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Regional Availability of Plants for Prairie Restoration

by Pamela Bailey and Chester O. Martin

PURPOSE: This technical note identifies and describes sources for seeds and plant materials that can be used for prairie restoration and management efforts on Corps of Engineers project lands. This document is a product of the Ecosystem Management and Restoration Research Program (EMRRP) work unit titled "Prairie/Grassland Ecosystems on Corps Projects." Many Corps of Engineers projects contain substantial grassland acreage (Figure 1), and there is considerable potential for Corps districts to improve prairie communities on project lands throughout the United States (Martin and Peloquin 2005). Prairies are important to watershed protection because they fulfill multiple functions on a landscape scale including their role as a buffer controlling sediment and non-point source pollution from entering waterways, providing erosion control, nutrient cycling, water purification, restoring aquatic habitats, improving wildlife habitat, and providing protection for rare plant and animal species. Additionally, native prairies function as a stable plant community and qualify as meeting the Corps' "Sustainable Lands Performance Measure," now tracked by the Operations and Maintenance Business Information Link (OMBIL) and incorporated in the Environmental-Stewardship Budget Evaluation SysTem (E-S BEST).

Figure 1. Pink Evening Primrose (*Oenothera speciosa*) and Texas Bluebonnets (*Lupinus texensis*) in a Texas prairie (photo courtesy of P. Bailey).

BACKGROUND: A healthy, unbroken prairie can have 200-300 species in a complex association depending on the soil type, slope, and moisture (Kurtz 2001). However, less than 1 percent of virgin prairie remains in North America, and removing plants from the wild is usually not an option for

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restoration projects. Also, many plant nurseries do not offer the diversity that occurs in native prairie lands (Figure 1) and managers need to be aware of other sources of native plant materials. A reliable, stable and economical supply of native prairie plants and seed is essential for prairie restoration, and regional availability of plant resources is of concern to anyone actively involved in restoration efforts. Often, more obscure prairie plants are not available commercially or the quantities of available seed vary from year to year. As the native plant industry expands, more selections become commercially available for prairie ecosystems; however, there are some alternative sources and techniques that may be useful in prairie restoration.

When planning prairie restoration projects, the land manager needs to understand that although the term "restoration" is generally used, prairies can only be replicated if they have been historically subjected to intensive grazing or haying. Many of the natural macrobotanical species occurring on a site may be lost forever and will not be available for re-establishment on a large scale. If the soil has been disturbed, many microbiological organisms also are lost and, in many cases, the soil structure itself is permanently altered. If historical land uses have resulted in extensive disturbance, managers can only attempt to replicate a facsimile of the original prairie flora on the site. A major problem with prairie replication is obtaining the seed from the locale where it is needed. Unfortunately, relic prairie sites are disappearing at such a rate that seed sources and genetically superior plants are being rapidly extirpated in many regions (Carey Weber, Lake Manager, Lake Georgetown, TX, Personal Communication, 2005).

Invasive species are also a concern in prairie restoration management efforts. Executive Order 13112, signed by President Clinton on February 3, 1999, contains policy to prevent the introduction of invasive species, provide for their control, and minimize the economic, ecological, and human health impacts that invasive species cause. The executive order established the National Invasive Species Council (Federal Register 1999). Currently, there are 12 federal agencies on the council. The ramification of this executive order is support in the use of native plant species on federal land. Invasive species are tracked through the Corps' OMBIL process.

Finding sources of native and locally adapted seed and plant materials for use on federal lands can be difficult due to unavailability of many species and lack of knowledge about the cultural requirements for many native plants. This technical note first describes in situ and ex situ conservation strategies with examples of seed and plant applications. Secondly, several exemplary prairie restoration projects currently under way on Corps lands are discussed and various techniques for acquiring prairie plants are examined. The roles of Botanical Gardens, Plant Material Centers, Commercial Sources, Native Plant Societies, and the Plant Conservation Alliance are discussed as important resources in the conservation of prairie plants, seed, and botanical information.

CONSERVATION METHODS: Plant conservation methods and techniques range from ex situ (offsite) to in situ (onsite) preservation strategies. In addition, the combination of ex situ and in situ methods is referred to as an inter situ strategy. These strategies are described below.

