2017 National Native Seed Conference

Native Plant Materials Development, Production & Use in Habitat Restoration

Program Guide & Schedule

NATIVE SEED NETWORK

Institute for Applied Ecology

Washington, D.C.

February 13 - 16, 2017

Hotel Map

Omni Shoreham
Main Level

Schedule AT-A-GLANCE

Sunday February 12

4:00 p.m. – 8:00 p.m.	Registration open, Palladian Foyer

Monday February 13

7:30 a.m. – 7:00 p.m.	Registration open, Palladian Foyer
8:30 a.m. – 12:00 p.m.	Field trip U.S. National Arboretum
9:00 a.m. – 12:00 p.m.	Field trip U.S. Botanic Garden Production Facility
9:30 a.m. – 12:30 p.m.	Field trip Smithsonian National Museum of Natural History
10:00 a.m. – 11:30 a.m.	Workshop: Seed Mix Design, Blue Room
1:00 p.m. – 4:00 p.m.	Field trip Norman A. Berg National Plant Materials Center
2:00 p.m. – 4:00 p.m.	Field trip Dumbarton Oaks Park
2:00 p.m. – 3:30 p.m.	Native Seed: Planning, Processing, Increase, and Application, Blue Room
4:30 p.m. – 6:30 p.m.	Next Steps: Initiating a New IUCN Seed Conservation Specialist Group, Blue Room

Tuesday February 14

7:30 a.m.	Registration open, Palladian Foyer
8:00 a.m. – 9:30 a.m.	General session, Palladian
9:30 a.m. – 10:00 a.m.	Coffee break, Diplomat
10:00 a.m. – 12:00 p.m.	Concurrent sessions: Palladian, Blue Room, Congressional, and Cabinet
12:00 p.m. – 12:20 p.m.	Lunch (on your own)
1:20 p.m. – 3:00 p.m.	Concurrent sessions: Palladian, Blue Room, Congressional, and Cabinet
3:00 p.m. – 3:20 p.m.	Coffee break, Diplomat
3:20 p.m. – 4:40 p.m.	Concurrent sessions: Palladian, Blue Room, Congressional, and Cabinet
4:45 p.m. – 6:45 p.m.	Poster & exhibit session, Diplomat

Wednesday February 15

7:30 a.m.	Registration open, Palladian Foyer
8:00 a.m. – 9:30 a.m.	General session, Palladian
9:30 a.m. – 10:00 a.m.	Coffee break, Diplomat
10:00 a.m. – 12:00 p.m.	Concurrent sessions: Palladian, Blue Room, Congressional, and Cabinet
12:00 p.m. – 1:20 p.m.	Lunch (on your own)
1:20 p.m. – 3:00 p.m.	Concurrent sessions: Palladian, Blue Room, Congressional, and Cabinet
3:00 p.m. – 3:30 p.m.	Coffee break, Diplomat
3:30 p.m. – 4:50 p.m.	Small group work sessions, Palladian, Blue Room, Congressional, and Cabinet
5:00 p.m. – 7:00 p.m.	Reception at the U.S. Botanic Garden Conservatory
5:15, 5:30, & 5:45 p.m.	Buses departing Omni for U.S. Botanic Garden

Thursday February 16

7:30 a.m.	Registration open, Palladian Foyer
8:00 a.m. – 9:30 a.m.	Concurrent sessions: Palladian, Blue Room, Congressional, and Cabinet
9:30 a.m. – 10:00 a.m.	Coffee break, Diplomat
10:00 a.m. – 11:00 a.m.	Concurrent sessions: Palladian, Blue Room, Congressional, and Cabinet
11:00 a.m. – 1:00 p.m.	General session, Palladian

ACKNOWLEDGEMENTS

Program Committee:

Matthew Benson, BFI Native Seeds
Patricia DeAngelis, USFWS
Steve Bosak, Tenworth Advisors
Jim Eckberg, Xerces Society for Invertebrate Conservation
Andy Ernst, Ernst Conservation Seeds
Rob Fiegener, Native Seed Network, Institute for Applied Ecology
Anne Frances, NatureServe
Megan Haidet, Seeds of Success
Kay Havens, Chicago Botanic Garden
Greg Houseal, Tallgrass Prairie Center, University of Northern Iowa
Sarah Kulpa, USFWS
Elizabeth Leger, University of Nevada, Reno
Sara Oldfield, Biodiversity Consultant
Peggy Olwell, BLM
Nancy Shaw, Society for Ecological Restoration
Carol Spurrier, US Forest Service
Ed Toth, Greenbelt Native Plant Center, City of New York
Victor Vankus, National Seed Laboratory, US Forest Service
Rob Ziehr, Plant Materials Program, NRCS

Field Trip Partners:

Gary Krupnick, Smithsonian Institution
Floyd Shockley, Smithsonian Institution
Anna Mische John, US Botanic Garden
Bill McLoughlin, US Botanic Garden
Kevin Conrad & staff of the National Arboretum, Agricultural Research Service
John Englert & staff of the Plant Materials Center, Natural Resources Conservation Service
Ann Aldrich, Dumbarton Oaks Park Conservancy
Amanda Shull, Dumbarton Oaks Park Conservancy

Graphic Design: Jessie Brothers, Institute for Applied Ecology

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2017 National Native Seed Conference

Native Plant Materials Development, Production & Use in Habitat Restoration

Welcome to Washington, D.C. and the fourth meeting of the National Native Seed Conference! I'm delighted to bring this community together with so many people dedicated to the successful development and deployment of native seed. The goal of this conference is to connect research, industry, land management, and restoration professionals, providing the premier opportunity to develop relationships and share information about the collection, research and development, production, and use of native plant materials. I'm excited to provide this opportunity for exchanging ideas and I hope during your time here you make many new connections that make your work more productive and enjoyable. The schedule is packed – I hope you find the program to be informative and inspiring, and your time here rewarding.

– Rob Fiegener, *conference chair*

Conference Planning Committee:

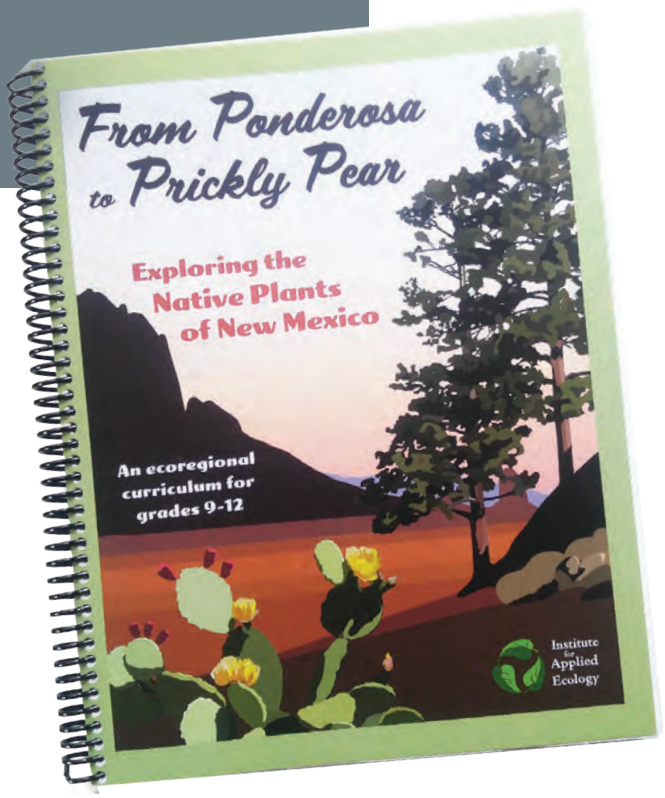
Rob Fiegener, Native Seed Network
Tom Kaye, Institute for Applied Ecology
Peggy Olwell, Bureau of Land Mangement
Patricia DeAngelis, U.S. Fish and Wildlife Service
Sarah Kulpa, U.S. Fish and Wildlife Service
Nancy Shaw, U.S. Forest Service

CONTENTS

Schedule	1
Schedule At-A-Glance	ii
Oral Abstracts:	
Monday	14
Tuesday	14-35
Wednesday	35-55
Thursday	55-65
Poster Abstracts	66
Venue map	Inside front cover
Plenary bios	Inside back cover

JUST RELEASED!

