A Seed Strategy for the Madrean Archipelago

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IMPLEMENTING THE NATIONAL SEED STRATEGY ON A REGIONAL SCALE

Purpose

This strategy is a chronicle of the Madrean Archipelago Plant Propagation (MAPP) Initiative, and a plan for the continued development of a plant materials program in southeastern Arizona between 2017-2022. It is a product of a multi-year collaboration between the Bureau of Land Management (BLM), the National Park Service (NPS), Borderlands Restoration L3C (BR), and the Gila Watershed Partnership (GWP).

Collectively, these partners have worked together since 2011 to support the Madrean Archipelago Plant Propagation Initiative (MAPP Initiative). The MAPP Initiative is a formal collaboration between BR and GWP, but is also a regional plant materials partnership with many points of entry for individuals, organizations and agencies.

The primary purpose of this strategy is to articulate how to connect seed collection, curation, and production of plant materials to on-the-ground regional-scale restoration work in the Madrean Archipelago. The strategy will increase the ability of local, state, and federal managers to respond appropriately to decreased landscape resiliency and catastrophe that will be associated with increasing burned area and other emergency stabilization efforts, pollinator decline, and climate change. This Strategy intends to magnify the efforts of the MAPP Initiative that have established BR and GWP as regional leaders in plant materials development, and is in support of goals articulated by the *2014 Presidential Memorandum on Pollinator Health*, the *National Strategy to Protect and Improve Pollinator Health*, and the *National Seed Strategy for Restoration and Rehabilitation 2015-2020*.

Vision and Goals

The goal of this Strategy is to ensure the reliable availability of genetically appropriate seed for the Madrean Archipelago ecoregion.

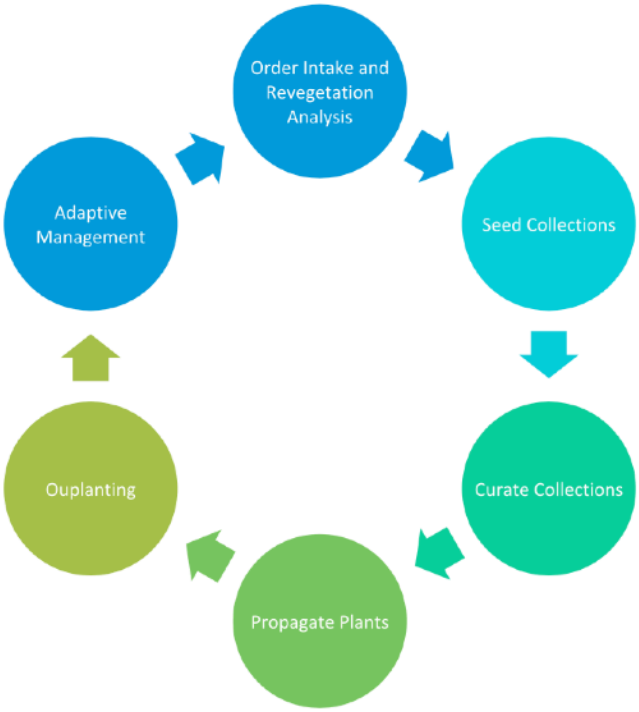
At the core of the Seed Strategy is the shared local and regional need to provide a programmatic approach to the collection, curation, and propagation of plant materials native to the Madrean Archipelago, in the southwestern United States and northwestern Mexico. This Strategy outlines an existing, innovative plant materials program that is poised, with the continued support of federal agency, NGO, and private sector partners, to maintain a sustainable seed collection and curation system that supports propagation, production, and development of plant materials for restoration work at scale and across jurisdictional boundaries in the Madrean Archipelago.

1) **Summarize an innovative plant materials program that supports an interagency seed collection team, cleaning and curation facility, and a network of propagation and production facilities.**

2) **Outline regional plant materials needs and assets.**

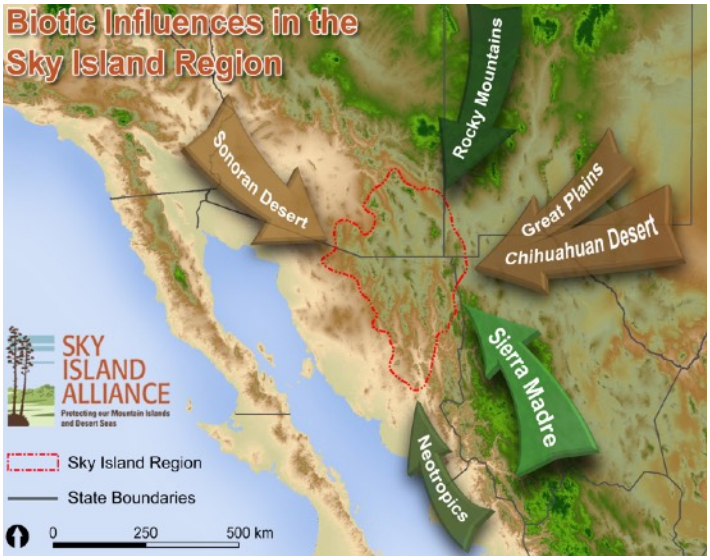
3) **Present a priority species list for collection in the Madrean Archipelago and a framework for priority species selection.**

4) **Provide guidance on how to develop missing components of a regional plant materials production system; including capacity for bulk seed cleaning, storage, and production.**



Relevance

The BLM is the largest purchaser of native seed in North America and has a long-term history supporting efforts that produce native plant material (BLM, 2016). BLM and other agency purchasing power seeks to lower the costs of native plant materials, and continues to reduce restoration costs by identifying best management practices both for the collection and production of plant materials, and for their successful installation on restoration projects. There is additional demand for local and genetically appropriate seed to support the Burned Area Emergency Response Program (BAER) (Napper, 2006), the Arizona Department of Transportation (and other state-level agencies), Clean Water Act mitigation projects, restoration operations by non-profits and community groups, along with the private market and other federal agencies. Implementation of a seed strategy at an eco-regional level provides opportunities for research and restoration at a large enough scale to provide for broad collaboration and potential to realize subsequent cost reduction. Seed collection in the Madrean Archipelago is central to genetically appropriate plant materials production, a growing regional economy based on restoration activities, and is a fundamental component of a long-term restoration strategy that engages multiple partners across the region in a tightly networked restoration economy.



