Policy Session

Peggy Olwell – Keynote Speaker

National Seed Strategy: The Power of Partnering

Considering the serious drought conditions and altered fire regimes in the West, the unusual weather events in the East such as Hurricane Sandy and the increase in flash flooding nationwide, land managers need to be able to respond quickly to landscape-scale ecological changes with appropriate restoration resources for all land ownerships across the United States. The National Seed Strategy provides a coordinated approach for stabilization, rehabilitation, and restoration of public and private lands.

The Strategy outlines a plan that will help coordinate and focus diverse efforts toward achieving four major goals: (1) Identify seed needs and ensure the reliable availability of genetically appropriate seed reserves, (2) Identify research needs and conduct research to provide genetically appropriate seed reserves and to improve technology for seed production and ecological restoration (3) Develop tools that enable managers to make timely and informed seeding decisions for ecological restoration, and (4) Develop strategies for internal and external communication. The Strategy provides a framework for actively working between land managers and private industry to respond appropriately to disturbances and other stressors that threaten important native plant communities and ecosystem services in the US.

Success on a national scale will be achieved through a coordinated nationwide network of networks, including a network of native seed collectors, a network of seed researchers, a network of farmers and growers, a network of nurseries and seed storage facilities to supply adequate quantities of appropriate seed, and a network of restoration ecologists who know how to put the right seed in the right place at the right time.

BIO: Peggy Olwell is the Plant Conservation Program Lead for the Bureau of Land Management in Washington, DC. Peggy built the BLM's nationally recognized Native Plant Materials Development Program, which promotes the use of native plants in habitat conservation and restoration projects. She was instrumental in developing the Plant Conservation Alliance in 1994, a partnership of 12 federal agencies and over 320 state and private organizations. Currently, she is chair of the PCA Federal Committee and led the effort on the recently published National Seed Strategy. Peggy co-edited an Island Press publication titled, Restoring Diversity: Strategies for Reintroduction of Endangered Plants. Peggy has worked on plant conservation and endangered species issues for more than 30 years in positions with National Park Service, Center for Plant Conservation and US Fish and Wildlife Service. Peggy received her undergraduate degree in Botany from the University of North Carolina at Chapel Hill and her M.S. in Biology from Southern Methodist University.

Stanford Young

Research Professor Emeritus, Utah State University, Logan, UT, 84322-4820

Seed Certification of Ecotypic Plant Materials

Official seed certification is conducted by member agencies (including most U.S. States, Canada, and certain other countries) of the Association of Official Seed Certifying Agencies (AOSCA). AOSCA agencies originally were set up to track the genetic identity and genetic purity of agricultural crop varieties, but within the last 25 years have developed

the Pre-Variety Germplasm (PVG) program. This allows for the tracking of ecotypic plant materials from original collection through seed and/or plant increase and on to the end user.

A seed analysis report from a seed laboratory does not normally differentiate between the many species of a genus, for instance penstemons or globemallows. And certainly not between subspecies, such as the subspecies of big sagebrush. Special testing using DNA analysis or ploidy levels or UV fluorescence or electrophoresis or seed weights are differentially effective, and some are still in the process of being vetted. They all add significantly to the cost of the seed analysis. In comparison, seed certification entails a generational paper trail, field and wildland on-site inspections, conditioner protocols, seed sampling, and application of seed analyses results. The cost to the producer is small relative to the value of the product. Recognition is instantaneous to the customer (involving only reading the data listed on certification tags), reliability is high, and it has an excellent practicality track record.

Source Identified certified seed is labeled as to the geographic location (minimum of state, county, and elevation) of the original collection (designated as Generation 0), and the generation and geographic location of any seed increase field. See the publication "The AOSCA Native Plant Connection" at aosca.org for more details.

BIO: Stan Young grew up on an orchard in northern Utah and has always been a fan of wildland places, whether for hiking or hunting or fishing or reading a book under the shade of a Box Elder tree. He graduated from Utah State University with BS in botany and chemistry and MS in Plant Pathology, and from Oregon State University with PhD in Plant Pathology and Plant Breeding. After a stint in research and development of agricultural chemicals in private industry, he accepted a position at Utah State University as the Seed Certification Specialist, dealing with certification, intellectual property rights, and stock seed and commercial production of plant materials for both agriculture and wildland revegetation. He recently retired from USU after 37 years as Research Professor with emeritus status, which means a smaller office and decreased clout, but a lot more time to enjoy wildland places.