Ex situ strategies include storage of propagules, seeds, and cryogenically stored tissue offsite. Cryopreservation includes seed, pollen or tissue frozen in liquid nitrogen at -196 °C. This technique allows for storage of plant species that cannot be stored by conventional means. This method is used

for the long-term storage of agricultural and horticultural taxa, and is increasingly used for wild species (Guerrant et al. 2004). Specific ex situ methods are as follows:

- Seed banking is the storage of seed in low moisture and temperature conditions, and is used for crop seeds and wild species.
- Tissue culture storage refers to reproductive tissue and seed propagated in vitro under light and temperature conditions controlled for slow growth (Guerrant et al. 2004). Tissue culture propagation is used for the proliferation of clonal plants and controlled seed production.
- Cultivation under a controlled environment (e.g., plants grown in an artificial environment such as a greenhouse) is yet another approach. Commercial cultivation is the production of selected taxa with a focus on profit.
- "Field gene bank" refers to an extensive planting field grown in open air, to maintain genetic diversity within a species. This method is often used for woody species.
- Community gardens refers to the production of plants by a community, family, or tribe as part of the traditional agriculture producing plants used by the group for some purpose (medicinal, food, fiber, etc.).

In situ preservation strategies maintain viable populations of wild plants in a field setting, where they are affected by the natural climatic and ecological processes. However, in situ can also include strategies such as managing wild populations; for example, hand-pollinating a wild orchid population. There are also in situ managed wild populations where wild plants growing in a managed zone are subject to community–level management, such as periodic burning, as in the case of a prairie ecosystem.

An **inter situ** strategy is the combination of ex situ and in situ techniques. An example would be utilizing plants cultivated horticulturally (ex situ) but managed in near-natural conditions (in situ), such as a managed population within a restored semi-natural condition.

SEEDS AND SEED MIXES: Seeds are a convenient means of long-term storage. They require little space, are low maintenance, and remain viable for long periods of time depending on species and storage conditions (Figure 2). In general, seeds require low temperatures and desiccation to remain viable (facilities for long-term storage can be expensive to maintain due to the necessity for germination tests, growth trails, and regeneration). Using certified seed is recommended because the seed has known identity and meets certified quality standards for purity and germination (NRCS 2005). Certified seed has the best chance of success and least chance of introducing unwanted seed problems. Varieties of seed have been developed and proven by the NRCS for specific geographic regions of the country. Native grass seed and wildflower seed are sold on a pure live seed (PLS) basis and are recommended because they ensure that the desired product is what is being paid for, not dead seed or unwanted plant pieces. A pound of pure live seed contains 16 oz. of living seed of the desired species plus additional weight of the other material that has not been removed by the cleaning processes (NRCS 2005). Using the seed analysis tag, the PLS can be calculated to compare quality of "lots" of seed. For example, a seed lot with a tested germination of 80 percent and a purity of 90 percent also has a PLS percentage of 72 ($0.80 \times 0.90 = 0.72$). In 1.0 PLS pound of this seed lot, the gross weight to buy and plant would be 1.39 lb (1.00 divided by 0.72) (NRCS 2005).

Figure 2. Seed from many prairie grasses and flowers can be easily gathered (photo courtesy of P. Bailey).

Native grass seed is often sold pre-mixed. However, one can buy individual species lots and mix them together prior to planting to attain the desired mix using good quality seed. Mixing a small amount of seed is most easily done in a 5-gal bucket. A larger amount of seed can be mixed on a clean smooth concrete floor, using grain scoops to turn the seed pile. Harvested seed can also be added to commercially purchased seed. Care in harvesting and collecting only 20 percent of any particular species from one place is a recommended percentage used in the Seed of Success protocol established by the Plant Conservation Alliance (PCA) (2004). Recommended rates for hand-collected seed depend on the species and site characteristics. For commercial seed mixes, which have been tested for germination and purity, the suggested rate generally varies from 10 to 15 lb/acre. The cost for a high-diversity commercial seed mix will be higher. To increase the genetic diversity in hand-collected wild seed, collecting over a period of two seasons is recommended (Kurtz 2001).

