



Section VII: Native Plant Development and Deployment

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Introduction/Problem Statement

Native plant materials are needed to create, enhance, or restore pollinator habitat. They provide critical foraging and breeding areas for wild and managed pollinator species, including transnational migratory species such as hummingbirds and monarch butterflies. Although many pollinators and plants are generalists, some have limited, obligate relationships (*i.e.*, one requires the other for survival) (Proctor 1996). While reproduction and propagation information is available for many commercially important plant species, this information is lacking for most native species. Commercially available native plant seed has typically gone through a selection process for particular genetic traits (USDA-NRCS 2014a), often for agricultural and production purposes. Sometimes these selections have been sold and planted across the country without regard to their origin. Today, Federal land-managing agencies are the largest purchasers of native plant seeds (US Government 2014), chiefly for native plant community restoration. Because Federal mandates require consideration of the conservation of native plant communities commensurate with multiuse management (Richards *et al.* 1998), plant community integrity, function, genetic diversity, and stability are paramount considerations when selecting plant materials for restoration purposes (Johnson *et al.* 2010). Native plants are adapted to their local conditions, but they can be moved by using seed transfer guidelines with good promise of establishment and persistence (Bower *et al.* 2014). For most native plant species, however, because we know neither the limits to genetic adaptability nor their specific seed transfer guidelines, provisional zones can be applied until better data are available (Bower *et al.* 2014).

Key Priority Research Themes

Although developing and deploying native plant materials specifically to sustain pollinators are emerging needs, many Federal programs and projects already include these topics as parts of an overarching, general strategy for habitat creation, enhancement, and restoration. Native plant communities provide critical ecosystem services (*e.g.*, clean water and economic activities such as ranching and recreation) and other benefits (*e.g.*, supporting sage-grouse and other wildlife).

Thus, existing knowledge and current projects should be leveraged to address these four priority research themes:

1. **Reproductive biology.** Identifying pollinator-plant associations and plant reproductive biology issues that should be considered when assembling native plant materials for habitat restoration.

2. **Native plant species mixtures.** Identifying local and regional native plant species mixtures that provide the best temporal support for the most pollinators now and under future climate scenarios.
3. **Propagation.** Identifying the most efficient propagation methods for native plants required by pollinators to ensure plant establishment, resilience, persistence, and genetic diversity within restored habitats.
4. **Establishment.** Identifying the most efficient, economic, and effective methods for the establishment and persistence of these plant mixtures in wildland, agricultural, and urban landscapes.

Existing/Current Research

1. **Reproductive biology.** Reports are available on general pollination requirements for some native plants, particularly those that are endangered (Tepedino *et al.* 1999) or have interesting specialized mechanisms (Lipow *et al.* 2002). Specific information about ecological and reproductive needs, community and pollination ecologies, and responses to wildfire and competition from exotic plants is available for fewer native species, and their responses to restoration and management techniques remain poorly understood. Current efforts are underway to complete or provide the information missing for prevalent native species, or for the ecotypes needed by diverse, valuable, native pollinators, in order to rehabilitate habitat in certain United States regions, such as the Great Basin (Cane 2008). Other regions have received less attention (Reed 1995).
2. **Native plant species mixtures.** Some research has been completed correlating pollinator populations with plant communities, as well as on the pollination needs of focal plants (Cane *et al.* 2013) and whether those needs are (or can) be met by pollinator populations in agricultural landscapes (*e.g.*, Cane 2011). While some excellent resources exist for promoting pollinator habitat on a small scale (such as Mader *et al.* 2011), completed and current research on practical plant species mixtures for native plant community restoration at larger scales is lacking. For instance, the two native species seeded most commonly because of their low cost and successful establishment in the Great Basin are proving unattractive to native bees (Cane and Love, unpublished data).
3. **Propagation.** Much research exists for general seed collection, increase, storage, and certification (*e.g.*, USDA-NRCS 2014b). General plant propagation techniques (Dumroese *et al.* 2008), and specific information on native plants, albeit limited, continue to be developed (*e.g.*, Borders and Lee-Mäder 2014). Although the appropriate seed-transfer guidelines are known for most commercial tree species (see Wright 2014), this information is lacking for all but a few other native plants. Provisional seed-transfer zones for all native plants, based on ecoregions and current climates, have been proposed (Bower *et al.* 2014). Putting seed into suitable habitats/climates enhances chances for success.
4. **Establishment.** Much research has been completed for seeding and planting restoration sites, but these generally involve limited species compositions and can be prone to failures, especially on harsh or competitive sites (Knutson *et al.* 2014). Some work evaluates optimal seeding depths for a few native forbs (Rawlins *et al.* 2009). More recent work has begun to evaluate novel

techniques (e.g. Herron *et al.* 2013) and combinations of techniques, which are particularly needed for reliable establishment and persistence of native plants on restored sites (Steinfeld *et al.* 2007). Researchers are determining proper plant material transfer guidelines (Bower *et al.* 2014) and discussing how these may be adjusted to meet future climatic conditions (Williams and Dumroese 2013). Research continues on pollinator community response to restoration (Cane and Neff 2011).