New Mexico *Native Plant Curriculum*



The Institute for Applied Ecology is excited to announce a new curriculum for native plants: *From Ponderosa to Prickly Pear · Exploring the Native Plants of New Mexico.* This high-school level ecoregional curriculum offers a complete study of native plants. Lessons encourage students to explore what is outside their door and to journey through the flora, ecology, landscape management, and cultural plant relationships unique to New Mexico and the Southwest.

Visit www.appliedeco.org to download a pdf of the curriculum or to order hard copies. An instructional webinar will be held for educators in Spring 2017. This project was made possible thanks to funding from the Bureau of Land Management and the Native Plant Society of New Mexico.

U.S. Botanic Garden *Reception*

Wednesday • 6:00 p.m. - 8:00 p.m.

Food and drink served. Bus transportation provided. Buses will leave the Omni Hotel from the Blue Room Prefunction area at 5:15 p.m., 5:30 p.m., and 5:45 p.m. Buses will leave the Botanic Garden at 7:30 p.m., 7:45 p.m., and 8:00 p.m. to return to the Omni.

MONDAY, ALL DAY

7:30 a.m.	Registration Open • **Palladian Foyer**	

MONDAY FIELD TRIPS

Field trips meet in the Blue Room Prefunction area

8:30 a.m.- 12:00 p.m.	U.S. National Arboretum	
9:00 a.m.- 12:00 p.m.	U.S. Botanic Garden Production Facility	
9:30 a.m.- 12:30 p.m.	Smithsonian National Museum of Natural History	
1:00 p.m.- 4:00 p.m.	Norman A. Berg National Plant Materials Center	
2:00 p.m.- 4:00 p.m.	Dumbarton Oaks Park	

MONDAY SYMPOSIA AND MEETINGS

8:00 a.m. - 5:00 p.m.	**BLM Plant Conservation Program Meeting** *(invite only)*	**Forum**
10:00 a.m.- 11:30 a.m.	**Ecological Restoration Considerations in Purpose Specific Seed Mix Design** *Christine Taliga, Natural Resources Conservation Service & National Park Service*	**Blue**
2:00 p.m.- 3:30 p.m.	**Symposium: Native Seed: Planning, Processing, Increase, and Application** *Megan Haidet, Kayla Herriman, Jason McNeal, Lynda Moore*	**Blue**
4:30 p.m.- 6:30 p.m.	**Next Steps: Initiating a New IUCN Seed Conservation Specialist Group**	**Blue**

Program Schedule

FEBRUARY 14TH

TUESDAY MORNING

7:30 a.m.	Registration Open • **Palladian Foyer**
8:00 a.m.-9:30 a.m.	Welcome Plenary • **Kristin Bail, Jean Franczyk, Mike Quigley** • **Palladian Room**
9:30 a.m.	Morning break • **Diplomat Room (30 minutes)**

TUESDAY SYMPOSIA AND MEETINGS

(Choose from four session topics)

Location	Palladian	Blue
Topics	**OPENING SESSION**	**SEED TRANSFER GUIDELINES**
10:00 a.m.	**Ecological resilience, adaptation and emergency preparedness - the need for seeds** Organizer: *Peggy Olwell, Bureau of Land Management*	**Building A Common Garden Network for High Throughput Seed Transfer Development** *Francis Kilkenny*
10:20 a.m.	**Seeding the Future: Creating Resilient Habitats to Benefit People and Wildlife** *Bruce Stein, National Wildlife Federation*	**Assessing Seed Zone Efficacy Using Two-Year Old Blue Bunch Wheatgrass** *Holly R. Prendeville*
10:40 a.m.	**Resilience in All Policies** *Linda Langston, National Association of Counties*	**Early Assessment of Local Adaptation in Juvenile Prairie Grasses** *Shelby Flint*
11:00 a.m.	**Colorado Resiliency Framework** *Iain Hyde, Colorado Office of Resiliency and Recovery*	**Predictive Provenancing: Can Southern Sourced Seeds be used in Midwest Restoration Efforts?** *Christopher Woolridge*
11:20 a.m.	**NY Rising** *Rachel Wieder, Governor Andrew M. Cuomo's Office of Storm Recovery*	**Intraspecific Variation In Germination Responses of *Asclepias Spp.*: Investigating Climatic Sensitivity Among Three Congeners** *Jessamine Finch*
11:40 a.m.	**Southern Grasslands, Initiative** *Dwayne Estes, Austin Peay State University* **Panel Discussion**	**Provisional Seed Zones for ʻŌhiʻa (*Metrosideros* Spp.) On Kauaʻi: A Mitigation Strategy for a New Fungal Pathogen** *Adam M. Williams*
12:00 p.m.	**LUNCH BREAK • ON YOUR OWN (80 minutes)**	

TUESDAY MORNING

7:30 a.m.	Registration Open • **Palladian Foyer**
8:00 a.m.- 9:30 a.m.	Welcome Plenary • **Kristin Bail, Jean Franczyk, Mike Quigley** • **Palladian Room**
9:30 a.m.	Morning break • **Diplomat Room (30 minutes)**

TUESDAY SYMPOSIA AND MEETINGS

(Choose from four session topics)

Location	Congressional	Cabinet
Topics	**SEED PRODUCTION**	**PLANT MATERIALS DEVELOPMENT**
10:00 a.m.	**Ecological Pest Management for the Native Seed Industry: A Multi-State Case Study** *Eric Lee-Mäder*	**Restoring Species Diversity: Uncovering the Gaps in the Native Seed Market** *Abbey White*
10:20 a.m.	**Native Forb Seed Production** *Kelsey Prickett*	**Development of Commercial Seed Supplies of Native Milkweeds and Pollinator Plants for Texas** *Forrest Smith*
10:40 a.m.	**Propagating Local Ecotype Native Plants from Local Native Seed to Preserve Biodiversity in Maryland** *Christopher F. Puttock*	**Development of Legume Germplasm Native to the Semi-Arid Western USA** *Shaun Bushman*
11:00 a.m.	**Wild Seed Project: Grassroots Seed Propagation of New England Native Plants** *Heather McCargo*	**Native Thistles: Significant Yet Underappreciated Plants For Habitat Restoration** *Eric Lee-Mäder*
11:20 a.m.	**Differential Seed Dormancy and Germination Requirements of Two Upland Prairie Sedges** *Kelly D. Broadlick*	**From the Wild to Farm and Back Again: A Strategy for Native Plant Material Development and Utilization** *Kevin Gunnell*
11:40 a.m.	**Are Plant Populations Evolving During the Process of Seed Increase for Restoration?** *Julie R. Etterson*	**Discussion**
12:00 p.m.	**LUNCH BREAK • ON YOUR OWN (80 minutes)**	