Seed mixes are more affordable than transplanting plants when restoring a large area. Prairie remnants are suitable seed sources. Remnants can be found in neglected places, including old railroad rights-of-way, old cemeteries, steep areas and wetland areas not suitable for farming or grazing. Removal of existing native plants on Corps project lands slated to undergo construction provided another opportunity for the location of plant species. Harvesting and keeping seed or plants for replanting back to the site after construction will reduce project costs and offer genetically diverse ecotypes adapted to the local conditions, thus increasing survivability. It is necessary to document the location of local seed sources to provide information on the genotype of the seed used in the restoration effort (Gustafson et al. 2005), and obtaining genetic data on the original source populations would help to establish the extent to which "local" genotypes were used.

Recent studies have shown the importance of genetics to restoration projects. McKay et al. (2005) identify two main concerns with respect to the genetics of restoration: (1) whether the restoration project will succeed or fail, and (2) whether the restored populations will be the "same" as the original populations. This involves maintaining the natural genetic structure of the species, as well as ensuring population survival and reproduction. Considering ecotopic variation, genetic diversity, and introgression of non-local genes into remnant populations are no longer just academic concerns, but have practical implications for field restoration practitioners (Gustafson et al. 2005). A growing concern recognizes that the preservation of adaptive genetic variation within and among populations ensures that evolutionary potential is maintained (McKay et al. 2005). One concern is whether locally adapted, novel genotypes will succeed in new environments and how existing populations, adapted to local conditions, will be affected by the introduction of these new genes and genotypes. McKay et al. (2005) make the following recommendations for genetic restoration: (1) collect locally, if at all possible near or on the restoration site, and (2) match climatic and environmental conditions between collection and restoration sites. Finally, the idea of using more widely available "coarsely adapted" genetic mixtures that contain genetic variation necessary for further adaptive fine-tuning is a practical approach that may increase the feasibility and economic viability of genetic restoration (Rice and Emery 2003).

CORPS RESTORATION PROJECTS, SELECTED EXAMPLES: A recent survey of Corps operational projects revealed that at least 151 projects in 19 Corps Districts report prairie grassland acreage (Martin and Peloquin 2005). Many Corps Districts in various parts of the country have been involved in prairie restoration work. Although prairie acreages may be limited on Corps land, a

recent study (Cully et al. 2003) indicated that small fragments of tallgrass prairie may be relatively intact and should not be overlooked as long-term refuges for prairie species and sources of genetic variability. Three examples of successful prairie restoration by the Corps include efforts at Granger Lake, Texas; a Sand Prairie in Kellogg, Minnesota; and Arkansas Grand Prairie, Arkansas.

Prairie restoration efforts are under way at Granger Lake in the Fort Worth District (Figure 3). At Granger Lake, the project staff, with assistance from the Texas Parks and Wildlife Department, Texas Soil and Water Conservation Board, and the Native Prairie Association of Texas, manages a gene bank and prairie replication sites. Established in 1991, the gene bank hosts a collection of genetic material from relic prairie plant species, which are preserved for future environmental and educational uses (Horky 1998). Granger Lake, which has the best collection of Central Texas grass and flower genotypes in the area, started with 64 parent plants and now has hundreds planted over a 4-acre area. Granger Lake has also replicated a 110-acre prairie planted with an array of grasses and wildflowers to show visitors how the prairie in this area appeared historically. Despite its limited size, a variety of native grasses and prairie wildflowers provide year-round color and give visitors a glimpse at the beauty the prairie offers.

Figure 3. A native chalk prairie remnant at Granger Lake, Texas shows Beardtongue (*Penstamon cobaea*) among the diversity of grasses and perennial flowers (photo courtesy of C. O. Martin).

Another prairie restoration project is under way at Kellogg, Minnesota, where the St. Paul District created sand dunes to resemble the adjacent Weaver Dunes on 131 acres owned by the Corps. The Weaver Dunes complex includes thousands of acres of sand dunes adjacent to the Mississippi River that are a mix of agricultural lands and native sand prairie communities. Publicly owned areas of

the dunes are managed by the Minnesota Department of Natural Resources and The Nature Conservancy, and are located immediately to the south of the Corps project site.

