainings for R6 personnel, as well as assistance on complex projects. The team also provides revegetation services to an increasing array of federal, state, and county partners throughout the PNW.
3.1.2 Use and where appropriate, expand the network of restoration field sites and demonstration areas.	USFS – Northern region	The Northern and Intermountain regions work with the Western Federal Lands Highway Division of FHA, providing native plant materials for roadside restoration.
	USFS – Rocky Mountain region	Bessey Nursery collected seed of 3 different milkweed species, used to grow 1,200 container plants that will be used for revegetation to public in 4H camps, Ranch Expos, Husker Days, and the Nebraska Conservation District Conference.
	Golden Gate National Parks Conservancy	In partnership with many federal, state, and local agencies, supporting the "Tunnel Tops" project, an innovative landscape project that will turn the space above highway tunnels into new parklands. The plans include native plant acreage, outdoor youth learning center, and recreation areas. The area is adjacent to a major city and connects two existing park parcels by using the space over the highway tunnels.
	University of Arizona - School of Natural Resources & the Environment	Developing experiments to investigate relationships between drought tolerant traits and restoration capacity in the southwestern US. This will involve the deployment of new restoration field sites and demonstration areas.
	Missouri Botanical Garden's Shaw Nature Reserve and Grow Native Program	Developed and hosted Restoration of Oak-Hickory Woodland and Bush Honeysuckle management project. Workshop featured tour of two demonstration woodlands undergoing restoration with native seed addition. Ongoing classes held to teach techniques for prairie, savanna, and wetland re-establishment.
	Cornell Botanic Gardens/Finger Lakes Native Plant Society	Continuing to provide/expand seed exchange for more than 50 species, including site provenance.
3.1.3 Develop resources for managers to highlight successful/unsuccessful projects, including site visits.	Southwest Seed Partnership (SWSP)	Large audiences have been reached through numerous native seed presentations and workshops, including a native seed collection workshop (Rio Mora NFW Refuge, NM) and a milkweed/grower outreach workshop (Los Lunas Plant Materials Center, NM).

Objective 3.2: Develop native seed source availability data and tools for accessing the data

Action	Agency/Org	Progress
3.2.1 Support regional/ nongovernmental native seed networks that provide seed with seed zone origin.	Institute for Applied Ecology	Developed a SW restoration seed buyer informational brochure.
	Rancho Santa Ana Botanic Garden	Been a key partner in the development of a new collaborative effort to establish a regional seed bank/network in greater Los Angeles, CA.
	Green Ribbon Initiative	Established the Native Plant Working Group, a network of native plant materials producers and consumers in the OH/MI Oak Openings region.
3.2.2 Maintain a website with seed zone maps and publications and develop a web-based seed selection tool to match seed source/planting site.	University of Arizona - School of Natural Resources & the Environment	Developing an online accessible guide to identifying restoration candidates for the southwestern U.S. based on management goals.

Action	Agency/Org	Progress
3.2.2 Maintain a website with seed zone maps and publications and develop a web-based seed selection tool to match seed source/planting site.	The Calflora Database	Live website with planting guide for California: http://www.calflora.org/entry/palette.html.
3.2.3 Create a multiagency and non-Federal partner seed inventory system.	The Smithsonian's National Museum of Natural History	Digitization conveyor project: Herbarium specimens in the plant groups Pteridophytes, Onagraceae, and Asteraceae have been fully digitized. Febaceae is also partially completed. Labels from the digitized botanical specimens have been transcribed and are ready to import to the museum's specimen data catalog.
	USFS – Pacific Northwest region	Clarno Hardwood Production Facility provides locally sourced willow and cottonwood cuttings to 16 federal lands partners for riparian restoration plantings. This facility also produces native milkweed seed for monarch butterfly habitat enhancement in central and eastern OR.
3.2.4 Develop/enhance Federal agreement/procurement tools for multiagency seed acquisition.		

Objective 3.3: Integrate and develop science delivery tools to support restoration project development and implementation

Action	Agency/Org	Status
3.3.1 Identify available restoration guides and protocols by ecoregion.		
3.3.2 Write and distribute ecoregional native plant project reports.	Chicago Botanic Garden	Reports on research into establishment trials testing outcomes in regionally sourced material of priority restoration forbs and grasses published on the CPNPP Conservation Registry website, presentation given at CPNPP annual meeting.
	Green Ribbon Initiative	Native Plant Working Group submitted annual regional native plant materials usage report to GRI steering committee for distribution to partner agencies.
3.3.3 Support field implementation of restoration tools.	USFS – Northern region	The Northern and Intermountain regions increasing Aspen fleabane (*Erigeron speciosus*) for sage grouse habitat improvement projects.