The Madrean Archipelago

The Madrean Archipelago is a bi-national bioregional crossroads on the US-Mexico border. It is influenced by four major bioregions across an area that covers 70,000-square-miles of Sonora, Chihuahua, Arizona and New Mexico. The Sky Islands and the northern highlands of the Sierra Madre Occidental together form a center of biological diversity that is globally recognized by both the International Union for Conservation of Nature and the World Wildlife Fund. The unique diversity in the Sky Islands is due to their proximity to the subtropical influence of the species-rich Sierra Madre Mountains of northern Mexico. This eco-region is additionally influenced by the Sonoran Desert from the west, the Rocky Mountains to the north, and the Chihuahuan Desert to the east. Fifty-five forested mountain ranges function as islands that are separated by massive expanses of desert and desert grasslands, and have among them some of most diverse ecosystems in the world (Felger, 1995).

The region has been severely impacted over the past hundred years by dramatic changes to fire regimes and other anthropogenic impacts, which has compounded losses of pollinator forage (Fule, 1997; Bahre, 1991). This has led to rapid habitat degradation, yet the region maintains the highest recorded diversity of native pollinators in North America, with over 600 identified species of native bees in addition to an impressive diversity of hummingbirds, nectar-feeding bats, butterflies, moths, and other pollinating patterns that depend upon phenological patters that have also been disrupted by changes in land use patterns and ongoing climatic change. The Madrean Archipelago is the only region in North America where Monarch butterflies are known to travel both to coastal California and Mexico, largely depending on the winds at the time of their migration. (Gail M. Morris, 2015).

Responding to the National Seed Strategy

The MAPP Initiative directly supports numerous action items in the National Seed Strategy (Plant Concervation Alliance, 2015), which has a vision of "the right seed in the right place at the right time." The MAPP Initiative supports the following Action items in the National Seed Strategy:

- 1.1 Agency Seed Needs Assessment
- 1.2 Assess Capacity and Needs of Partners
- 1.3 Increase Supply of Genetically Appropriate Seed
- 2.2 Species-Specific Research
- 2.3 Conduct Establishment and Restoration Research
- 3.1 Develop Training Programs
- 3.2 Develop Native Seed Source Data and Tools
- 4. Develop Strategies for Internal and External Communication

Today, the partnership supporting this Seed Strategy is working to accomplish the following:

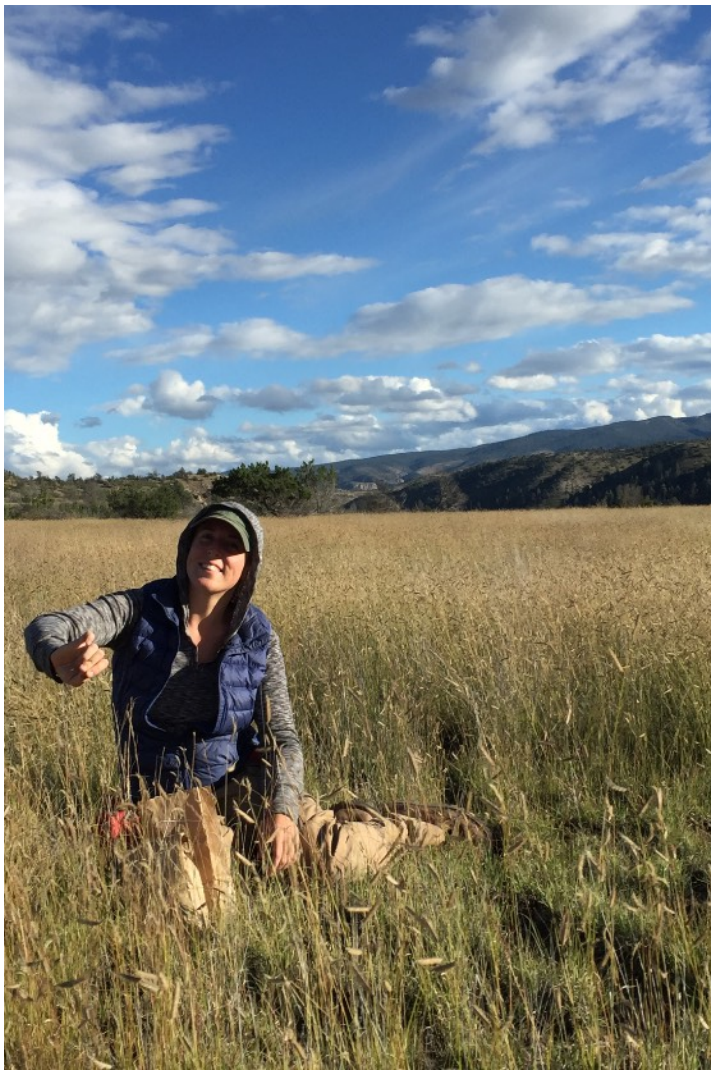
1) **Increase the supply of seed for plants native to the Madrean Archipelago and adjoining regions; (1.1, 1.2, 1.3)**

2) **Develop the MAPP Initiative as a regional seed hub in Patagonia, AZ, offering seed collection, curation, cleaning, and eventual large-scale seed storage; (1.1, 1.2, 1.3)**

3) **Provide a transparent seed collection data management system to track collections wherever made – federal, tribal, state, county, private, and NGO – with the hope that such data management can help to improve restoration outcomes through improved seed selection and the adaptive management of curation and restoration work in tandem; (2.3, 3.1, 3.2)**

4) **Engage with partners in the emerging restoration economy and support training and job opportunities in seed collection and curation, horticulture, and other natural resource related fields; (1.2, 3.1, 3.2)**

5) **Inform decision-making for choosing appropriate plant materials for ecological restoration at all scales, including site selection for critical restoration needs and the capacity to respond quickly and effectively to emergent ecosystem needs; (2.2, 2.3)**



Related Regional Efforts

The Madrean Archipelago is home to a number of agencies, NGOs, and private enterprises active in the production of materials for environmental restoration activities. The majority of the following organizations and businesses participated in our producer survey, detailed in Appendix B.