This project resulted from the need to transfer 1.3 million yd^3 of dredged materials from a temporary placement site within the Mississippi River floodplain to a permanent location. The St. Paul District acquired the 150-acre former agricultural field in the early 1990s and allowed the land to go fallow. Plant inventories conducted on the project site in the fall of 2002 and spring of 2003 identified more than 50 native sand prairie species that established naturally when the site was allowed to go fallow. It was decided to strip the topsoil containing this seed bank and use the soil as containment berms during the hydraulic placement of dredged material. Following construction of the sand dunes, stockpiled topsoil was spread back onto the site. Concurrent with this, the District partnered with The Nature Conservancy to mechanically harvest seeds from their lands as well as hand-collect seed using volunteers (Figure 4). First, a total of 32 species of local ecotype seed was acquired for the project. A contractor planted 47 species, and an additional 13 species were hand-planted by volunteers, for a total of 60 species. The contractor will monitor the site for four growing seasons and control weed species as necessary.

Figure 4. Researchers harvest seed on Nature Conservancy land. The seed was used to plant more sand prairie in Kellogg, Minnesota. (Photo courtesy of Kurt Brownell).

A third cooperative effort is the Arkansas Grand Prairie Demonstration Project, a prairie restoration project that hosts a large group of partners synergistically restoring large tracts of prairie. Partners include the Arkansas Natural Heritage Commission, the Natural Resource Conservation Service (NRCS), the U.S. Army Engineer District, Memphis, the U.S. Fish and Wildlife Service, the University of Arkansas at Pine Bluff (UAPB), and private landowners. Several techniques were used to produce enough grass seed for the prairie restoration. A small remnant prairie was to be impacted

by a reservoir project, so UAPB removed all plants by cutting and rolling the sod. This sod was transplanted by unrolling it onto a plowed field at a farm owned by the university, and was watered and maintained as a supply for seed. Additionally the UAPB harvested seed from local remnant prairies, grew the seed in their greenhouses, and established seed production plots to develop local genotypes of four dominant grass species. The intent is to grow enough seed to restore 3,000 additional acres on canal levees and berms on Corps lands (Pogue 2001). Additionally, the city of Stuttgart will restore 300 acres on Stuttgart Municipal Airport lands, and the USFWS is planning the restoration of 600 or more acres of Grand Prairie and oak savanna.

Other efforts at the Grand Prairie project include the Arkansas State Parks collecting seed from the Railroad Prairie, and the Roth Prairie Natural Area in the development of a seed propagation plot. These natural areas serve as critical refuge for a number of rare plant and animal species, including some species endemic to the Grand Prairie. Approximately 430 acres of tallgrass prairie remain on the Grand Prairie today. Private landowners have shown their dedication to the effort by preserving a number of prairie remnants that would not exist without their concern and sacrifice. This multi-partner approach has been successful in generating interest and increasing the total acreage of the Grand Prairie, the last fragment of the tall grass prairie remaining in eastern Arkansas.

SOURCES OF PLANT MATERIALS AND RESTORATION EXPERTISE

Botanical Gardens and other ex situ facilities, such as seed banks, are artificial centers of species diversity and are among the most concentrated sites of species richness available (Guerrant et al. 2004). Botanic Garden Conservation International (BGCI) is a non-profit organization founded in 1986 to curb the threat to plant diversity worldwide. It is composed of 2,200 botanical gardens worldwide (Shepard 2005), representing 148 countries. These botanic gardens hold 80,000 species (Wyse 2001).

In many countries botanic gardens have developed seed banks for the storage of seeds, mainly wild species. As of 1998 there were 200 botanic gardens with seed banks (Botanic Garden Conservation International 2005) maintained in long-term storage. Several botanic gardens have developed the capacity to store tissues under cryopreservation. There are 76 botanic gardens within the United States. The Missouri Botanical Garden hosts the nonprofit Center for Plant Conservation (CPC). The CPC is a national network of community-based institutions that provide professional hands-on assistance to prevent extinction and achieve recovery of imperiled plants. The activities and scientific approach of the CPC have generated productive debate on the conservation role of botanic gardens (McMahan 1995). The CPC also established the adoption of plant genetics as the guiding tool for botanic garden conservation activities (Center for Plant Conservation 1991, McMahan and Guerrant 1991). More information on CPC can be found at: www.centerforplantconservation.org (CPC 2006).