TUESDAY AFTERNOON

Location	Palladian	Blue
Topics	**PANEL DISCUSSION**	**SYMPOSIUM**
1:20 p.m. - 3:00 p.m.	**Panel: Public/Private Partnerships in Conservation Plantings: Past Successes and Future Opportunities** **Organizer:** *Virginia Houston, American Seed Trade Association* **Panelists:** *Kreig Rasmussen, US Forest Service* *Danny Summers, Utah Department of Wildlife* *Scott Uhrig, Bureau of Land Management* *Rob Wendell, Granite Seed Company*	**NRCS Plant Materials Program (PMP) Plant Development Efforts for Revegetating Landscapes: History, Successes, Challenges, and Future Directions** **The NRCS PMP: An 80-Year History of Plant Development** *John Englert* **Native Plant Selection to Improve Rangeland Health in the Northern Great Plains** *Joe Scianna* **Cooperative Plant Development in the Southwest US** *Heather Dial* **Partners in Plant Solutions: Collaborative Approaches to Resource Management in South Texas** *John Reilley and Forrest Smith* **Future Plant Development Activities in the NRCS Plant Materials Program** *Ramona Garner*
3:00 p.m.	**AFTERNOON BREAK - Diplomat (30 minutes)**	
Topics	**SEED QUALITY**	**INNOVATIONS IN SEED TECHNOLOGY**
3:30 p.m.	**A Bottom-Up Approach to Seed Quality and Certification: A Survey of the Native Seed Community** *Holly Abbandonato*	**New 'Flash Flaming' Technique Improves Seed Handling and Coating Potential of Difficult-To-Handle Grass Species** *Todd E. Erickson*
3:50 p.m.	**Panel: Weed Contaminant in Native Seed - Challenges of Meeting Reliable Seed Demand** **Organizer:** *Steve Popovich, US Forest Service* **Panelists:** *Steve Popovich, US Forest Service; Christine Taliga, Natural Resource Conservation Service; Jerry Benson, BFI Native Seeds; Randy Crowl, CSU Seed Lab; Patricia Roller, Bureau of Land Management* **Moderator:** *Adrienne Pilmanis, BLM*	**Seed-based Approaches to Improving Restoration of Dryland Systems** *Olga A. Kildisheva*
4:10 p.m.		**Enhancing Native Forb Establishment in the Great Basin Using Snow Fences, N-sulate Fabric, and Seed Coatings** *Adam Fund*
4:30 p.m.		**Soils Rehabilitation with Biocrusts: A Review of Current Technologies** *Kyle Doherty*
5:00 p.m. - 7:00 p.m.	**Poster Exhibit; Workshop:** Challenges of Sampling and Testing Seed of Native Species - **Diplomat**	

TUESDAY AFTERNOON

Location	Congressional	Cabinet
Topics	COLLECTION STRATEGY	POLICIES AND OPPORTUNITIES
1:20 p.m.	**Distributions and Collecting Priorities for Crop Wild Relatives in the United States** *Colin K Khoury*	**The Roles of Seed Science and Restoration in the Integrated Rangeland Fire Management Strategy** *Deborah Finch*
1:40 p.m.	**How Much Seed is Needed for Ex Situ Collections: Ash as a Case Study** *Sean Hoban, Simon Kallow, Clare Trivedi*	**National Park Service Policies for Seed Collections and Use** *Gregory E. Eckert*
2:00 p.m.	**Using Climate Change Vulnerability Assessments for Rare Plant Conservation in the Western United States** *Shannon Still*	**Native Plant Use and Ecosystem Services Considerations at Superfund Sites** *Jewel Lipps*
2:20 p.m.	**Bi-state Strategic Native Forb Seed Collection and Increase Efforts** *Susan Fritts*	**Invasive Species Management, Restoration and the Use of Native Seeds and Plants** *Stanley Burgiel*
2:40 p.m.	**Discussion**	**The Use of Native Species in Assessing and Implementing Bonn Challenge Commitments to Forest Landscape Restoration** *Craig Beatty*
3:00 p.m.	**AFTERNOON BREAK - Diplomat (30 minutes)**	
Topics	MOLECULAR GENETICS	POLICIES AND OPPORTUNITIES
3:30 p.m.	**Beyond Climate: Incorporating Novel Factors into Seed Transfer Guidelines** *Alexis Gibson*	
3:50 p.m.	**Integrating Molecular Genetics into Seed Management Programs** *Valerie Hipkins*	
4:10 p.m.	**The Applicability of Next-Generation Sequencing to Native Plant Materials Development** *Rob Massatti*	
4:30 p.m.	**Genetic and cytotypic variability in a dominant southwestern grass *(Bouteloua gracilis)*: Implications for restoration and seed sourcing** *Katrina Tso*	
5:00 p.m. - 7:00 p.m.	**Poster Exhibit; Workshop:** Challenges of Sampling and Testing Seed of Native Species - **Diplomat**	

WEDNESDAY MORNING

7:30 a.m.	Registration Open • **Palladian Foyer**	
8:00 a.m.- 9:30 a.m.	Plenary Session • **Ann Bartuska, Cristina Eisenberg, Tom Kaye** • **Palladian Room**	
9:30 a.m.	Morning break • **Diplomat Room (30 minutes)**	
Location	**Palladian**	**Blue**
Topics	**PANEL DISCUSSION**	**ECOLOGICAL RESTORATION**
10:00 a.m.	**Panel: Implementing the Pollinator Friendly Native Seed Reserve** Organizer: *Carol Spurrier, U.S. Forest Service* **Panelists:** *Cynthia Martinez, Chief of the Refuge System, USFWS* *Eric Lee-Mäder, Xerces Society* *Andy Ernst, Ernst Conservation Seed* *Others TBA*	**Evidence for Long-term Persistence of Cultivars in Ecological Restoration** *Kristina M. Hufford*
10:20 a.m.		**Use of Native Grasses and Forbs for Diversification of Crested Wheatgrass Stands** *Jerry Benson*
10:40 a.m.		**The South Texas Approach to Restoring Native Vegetation on Exotic Invaded Landscapes** *John Reilley*
11:00 a.m.		**Manipulating Cheatgrass Seed Dispersal to Benefit Native Plants** *Danielle Johnston, Phillip Chapman*
11:20 a.m.		**Functional Diversity in Prairie Plant Communities: A Barrier to Invasion Modulated by Nitrogen** *Jacob Zeldin*
11:40 a.m.		**Using Past Restoration Treatments to Inform Future Seed Sourcing in the Colorado Plateau** *Andrea Kramer*
12:00 p.m.	**LUNCH BREAK • ON YOUR OWN (80 minutes)**	