Wildlands Restoration/Nighthawk Natives: Wildlands Restoration supplies native seed for Sonoran Desert, Great Basin, and Rocky Mountain revegetation and restoration projects, and provides site-specific collections as requested. Nighthawk Natives provides nursery stock of select native plants for wholesale and retail sale.

Arizona Revegetation Inc.: Arizona Revegetation and Monitoring Co. specializes in reseeding projects, native seed sales and rangeland monitoring for the mid elevations of the Southwest. It is owned and operated by Jim Koweek, who has well over 25 years of working with native plants and seed in Southeast Arizona.
Info: www.azreveg.com

Pima County Natural Resources: The Pima County Native Plant Nursery produces container stock of native plants for Pima County revegetation and restoration projects.
Info: www.webcms.pima.gov

Cuenca Los Ojos: Valer Austin employs local residents on her ranch in San Bernadino, Sonora, for native seed and hay production and cleaning. The organization plans to initiate a native plant nursery and seed lab operation in the coming years.
Info: www.cuencalosojos.org

SW Seed Partnership: The 'Southwest Seed Partnership' was formed in 2015 by the Institute for Applied Ecology, Forest Service Region 3, NM Bureau of Land Management, and the National Park Service. The Partnership is dedicated to improving the supply and diversity of native seed for NM and AZ and implementing the National Strategy. Developing locally adapted, ecologically appropriate native seed is a priority.
Info: www.appliedeco.org/southwest-program/

Verde Valley Plant Materials Partnership: This partnership is working to connect NGOs, national forests, and seed producers in the Verde Valley of central Arizona to get target species of needed seed into production.

2011-2012

- Support from the Seeds of Success program initiates wild seed collection based at the Safford Field Office (BLM)
- Propagation trials in Safford in cooperation with the UofA Agricultural Extension (BLM, GWP)
- NPS pilot seed collection program at SEAZ Parks (Chiricahua NM, Coronado NMem, Ft. Bowie NHS) (NPS)
- Formation of Borderlands

2013

- BLM initiates a plant materials partnership with Borderlands Restoration L3C (BR, BLM)
- First year of operation at the BR Native Plant Nursery in Patagonia, AZ (BR, NSS, NPS, BLM)
- First year of operation at the GWP Gila Native Plant Nursery (GWP, EAC, NFWF, WFF, BLM)
- Launch of MAPP Initative Database (BR, BLM, NPS)
- First year of operation at the BR Seed Lab (BR, BLM, NPS)

2014-2015

- Seed collection expands to all public lands (BR, GWP, BLM, NPS)
- Continued support for containerized plant production and propagation research (BLM, NPS)
- Interagency agreement between BLM and SWEPMT to complete regional Seed Strategy (BLM, NPS)
- First year of support for an American Conservation Experience interagency botany crew (BLM, NPS, USFS)
- Multiple small grants and contracts support ongoing nursery production (BR, GWP)

Synopsis of the Madrean Archipelago Native Plant Materials Program

Localized seed collection in the Madrean Archipelago has been ongoing for many years. Private groups and businesses, conservation minded non-profits, federal agencies, all have collected seed for localized projects. Coordinated seed collection efforts began in earnest in 2011 with support from the Seeds of Success program, and have grown in scope with each additional year of the program's development. The BLM and NPS worked closely with the NRCS Plant Materials Center to assess what had previously been done, and outline regional needs.

With an expansion of seed collection on both BLM and NPS lands, 2013 was a pivotal year in the development of the program. BLM received funds to support a $250,000 multi-year plant materials partnership with BR that was designed to increase capacity for seed collections and plant production. The goals of the partnership were to develop more local production knowledge and a broader regional awareness and interest in integrating local native plants in restoration projects. These efforts also connected to the larger project of developing best practices and recommendations for plantings, including training and employing local residents for the work. BR invested in the refurbishment of a greenhouse on Native Seeds/SEARCH (NSS) property, and entered into an open-ended yearly lease for three acres of land. Plant production continued to expand at BR and grew to include a small Seed Lab facility. The organization grew the restoration network through small grants and contracts with multiple agencies and organizations in need of restoration materials.

In Safford, funding was obtained through the National Fish and Wildlife Foundation's Native Plant Conservation Grant and the Walton Family Foundation's Freshwater Initiative to purchase and construct a 2800-square foot greenhouse and 800-square foot shade structure at the Discovery Park Campus of Eastern Arizona College. Agreements between the BLM, the Gila Watershed Partnership (GWP), and Eastern Arizona College to share operational costs and nursery management allowed for a sustainable financial model to continue producing and researching native plants in the region. The collaboration emphasized developing strategies to improve planting success in restoration projects. Eastern Arizona College was also able to provide an avenue for students to be trained in horticulture, restoration ecology, and biology, while exposing them to job opportunities with federal agencies and NGOs.