A large network of 3,240 herbaria located in 165 countries are listed in *Index Herbariorium*, a compilation of herbaria available through the New York Botanical Garden (New York Botanical Garden 2006). In the United States, herbaria are associated with botanical gardens and universities. These collections are invaluable to botanists because they provide species information that can be used to verify specimens, location data that can be used to compile range data for the species of the specimen collected, and historic records of the species. Several herbaria offer on-line collections.

The Natural Resource Conservation Service (NRCS) Plant Material Centers provide native plants that can be used to restore sites and help solve natural resource problems. Scientists at these centers seek out plants that show promise for meeting an identified conservation need and test their performance. A conservation need may include erosion reduction, wetland restoration, water quality improvement, or streambank protection (Natural Resource Conservation Service 2005). At 26 Plant Material Centers located across the country (Figure 5), seed mixes are developed and plants are adapted to a particular region. After seed mixes and plants are certified through testing, they are released for commercial production. The work is carried out cooperatively with federal and state agencies, commercial businesses, and seed and nursery associations.

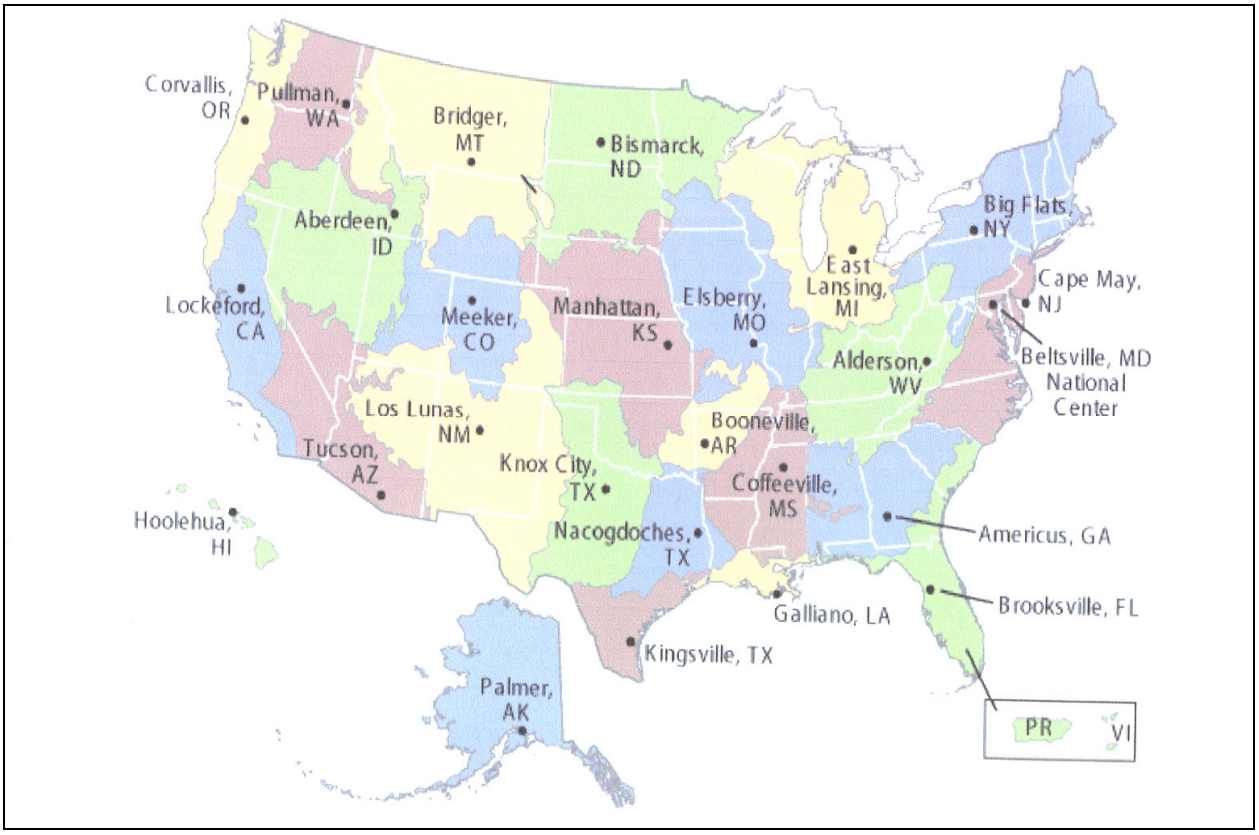

Figure 5. Natural Resource Conservation Service, Plant Material Center locations (from http://plant-materials.nrcs.usda.gov/centers).