Tyler Johnson

Regional Botanist & Regional Native Plant Materials Coordinator, US Forest Service Rocky Mountain Region

Native Plant Materials and the US Forest Service

Understanding the guidance and policies for the use of plant materials on federal lands is difficult and confusing even for federal employees. Translating those policies and guidelines for the public we serve is an even more confusing task. Adding to this confusion is a recent national emphasis on conserving pollinators and their habitat, which spoke volumes about *why* such conservation is important, but spoke little about *how* to go about conserving pollinators on federal lands. This talk will outline the basic tenants of plant material use on National Forest System lands (National Forests and National Grasslands) and how those tenants can be applied in the Southern Rockies with an emphasis on the use of ecotypic plant materials and pollinator conservation.

BIO: on the way

Steve Monsen

Co-founder of the Uncompaghre Plateau Collaborative Restoration Project

Development of Native Plant Materials for Ecological Restoration, and the Native Plant Programs necessary to Sustain them

Restoration of natural communities is the primary objective of most restoration projects. This often requires planting adapted but unavailable and untested species. Thus, plant development programs are required to furnish desired materials. The decline of wildlife habitats within the Uncompahgre Plateau instigated a native plant program that extended throughout the Colorado Plateau. The following situations were identified as contributing to declining habitats and required attention.

1.) Disruptions of various sagebrush *Artemisia spp*. communities.
2.) The occupation and invasion of cheatgrass *Bromus tectorum* into critical habitats.
3.) Natural and imposed alterations of Pinyon/juniper woodlands and planting improper species.
4.) The lack of a native seed industry and species adapted to the problem sites.

Selection of candidate species initially required identifying and defining the occurrence of individual plants, suspected subspecies, and ecotypes. Assessment of the cultural requirements and restoration capabilities of individual species was also emphasized. Various reports continue to support plantings of inappropriate species. In addition, the acceptance of recently released introduced cultivars and unadapt native selections delay the current use of native species.

Site adapted ecotypes have been identified by establishing comparative plantings within a series of regionally located common gardens. This process was particularly useful in Colorado where little information was available to direct the selection process. Current seed zones were used to assist species selection and seed collections. However, highly variable species were encountered throughout the diverse sites in Colorado and Utah. Some ecotypes and species exhibited a wider range of fitness than expected.

We recognized that species adaptability trials need to be conducted amid conditions including species and conditions that naturally exist in specific plant communities. Studies indicate the genetic complexity of individual species influence plant establishment and persistence. Associated studies also indicate species adaptation may change as plant successional processes evolve. Changes in species composition of planted sites responded somewhat differently within similarly perceived situations in the Colorado Plateau and Great Basin. We extended plantings with cooperators, particularly in Utah, to expedite the collection of data related to site adaptability, seedbed preparation and planting methodologies.

We established cultivated field studies with newly assembled plants to define the seed production and rearing requirements of each species. We also established wildland seed production nurseries of some shrubs as it became apparent that wildland stands, field cultivation, and managed nurseries will be required to produce required materials. Some important shrubs also exist on quite unique sites and are slow to develop precluding establishment of field grown stands.

An emerging seed industry is dependent on the acceptance by users, which currently is a deterrent to new programs. We collaborated with the Utah Watershed Restoration Intuitive, a successful large-scale restoration program. The organization includes agencies, conservation, wildlife, and business groups with an annual budget exceeding twenty million dollars. The organization conducts annual restoration projects by pre-purchasing and warehousing site adapted species and utilizing newly developed native selections. The organization also concentrates on the development of equipment to create seedbeds and plant desired species.