Research Gaps/Needs

1. **Reproductive biology.** A better understanding is required of the spatial and temporal relationships of native plants and their pollinators, especially in areas identified as critical for pollinators. Investigating large-scale (transnational and nationwide) and small-scale (landscape-level) relations between plant and pollinator distributions will help determine where specific plant species are appropriate, and elucidate which species are “broad-spectrum” (appropriate in many locations and contexts and for many pollinators) and “specialist” (appropriate to support one or a few obligate pollinators). Documenting the phenology of plant-pollinator interactions in high-priority settings, and how those may be influenced by, for example, invasive species and changes in climate, will help ensure that resilient plant species mixtures provide resources critical to pollinators throughout all life stages of species in the pollinator community.
2. **Native plant species mixtures.** Information is needed to assemble sustainable, context-appropriate plant mixtures that ensure the availability of seasonal, essential needs of all life stages of targeted pollinators locally and regionally, including species that migrate transnationally. Most native bees are highly seasonal and feed their larvae specific ratios of nectar and particular kinds of pollen. Research is needed to identify (a) plant species that are compatible with each other and complementary in the resources they provide for pollinators, (b) critical site conditions (e.g., soil type, aspect, elevation, level of degradation) in which different mixtures are needed to assure success within wildland, agricultural, and urban landscapes, (c) individual and population genetic characteristics critical for perpetuating resilient pollinator support, and (d) spatial distribution of plant species’ genetic variants for delineating seed-transfer guidelines under current and future climate scenarios.
3. **Propagation.** There is an essential need for information about the propagation of native plants. Research is needed to identify cost-effective means for properly collecting, processing, storing, and germinating seeds of high-priority plants, and for growing these plants for large-scale seed or seedling production. Different and/or multiple techniques will likely be needed and practical to conserve genetic diversity within species, establish an array of important pollinator plants, and provide efficient and economically-feasible strategies to address appropriate restoration of pollinator habitat in wildland, agricultural, and urban landscapes.
4. **Establishment.** Site properties, plant propagation quality, and the scale of the habitat to be created, enhanced, or restored should influence the type and mix of plant materials used. We require new concepts and techniques—which may include novel combinations of existing techniques—for establishing the broad palette of plants required for pollinator habitat

restoration at different spatial scales across diverse regions to address variable levels of site degradation. Understanding how best to deploy those materials spatially and temporally is imperative, especially for recovery of habitats within wildlands and at the wildland/agriculture interface, reflecting Federal mandates to ensure species and genetic diversity. Research is needed to compare the cost and effectiveness of establishment techniques for high-priority species mixtures to identify optimal establishment techniques for different species, mixtures, and settings. Projects should span several years to monitor the full impact of different seed mixes on pollinator species as the restored communities mature.

Priority Actions

Priority Actions 1 and 2 summarize the existing state of knowledge of the relationship between native plants and pollinators, and catalog the current status of available native plant materials that benefit pollinators. This foundation allows Action 3 to assess gaps to determine priorities for future research in pollinator plant development. Based on the gaps and priorities, Action 4 begins the process of enhancing the available inventory of native plant species for wildland, agricultural, and urban use. Finally, Action 5 establishes a mechanism to assess long-term success of native plant development and deployment. The scope, timeframes, and outcomes of all priority actions are contingent on available resources and staffing.