Borderlands Restoration concurrently developed a database to track plant materials through the entire restoration process. Using this effective data tracking, seeds and plant materials become effective tools for restoration, allowing restoration practitioners to make better-informed decisions about their use to maximize success. With the potential to substantially increase the number of collection records and provide support for data curation, the MAPP Initiative is now working with the BLM, NPS, and Northern Arizona University to develop next generation data management systems that will further increase efficiencies and effectiveness.

Seed collection expanded to all regional public lands in 2014 through through a combination of permits and other agreements between the NPS, BLM, USFS, and US Fish and Wildlife Service. The BLM continued to provide funding to work through production processes and better understand challenges, limitations, and timing of both native plant production and restoration operations. BR began to expand outreach activities using BLM education funding. This further

to the Coronado National Forest (USFS). The NPS involvement expanded from operations at the Southeast Arizona Group (SEAZ) to include the Southwest Exotic Plant Management Team (SWEPMT), which responded quickly by providing funding to support a pilot study of concentrated seed collection efforts at SEAZ.

Meanwhile, GWP and partners continued to expand production of native plants at what had become the Gila Native Plant Nursery (GNPN). GWP's Upper Gila Riparian Restoration Project implementation phase commenced, involving large-scale removal of invasive salt cedar (Tamarix spp.) and revegetation of the Gila River helped to form a robust network of stakeholders, including the BLM, U.S. Fish and Wildlife Service, Freeport McMoRan, Inc., and other private landowners along the Gila River. The group's interest in acquiring locally adapted plant materials aligned with GWP's activities at GNPN, resulting in further expansion and the development of innovative revegetation strategies. GNPN began providing native grass plugs to the Nature Conservancy to assist with native grass seed and hay production in many of their fields along Aravaipa Creek.

In 2015 the BLM and SWEPMT formally entered into an Interagency Agreement with NPS to develop a seed strategy for the Madrean Archipelago. The position support was critical to helping to integrate and coordinate efforts across the region. In mid 2015, the BLM, NPS, and USFS began to work together and coordinate an interagency botany crew. The crew drew on resources from all three organizations, requiring support in the form of supervision, vehicles, computers, housing, and funding from several other organizations to support equipment and other costs. The agencies invested $90,000 to fund the 3-person botany crew that collected from over 100 populations of native plants, totaling over 50 lbs. of of wild-collected source identified native seed for propagation, seed treatments for restoration projects, local and national curation, and research. The botany crew was based out of Patagonia, AZ to capitalize on proximity to the BR Seed Lab.

In 2016, the MAPP Initiative was formalized with the signed MOU between GWP and BR. The MOU outlines a path forward for future collaboration between the partner organizations with particular focus on plant material collections and sharing of resources.

BR and GWP committed in the MOU to jointly supporting the MAPP Initiative Seed Lab, which expanded in 2016 into a unique historic school facility. The expanded MAPP Initiative Seed Lab provides a center for instruction, study, and research, and consists of seed cleaning machines provided on loan from NSS and the NPS, refrigerators and freezers for short and long-term cold storage, a large dry storage area, and adjacent office. Today, the Seed Lab holds the most extensive collection of species native to the Madrean Archipelago. It has developed data management techniques, collected propagation data on thousands of plants for dozens of restoration projects, and collected over 100 lbs. of native seed from wild populations.

The Institute for Applied Ecology and Region 3 USFS office committed in 2016 to supporting capacity building of the BR Nursery and Seed Lab through funding, advising, and networking through the SW Seed Partnership.

The Madrean Archipelago Plant Materials Program has seen significant expansion over the 5 years of development, with its success due to substantial networking and collaboration. BR expects to further expand the scope of this program and the MAPP Initiative through the launch of the Borderlands Restoration Leadership Institute, an endeavor of the Biophilia Foundation and Borderlands Habitat Network (BHN) to connect NGOs across the U.S.-Mexico border, share resources and jointly advance habitat restoration efforts in the region.

2016-2017

- **Funding provided to support propagation, seed curation and cleaning (BR, BLM, NPS)**
- **Formalization of the MAPP Initiative partnership (BR, GWP)**
- **Funding provided to improve capacity and infrastructure (BR, IAE, USFS)**
- **2nd year of interagency botany crew including a defined supervisor position (BLM, NPS, USFS)**
- **Collection and curation protocol developed for Gila River *Salicaceae* species (GWP, WFF)**
- **Prototype development of seed pellet machine (BR, BLM, NPS)**
- **ACE internship supports "boutique-scale" seed production trials at the BR Native Plant Nursery (BR, NPS)**
- **Network development with the MAPP Initiative Seed Summit (BR, GWP, NPS)**
- **Launch of the Borderlands Restoration Leadership Institute (BR, BHN, Biophilia Foundation)**

The Madrean Archipelago Seed Summit

The MAPP Initiative is supported by a growing number of regional partners – restoration practitioners, farmers, NGOs, agencies, and more – both economically through the purchases of container plants and seeds, and collaboratively through continued practice, research, and development in the collective effort to strengthen habitats across the Madrean Archipelago. The *MAPP Initiative Seed Summit* held in the summer of 2016 provided an opportunity for regional leaders to convene and discuss current and projected needs for native plant materials.

A critical component of the summit was the wide distribution of a *Seed Needs* survey, which sought to quantify and categorize regional needs. The results outlined below indicate that often, organizational needs for native seed and plants are greater than current funding allows. The survey revealed a disparity of scales at which native seed is required for restoration use in the Madrean Archipelago, with the quantity of seed needed for small to medium-scale restoration significantly less in comparison to the quantity required for response to emergency stabilization needs (e.g. following wildfire). The need for material at varying scales could provide opportunities for multiple stakeholders to play a role in the development of a native seed supply for the region.