BIO: Stephen Monsen is a retired Research Botanist of the US Forest Service, Rocky Mountain Research Station Provo, Utah. He was also employed by the Utah Division of Wildlife Resources at the Great Basin Research Station, Ephraim, UT. His work included the development of native shrubs and herbs and the formation of site preparation and planting practices to restore big game winter ranges and rectify logging disturbances within the Idaho Batholith. This work resulted in the release of a number of forbs, perennial grasses, and shrub cultivars. He directed the improvement of big game habits in Idaho concentrating on big sagebrush communities subjected to wildfires and the invasion of annual weeds. His work resulted in the development of ‘Anatone’ bluebunch wheatgrass, ‘Eagle’ yarrow, ‘Mtn Home’ Sandburg bluegrass and the selection and use of species capable of limiting the spread of wildfires. He formulated and established the Great Basin Native Plant Program and served as the initial Team Leader. Following retirement, he organized and directed the Uncompahgre Native Plant Program. He actively encouraged the restoration of native communities and the reestablishment of stable plant associations. He focused on the development of planting methodologies to facilitate the establishment diverse species. He applied this concept to reestablish a complex of adapted tall forbs amid disturbances within the Manti LaSal and Uintah National Forests. He published various various scientific papers including a 3 volume series titled, Restoration of Western Range and Wildlands.

Practice Session

Claire DeLeo

Senior Plant Ecologist, Boulder County Parks and Open Space, Longmont, CO

Lessons Learned from a Native Seed Increase Program in Boulder County, Colorado

The availability of locally-sourced native plant material can be a major limitation for restoration projects, particularly for local agencies with limited resources. In Boulder County, two local government agencies (Boulder County Parks & Open Space and the City of Boulder Open Space and Mountain Parks) and a local restoration non-profit (Wildland Restoration Volunteers) partnered in 2007 to develop a joint seed collection and increase program. Working with various government agencies, non-profits, volunteers, and private growers, we have increased 16 grass and forb species over 7 years. Through successes and failures, we have learned which species grow well in seed increase fields and which do not. In our most successful cases, local ecotypes were grown at a rate comparable to commercial varieties, with the lowest cost at $11.71 a PLS pound. However, other species had exorbitant increase costs of over $5,000 a PLS pound. This talk will explore various options for increasing local seed, along with the benefits and pitfalls of each and their associated costs. Our goal is to share our experiences and hopefully inspire others as to how to focus their efforts and succeed with a local seed program of their own.

BIO: on the way

Stephanie Greene

Seed Curator, USDA ARS NLGRP

Need to Back Up Your Seed Collection? Black Box Storage at the USDA National Laboratory for Genetic Resource Preservation

The USDA National Laboratory for Genetic Resource Preservation (NCGRP) is a part of the National Plant Germplasm System (NPGS), the U.S. gene bank. An important role of the NLGRP is to provide backup storage of the US collection. Seed collecting efforts are occurring across the U.S. by many organizations. A basic tenant to ensure the security of seed collections is to have them stored at multiple locations. But this can be difficult to accomplish with limited resources. Our laboratory provides a black box service free of charge to organizations that freely distribute their seeds to others. We are providing storage for native wild species collected by the BLM Seeds of Success program, Center for Plant Conservation, US Forest Service and many Native American tribes and private botanical gardens.

BIO: Dr. Stephanie Greene is a plant physiologist with the USDA Agricultural Research Service. Dr. Greene is responsible for curating the base seed collection for the USDA gene bank. The base collection, housed in a secure facility in Fort Collins, safely backs up our Nation's seed collection- over 560,000 accessions representing 15,000 species collected from around the world. We also provide secure backup storage for domestic and international seed and microbe collections. Seed receiving, processing, packaging and monitoring is done by a dedicated staff of certified seed analysts, IT specialists and technicians. Dr. Greene's main research focus is the conservation of crop wild relative species that are native to the United States. These wild species are important genetic resources that can be used by breeders to develop productive, climate-resilient crops. Dr. Greene has worked in the USDA gene bank system for the last 24 years, curating the forage legume collections in eastern Washington until 2014, when she transferred to Fort Collins. Dr. Greene was educated as a plant breeder, receiving her B.S. and M.S. from the University of Idaho, and her PhD from Kansas State University.

Jim Tolstrup

Executive Director, High Plains Environmental Center, Loveland, CO

Creative Approach to Ecotypic Plant Materials Development at the High Plains Environmental Center

High Plains Environmental Center (HPEC) is in the process of building an Educational Visitor Center with a specific focus on conserving and restoring Colorado's unique native bio-diversity in the midst of development. The center will demonstrate, through extensive gardens and exhibits, the benefits to wildlife and water conservation derived from the use of native plants in landscaping, open space, and urban stormwater ponds.

