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Federal Agency and Tribal Partnerships for Native Seed Collection and Ecological Restoration in the Western United States

Bringing land and culture to life through knowledge, practice, and community partnership

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Abstract

Indigenous communities have affected the landscapes of North America for centuries past and the accumulative knowledge of plant resources and harvesting methods can enhance the seed collection efforts of federal agencies and reduce the risks of using unsourced or non-local seed stocks for direct seeding and/or propagation. Indigenous participants can benefit from economic opportunities through partnerships for greenhouse and seed collection contracts or by volunteering and sharing knowledge by collaborating with land managers to continue traditional harvesting activities through organized events held on public lands. Both federal agencies and indigenous tribes hold a mutual interest in restoring and maintaining the health of the land. The exchange of knowledge and the involvement of indigenous communities in land management efforts can benefit both land managers and indigenous communities by restoring cultural activities and collaborating to improve the integrity of the land. Collaborative efforts should focus on meeting the cultural objectives of the participant indigenous communities.

Keywords: traditional ecological knowledge, ecological restoration, indigenous land management, seed collection, interdisciplinary.

Photo: Native plant propagation facility in southern Nevada.

Introduction

Indigenous ecological knowledge is often referred to as traditional ecological knowledge (TEK) which evolves and adapts as people develop new understandings of changes in local conditions such as invasive species and fire ecology regimes, climate change, alterations in wildlife migration patterns, or other environmental changes. Berkes (2012) defined traditional ecological knowledge as a body of knowledge, practices and beliefs about human and landscape relationships (including plants and wildlife) which evolves and adapts to changing conditions and is culturally passed down through generations (p.7). Together the experiences and knowledge of individuals form a coherent, culturally bonded, living, scientific body of knowledge on local environments. As each new generation becomes less dependent on traditional subsistence and survival activities the knowledge of elders is seldom passed on to younger generations. Kuhnlein and Turner (1991) explained that younger generations are less often taught how to survive on the land due to lifestyle changes and new technologies resulting in the loss of valuable information from both indigenous communities and “collective human knowledge” (p.5).

Although some indigenous groups have begun to use audio/video recordings as a method to preserve language, traditional practices, and knowledge, this method might only capture a static image of relict culture. Traditional ecological knowledge is not static; it is continual and has adapted and been passed down through generations. In order for TEK to evolve proceeding generations need to continue to interact with the natural environment and encourage the cultural transmission of this information. By continuing survival and subsistence activities past culture and new TEK is not only developed and preserved, but present living culture is also revitalized and maintained through living humans and their

continual experiences.

The purpose of this article is to emphasize the importance of native plant seed collection for ecological restoration on public lands in the western United States and to argue that interdisciplinary community-based natural resource management programs can benefit both indigenous communities and federal agencies and contribute to the success of restoration programs for federal public lands. The exchange of knowledge and the involvement of indigenous communities in land management efforts can benefit both land managers and indigenous communities by restoring cultural activities and increasing opportunities for collaboration and knowledge exchanges.

Interdisciplinary Framework

Similar to the decreasing transmission of knowledge and practices between elders and youth in postmodern society there is also a lack of knowledge transmission between contemporary land managers and indigenous land users. Communication and collaboration are essential elements of knowledge transmission. In addition to these cultural elements the transdisciplinary nature of natural resource management requires researchers, managers, and communities to explore both the natural and social sciences using different ways of knowing to gain holistic understandings of environmental changes, natural resources uses, and ecosystems. Higgs (2005) argued that there is a separation of science and culture in current land management approaches and suggested that practitioners use interdisciplinary frameworks to bridge the natural and social sciences or western scientific and indigenous knowledge systems for effective and comprehensive ecological restoration programs. Higgs described the restoration efforts on Discovery Island (British Columbia, Canada) as a case study in which land managers recognized the ecologically and culturally beneficial relationships for the aboriginal Lekwungen community's traditional harvesting of Camas for ecological restoration programs. The organized harvesting activities improved relationships between land managers and the Lekwungen community because the cultural objectives of the Lekwungen people were incorporated with land management objectives leading to both effective ecological and cultural restoration (Higgs, 2005).