Salient points from the Seed Needs Survey (full report in Appendix)

- **All respondents, to whom the question was posed, indicated that their organizational need for locally sourced plant materials is increasing.**

- **Current annual seed use was reported at a median of 35 lbs; the median for the annual desired quantity of seed was reported at close to 300 lbs. Responses ranged greatly, from 5 lbs. to 250,000 lbs.**

- **Current annual seeded acreage was reported at a median of 10 acres, while the median for the annual desired seeding acreage was reported at 125 acres.**

- **Most common limiting factors to use of native plant materials included organizational priorities and budget limitations.**

Strategic Activities

Seed Collection

Objective: support ongoing collection of genetically appropriate ecotypes for a range of target species.

To direct collection activities, the MAPP Initiative works with the interagency botany crew and restoration practitioners to develop a target species list. The list is revised annually to adapt to project needs and seed availability (e.g. if there are continued opportunities for collection from previously unvisited populations), and includes about 25 species selected using the criteria outlined to the right. To capture a diversity of genotypes across each species' distribution, material will be collected from 5-20 populations of each target species over the 5-year period proposed in this strategy, which when combined with additional opportunistic collections would result in a minimum of 50 collections annually.

Categories used for selecting target species:

1. **Early Successional Restoration - species that do well in disturbed sites and germinate readily.**
2. **Erosion Control and Soil Stabilization - species that act to hold soil in place in eroded slopes and streams.**
3. **Pollinator Support - species that provide nectar sources for a diversity of pollinators throughout the year.**
4. **Biodiversity and Maternal Line Conservation - species with limited or unique distributions, or species in decline.**

Seeds Of Success

The MAPP Initiative has adapted the Seeds of Success (SOS) collection protocol to an internal protocol that stresses a strong ethic of protecting wild populations through careful data tracking and collection for genetic and ecological integrity.

Collections of 10,000 seeds or greater will be sent to SOS facilities where they can be requested for use in research and restoration projects, as well as be made available for long-term conservation in the national seed storage facility in Ft. Collins, Colorado. When possible, a portion of each collection sent to SOS will remain at the MAPP seed lab in Patagonia for immediate regional use and storage. By participating in the national SOS program, the MAPP center alleviates stress on storage capacity, allowing the MAPP seed facility to focus on short-term seed storage (1-2 years) for regional restoration projects and other activities. Sending accessions to SOS also makes the collections available for projects of broad significance and impact.

Target Species, 2016-2017

Categories into which the species fall are listed next to the species name, and correspond with descriptions above

Atriplex canescens (1,3)
Heteropogon contortus (1,2)
Ericameria nauseosa (1,3)
Isocoma tenuisecta (1,3)
Muhlenbergia emersleyi (1,2)
Muhlenbergia rigens (1,2)
Sporobolus spp. (1,2)
Schizachyrium scoparium (2)
Bouteloua spp. (1,2)
Hilaria mutica (1,2)
Gossypium thurberi (1,2,3)
Agave spp. (3,4)
Dalea pulchra (2,3)
Penstemon barbatus (3)
Rhus spp. (3)
Senna hirsuta (3)
Tecoma stans (3)
Chilopsis linearis (2,3)
Clematis drummondii (3)
Tripsacum lanceolatum (4)
Cupressus arizonica (4)
Tithonia thurberi (3,4)
Asclepias spp. (3,4)
Sphaeralcea spp. (1,3)
Krascheninnikovia lanata (1)

Strategic Timeline

2017-2018

- Gather baseline data about native plant material production in the region and produce business plans (BR, GWP)
- Develop communication networks and disseminate strategic information and timelines (BR, GWP)
- Expand capacity for bulk seed cleaning and storage (BR, GWP)
- Coordinate interagency seed collection efforts (BLM, NPS, USFS)
- Conduct small-medium scale field trials of select species (BR, NPS, BLM)
- Build capacity to further research on seed transfer zones (BR, IAE, USFS)
- Identify potential growers (BLM)

2019-2020

- Advise on target species for bulk seed production (BR, BLM)
- Coordinate interagency seed collection efforts (BLM, NPS, USFS)
- Continue to expand capacity for bulk seed cleaning storage (BR, GWP)
- Develop online and print resources to promote locally adapted native plant materials use (BR, GWP)

2021-2022

- Continue to expand capacity for bulk seed cleaning and climate controlled storage
- Support seed production efforts
- Revisit strategy, complete market analysis and report on execution and results with agency support (BR)

Seed Cleaning, Curation, and Data Management

Objective: increase local cleaning and storage capacity, and expand potential for information sharing

The current space managed as the MAPP Initative Seed Lab is a significant upgrade from its original home in a small cottage, and reflects the increasing demand in the Madrean Archipelago for ethically sourced seed of local genotypes. Cleaning of seed for local projects is currently completed using relatively low-tech methods suited to smaller collections, but the need of regional agencies, NGOs, and commercial operations for large seed cleaning and storage capacity is rapidly increasing. The MAPP Initiative Seed Lab is uniquely positioned to respond to these needs due to institutional knowledge and experience, high potential for investment, and strong existing connections to the network of agency and NGO partners that would be the dominant users of a native seed extractory operation.

Partners in the MAPP Initiative are committed to growing capacity for seed cleaning and storage as the regional need arises, likely in coordination with seed production efforts. Strategic goals for the program include:

- **Stabilize annual funding through a combination of agency, NGO, and private investment**
- **Assess and respond to the regional need for bulk seed cleaning, either through capacity increase or effective networking to secure the required services**
- **Work with leaders in the Southwest to increase information sharing for plant materials collection and curation data**

Production

Over the 5 years described in this strategy, the MAPP Initiative proposes to strengthen the Madrean Archipelago Plant Materials Program by accomplishing the following strategic goals:

- **Explore potentials for native seed production at multiple scales, engaging a variety of stakeholders**
- **Document and disseminate information related to native seed cleaning, propagation, establishment, and seed increase**
- **Develop partnerships to conduct rigorous examinations of seed transfer zones, seed and seedling establishment, among others**
- **Create flexible communication networks to connect producers and consumers of native plant materials**

Objective: build a balanced market by connecting producers and users of container plants, seed, and hay, and inform ordering and production timelines

Production: Plants

Container plants continue to be a sought-after source of material for restoration in the Madrean Archipelago (Seed Needs Survey, Appendix A). The Borderlands Restoration Native Plant Nursery and Gila Native Plant Nursery have to date produced hundreds of thousands of plants that have been installed on public and private lands with a focus on grassland, riparian, and pollinator and wildlife habitat restoration. By providing a source of restoration-quality plant materials, the MAPP Initiative has invigorated restoration efforts and built a strong reputation. Access to multiple nurseries for propagation and potential seed increase strengthens the MAPP Initiative's ability to respond to the needs of the entire region. Creation of production and ordering timelines to guide users will be key to supporting existing capacity.