HPEC Director, Jim Tolstrup, will present the center's unique non-profit business model which focuses on providing natural areas management services to HOA's and other land owners, as well as growing and selling native plants, in order to fund public outreach and education in the fields of environmental restoration and stewardship. The HPEC native plant nursery produces tens of thousands of ecotypic plants every year for restoration and landscaping projects throughout northern Colorado.

BIO: Jim Tolstrup is the Executive Director of the High Plains Environmental Center in Loveland, CO, a unique model for preserving native bio-diversity in midst of development. Jim works to promote the conservation, restoration and landscape use of native plants and is the State Horticulture and Restoration Chair for the Colorado Native Plant Society. His past work experience includes serving as Land Stewardship Director of Shambhala Mountain Center in Red Feather Lakes, CO and running his own landscape design business in Kennebunkport, Maine where he installed gardens at George and Barbara Bush's "Summer White House." Jim holds a Certificate in Gardening Arts from the Landscape Institute of Harvard University and the Arnold Arboretum, he has written numerous articles on gardening and environmental stewardship for various publications, and is a past recipient of Denver Water's Xeriscape Award and ALCC's Excellence in Landscaping Merit Award and ASLA Land Stewardship Award.

Science Session

Nancy Shaw

Research Botanist (Emeritus) with the US Forest Service, Rocky Mountain Research Station's Grassland, Shrubland and Desert Ecosystems Program.

Wildland Shrubs - Seed Sourcing, Collection, Technology, and Use

Shrubs are dominant life forms in many ecosystems of the intermountain West ranging from low elevation salt desert shrublands to mountain brush communities and forested lands. Although many shrub species have been included in rehabilitation and habitat improvement projects, few have been studied extensively, and the potential impacts of human activities, including climate change, on their future distributions are poorly understood. Nearly all shrub seed is wildland collected. This offers the potential for control of collection areas to provide adapted material for planned seedings or plantings. Similarly, supplies may be maintained for specific areas or seed zones based on long-term seed use records for planned and unplanned (e.g. post-fire rehabilitation) needs. The provisional seed zone map developed by Bower et al. (2014) combined with available literature and local knowledge may be used to guide seed collection and deployment. Empirical seed zones based on common garden genecology studies are available for only a very limited number of species and few studies are ongoing. For purchased seed, whether through contracts or obtained from the commercial market, source-identified certification can provide information on seed origin. However, closer regulation may be required in some instances and for some species when obtaining the correct seed may be problematic (e.g. requirements for particular subspecies, ploidy levels, soil conditions). Additional controls include in-house collecting, particularly when only small quantities of seed are required; permitting (public lands) for specific collection sites combined with direct inspection of harvesting activities; designation and protection of seed collection areas; and establishment of seed orchards. Native shrub seed research, including seedling production techniques, has been summarized in the Woody Plant Seed Manual (Bonner and Karrfalt 2008) and a number of online databases, though many knowledge gaps exist. Research results and local knowledge of seeding and transplanting techniques, compatibility of shrubs with other native revegetation species, establishment and growth characteristics, and stand management are available for some species and communities. The current status of research and revegetation use of

several common shrub genera, including Artemisia, Purshia, and Cercocarpus, will be discussed. Consideration of the National Seed Strategy goals (seed needs assessments, identification of research gaps, decision tool development and increased communication) with respect to individual native shrubs will direct problem solving and contribute to increased and more successful restoration of our native shrubs.

Bonner FT, Karrfalt RP. 2008. The woody plant seed manual. Agric. Handb. 747. Washington, DC: U.S. Department of Agriculture, Forest Service. 1223 p.
Bower AD, St. Clair JB, Erickson V. 2014. Generalized provisional seed zones for native plants. Ecol. Applications 24:913-919.

BIO: Nancy Shaw is a Research Botanist (Emeritus) with the US Forest Service, Rocky Mountain Research Station's Grassland, Shrubland and Desert Ecosystems Program. She received B.S. in Zoology from the College of Idaho, an M.S. in Botany from Idaho State University and a Ph.D. in Crop Science (seed technology emphasis) from Oregon State University. Her research interests include selection of native plant materials, cultural practices for seed production, and strategies for restoration of degraded sagebrush communities. Nancy served as Team Leader of the Great Basin Native Plant Project for 13 years prior to her retirement. She is currently a Board member of the Society for Ecological Restoration and the International Network for Seed-based Restoration.