An agreement is currently under way between the NRCS and the Corps at Marmet Locks and Dam, West Virginia. The Corps and the NRCS Plant Material Center in Alderson, WV, signed a Memorandum of Understanding (MOU) through the Economy Act to harvest propagules from six native plants on the proposed construction site. These plants were grown at the plant material center, and young trees and shrubs were provided to the contractor for replanting on the site at Marmet. Although the six species were not prairie species, they were dominant native plant species on the site as indicated by initial botanical survey work and were unavailable commercially. By growing the six species and returning these local ecotypes to their original site, genetic integrity will be maintained after construction is completed. Additionally, the NRCS will field test their seed mix of native shrubs, then seed will be planted in a designated area of the construction site (all species are native to the watershed in which they will be planted). After field trials, which determine the desired

percentage of each species present within the seed mix, the mix will be released for commercial production. The NRCS plant material centers are willing to assist in development and storage of locally adapted seed mixes at a reasonable cost.

One of the NRCS cost share programs that has successfully aided in the preservation of prairie lands is the Wetland Reserve Program (WRP). The WRP is a voluntary program that provides technical and financial assistance to eligible landowners to address wetland, wildlife habitat, soil, water and related natural resource concerns on private lands. Glacial Ridge Tallgrass Prairie, with 24,000 acres that form the largest ongoing tall grass prairie restoration project, is one example of a prairie restoration that received funding. This project, located in Minnesota's Northern Tall Grass Ecoregion, is a cooperative effort between NRCS and 30 other public and private partners. Glacial Ridge became the Nation's 545th National Wildlife Refuge in October 2004 (U.S. Fish and Wildlife Service 2006).

Native plant commercial nursery production is increasing in areas around the country in an expanding market. Seeds or plants should be collected or bought as close as possible to the restoration site because they will adapt to the soil, water, and climate of the region. The grower can be consulted about the seed and plant sources and this information should be maintained in records on the restoration project. When seeds and plants are not available locally, they should be purchased within the same ecosystem and under similar climatic conditions. If purchased plant stock is derived from tissue culture propagation, the genetic variability may be limited. It is necessary to ensure that the seed collection and propagation techniques allow for genetic variation for the seed to survive and reproduce.

A Public Works Technical Bulletin entitled, "Sources of Plant Materials for Land Rehabilitation" (USACE 2005a) has been compiled. Additionally, the Corps has produced an interactive database at http://www.cecer.army.mil/nativeplant/planthome.htm (USACE 2005b). The US Forest Service has compiled the "Eastern Resource Directory for Native Plants" that lists commercial nurseries for native plants (Dagnan 2004). The intent of these documents is to provide a listing of vendors; neither agency promotes a particular vendor.

Native Plant Societies are located in each state and memberships are often composed of professional and amateur botanists with knowledge of the state's flora. The Eastern Resource Directory for Native Plants (Dagnan 2004) also lists Native Plant Societies in each state and provides contact information. Most of these societies offer memberships at a minimal fee and have a number of scheduled events, including field trips to various natural areas to view native plants. These various societies may be interested in partnering opportunities for prairie restoration projects.

Another tool that can be used on land proposed for development is a native plant rescue. This consists of writing a brief MOU for the period of time needed to harvest the plants. The MOU includes the partnering organizations that will assist in the effort on federal lands. It is advisable to have the local Office of Legal Counsel review the document to protect the agency from liability. Once this is in place, the organizations involved harvest plants threatened by destruction, and transplant them into another location. Partners can include state natural resource agencies, school systems, native plant societies, and any other organizations. Although cost-effective, it is a labor-intensive method.