Since the western scientific paradigm is only one method of understanding human-nature relationships, indigenous TEK may provide complementary knowledge to form a more holistic interpretation of land management. Therefore it is ecologically, culturally, and scientifically important to continue many of the traditional practices that have enabled indigenous peoples to survive and thrive for generations as a functioning part of the ecosystem. Indigenous community participation, the mutual exchange of TEK and western scientific technical knowledge, and the culturally-vested interest in protecting the health of the land can contribute to the success of long-term land management efforts, although contemporary managers seldom integrate this aspect into management plans (Higgs, 2005).

Public Land Restoration and Seed Collection

Federal agencies, referring specifically to the Bureau of Land Management (BLM), the National Park Service (NPS), and the US Department of Agriculture (USDA),

are responsible for managing the nation's 657.3 million acres of federally owned land (BLM, 1994). These holdings represent approximately 30% of the total land area of the United States with more than half of the total acreage located in western states (Table 1). Ecological restoration is a major goal/activity on public lands. Federal agencies operate a number of propagation facilities throughout the western states in correlation to the high percentage of public land in this region. For example, approximately 80% of the state of Nevada is federally owned land (Table 1). In southern Nevada the BLM and the NPS operate nurseries for restoration projects at national parks, recreation areas, areas of critical environmental concern, and other public land areas. The purpose of having federal propagation facilities nationwide is to produce vegetative material for restoration projects on public land. Restoration activities such as plantings or seed broadcasting aim to speed up the recovery of plant communities on land which have experienced adverse impacts from disturbances such as burns (in areas where fire is not a regular occurrence), to prevent the spreading and/or establishment of invasive weeds, and to mitigate the impacts of intensive livestock grazing (BLM, 2009a; DOI, 2009). Successful restoration initiatives require careful planning in all stages of development, beginning with the source of the seed.

Table 1. Total acres of federally owned land for the western states

State	Federal Land (Acres)	% of Total State Acreage
Arizona	32,488,417.9	44.696
California	46,956,437.6	46.860
Colorado	24,140,220.4	36.309
Idaho	32,946,170.9	62.241
Montana	25,959,402.3	27.832
Nevada	58,264,528.6	82.922
New Mexico	26,549,504.6	34.140
Oregon	36,939,181.5	59.967
Utah	33,838,181.9	64.213
Washington	11,456,307.5	26.834
Total Acres	329,538,353.2	

*Data retrieved from *www.access.gpo.gov/blm/images/1-3-96.pdf*. (1994).

Why is seed collection so important? Seed collection programs and their ability to provide quality native seed are vital for successful for restoration efforts (Lippitt, Fidelibus, & Bainbridge, 1994). In the past, federal agencies have used non-native grass seeds and sterile grains to rehabilitate burn sites but there has been a shift in interest towards increasing the use of native plant species. This, however, is severely limited by availability (Beyers, 2004). There is a growing demand for native seed resources for restoration projects but seed availability

remains low (Shaw, Lambert, DeBolt, & Pellant, 2005; Beyers, 2004). For federal restoration projects it is important to harvest native seeds from healthy local plant populations since many regional or site-specific populations have developed distinct traits for improved survival rates in specific environmental conditions.

There is great concern over the use of non-local seed sources and potential ecological impacts (Beyers, 2004). Native plant materials should be collected from populations with site characteristics similar to those of the intended planting site, ranging from similar geographic distribution to similar elevation ranges to similar precipitation and temperature conditions. Germplasm (genetic seed resources) collected from local plant populations which are carefully selected from healthy specimens and from a multitude of individual plants over a large area are also essential to protect the genetic integrity of the plant populations in a region and/or locality (Lippitt et al., 1994). The application of scientific seed collection principles is another important aspect for natural resource managers.