Kristina Hufford

Department of Ecosystem Science and Management, University of Wyoming

Cultivar Vigor and Ecological Restoration: What Do We Know?

The demand for large quantities of native plant seed has largely been met through cultivation. Cultivation of native species often results in selection for large plants, prolific seed production, rapid growth rate and better establishment, leading to the hypothesis of greater "cultivar vigor" relative to wild seed sources. Use of commercial, cultivated plant materials for ecosystem restoration raises questions about impacts in native ecosystems. Are cultivars more vigorous than wild populations? Do cultivars persist over time? Here we discuss the accumulating evidence in tests of cultivar vigor and possible outcomes plant community dynamics. Our goal is to summarize recent data from comparisons of cultivated varieties and wild seed sources used in rehabilitation and reclamation. In addition, we describe results of current research to address the question of vigor and persistence of cultivars at restoration sites.

BIO: on the way

Randy Mandel

Senior Managing Ecologist, Great Ecology

Germination Protocols and the River Restoration Database

Following the 2013 flooding of Colorado's Front Range, significant attention was paid to emergency recovery needs, with subsequent focus to restoration and channel improvements. Most recovery work to date has been via master planning supported by DNR Colorado Water Conservation Board (CWCB) and implemented through local watershed coalitions. The purpose of my talk will be to discuss the CWCB searchable river restoration database that was completed in compilation with the "Living Streambanks: A Manual of Bioengineering Treatments for Colorado Streams".

The species included within the searchable database includes woody, forb, and graminoid plant types that were prioritized based on feedback to Southern Rockies Seed Network over the past several years. The database includes 51 different design parameters including nomenclature, county, hydrology, physiographic preference, morphology, seed weight, seed storability, propagules type, and germination protocol. Also included within the database are root parameters that allow better incorporation of native species into bioengineering practices. My talk will drill down into

the details and utilization of the searchable restoration database, focusing especially on the included germination protocols and their derivation.

BIO: Randy Mandel has 30+ years of experience as a restoration ecologist, and currently works for Great Ecology as their Vice President, Technical Services. His graduate and undergraduate work at CSU were in Forest Biology, Concentration Physiology and Genetics. His expertise includes the native plant ecology; plant taxonomy and synonymy; restoration design and implementation; site assessment and monitoring; ecotypic seed collection and increase; native plant propagation and cultivation; wetland delineation; threatened and endangered species survey; and the integration of native species into landscape design. Mr. Mandel's past positions include: (1) Co-Founder of Rocky Mountain Native Plants Company; (2) Co-Founder of Warm Springs Mitigation Bank; (3) USDA-NRCS Regional Native Plant Specialist; and (4) Director of the USDA-NRCS Upper Colorado Environmental Plant Center. Mr. Mandel currently serves as the lead vegetation ecologist for the State of Colorado's Flood Recovery efforts.

Poster Presentations

Natasha Coumou

Student, Pacific Island Program for Exploring Sciences, University of Hawai'i at Hilo

Understanding relationships between avian frugivores and understory plant community in hawaiian mesic forests

Seed dispersal by avian frugivores is a significant factor in determining the natural regeneration of native shrub understory at the Hakalau Forest National Wildlife Refuge (Hakalau Forest NWR), Hawaii where dispersal of forest plants seeds largely depends on birds. Understanding the relationship between the density of the fruiting understory plants and avian frugivore visitation rates as well as the conditions that influence it, can help in determining reforestation strategies that facilitate seed dispersal. Establishing transects we quantified the density of four common species of fruiting understory shrubs—olapa (Cheirodenron trigynum), ohelo (Vaccinium spp.), akala (Rubus hawaiensis), and sawtooh blackberry (Rubus argutus)— in two types of habitats: native koa-ohia forest with native shrub understory (intact), and native koa-ohia forest with invasive grasses and native shrub understory (reforested) area to establish baseline differences between type of habitats. We monitored 19 olapa (intact N=13, reforested N=6) and 20 ohelo (intact N=14, reforested N=6) fruiting plants to record visitation by the Japanese White-eye (Zoosteros japonicus), Red-billed Leiothrix (Leiothrix lutea) and Omao (Myadestes obscurus) in aim of comparing bird visitation rates. The monitored shrubs, were further categorized by immediate surroundings (presence/absence of neighbors). The density of two species (olapa and ohelo) was higher in the intact area. There was no difference in visitation rates between habitats. In 100% of the cases the shrubs with no neighbor had no bird visits, regardless of type of habitat. These observations may turn the attention to not only the availability of food to avian frugivores, but also the environment setting in which the food is found. This limited research can influence the decision making in future restoration efforts in the Hakalau Forest NWR. Planting fruiting shrubs closer together may directly impact the likelihood of seed dispersal of understory shrub species in island ecosystems.