1. **Synthesize existing science** to identify geographic, taxonomic, ecological, and temporal gaps in knowledge of which plant species provide broad-spectrum pollinator support. This action will help ensure land-managers can make sound science-based decisions now, and help enable scientists to focus new research most effectively.
 - **Strategy:** Identify existing science capacity to develop an inter-agency synthesis document. Subdivide pertinent areas among agencies based on specialties/expertise (*e.g.*, ARS: pollinators; NRCS: seed increase; USFS: genetic conservation).
 - **Timeframe:** 2 years.
 - **Metric:** Document(s) summarizing best available science for land managers to implement and critical knowledge gaps to be addressed.
 - **Future opportunities:** Develop and maintain a national, on-line clearinghouse for “best restoration science and practice” with emphasis on pollinators.
2. **Develop a science-based plant selection decision support tool** to assist land managers in appropriate deployment of the most effective and affordable plant materials currently commercially available for pollinator habitat in wildland, agricultural, or urban areas. These materials may be named cultivars or germplasm or local selections, and their appropriate use determined by management objectives.
 - **Strategy:** Identify existing science capacity to produce a decision-support tool.
 - **Timeframe:** 2–3 years.

- **Metric:** A decision-support tool that land managers can use to select appropriate available plant materials for improving pollinator habitat in their restoration projects.
- 3. **Systematically address important science and resource gaps,** using knowledge from Actions 1 and 2, concerning the Priority Research Themes to inform future priorities for development and deployment of locally-adapted, pollinator-friendly, native plant materials suitable for wildland, agricultural, and urban landscapes.
- **Strategy:** Identify existing science capacity to combine the results of the science synthesis with the plant section decision-support tool to determine where geographical and/or ecological gaps exist in either knowledge or seed resources available for restoring particular habitat.
- **Timeframe:** 3 years.
- **Metric:** Knowledge and resource gaps identified to inform future research and seed mix development priorities.
- 4. **Initiate work on additional, critical native plant species needed specifically to restore and enhance pollinator habitat,** leveraging Action 3. This four-step process follows the Priority Research Themes and adds native plant species to those currently available as described in Action 2. Progress on this action item will be commensurate with the amount of available funding.
 - I. Develop comprehensive knowledge of specific native plant-pollinator species' reproductive biology (e.g., "broad-spectrum" and/or threatened and endangered species) for wildland, agricultural, and urban settings.
 - II. Identify resilient, self-sustaining native plant species mixtures for public lands and plant species mixtures appropriate for private lands of important pollinator-appropriate native plants, and determine appropriate seed transfer guidelines.
 - III. Discover information about the propagation of these plant species, especially annual plants, as it pertains to seed collection, processing, storage, germination, and increase. Many native plants are difficult to propagate. Thus it is likely that research is required to increase their availability for use.
 - IV. Identify and develop novel outplanting techniques to increase the efficient, economic, and efficacious establishment of selected native plant materials, particularly as site degradation increases. Native plants have an immense variety of establishment requirements. Thus, ensuring that all species within desired mixtures are present after restoration likely will require novel and integrated methods.
- **Strategy:** Leverage existing Federal and NGO/private industry knowledge to expand the currently-available native plant palette through the four steps outlined above.
- **Timeframe:** 10 years.
- **Metric:** For key habitat restoration priorities: expanded knowledge of the reproductive biology of key plant-pollinator species associations, quantified seed mixtures, with sound transfer guidelines and reliable techniques for seed propagation and establishment for those mixes.

5. **Develop a system for monitoring deployment of native plant materials.** We currently lack a mechanism for tracking deployment of native plants, the long-term success of those deployments, and their benefit(s) to pollinators on Federally-managed (*e.g.*, BLM, USFS, USFWS) and Federally-subsidized (*e.g.*, CRP, EQIP) restoration projects. This missed opportunity to assess success and failure condemns land managers to repeat the same mistakes.
 - **Strategy:** Develop an interagency, online, searchable database based on the USGS Land Treatment Digital Library to collect and analyze relevant data efficiently (species, plant material type, location, acreage, year, establishment, impacts on pollinators, etc.) to evaluate the developed and deployed native plant materials.
 - **Timeframe:** 2 years.
 - **Metric:** An online database available to land managers and researchers.

Agency Roles

The USDA and DOI are members of the Plant Conservation Alliance (PCA), a collaborative partnership among 12 Federal agencies and almost 300 non-Federal cooperators. PCA, through its proposed Interagency Seed Strategy, proposes similar research work. Research coordinated through the PCA framework could ensure focus, optimization of resources, and enhance dissemination of results. The following USDA/DOI agencies could provide collaborative leadership within PCA to address the five priority actions described above:

Priority Action 1: ARS, USFS, USGS

Priority Action 2: ARS, USGS, NRCS

Priority Action 3: BLM, ARS, USGS, USFS, NRCS

Priority Action 4: USFS, NRCS, BLM, USGS, NSF

Priority Action 5: USFS, NRCS, USGS, BLM, ARS