In 2001 the Seeds of Success program was initiated to address the shortage and quality of native seeds and improve seed availability for future restoration needs (BLM, 2009b). The BLM has initiated other projects since 2001, including the Native Plants Material Development Program and the Great Basin Native Plant Selection and Increase Project, to protect local natural variations and the genetic integrity of populations, to increase the supply of native seeds, improve the diversity of species available, and to develop programs to procure native plants through partnerships with botanical gardens or other growers (BLM 2009b). The BLM relies heavily on volunteers for seed collection efforts and in recent years the new seed programs have increased funding for native plant programs and increased the number of seed collection jobs for restoration efforts.

The growing demand for native seeds for restoration projects on public land illustrates the need for community assistance through volunteer programs and partnerships. Seed collection programs usually rely heavily on volunteers for seed collection efforts, especially for dominant species which produce seed irregularly or during short time periods. In 2008 numerous emergency volunteer seed collection groups were mobilized in southern Nevada to collect *Coleogyne ramosissima* (blackbrush) seeds during a rare seeding event; volunteer efforts were essential for success since the collection window was narrow and massive quantities were required to collect enough seeds to meet the high demand (NPS, 2008). Without volunteer participation for that event the ability to collect mass quantities of seed would have been greatly diminished. Cooperation among agencies, communities, private growers, and volunteers is essential for successful development of seed collection and ecological restoration programs.

Benefits to Federal Public Land Management Agencies

Community based natural resource management programs with indigenous community partnerships can benefit federal agencies by improving the capacity to collect large quantities of native seeds through volunteer programs, increasing the quantity of native plant materials available through tribal nursery growing contracts, or maintaining local genetic integrity through site specific collection activities. Another mutually beneficial aspect of collaborative indigenous community partnerships is the exchange of TEK and western scientific knowledge, such as learning about effective traditional seed collection (harvesting) methods

and traditional tools or knowledge about when and where to harvest important food plant species.

Seed Collection Volunteers

Changes in restoration strategies have increased the demand for volunteer seed collectors. During the past few decades, federal agencies have begun to "clean up" their methods of restoration to better reflect ecological needs. Standard post fire restoration methods, which involve the rehabilitation of post fire sites by the direct seeding of non-native grasses in order to provide quick-growing vegetation for forage and soil stabilization, were originally designed in the early to mid 1900's and were based on satisfying commercial and economic needs (Shaw et al., 2005). Restoration methods which focus on the use non-native plant species fail to meet the new millennium's less utilitarian conservation values and ecosystem-based holistic management goals. In response to changing public views and scientific research the Department of the Interior (DOI) now encourages restoration planners to incorporate the use of locally collected native germplasm when possible (DOI and USDA, 2002). This emerging methodology is an essential (and long awaited) leap forward, yet, unfortunately, its application is limited by native seed availability and the lack of sourceable locally-collected germplasm (Shaw et al., 2005).

In the face of the growing demand for local and high quality native germplasm the role of volunteer and contracted partnerships for seed harvesting is even more valuable to public land managers than ever before. Federal agencies are in need of volunteers and there are additional mutual benefits that may accrue by encouraging local indigenous communities to participate in volunteer efforts.

Effective Harvesting Methods

Fruit, seeds, and vegetative materials collected for subsistence, cultural significance, and restoration programs serve different purposes yet the methods and tools used to harvest the resources can sometimes be very similar. For example, an ethnography of the Owens Valley Paiute (Steward, 1933) described groups of women harvesting seeds for subsistence purposes by beating plants with specialized "seed beaters" and collecting the seeds in conical baskets as they dropped from the plants. It is a common practice for restoration seed collectors to use badminton rackets or tennis rackets to beat seeds from plants and collect the seeds by placing a tarp or burlap material on the ground below. Even though the purposes of collection and the tools are different the same method can be applied for efficient seed harvesting.