Production: Hay

Native hay is a product of lesser demand in the Madrean Archipelago, likely due to a combination of lack of awareness and market availability. The Nature Conservancy's Cobra Ranch property near the BLM's Aravaipa Canyon Preserve, under Mark Haberstitch, has converted substantial acreage of fallow agricultural land to native grass production for hay. The Nature Conservancy's production system has been used as a model for several other regional producers pursuing native grass production. There is a growing need for greater communication across the network of native plant materials suppliers and users in the region related specifically to native hay availability.

Production: Seed

Without a substantial agricultural or seed industry endemic to the Madrean Archipelago, the initiation of a native seed production program will inherently be challenging and require significant coordination from agencies and NGOs to meet complex needs. Currently, small-scale seed production can be easily matched to an existing market, demonstrated by buyer response to the Seed Needs Survey (Appendix A), fueled by the demand of national parks and NGOs for specific species of seed from locally sourced genotypes. Proposed strategies for small-scale seed production include "boutique" seed production in an agricultural setting or harvesting from wildlands restoration sites that may be intentionally managed for seed production.

Governmental agencies such as the BLM and USFS, as well as state and county transportation and revegetation departments such as ADOT and County offices and Flood Control Districts, all have needs for native seed in quantities that small producers cannot meet. The successful initiation of a plant materials program in the neighboring eco-region of the Verde Valley, home to the Verde Valley Plant Materials Partnership (VVPMP), reveals a promising strategy. With assistance from the SW Seed Partnership, a collaboration between the Institute for Applied Ecology and the USFS Region 3 Office, the VVPMP secured an agreement with the Tonto NF to complete a 3-year grow-out for seed production. This strategy of connecting bulk seed users directly to growers with NGO support and facilitation has promise for replication in other eco-regions including the Madrean Archipelago.

Asclepias Production in the Madrean Archipelago

The Borderlands Restoration MAPP Center in Patagonia, AZ has produced over 15 different species of *Asclepias* for restoration. It was profiled as a regional leader in the report "Monarch Recovery from a Milkweed's Point of View", released by the organization Make Way for Monarchs. While demand for seed and container plants of *Asclepias species* continues to grow, there is a widespread lack of understanding about effective wildlands establishment methods, being referred to in the aforementioned report as "art more than science." For the period of this strategy, the MAPP Initiative expects to maintain a significant focus on research surrounding *Asclepias* propagation, field establishment, and seed production, moving towards the end goal of increasing supply and reducing the cost of production.

Pictured below: Asclepias angustifolia

Objective: nurture collaboration and expand networks to avoid duplication of efforts and redundancy across the southwest

Research & Restoration

The development of a sustainable native seed, hay, and container plant supply chain must be accompanied by rigorous examination of seed transfer zones, field establishment, and post-fire revegetation.

Provisional seed transfer zones based on temperature, precipitation, and elevation for the entire United States reveal that eco-regions are an appropriate scale for seed-transfer zones, however research shows that zones may differ dramatically for individual species (Miller et al., 2011). Additionally, research into the effectiveness of seeding in desert ecosystems has been inconclusive or discouraging, due to dry conditions and predation among other factors (Woods & Fehmi, 2012; Suazo et al., 2013).

To meet these challenges, partnerships between universities, private industry, and funding agencies must be forged with an emphasis on informing and refining restoration efforts. Encouraging the integration of monitoring activities into restoration practices is essential, and multi-organization collaboration will be vital to achieving this goal.

Objective: support the growing economic base by practicing effective restoration strategies

The continued development of a plant materials program in the Madrean Archipelago must be guided by the emergent needs of agency, NGO, and private restoration practitioners in response to well-informed research and regional strategy. MAPP Initiative collaborators benefit not only from years of experience in seed collection, curation, and propagation, but also from the very nature of their work being rooted in continuous on-the-ground restoration activities. Both organizations contribute to the Sky Island Restoration Cooperative (SIRC) and participated in 18 of the 29 SIRC profiled restoration projects in 2015, demonstrating a deep connection to a regional network of restoration collaborators. Restoration practitioners are crucial to forging and maintaining network connections between plant materials and restoration needs in the field as they emerge across federal, state, and private jurisdictional boundaries. Support of these networking activities is therefore imperative to the successful implementation of this strategy.

While there is great opportunity to continue to refine our restoration practices and support rigorous experimental inquiry, the experiences of restoration practitioners across the southwest for the past 25 years provide us with a suite of “best practices” that should be highlighted. Work by Cuenco Los Ojos, Borderlands Restoration, the Quivra Coalition, and Sky Island Alliance demonstrates that revegetation strategies are most effective when combined with hydrological support. Combining container plantings and seeding with rock structures that slow, sink, and spread water, is highly suspected to improve the establishment success of restoration plantings. Studies by the USGS of gabbions locally installed at the Babocomari Ranch in Santa Cruz County have shown that such structures increase water infiltration and therefore present better soil conditions for seed germination and root establishment.