The Plant Conservation Alliance (PCA) is a consortium of 10 federal agencies (including Department of Defense) and over 200 cooperating organizations involved with native plant restoration and conservation in North America. The PCA provides a collaborative framework for linking resources and expertise in the development of sound, scientific projects. The organization responds to the World Conservation Union (formerly ICUN) on the status of native plants in North America (World Conservation Union 2006). Its vision is

> *For the enduring benefit of the Nation, its ecosystems, and its people; to conserve and protect our native plant heritage by ensuring that, to the greatest extent feasible, native plant species and communities are maintained, enhanced, restored, or established on public lands, and that such activities are promoted on private lands.*

More information about the PCA is available at www.nps.gov/plants.

"Seeds of Success" is an interagency program coordinated by the PCA that supports and coordinates seed collection of native plant populations in the United States. Its objective is to increase the number of species available for use in stabilizing, rehabilitating and restoring federal lands. This is the first program in the United States to support long-term conservation storage of all common native plant species. PCA supports three types of seed collection; (1) collection of seed for the Royal Botanical Gardens, Kew Millennium Seed bank, (2) collection of seed for the Agriculture Research Service Native Plant Germplasm Collection, and (3) collection of seed locally for specific rehabilitation and restoration projects. In each case, seeds are collected at the population level following the Seeds of Success protocol (U.S. Bureau of Land Management 2004). Additionally the U.S. Bureau of Land Management (BLM) is quite active in the western states and operates a warehouse in Boise, ID with storage capacity for 1 million pounds of seed (PCA 2006). A number of native species of prairie grasses and sagebrush seed are available for restoration on their land and used for restoring areas within the Great Basin, including the endangered Great Basin Sagebrush ecosystem.

The North American Prairie Conference (NAPC) is a biennial event that is geared toward a wide audience including professionals, managers, and academics. The NAPC is held at various locations, and the most recent conference was held at the University of Nebraska in Kearney, Nebraska, in July 2006; http://nacp2006.org/ (North American Prairie Conference 2006). The 4-day event included presentation of scientific papers, a poster session, access to vendors and field trips to area prairies. The conference is well organized and offers an excellent opportunity to learn and share information on restoration techniques, ecology, and conservation of prairie lands. It is well-attended by scientists and researchers prominent in the area of prairie restoration. The authors presented a paper titled "Status of Prairie Ecosystems on Corps of Engineers Project Lands" at the 2006 conference (Martin et al. 2006).

CONCLUSIONS: This technical note identifies and describes sources for seeds and plants to be used in ecologically sound prairie restoration projects. With only 1 percent of virgin prairie remaining in the United States, removing plants from the wild is usually not an option. A range of in situ and ex situ plant conservation strategies and some alternative sources have been described. Practical information is provided on seed, seed mixes, and other sources of plant materials. Restoration advice is also included. Examples of successful Corps projects involving prairie

restoration are described. Sources of plant materials and expertise include botanical gardens, NRCS plant material centers, commercial sources, native plant societies, the Plant Conservation Alliance, and the North American Prairie Conference.

Prairies are important in watershed protection because they fulfill multiple functions on a landscape scale. Prairies serve as a buffer to keep sediment and non-point source pollution from entering waterways; they provide erosion control, nutrient cycling, water purification; and they restore aquatic habitats, offering protection of rare plant and animal species and improvement of critical habitats. Many Corps projects contain substantial prairie and grassland acreage. Corps Districts can use prairie restoration projects to make a significant contribution to restoring prairie communities throughout the United States.

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SUMMARY: Prairies are important in watershed protection, fulfilling multiple functions on a landscape scale. Rare and endemic prairie plants on existing prairie remnants are a major resource nationwide and globally. Restoring prairie lands increases the area of this rare, valuable ecosystem while providing a unique opportunity to preserve a significant diversity of plants and the gene pool of each plant species.

This technical note provides information relevant to the science of plant conservation, summarizes several exemplary prairie restoration projects across the country, and describes the roles of instrumental agencies and organizations in the area of prairie ecosystem restoration and native plant preservation. This note also identifies some techniques and alternative sources of plants and seeds to aid managers involved in prairie restoration work.

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