Despite the similarities of certain seed collection methods and slight differences in the design of some of the tools (i.e. the modern badminton racket versus the traditional seed beater) the knowledge of traditional harvesting methods and tools can be particularly useful in cases where certain species are difficult for restoration seed collectors to harvest in an efficient or practical manner. For example, harvesting cones from pine species which grow to enormous heights can prove to be particularly difficult. The Provincial Forestry Service of British Columbia (Canada) exerts great efforts to collect seeds from pine species including the extreme tactics of gathering pine cones by helicopter or shooting down individual cones or branches from the ground (R. Bandringa, personal

communication, July 17, 2009). As an experimental alternative to gathering pine cones by gun or helicopter the traditional *Pinus monophylla* (singleleaf pinyon) pine cone harvesting techniques of the Timbisha Shoshone of Southern California could offer some guidance on the development of a specialized tool for large-scale pine cone harvesting efforts for other pine species in other geographic areas.

Dutcher (1893) observed groups of Panamint people (Timbisha Shoshone) using a specialized tool to harvest the pine cones of singleleaf pinyon pines, a staple food source. Groups of women used long hooked sticks for whipping and pulling the pine cones from the tree limbs and high branches (Dutcher, 1893; Anderson and Roberts, 2001).

> The beating or pulling sticks were straight rods, about an inch in diameter and five or six feet long, stripped of bark and with all the branches removed, save one at the outer extremity, which was cut off about six inches from its union with the main staff. The stick itself terminated immediately beyond this point. To prevent this spur or limb from being split off by the rough usage to which it was subjected a stout thong was wrapped around from one branch to the other about three or four inches from the vertex of the angle. To give a clearer idea of this instrument, it may be compared to an A, in which the uprights stand for the limbs, one being greatly prolonged, and the cross-bar for the binding thong. (Dutcher, 1893)

The description continued to describe methods for processing the cones; green pine cones were hammered to release the nuts then the seeds were cleaned by tossing the nuts into the air (from a flat, woven dish) and allowing the wind to filter the debris (much like a modern day seed blower). This specialized tool and traditional processing technique allowed the Panamint women to collect and process about one to two bushels of pine nuts in a single day (Dutcher, 1893). Adapted versions of the harvesting pole and the use of traditional field cleaning methods may increase the efficiency of current collection efforts.

Knowledge of when and where to harvest

Volunteers do not only contribute their time and labor to restoration efforts but they may also offer their personal experiences and traditional knowledge. Indigenous elders should be recognized as authorities in their specific field of knowledge which may include plant ecology, knowledge of quality harvesting locations, identifying probable time periods for species-specific harvests, and the ability to construct specialized tools and usage techniques. Interested elders should be given the opportunity to be directly involved in the planning of volunteer harvesting events because of their specialized knowledge and experience, place in the community, and desire to continue traditional activities through partnerships.

In order to develop a successful partnership between indigenous communities and federal resource/land managers sociocultural dimensions, such as respecting the knowledge and authority of elders or communicating with community leaders to identify mutual objectives, should be built into the design of partnership programs. Land managers should also be aware that partnerships with indigenous

communities may develop slowly over time as community interests and objectives are identified. The resulting volunteer projects and/or commercial partnerships should further the interests of both land managers and indigenous communities and should aim to achieve cultural/social development goals and the subsistence or economic activities of indigenous communities as well as aid in the facilitation of public land restoration projects through seed collection and plant materials development.

Increasing the Availability of Quality Native Seeds

A well-designed volunteer-based seed collection program can contribute to the success of federal programs aimed at increasing the availability of native seeds by maintaining a consistent supply of seed from local plant populations (dependent on plant production). Volunteers and/or a program manager with the appropriate knowledge base should monitor and test seed viability to ensure that old seed lots are replenished to maintain sufficient quantities for time-sensitive restoration projects, such as burn sites. Emergency collection teams comprised of on-call volunteers may collect seed as it becomes available for site-specific restoration needs. Site-specific seed collection means that seeds from a distinct population are collected specifically to be broadcasted or planted on restoration sites of the same population. This practice reduces the likelihood of adverse impacts on wild plant populations such as the unnatural transfer of genetic materials between different populations. This adverse impact can also result from the purchase of unsourced native plants or seeds from growers in different regions since some species have broad ranges across the western United States, such as *Atriplex canescens* (four-wing saltbush) of which distinct populations in different regions often exhibit very different characteristics.