WEDNESDAY MORNING

7:30 a.m.	Registration Open • **Palladian Foyer**	
8:00 a.m.- 9:30 a.m.	Plenary Session • **Ann Bartuska, Cristina Eisenberg, Tom Kaye** • **Palladian Room**	
9:30 a.m.	Morning break • **Diplomat Room (30 minutes)**	
Location	**Congressional**	**Cabinet**
Topics	**SEED NETWORKS**	**NATIVE SEED COLLECTION TOOLS**
10:00 a.m.	**The Emergence of Seed Networks as an Effective Strategy in Building Regional Cooperation to Improve Native Seed and Plant Material Development and Delivery** **Introduction:** *Ed Toth, City of New York; Megan Haidet, Seeds of Success (10 minutes)* **Presentations** *(20 minutes each)*	**Weather and Climate Tools for Rangeland Restoration Planning and Management** *Stuart Hardegree*
10:20 a.m.		**Matching Seed to Site By Climate Similarity: Tools to Prioritize Plant Materials Development and Use** *Kyle Doherty*
10:40 a.m.	**The Great Basin Native Plant Project: A Plant Material Development Partnership** *Francis Kilkenny, Fred Edwards*	**How do I find seeds?: Using AIM and Other Datasets to Locate Viable collection Populations** *Jessa Davis*
11:00 a.m.	**Creating a Southwest Seed Partnership to Implement the National Seed Strategy in New Mexico and Arizona** *Melanie Gisler* **Colorado Plateau Native Plant Program** *Adrienne Pilmanis*	**Elements of an Ecologically Designed Seed Mix for Tallgrass Prairie Plantings** *Greg Houseal*
11:20 a.m.	**Assessing Plant Material Needs and Production Capacity: Building a Sustainable Seeds of Success in the East** *Shanyn Siegel*	**Mixing And Matching: Composition and Diversity of Commercially Available Seed Mixes Compared with Remnant and Restored Tallgrass Prairies** *Rebecca S. Barak*
11:40 a.m.	**Discussion Session (30 minutes)**	**Discussion**
12:00 p.m.	**LUNCH BREAK • ON YOUR OWN (80 minutes)**	

WEDNESDAY AFTERNOON

Location	Palladian	Blue
Topics	PANEL DISCUSSION	PLANT ESTABLISHMENT
1:20 p.m.	**Panel: Seed Industry Perspectives** **Organizer:** *Robby Henes, Southwest Seed* **Panelists:** *Robby Henes, Southwest Seed* *Mark Mustoe, Clearwater Seed* *Steve Parr, Upper Colorado Environmental Plant Center* *Blake Curtis, Curtis & Curtis Seed* *Ed Kleiner, Comstock Seed* *Jerry Benson, BFI Native Seed*	**The Role of Germination in Early Plant Establishment: Characterization of Germination Syndromes in a Highly Variable Field Environment** *Stuart Hardegree*
1:40 p.m.		**When and Where to Seed? Effects of Sowing Time and Relative Prairie Quality on First Year Establishment of 23 Native Prairie Species** *Sarah Krock*
2:00 p.m.		**Comparing Seeding Rates and Timing of Big Sagebrush *(Artemisia tridentata)* in Utah** *Danny Summers*
2:20 p.m.		**Use of abscisic acid to enhance the survival of fall sown seeds** *Matthew Madsen*
2:40 p.m.		**Comparing competition intensity between heterospecific and conspecific seedling pairings: what story do the roots have to tell?** *Alicia Foxx*
3:00 p.m.	**AFTERNOON BREAK (30 minutes)**	
Topics	ROUNDTABLE	
3:30 p.m.-5:00 p.m.	**The Right Seed in the Right Place at the Right Time: Working Together on the National Seed Strategy**	
5:15, 5:30, 5:45 p.m.	**BUS DEPARTURES for the U.S. Botanic Garden - Blue Room Prefunction area**	
6:00 p.m. - 8:00 p.m.	**Reception at U.S. Botanic Garden**	

WEDNESDAY AFTERNOON

Location	Congressional	Cabinet
Topics	SEED SELECTION TOOLS	COMMUNICATION AND PARTNERSHIPS
1:20 p.m.	**Climate-smart Seed Lot Selection Tool: Seed Sources for Restoration in the 21st Century** *Brad St. Clair*	**The #OhiaLove Project: Banking Seeds of a Hawaiian Keystone Species During the Rapid ʻŌhiʻa Death Crisis** *Marian M. Chau*
1:40 p.m.	**Techniques to Determine Big Sagebrush Subspecies in Seed Lots and Why This is Important** *Bryce Richardson*	**Trained Extension Volunteers Produce High-Quality Native Seed** *Sara Tangren*
2:00 p.m.	**Suitability For Seed Farming As Part of a Traits-Based Selection Tool for Promoting Native Cover Crops in Mediterranean Agroecosystems: A Case Study from Spanish Olive Orchards** *Stephanie Frischie*	**Enhancing the Edibility of New England's Landscapes with Native Species** *Russ Cohen*
2:20 p.m.	**The Ecoregional Revegetation Assistant: A National Online Plant Selection Utility** *Matt Horning*	**Madrean Archipelago Plant Propagation Initiative: A Strategy in Regional Plant Material Availability and Resiliency** *Francesca Claverie*
2:40 p.m.	**Discussion**	**Sage Grouse Habitat Conservation Through Prisons** *Shannon Swim*
3:00 p.m.	**AFTERNOON BREAK (30 minutes)**	
3:30 p.m.-5:00 p.m.		
5:15, 5:30, 5:45 p.m.	**BUS DEPARTURES for the U.S. Botanic Garden - Blue Room Prefunction area**	
6:00 p.m. - 8:00 p.m.	**Reception at U.S. Botanic Garden**	

THURSDAY MORNING, PART ONE

7:30 a.m.	Registration open • **Palladian Foyer**	
Location	**Palladian**	**Blue**
Topics	**SYMPOSIUM**	**SEED AROUND THE WORLD**
8:00 a.m.	**Overcoming the effects of plant blindness with education and outreach** **Organizers:** *Andrea Kramer & Kay Havens, Chicago Botanic Garden*	**Session Introduction: International Network for Seed-based Restoration and the Value of Partnerships** *Kingsley Dixon, Nancy Shaw, Olga Kildisheva*
8:10 a.m.	**Seventeen years of plant blindness: Is our vision improving?** *Elisabeth Schussler*	**Challenges and Opportunities for Seed-based Restoration Strategies in Chile** *Cara Nelson*
8:30 a.m.	**Visibility of plants under the Endangered Species Act: Causes and Implications** *Vivian Negrón-Ortiz*	**Addressing Seed Challenges in Lebanon and Jordan** *Karma Bouazza, Khaled Sleem, Mohammad Nsour, Anthony S. Davis*
8:50 a.m.	**Influencing the Federal Budget Process: How to Advocate for Conservation Funding** *Cameron Witten*	**Agroforestry and Citizen Science in Togo, West Africa** *Becca Lieberg and Anthony S. Davis*
9:10 a.m.	**Federal policies and funding for plants** *Rob Bradner*	**Native Plant Propagation For Restoring Rangelands** *Alicia Melgoza, Carlos Morales, Otilia Rivera*
9:30 a.m. - 10:00 a.m.	**MORNING BREAK (30 minutes)**	