Outreach

The continued progress of the MAPP Initiative is dependent on strong relationships with a range of regional stakeholders. This mirrors the goals established herein based upon the BLM's National Seed Strategy that emphasize the creation of partnerships between public, private, and non-profit entities to strengthen local plant materials storage and support capacities. Outreach, in the form of meetings such as the "Seed Summit" hosted by the MAPP Initiative in August 2016, will expand the Initiative's collaborating network by developing burgeoning partnerships with and pursuing means of support for groups like Native Seeds/SEARCH in Tucson/Patagonia, AZ, and the expanding Verde Valley Plant Materials Partnership in central Arizona, each of which has solicited our assistance as they develop their programs.

To maintain and develop these relationships, it is critical to create forums for effective communication. The MAPP Initiative plans to play a significant role in exploring and refining communication strategies in the near future, which include email group communication (SIRC and MAPP Google Groups), Plant Materials Newsletters, participation in the Transboundary Madrean Archipelago Working Group, and additional Summit meetings internal to the Madrean Archipelago. Coordinating with plant materials programs external to the eco-region, such as the VVPMP, SW Seed Partnership, Native Seed Network, Institute for Applied Ecology and Society for Ecological Restoration, is an additional component of critical importance to avoid duplication of efforts and redundancy across the southwest.

Conclusion

The need for a coordinated plant materials program and seed strategy specific to the Madrean Archipelago is evidenced by the eco-region's unique biological and topographic diversity, and a high number of agencies and NGOs seeking to respond to the National Seed Strategy and National Pollinator Strategy using a suite of restoration activities. The execution of this strategy has already begun, through the needs assessment distributed at the MAPP Initiative Seed Summit (see Appendix) (corresponding to national goals 1.1, 1.2), and builds upon 5 years of program development in the region. These efforts have substantially increased the available supply of genetically appropriate seed (1.3) through the expanded capacity of the MAPP Initiative Seed Lab and nurseries that are conducting species-specific, establishment, and restoration research (2.2, 2.3). The realizable goals of increasing information sharing and creating strong communication networks (3.1, 3.2, 4) are the immediate stepping stones to establishing the Madrean Archipelago as a model of bioregional seed resiliency.

You can participate by contacting us.

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Appendix A.Survey Results, Madrean Archipelago Seed Needs (Page 1 of 2)

Number in (brackets) represents quantity for a particular response

General Information

19 representatives responded to either our short or long survey, representing the Arizona Game and Fish Department (1), Arizona State Parks (1), Buenos Aires National Wildlife Refuge (1), The Bureau of Land Management (1), The Bureau of Reclamation (1), Cuenca Los Ojos Foundation (1), Coronado National Forest (2), Gila Watershed Partnership (1), The National Park Service (2), The Nature Conservancy (2), Pima County Regional Flood Control District (2), Saguaro National Park (1), Sky Island Alliance (1), the Sweetwater Center (1) and Tucson Audubon Society (1). Respondents purchase plant materials on behalf of Federal Agencies (8), State Agencies (3), Local Agencies (2), Nongovernmental agencies (6) and themselves (6).

Current Native Plant Material Use

All respondents answering the longer survey (4) asserted that their organization's need for locally sourced native plant materials is increasing. The kinds of plant material acquired by survey respondents fall into the categories of Seeds (18), Container plants (18), Native Hay (5) and Rootstock/ Poles (5), with respondents sourcing these from Local or Regional Partners/Growers (12), Regional vendors (5), Internally to their Organisation's Lands (2) and National Vendors (1). 2 respondents highlighted that not being able to use local plant material because of either a lack of desired species or sufficient quantities necessitated them sourcing from regional producers/vendors. Acquired plant materials were used for Restoration (17), Water Conservation (9), Pollinator Conservation (11), Research (6), Exhibits/Events (5), Education (6), Cultural Reasons (1) and Wildlife/Animal Fodder (1). Respondents (10) who put forward the average amount their organization spends on native plant materials each year (Answers appear to reflect a mixture of averages and what they had spent in the last year) represented $635,000 worth of spending. The median amount spent was $10,000, with two organizations making up the lion share of spending: The Forest Service ($320,000) spent on reseeding following the Aspen Fire and Pima County Regional Flood Control District ($200,000) spent on Capital Improvement, Floodplain Restoration and Maintenance Projects. Spending was noted as being highly variable and for some, through exchanging services for plants and through on-site collections do not make market transactions for Native Plants.

Current Native Seed Use

Respondents who procure seed do so for Restoration Projects < 10 Acres (12), Restoration Projects > 10 Acres (11), Post-Catastrophe Seeding (5), Agriculture (3) and Pollinator Conservation, Residential Use and Education (1 a-piece). Important characteristics sought when purchasing seeds are that seed is: Sourced adjacently to the watershed or sub-watershed of a project (14), Sourced from within the Madrean Archipelago (14), Is Source Identified (13), Certified (8) and Available to the Public too (1). When representatives were asked if organization had an internal policy regarding native species use of 12 responses, 4 did not have such a policy, 4 were unsure whether their organisation had one whilst 4 did (The BLM, The National Park Service, Coronado National Forest, Pima County Regional Flood Control District). For the BLM, plant material needs to be Native or Sterile, The Park Service is meant to source seed internally to their sites as first priority, the Coronado National Forest requires seed certification which it too requires of partners and the Pima County Regional Flood Control District's has project specifications which stipulate that native materials should be sourced from the same watershed as a project. Of 14 respondents explicating the quantity of Native Seed used by their organisation each year, whilst year-to-year variability was emphasised, the sum was 254,250 lbs, with a range between 5 and 250,000 lbs and the median quantity acquired being 35 lbs. Again, post Aspen Fire rehabilitation accounted for the lions share of this.