Regions which are subject to new fire regimes due to invasive species and the resulting changes in plant community dynamics often have fire-sensitive plant species that respond poorly to fire. The regions need to maintain a constant supply of seeds for sensitive dominant species. Another consideration for maintaining a constant supply of native plant materials involves knowledge of individual species and their seed production habits and conditions. For example, *Coleogyne ramosissima* (blackbrush) populations in southern Nevada had not produced the quantities or quality of seed to warrant collection for several consecutive years. The demand for blackbrush seed for restoration projects on public land was high due to an increase in fire disturbance in the Spring Mountains and Red Rock National Conservation Area during previous years, but seeds were not available (NPS, 2008). In the spring of 2008 blackbrush flourished and seed production was regionally abundant. The BLM and NPS restoration managers coordinated emergency volunteer groups to collect large quantities of blackbrush seed to meet current demands for local restoration needs. Maintaining a constant viable supply of local germplasm can aid restoration efforts in the event of fire disturbance and ensure that dominant plant community species are available for time-sensitive rehabilitation efforts. Volunteer-based seed collection programs can also extend their efforts to provide additional care for the land. This may include post-rehabilitation monitoring, additional seeding, weeding or re-planting efforts.

The valuable training and exchange of knowledge and practices between

indigenous participants and land managers may also provide opportunities for indigenous communities to establish native seed provider companies in the future which might be able to satisfy both economic and cultural objectives.

Benefits to Indigenous Participants

Indigenous tribes can benefit from plant material development partnerships in a number of creative ways but it is essential for tribal partners to establish relative social, cultural, economic, and ecological objectives as goals for the partnership with the respective federal agency. One benefit would be to improve access to harvesting sites within national parks or on federal lands in locations where harvesting activities were previously restricted or prohibited, such as in the case of the organized traditional Camas harvesting events on Discovery Island (Canada). Seed collection partnerships can also increase the number of opportunities for indigenous communities to become involved with decision-making and planning processes for natural resources within a national park or on other federal public lands. Another benefit may be the opportunity for the 'hands-on' cultural transmission of TEK through seed collection and restoration activities and opportunities to meet economic, cultural, and ecological objectives through native plant growing contracts or seed collection contracts.

Access to Harvesting Sites

Federal lands managed as national forests, parks, monuments, leasable grazing and timber lands, and multiple use areas reserve a sizable proportion of the traditional home ranges of indigenous Americans of the western United States. Through seed collecting partnerships indigenous communities may gain improved access to traditional food sources. Not only can indigenous communities share knowledge of historical collection areas, methods and tools, but they can also continue traditional harvesting practices at culturally important sites. Native seeds are usually collected by restoration managers for one of two purposes, propagation or direct seeding; but to develop mutual partnerships project coordinators or co-coordinators should also organize subsistence harvesting events to meet cultural objectives.

Participatory and Collaborative Natural Resource Management

Seed collection activities pose realistic opportunities for the community to become involved with restoration and management planning for local public lands. A growing trend has emerged with the establishment of collaborative partnerships between public land agencies and tribes with a central focus around native plants and seed collection. Another major goal of federal agencies is to develop collaborative programs between agencies and with communities to participate in land management and restoration projects (USDA, 2012). Encouraging collaboration between federal agencies and tribal communities, such as through volunteer projects, collaborative research contracts, or private business contracts, can benefit both resource managers and indigenous communities by increasing opportunities for communication and continuing the transmission of ecological knowledge and/or cultural ecological activities. Consequently, these activities may aid in the preservation of cultural practices and improve the integrity of the land.