FOLLOWING PAGES: THURSDAY MORNING, PART TWO

THURSDAY MORNING, PART ONE

7:30 a.m.	Registration open • **Palladian Foyer**	
Location	**Congressional**	**Cabinet**
Topics	**SYMPOSIUM**	**SEED STORAGE**
8:00 a.m.	**Texas Ecotype Approach to Commercial Native Seed Provision and Ecosystem Restoration** **Organizer:** *Forrest Smith, South Texas Natives* **Panelists:** *Forrest S. Smith* *John Reilley* *Keith A. Pawelek* *Anthony D. Falk* *Colin S. Shackelford* *John R. Bow*	
8:10 a.m.		**Does Frozen Storage Change the Germination Performance of Native Southwestern Forb Species?** *Alexandra Seglias*
8:30 a.m.		**Maternal Habitat Environment Influences of Storageability and Germination Response of Desert Seeds** *Narayana R. Bhat*
8:50 a.m.		**The Effect of Seed Storage and Water Balance Characteristics on Seed Germination Success in 26 Ficus Species from Tropical and Subtropical South China** *Uromi M. Goodale*
9:10 a.m.		**Picking From the Past in Preparation for a Pest: Assessing the Potential for Herbarium Seeds to Combat ROD** *Dustin Wolkis*
9:30 a.m. - 10:00 a.m.	**MORNING BREAK (30 minutes)**	

FOLLOWING PAGES: THURSDAY MORNING, PART TWO

THURSDAY MORNING, PART TWO

Location	Palladian	Blue
Topics	PROCUREMENT	SYMPOSIUM
10:00 a.m.	**How can California Benefit from the National Seed Strategy for Rehabilitation and Restoration** *David Gilpin*	**Integration of seed into broad-based restoration programs** *Kingsley Dixon*
10:20 a.m.	**Procurement and Contracting Challenges for the Seed Industry** *Ed Kleiner*	**The role of botanic gardens in native plant restoration** *Sara Oldfield*
10:40 a.m.	**Natives First - A Native Vegetation Standard for the Conservation Title of the Farm Bill** *Jef Hodges*	**NASSTEC: A European project aimed at strengthening collaboration among native seed stakeholders** *Costantino Bonomi, Marcello de Vitis*
11:00 a.m. - 1:00 p.m.	CLOSING PLENARY	
1:00 p.m.	ADJOURN	

THURSDAY MORNING, PART TWO

Location	Congressional	Cabinet
Topics	SYMPOSIUM	SEEDS OF SUCCESS
10:00 a.m.	*CONTINUED FROM MORNING, Part One* **Texas Ecotype Approach to Commercial Native Seed Provision and Ecosystem Restoration** *Organizer:* *Forrest Smith, South Texas Natives* *Panelists:* *Forrest S. Smith* *John Reilley* *Keith A. Pawelek* *Anthony D. Falk* *Colin S. Shackelford* *John R. Bow*	**Seed Collections for Coastal Restorations in the East** *Clara Holmes, Amanda Faucette, Michael Piantedosi*
10:20 a.m.		**Seeds of Success (SOS) Web Portal for Documenting Seed Collections** *Michael O'Neal*
10:40 a.m.		**Looking to BLM Seeds of Success as a Model and Partner to Secure Native Crop Wild Relatives** *Stephanie Greene*
11:00 a.m. - 1:00 p.m.	**CLOSING PLENARY**	
1:00 p.m.	**ADJOURN**	

MONDAY 8:00 A.M. – 4:00 P.M. FIELD TRIPS

8:30 a.m. - 12:00 p.m.	**U.S. National Arboretum**
9:00 a.m. - 12:00 p.m.	**U.S. Botanic Garden Production Facility**
9:30 a.m. - 12:30 p.m.	**Smithsonian National Museum of Natural History**
1:00 p.m. - 4:00 p.m.	**Norman A. Berg National Plant Materials Center**
2:00 p.m. - 4:00 p.m.	**Dumbarton Oaks Park**

MONDAY 10:00 A.M. – 6:30 P.M. SYMPOSIA AND MEETINGS

Monday 8:00 a.m. - 5:00 p.m. - Forum

Meeting: BLM Plant Conservation Program (invite only)

Monday 10:00 a.m. - 11:30 a.m. - Blue

Workshop: Ecological Restoration Considerations in Purpose Specific Seed Mix Design

Christine Taliga, Natural Resources Conservation Service & National Park Service

Monday 2:00 p.m. - 3:30 p.m. - Blue

Symposium: Native Seed: Planning, Processing, Increase, and Application

Megan Haidet, Kayla Herriman, Jason McNeal, Lynda Moore

Monday 4:30 p.m. - 6:30 p.m. - Blue

Next Steps - Initiating a New IUCN Seed Conservation Specialist Group

Dustin Wolkis & Marian Chau

TUESDAY 8:00 A.M. – 9:30 A.M. PALLADIAN // OPENING PLENARY

Tuesday 8:00 a.m. - Palladian

Welcome to the 2017 National Seed Network Conference

Rob Fiegener, Director, Native Seed Network, Institute for Applied Ecology

Kristin Bail, Acting Director, Bureau of Land Management

Jean Franczyk, President & CEO, Chicago Botanic Garden

Congressman Michael Quigley (D-IL)

TUESDAY 10:00 a.m. – 12:00 p.m. PALLADIAN - OPENING SESSION

Ecological resilience, adaptation and emergency preparedness - the need for seeds

Organizer: Peggy Olwell, Bureau of Land Management

This panel will address the need to restore degraded ecosystems and build ecological resilience in response to increasing frequency and intensity of extreme weather events such as wildfires, flooding, hurricanes and droughts. The critical importance of the National Seed Strategy in supporting ecological restoration as an adaptation mechanism and insurance policy will be discussed. The national policies that require ecosystem resilience as a component of emergency preparedness and homeland security will also be discussed and the relevance of the National Seed Strategy in this context will be emphasized.

Seeding the Future: Creating Resilient Habitats to Benefit People and Wildlife

Bruce Stein, Associate Vice President, Conservation Science; Climate Adaptation, National Wildlife Federation

Resilience in All Policies

Linda Langston, Director of Strategic Relations, National Association of Counties

Colorado Resiliency Framework

Iain Hyde, Deputy Director, Colorado Office of Resiliency and Recovery

NY Rising

Rachel Wieder, Director, NY Rising Buyout and Acquisition Programs, Governor M. Cuomo's Office of Storm Recovery

Southern Grasslands, Initiative

Dwayne Estes, Professor, Austin Peay State University

Panel Discussion (45 Minutes)

TUESDAY 10:00 A.M.– 12:00 P.M. BLUE SEED TRANSFER GUIDELINES

Tuesday 10:00 a.m. - Blue

Building a common garden network for high throughput seed transfer development

Francis Kilkenny, Fred Edwards

Seed transfer guidelines help ensure that genetically appropriate seed is being used in revegetation and restoration programs. These guidelines were initially developed in forestry but are now being adopted for use

in non-tree species. Developing seed transfer guidelines can be costly and often take several years to complete. This is particularly true when the goal of seed transfer guidance is to determine species-level variation in climate adaptation, which require common garden studies. Given the large number of species in need of seed transfer guidelines, methods will need to be developed to make seed transfer development more efficient. Common garden networks designed for a high-throughput of species are a way forward. This talk describes the development of a seed transfer common garden network in the Great Basin of the United States.

Dr. Kilkenny is a USFS research biologist and lead of the Great Basin Native Plant Project, an interagency project between the BLM Plant Conservation Program and the USFS Rocky Mountain Research Station. His research interests include the ecological and evolutionary impacts of climate change on native and invasive plant species, the evolution of local adaptation in native and invasive species, and the use of ecological genetics in restoration practice.