Future Seed Needs

For 80% of respondents, the target species seed list provided was deemed to largely represent their organization's needs accurately. One respondent working in the Sonoran Desert ecotype recommended including additional low-desert species, such as *Aristida spp., Zinnia acerosa,*

Appendix A.Survey Results, Madrean Archipelago Seed Needs (Page 2 of 2)

Number in (brackets) represents quantity for a particular response

Artemisa tridentata, Encelia spp., Asters and Mallows (Although inapplicable to us if we cannot grow them). Recommendations of seeds to have available locally in large quantities include those of local pollinator and riparian plants, trees, shrubs and grasses, with species specified overleaf (Table 1. 7). 15 respondents represent organisations which respond to emergency environmental situations. In such events 1 respondent required <5 lbs, 5 require 25 - 75 lbs of seed, 3 require 75 - 500 lbs and 6 require >500 lbs. Seed species sought for emergency stabilization included native bunchgrasses, *Sporobolus wrightii* and *S. airoides* as well as species of *Asclepias, Aristida, Eragrostis, Sphaeralcea* and *Zinnia* (the latter 4 named specifically for the Sonoran Desert ecotype). A selection of species sought for projects but hard to source included *Glandularia spp.*, *Mirabilis spp.*, *Prosopsis spp.*, grasses such as *Heteropogon contortus*, *Muhlenbergia spp.,, Hopia obtuse, Tridens muticus, Hordeum pusillum, Aslcepias spp.* and other species for pollinator support generally.

Limiting Factors

All respondents answering the longer survey (4) put forward 'organizational priorities lying elsewhere' as a limiting factor for the use of native seeds. Budget limitations (2) came after, followed by technical factors such as 'limited resources for irrigating new plantings' and 'lack of research/good data'. When asked *"With an unlimited budget and supply, what volume of seed would you purchase?"* the volumes mentioned by responding organizations pointed to a median of 287.5 lbs, far above the median of 40 lbs purchased under current budgets. Similarly, when asked the acreage they would restore with native seeds with an unlimited budget, the median reached 125 acres (versus 10 acres under current budget). Both deviations illustrate the fact that often organizational needs for native seeds are greater than current funding supports.

Future Partnerships

Ideas for desirable partnerships and initiatives include: small collections of seed with identified origins available by watershed to be grown out and made available for projects and opportunities which arise; cross-border partnerships providing workshops on how to build a network of plant material producers; the incorporation of a broader use of native grasses into conservation plans for farmers and ranchers and the better use native plants when required under mitigation.

Further Research

Identifying which species of native seeds could be grown/collected and sold in quantities sufficient to generate economies of scale and meet Government and Non Governmental organizations' budget and restoration needs.

Table 1 - Seeds recommended to have available locally & in large quantities

Asclepias speciosa
Atriplex canescens
Bahia absinthifolia
Bouteloua curtipendula
Bouteloua curtipendula
Bouteloua gracilis
Bouteloua hirsuta
Digitaria californica
Digitaria californica
Eragrostis intermedia
Eragrostis intermedia
Fremont cottonwood
Glandularia spp.
Goodding's willow
Heliathus annus
Heteropogon contortus
Heteropogon
Krascheninnikovia lanata
Leptochloa dubia
Mexican blue elderberry
Plantago patagonica
Pleuraphis mutica
Setaria vulpiseta
Sphaeralcea
Sporobolus airoides
Salix gooddingii
Sambucus cerulea
Sporobolus cryptandrus
Sporobolus wrightii
Velvet mesquite

Appendix B. Survey Results, Madrean Archipelago Native Plant Material Producers

Number in (brackets) represents quantity for a particular response

General Information

5 supplier representatives responded to the native plant questionnaire, doing so from Wildlands Restoration/Nighthawk Natives Nursery (1), Arizona Revegetation & Monitoring Co. (1), Pima County Natural Resources Parks and Recreation (1), Gila Watershed Partnership (1) and Borderlands Restoration (1). The capacity and resources each respondent put forward for producing and disseminating native plant materials varied. Wildlands/Nighthawk Natives had the capacity for tens of thousands of plants to be grow out, the widest range of native seed mixes for sale at both the retail and wholesale level and 250 S. Arizona species available for contract production in forms ranging from liners to 15 gallon pots. Pima County has 2 acres of land, 20,000 plants in production and 3 full-time staff. GWP has one full-time member of staff, numerous part-time employees and volunteers, 1 greenhouse, 1 shade house and access to land and utilities for future expansion.

Practices

When asked 'Are you collecting, cleaning and/or storing regionally sourced native seed specific to the Madrean Archipelago of Southern Arizona', Wildlands Restoration & AZ ReVeg responded that some of the seed they worked with is from regionally sourced native plants, whilst the remainder asserted that all seed they worked with came from regionally sourced native plants. Respondents who collect seed from regional populations (5) clean and store this seed at their own organization's facilities. (2) respondents track their organization's sourcing data using paper records, (2) track through the use of an intra-organization database and (1) does so through the use of a regional server (SEINet). (4) out of (5) responses to the question 'Are you currently growing/producing native plant materials' answer affirmatively, with AZ ReVeg the sole respondent who did not. For those who do grow native plants, the number of species currently being grown were 11-50 (1), 100 + (2) and 230 + (1).

Looking to the Future

Reasons which would incentivize respondents to scale up their operations included: Increasing income from growing and selling native plants (3), Building relationships with buyers who purchase plants (3), Networking with other plant producers (3), Innovating methods used for growing plant materials (3), and the marketing benefits associated with being associated with a partnership (2). Nevertheless, in answer to the question 'what obstacles prevent you from scaling up?', responses included difficulty in securing contracts (3), difficulty in securing funding (2), inadequate marketing (1), competing with larger commercial growers (2), competing with other local businesses (2), the market being too small (1), currently meeting market demand (2), there being no demand for their product (1) and a lack of ambition (1).

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