At the onset of this new millennium public agencies have begun to develop partnerships with tribal organizations to exchange western scientific technical knowledge and TEK through trainings, meetings, and collaborative research. Numerous partnerships with indigenous communities have been established through BLM and USDA district offices for the collaborative development of native plant materials such as seeds. A BLM district office in Idaho established partnerships with several different local tribes to develop greenhouse and growing facilities (for which the BLM provides free technical assistance) to aid Great Basin seed collection and plant growing initiatives (BLM, 2009b). The Intertribal Nursery Council was formed by the USDA Forest Service and tribal leaders to preserve TEK and share technical information about native plant propagation for forestry programs (USDA, 2012). Although ecological and economic benefits may accrue to tribes from native plant nursery operations, cultural objectives also need to be identified and woven into partnership activities.

It would be beneficial for tribes to designate an employee to co-coordinate cultural ecological activities. Culturally significant activities related to land restoration and management might range from prescribed burns, food harvesting or seed collection, indicator monitoring or wildlife monitoring, improving access to native food plants through gardening or agriculture programs, or propagating native plants for restoration and conservation programs. Economically supportive activities might consist of indigenous communities or individuals starting their own seed supplier companies, sharing seed collection and processing equipment, arranging growing contracts with federal agencies, or participating in technical training with federal agency staff members.

Land management partnerships also have the benefit of possibilities for academic co-research projects whereby multicultural interdisciplinary teams of specialists can collaborate to co-produce research on ecology, environmental change, the effectiveness of land restoration trials, etc. Regardless of the activities being carried out, a tribal co-coordinator can ensure that partnerships will further the tribes' interests as well as support agency efforts. A tribal coordinator may also be better equipped to seek out interested volunteer groups in the community and to coordinate projects with indigenous educational institutions, such as high schools or colleges.

Continuing TEK Through Practice

Seed collection also involves hands-on educational opportunities, such as students learning about traditional food plants and medicinal species from elders or agency employees in an outdoor setting, monitoring seed collection sites, identifying plants in the field, or learning about effective seed collection methods and seed collection principles. Involving the community in seed collection activities can increase public awareness on the ecological conditions of their local public lands, and from a broader perspective, can contribute to public education for students and adults on the topics of ecology, biology, botany, and anthropology. The BLM Twin Falls district provided funds to build two greenhouses on two reservations nearby schools so that students could have hands-on classrooms to learn about plant propagation and greenhouse management to meet the plant material development needs for fire rehabilitation in the region

(BLM 2008). Partnerships can provide learning opportunities and educational resources for students and can also provide job training for future plant materials development programs with federal agencies or private companies.

Meeting Economic and Cultural Objectives

Seed collection volunteers and contract growers/collectors have the opportunity to develop professional working relationships with local restoration practitioners. Partnership participants can benefit from technical trainings on plant propagation and seed collection, agency funding for capital such as greenhouses and supplies, and reduced operating costs from sharing expensive capital, such as seed processing equipment. The BLM's partnership with Shoshone-Bannock Tribes in Idaho has improved their relationship and has led to the addition of several tribal nursery and restoration jobs for students and full time employees (BLM, 2009c). Indigenous-owned and operated seed provider and native plant propagation companies can offer professional jobs where employees can share TEK and other forms of knowledge through a contemporary medium to meet both economic and cultural objectives.

Conclusion

Continuing traditional practices can facilitate the transmission and exchange of TEK and western scientific knowledge from adults to youth and/or between tribes and federal land management agencies, which can contribute to efforts to restore the integrity of public lands. Federal land managers make great efforts to restore land which has been damaged by situations such as changing fire regimes, invasive species, and intensive livestock grazing. Native plant seed collection is the foundation of most restoration project as managers now strive to use local and native plant materials for restoration projects in order to maintain the genetic integrity of local ecosystems and regions. The current demand for native seeds for public restoration projects outweighs the amount available from commercial providers (Shaw et al., 2005) emphasizing the need for volunteer assistance and commercial partnerships to harvest this valuable resource. Partnerships between federal land management agencies and indigenous tribes can enhance native plant materials development programs and meet cultural, economic, and ecological goals.

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