April Goebl

PhD student, Department of Ecology and Evolutionary Biology, University of Colorado Boulder

Evaluating phenotypic and genotypic variation in Helianthus annuus and H. petiolaris ecotypes

Furthering our understanding of local adaptation and the role of genetic variation in native plant populations is important for informing restoration and conservation efforts. In order to improve population persistence in increasingly variable climates, research into how plants adapt to changing environments is becoming ever more pertinent. Our current work is aimed at investigating phenotypic and genotypic variation of different ecotypes of both *Helianthus annuus* and *H. petiolaris* from across the range of both species. Preliminary experiments have included 10 ecotypes of each species, originating from different elevations and precipitation regions, grown in a common garden experiment in

Lefthand Canyon (approximately 10 miles north of Boulder, CO, USA). Firstly, we are determining individual plant fitness to address the following questions: 1) Based on climate data from the home location, can we predict the performance of each ecotype in a given environment? And 2) Are some ecotypes more successful in a wider range of environments than others? Additionally, we are measuring a selection of phenotypic traits in order to infer functional explanations for success via correlations to fitness. Lastly, we will perform population level genomic analysis; here we seek to identify genomic regions that may be involved in local adaptation and quantify genomic variation within populations as it may pertain to the ability of each ecotype to adapt.

Annette Miller

Biological Science Lab Technician USDA/ARS National Laboratory for Genetic Resources Preservation, Fort Collins, CO USA

Dormancy as an ecotypic variation indicator

The seed quality lab at USDA/ARS National Laboratory for Genetic Resources Preservation (NLGRP) tests the viability of a wide range of wild-collected seeds from the BLM's Seeds of Success program as part of preparations for long term storage. For species that exhibit a range of dormancy from very low to very high, we wondered if dormancy behavior was an indicator of ecotypic variation. We evaluated the correlation of dormancy data with a number of environmental factors for a number of species. For *Heliomeris multiflora*, we found a significant positive correlation showing a relationship of high dormancy and xeric conditions. We also found high dormancy was correlated with extreme diurnal temperature swings for this species. Our poster will elaborate on our analyses and discuss the limitations and implications of our findings.

Jon Plybon

Graduate student, Master of Natural Resources Stewardship – Ecological Restoration, Colorado State University

Sustainability implications of soil amendments in coal mine restoration

Ecosystem services are essential for human survival, and yet these critical services are in substantial decline. Anthropogenic disturbances have resulted in the degradation of nearly two-thirds of the planet's ecosystems. Conservation of intact ecosystems and restoration of degraded ecosystems are both crucial for sustaining human systems. This report reviews a pilot project comparing a number of different soil amendments and the efficacy of those amendments in establishing native vegetation and soil health in an area damaged by coal mining waste in Western Colorado. It is a continuation of the United States Forest Service Upland Restoration Project at Coal Basin, a watershed that has experienced significant impacts from the coal mining industry over the last century. This project was conducted to determine the cost-effectiveness and utility of using soil amendments and native plants for landscape-scale restoration. Environmental and social impacts of the various amendments were also evaluated to determine which approach provided the most sustainable method for restoring damaged soils. Although the results of this study are preliminary, the anecdotal evidence indicates that certain native plants may be better suited than others, and that compost provides the most benefit with the least economic cost and environmental risk when restoring drastically disturbed soils. Continued monitoring and experimentation is required for a more definitive analysis of soil amendments and native plants in coal mine restoration.