Tuesday 10:20 a.m. - Blue

Assessing seed zone efficacy using two-year old bluebunch wheatgrass

Holly R. Prendeville, Francis F. Kilkenny, J. Brad St. Clair*

Plant species span a range of climates from arid desert to temperate rain forest to alpine areas. Climatic extremes can lead to natural selection on populations leading to adaptation, improved survival and reproduction in local environments. To guide the movement of appropriate plant materials in restoration and reforestation, seed zones have been developed. Seed zones separate areas by plant performance and/or climatic conditions important to plant growth, survival, and reproduction. To examine if populations are locally adapted, we used a reciprocal transplant experiment to investigate the efficacy of bluebunch wheatgrass seed zones (*Pseudoroegneria spicata*). This experiment is being conducted in the Interior Northwest U.S. with 16 common garden sites in two transects in regions with different environmental conditions. Each site was planted with seedlings of 20 replicates from 39 populations plus two propagated lines. Across all sites, first-year survival was high (80%) and reduced in the second year to 59%. Populations varied in survival and reproduction within many sites, which is evidence of genetic differentiation among populations for these traits. Plants from local seed zones had statistically different phenology and reproduction than plants from non-local seed zones. Bluebunch wheatgrass is a perennial plant that can live for decades. Thus the first two years of life is only a glimpse into understanding how variation observed in morphology, phenology, fitness traits will affect long-term survival and fitness. Results from this experiment will determine if seed zones for bluebunch wheatgrass are delineated appropriately or if they need modification.

Holly Prendeville is currently the Coordinator for the USDA Northwest Climate Hub. Her research focuses on understanding how the environment and other species affect wild plant populations. Holly studies wild plants to comprehend factors that affect how plant populations grow, timing of life events, and how traits change over time.

Tuesday 10:40 a.m. - Blue

Early Assessment of Local Adaptation in Juvenile Prairie Grasses

Shelby Flint, Kane Keller, Georgiana May, and Ruth Shaw*

Since European settlement, formerly vast expanses of Minnesota prairie have been drastically reduced. As recognition of the value of prairies has increased, so have restoration efforts. However, such work faces daunting challenges, including adequate availability of appropriate native plant materials. Populations tend to be adapted to local abiotic conditions and to the other organisms in their local communities of origin. The geographic scale of local adaptation is not well understood, however, and must be experimentally determined to inform plant-material choice in restorations. We are investigating local adaptation in 2 prairie grasses, sideoats grama (*Bouteloua curtipendula*) and

little bluestem (*Schizachyrium scoparium*). Seed of both species was collected from 12 remnant Minnesota prairies and germinated in a greenhouse. Resulting seedlings were transplanted into a common garden and allowed to randomly cross within each of the 12 populations. The seeds thus produced were then sown into 3 evaluation sites in western Minnesota. These sites, which span 3.50 of latitude, represent "home" environments for 3 populations of each species and "away" environments of varying distance for the other nine populations. Juvenile fitness, as in-field germination rate, plant height, and leaf number, was assessed during the first growing season. This early assessment did not indicate local adaptation of sideoats grama or little bluestem. Planned future work will continue evaluation of fitness components of these long-lived species for a more comprehensive assessment of local adaptation, with the goal of clarifying the extent to which translocating species across regions affects fitness, thereby informing choice of restoration germplasm.

Shelby Flint is a post-doctoral research associate with the Healthy Prairies Project, investigating local adaptation and adaptive capacity in native prairie plant species. Her previous work focused on risks related to translocated switchgrass populations used for restoration and bioenergy projects.

Tuesday 11:00 a.m. - Blue

Predictive provenancing: Can southern sourced seeds be used in Midwest restoration efforts?

Christopher Woolridge, Emily Dangremond, Jeremie Fant, and Andrea Kramer*

Most current seed sourcing strategies in ecological restoration attempt to use locally-sourced plant material, as these are more likely to be adapted to local environmental conditions. One of the concerns with using non-local sources is that they may mix with local genotypes and possibly result in outbreeding depression in successive generations. By contrast, there is also a concern that native plant populations may not be able to adapt to the rapid rate of climate change, and the fitness of those adapted to current conditions may decline in the near future. Hence there has been increasing interest in the use of alternative seed sourcing methods that would include genotypes currently adapted to the predicted conditions of the intended restoration site. Research is needed to explicitly test the viability of using predictive seed sourcing in restoration sites to produce populations that are more resilient to future climates. In this study, we quantify relative fitness and vital rates in five commonly used restoration species (*Allium cernuum, Chamaecrista fasciculata, Lobelia inflata, Rudbeckia hirta, Sisyrinchium campestre*) from three different regions across a latitudinal gradient that represents past, present and future climates. Using a common garden experiment in the Chicago area, we determine if individuals sourced from southern latitudes significantly differ in fitness compared to individuals sourced locally, and from areas north of the study site. These data will be incorporated into demographic models to determine when and where mixing seeds from local and non-local sources may improve population establishment, survival, and reproduction in restoration plantings.

Christopher Woolridge is a master's student in the Plant Biology and Conservation program at Northwestern University and the Chicago Botanic Garden. Chris is interested in determining appropriate seed sourcing for ecological restoration in light of climate change. His work can help to plan efficient restorations and perhaps create resilient populations.

Tuesday 11:20 a.m. - Blue

Intraspecific variation in germination responses of milkweeds (*Asclepias* spp.): Investigating climatic sensitivity among three congeners

Jessamine Finch and Kayri Havens-Young*

Seed dormancy break, germination, and seedling establishment are critical stages in plant regeneration, with consequences for fitness, population persistence, and colonization. Understanding how early life stages vary–among species and populations–is essential to predicting responses to climate change and implementing successful

restorations. We predict that life history traits linked to gene flow influence environmental tolerance range, and hence, climate sensitivity. To test this relationship, we selected three common, restoration-relevant congeners presumed to differ in geographic extent of gene flow: *Asclepias incarnata*, *A. syriaca*, and *A. verticillata*. Study taxa vary in pollination syndrome, breeding type, habitat, and degree of clonality. Seed collected along a climatic gradient (44–38°N) in the Midwest U.S. was used in lab germination trials testing responses to cold stratification length and incubation temperature. A space-for-climate approach was used to examine the impact of simulated climate change on early life stages for *A. incarnata* and *A. syriaca* populations, with field plots at 41 and 38°N. Lab investigations found greater variation in germination responses among populations than species. Contrary to expectations, collection region did not significantly impact germination responses. However, collection region was significant in field trials. In response to simulated future climate, both species demonstrated earlier germination with greater overall germination. Interestingly, southern populations outperformed northern populations at both sites. These results demonstrate the complexity of early life stages, highlighting the need for increased understanding of population-level differences. Future work will investigate if observed differences in germination responses are related to each species' genetic structure.

Jessa Finch is PhD candidate in Plant Biology and Conservation at Northwestern University and the Chicago Botanic Garden. Her dissertation research investigates the impact of climate change on early plant life stages, focusing on seed dormancy break and germination of several native milkweeds (Asclepias spp.) in the Midwest U.S.