Objective 3.4: Build on ecological assessments and disturbance data and provide training that will allow managers to anticipate needs and establish spatially explicit contingency strategies

Action	Agency/Org	Status
3.4.1 Identify/inventory climate-based geospatial tools to inform decisions on restoration site priority/methods.		
3.4.2 Develop crosswalk of agency habitat restoration priorities/tools by provisional seed zone and plant community		
3.4.3 Assess climate modeling and soil/water remote sensing to forecast seedling establishment and persistence.		
3.4.4 Develop GIS-based tools with disturbance data for prioritizing seed needs/projects.		
3.4.5 Use risk-based assessment tools to prioritize treatment locations and refine strategies based on wildfire.		

Action	Agency/Org	Status
3.4.6 Develop a decision tool of belowground assessment and treatment.		
3.4.7 Develop informational tools and guidelines on the appropriate use of cultivars, hybrids, and noninvasive nonnative species.	Cornell Botanic Gardens	Provide guidelines on native plant cultivation techniques.

Goal 4: Develop strategies for internal and external communication

Objective 4.1: External communications: Conduct education and outreach through the PCA network

Action	Agency/Org	Status
4.1.1 Develop a communications plan.	Comms WG	Electronic toolkit, including PPT presentation, briefing paper, fact sheet, talking points, key messages, and the communications plan are easily accessible to PCA members to share the Seed Strategy with their internal audiences.
4.1.2 Involve the Plant Conservation Alliance in communications.	Chicago Botanic Garden	Regular communications provided to all 357 PCA Non-Federal Cooperators, session organized on Plant Blindness and Plant Conservation at National Native Seed Conference.

Objective 4.2: Internal communications: Distribute and implement the strategy across agencies and provide feedback mechanisms

Action	Agency/Org	Status
4.2.1 Develop internal communications plans.	Southwest Seed Partnership (SWSP)	A SWSP Steering Committee, comprising 12 representatives/resource experts from public and private organizations, met in April 2016 and identified 1) areas of overlap and gaps for native seed development, 2) opportunities collaboration or leadership, 3) a process for prioritizing target species, determining seed transfer zones, and helping seed users project seed needs into the future, and 4) funding strategies and initial recommendations for structuring a seed partnership for the southwest. SWSP presentations were provided to FS R3 Biologist Annual Meeting, FS Supervisors Meeting, and NM BLM state office resource managers. Coordination meetings with BLM NM field offices (Rio Puerco, Socorro, and Taos) and Region 3 Forests (Tonto, Coronado, Kaibab, Santa Fe, Coconino, Cibola, and Carson) also occurred in 2016.
4.2.2 Identify and use communication mechanisms for implementing the Strategy.		
4.2.3 Make existing agency native plant policies available to the public.	Green Ribbon Initiative	Developed landowner registry plant materials distribution protocol. Public may trade volunteer hours for seed and other plant materials.
4.2.4 Incorporate Strategy goals and key messages into landscape-scale restoration initiatives.	Green Ribbon Initiative	Included Strategy goals in the 10-year Oak Openings Region native plant materials strategic plan.

Objective 4.3: Report progress, recognize achievements, and revise strategy

Action	Agency/Org	Status
4.3.1 Establish mechanism to report progress, including successful native plant projects and lessons learned.	Golden Gate National Parks Conservancy	Representative on Tools for Collectors task force.
	Chicago Botanic Garden	Work with federal PCA partners to solicit progress reports from non-federal cooperators and synthesize information for annual report.

Action	Agency/Org	Status
4.3.1 Establish mechanism to report progress, including successful native plant projects and lessons learned.	Green Ribbon Initiative	Native Plant Working Group submits annual reports to GRI steering committee.
4.3.2 Recognize/promote achievements/needed improvements across all agencies and partners.	Southwest Seed Partnership (SWSP)	Native seed topics and SWSP information was presented to Native Plant Society (3 chapters), Albuquerque Wildlife Federation, NM Game & Fish NM Undercover meetings and Quivira Coalition, Society for Ecological Restoration, and the Colorado Plateau Native Program conferences. Meetings to engage a broad group of native seed stakeholders, both users and producers, in NM and AZ are scheduled for 2017.
	PCA members	Presentations at key national and international conferences and meetings, such as the IUCN World Conservation Congress and Natural Areas Association conference.
	PCA members	Written articles for diverse audiences, published in a variety of publications, from *Bioscience* to *LA Times*.
4.3.3 Review and revise the Strategy every 5 years or as needed.		