Tuesday 11:40 a.m. - Blue

Provisional seed zones for ʻōhiʻa (*Metrosideros* spp.) on Kauaʻi: a mitigation strategy for a new fungal pathogen

Adam M. Williams, Dustin Wolkis, Ben Nyberg, Seana Walsh*

Generalized Provisional Seed Zones have helped guide landscape restoration projects across the continental United States. However, this location-based approach to seed distribution has not been applied in the Hawaiian Archipelago, where highly eroded mountains, cliffs, and valleys contain many different microclimates in relatively small areas. Recently a new fungal pathogen (*Ceratocystis fimbriata*) has emerged, threatening to extirpate the most ecologically important and widespread native tree in the State, ʻōhiʻa (*Metrosideros* spp.). The disease the pathogen causes has been named Rapid ʻŌhiʻa Death (ROD) and is decimating large stands of ʻōhiʻa on Hawaiʻi Island. In preparation for the potential spread of ROD across all the islands of the State, ex situ collections are underway along with plans for reforestation. We developed provisional seed zones for the island of Kauaʻi with the aid of Geographic Information Systems software. Using local knowledge of the environment, along with climate and vegetation data, seed zone confines were delineated to capture areas of similar habitat within which seeds might be transferred while minimizing potential maladaptation. The result is a map of eleven distinct general seed zones that may be utilized to guide current seed collections, banking, and future reintroduction. Although ʻōhiʻa and the threat of ROD were the stimulus for this project, these guidelines have relevance for all native species occurring across Kauaʻi and provide a framework for future native plant conservation efforts involving widespread species in Hawaiʻi.

Mr. Williams serves as Kauaʻi Botanist for the Hawaiʻi Division of Forestry and Wildlife. After graduation from the University of Hawaii with a degree in Botany and minor in horticulture, he worked as a watershed field technician, and later as an administrator with the State's Rare Plant Program

TUESDAY 10:00 A.M. – 12:00 P.M. CONGRESSIONAL SEED PRODUCTION

Tuesday 10:00 a.m. - Congressional

Ecological pest management for the native seed industry: a multi-state case study

Eric Lee-Mäder, Jim Eckberg, and Thelma Heidel-Baker

Pests and diseases can be a major challenge for native seed producers. Unlike conventional crops, few tools or educational resources are available for managing native plant pests. When issues arise, solutions often need to be developed by individual producers through trial and error using limited information. These solutions are rarely shared among seed companies. Further complicating the situation, native seed plots are also attractive to beneficial insects and wildlife, creating significant risks whenever pesticides are used. In this session we highlight a widespread complex of pest challenges faced by milkweed seed producers across the country, and a collaborative partnership intended to help growers improve yields while minimizing impacts to beneficial wildlife. The result of this partnership is a model pest management system for milkweed focused on the principles of Integrated Pest Management (IPM) that includes 1) natural biological control as a pest preventative strategy, 2) regular crop scouting protocols, 3) establishment of damage thresholds as a basis for insecticide applications, and 4) selection and targeting of insecticides that minimize impacts on monarch caterpillars and other beneficial insects. This model system is being packaged into an open-source toolkit for distribution within the conservation and seed producer communities and provides an example of how pest management might be approached for other high value native crops.

Eric Lee-Mäder, co-director of the Xerces Pollinator Conservation Program works internationally with farmers, companies, and government agencies to enhance biodiversity in agricultural lands. His background includes work in Extension, beekeeping, and crop consulting. He has authored several books and owns Northwest Meadowscapes, a native seed farm on Washington's Whidbey Island.

Tuesday 10:20 a.m. - Congressional

Native Forb Seed Production

Kelsey Prickett

Native forb seed production offers many opportunities for success along with challenges. Various factors contribute in the decision-making process to contract with growers for field production. These factors will be addressed in this presentation and this includes species selection, seed quantity requirements, field establishment and longevity, harvest method, production yields, and cost. There is an increased demand for native forb seed and this discussion will be an informative tool for restoration project planning.

Kelsey Prickett is the Forb Production Manager at BFI Native Seeds. She has spent 7 years researching and producing more than 100 species of forbs as agricultural crops. Prior to her career at BFI, she received her Bachelor of Science degree in Plant and Soil Sciences from the University of Hawai'i. Kelsey has a deep appreciation for native plant communities and habitat restoration and is excited to share her enthusiasm for native forb seed production with others.

Tuesday 10:40 a.m. - Congressional

Propagating local ecotype native plants from local native seed to preserve biodiversity in Maryland

Christopher F. Puttock and Rochelle P. Bartolomei*

In Maryland there are only two nurseries that have as their mission to propagate native plants from locally collected seed. They are Chesapeake Natives, Inc., a dedicated local ecotype plant nursery at Mt. Airy Mansion Greenhouse in Upper Marlboro, and Montgomery County's native plant nursery facility at Pope Farm in Gaithersburg. Between these two nurseries more than 25% of the Maryland's declining native perennials are grown from seed collected from two watershed in the three counties of Montgomery County, Anne Arundel County, and Prince Georges County surrounding Washington DC. We will present a summary of our experiences in finding, storing, germinating and propagating the hard-to-find elements of the local perennial flora.

Dr. Puttock is Executive Director of Chesapeake Natives, Inc., a Research Associate at the NMMH, Smithsonian Institution, and a Board Member of the Maryland Native Plant Society and the Hawai'i Conservation Alliance Foundation. A plant systematist by training, his broad interests include landscape restoration, and declining meadow and wetland floras.

Tuesday 11:00 a.m. - Congressional

Wild Seed Project: Grassroots Seed Propagation of New England native plants

Heather McCargo

The seeds of New England native plants have different germination requirements than the seeds from warmer and dryer climates. This talk will discuss the different types of strategies needed to collect and sow northeastern wildflowers, ferns, shrubs, and trees with an emphasis on outdoor seed sowing in pots or growing beds with organic nursery practices. Growing natives from seed is a great way to produce a lot of plants inexpensively and to protect the genetic diversity of our native plants. Maine base Wild Seed Project is a 501c3 nonprofit that works to educate the general public and nursery professionals on how to demystify native seed sowing so that a wide range of citizens can participate in increasing native plant populations in developed and wild landscapes.

Heather McCargo, the founder and director of the Wild Seed Project, is an educator with 30 years of expertise in plant propagation, landscape design and conservation. She was the head plant propagator at the New England Wildflower Society's Garden in the Woods in the 90's, worked at several landscape architecture/planning firms specializing in ecological design, has been a contributor to several research projects with USAID, National Gardening Association, and with MOFGA. She has lectured nationally and is widely published in journals and magazines such as Horticulture, Taunton Press and American Nurseryman.

Tuesday 11:20 a.m. - Congressional

Differential seed dormancy and germination requirements of two upland prairie sedges

Kelly D. Broadlick and Jonathan D. Bakker*

Seeds of *Carex inops* ssp. inops and *Carex tumulicola* are desired for prairie restoration in the Puget Sound region of Washington State, but partners were struggling to establish seed increase beds due to extremely poor seed germination. In response to this need, we tested methods for breaking seed dormancy and enhancing germination. The first experiment assessed germination following different lengths of cold-moist stratification and in different temperature regimes. For *C. tumulicola*, two months of stratification resulted in 40% germination with good speed and uniformity. For *C. inops*, the highest germination (50%) was observed with no stratification and spring or late spring temperatures. These results suggest that *C. tumulicola* germinates in the spring and *C. inops* germinates in the fall. The second experiment tested whether germination was enhanced if the perigynia was removed and if seeds were exposed to smoke water or liquid smoke. Smoke diluted to 10 parts per billion increased germination by 10% for both species. Perigynia removal increased the rate of germination for *C. inops* (this treatment was not tested on *C. tumulicola*). Storage temperature may have also played a role in seed dormancy and germination. That these congeners grow in similar prairies but have distinctly different dormancy requirements demonstrates that one-

size-fits-all propagation techniques are insufficient. More research will be needed as the National Seed Strategy is implemented and new species are incorporated into restoration programs. Collaboration between universities and restoration practitioners is one way to fill these information gaps.

Kelly Broadlick works at Fourth Corner Nurseries in Bellingham, WA, a wholesale native plant nursery that supplies plant materials to restoration practitioners around the Pacific Northwest. She graduated from the University of Washington with a Master of Environmental Horticulture in August 2016.

Tuesday 11:40 a.m. - Congressional

Are plant populations evolving during the process of seed increase for restoration?

Julie R. Etterson, Erin K. Espeland, Nancy C. Emery, Kristin L. Mercer, Scott A. Woolbright, Karin M. Kettenring*

Restoration is normally conducted with the goal of creating plant populations that establish, survive, successfully reproduce, contribute to ecosystem function, and persist in the long term. For large-scale restorations, it is often necessary to rely upon plant materials that have undergone agronomic increase to produce a sufficient number of seeds. During this propagation process, restoration populations are subject to genetic sampling as well as natural and artificial selection that could result in adaptation contrasting sharply with that of native populations. In this seminar, I will draw on insights from the evolutionary and agricultural literature to illustrate how changes in the amount and type of genetic variation in agronomically produced seeds could affect plant performance in restoration. The consequences of intentional and/or inadvertent evolutionary modification of restoration materials will be discussed with respect to population viability and ecosystem function. I will describe two feasible methods to test for evolutionary change in plant materials using neutral molecular markers and/or field observations and six practices decrease the potential for unintentional evolution and maladaptation.

Julie Etterson (Department of Biology, UM-Duluth) is an ecological geneticist whose research is focused on understanding whether wild plant populations will be able to adapt fast enough to keep pace with climate change and how restoration can be used as a tool to ameliorate the negative effects of climate change.

TUESDAY 10:00 A.M. – 12:00 P.M. CABINET PLANT MATERIALS DEVELOPMENT

Tuesday 10:00 a.m. - Cabinet

Restoring species diversity: Uncovering the gaps in the native seed market

Abbey White, Jeremie Fant, and Andrea Kramer*

Many restoration efforts aim to restore high species diversity, but financial constraints and a lack of sufficient quantities of site-appropriate seed often limit the number of species that can be included in restorations. For many common species, wild-collection or commercial production produces sufficient quantities of seeds needed for large-scale restorations. For species that are threatened with extinction, small-scale, site-specific reintroductions are increasingly used to support conservation efforts. Yet these reintroductions are often seed-limited and resource-intensive, so they are only carried out for the most highly threatened species. This means that vulnerable species, which are neither common nor highly threatened with extinction, often fall through the cracks and are likely not included in restoration efforts, nor available for commercial purchase. The objective of this study is to investigate the native plant market and determine what groups of species (by conservation rank, family, etc.) are missing or underrepresented. Using publicly available online directories, I compiled a list of approximately 1350 vendors of native plant material in the United States and acquired their lists of available species. Preliminary analyses of vendors in the Western United States (presented at the 2016 National Native Seed Conference) revealed very

large percentages of plants unavailable for purchase. Here, I present the results of the analysis for the entire United States and discuss strategies for including missing species in restoration seed mixes. Additionally, I will describe the difficulties facing restoration practitioners due to the gaps in our native plant market, as well as how to move forward.

Abbey White is a master's student in the Plant Biology and Conservation program at Northwestern University and the Chicago Botanic Garden. Abbey has worked in restoration and land management in the past and is interested in strategies for improving restoration success.

Tuesday 10:20 a.m. - Cabinet

Development of commercial seed supplies of native milkweeds and pollinator plants for Texas

Forrest Smith, Anthony Falk, Keith Pawelek, John Reilley, Chris Best, and Shelly Maher*

Native milkweeds are difficult to produce seed of commercially, resulting in prohibitively expensive seed that is impractical for use in large scale restoration projects. We began work in 2015 to determine better techniques to produce more affordable milkweed seeds, and make seed source selections to enable large scale seed provision to meet agency and consumer demand for seed. Several species of milkweed are common in South, Central, and West Texas, but the most geographically widespread species are zizotes, green antelopehorn, and antelopehorn milkweeds. Of these species, zizotes milkweed has the growth form and seed production ability most conducive to large scale seed production. In 2016, we selected two top-performing zizotes milkweed populations from an evaluation of 40 Texas milkweed populations, and grew 800 plants for establishment of seed production plots, and began harvesting seed. Pending successful refinement of harvest and seed cleaning procedures, we hope to start distributing zizotes milkweed seeds to commercial seed companies by spring 2017 to enable large scale seed production. We have also determined that some secondary milkweed species may have commercial potential, especially thin milkweed. In addition to milkweeds, we have also made selections of known-origin plant materials and began increasing ecotypic selections of a number of other pollinator plants, especially those that may provide benefit as nectar plants to migrating monarchs. Commercial availability of regionally adapted and affordable seed sources of native milkweeds and nectar will enable efforts throughout Texas to restore and enhance monarch habitat.

Forrest Smith is the Dan L Duncan Endowed Director of the South Texas Natives and Texas Natives Seeds Projects at the Caesar Kleberg Wildlife Research Institute. He has worked for the programs since 2001, and led the efforts since 2008. He earned a B.S. in Range and Wildlife Management from Texas A&M University-Kingsville.

Tuesday 10:40 a.m. - Cabinet

Development of legume germplasm native to the semi-arid western USA

Shaun Bushman, Doug Johnson, Thomas Jones*

After wildfire or other disturbances, revegetation efforts with native legumes can increase plant biodiversity, native pollinator resources, soil fertility (via nitrogen fixation in association with rhizobial bacteria), and forage quality for wildlife and livestock. However, obtaining sufficient seed for revegetation is challenging as hand collected seeds are of unpredictable quality and quantity, and agronomic seed production is lacking or must be specialized for each species. To address this need, the USDA-ARS Forage and Range Research Laboratory initiated a native legume collection and germplasm development pipeline. Species native to the semi-arid western USA were identified with commercial seed production potential. Initially, collections of each species were made across their known distribution. The collections were evaluated in common garden plots for differences in morphology, productivity,

phenology, and forage quality. Collections were also evaluated with predominantly neutral DNA markers for their genetic relationships and evidence of gene flow barriers. Based on the common garden and genetic marker data, appropriate collections were selected for germplasm release. Seed germination, establishment, and harvest methods were investigated to overcome obstacles such as seed dormancy, low seedling vigor, and indeterminate flowering. These efforts have led to the germplasm releases of basalt milkvetch (*Astragalus filipes*), western prairie clover (*Dalea ornata*), and Searls prairie clover (*Dalea searlsiae*). Further releases are planned for other *Astragalus* and *Lotus* species adapted to the Great Basin and Colorado Plateau. Cooperation with seed producers, NRCS Plant Material Centers, and BLM/USFS regional offices has been critical for development of commercial seed sources for rangeland restoration.

Dr. Bushman is a research geneticist for the USDA-ARS Forage and Range Research Laboratory in Logan, Utah. He splits his time among investigations into genetic mechanisms responsible for improving turf, pasture, and range plant establishment, persistence, and drought tolerance.

Tuesday 11:00 a.m. - Cabinet

Native Thistles: Significant yet Underappreciated Plants for Habitat Restoration

Jim Eckberg, Eric Lee-Mäder, Jennifer Hopwood, Sarah Foltz Jordan and Brianna Borders*

Native thistles are largely misunderstood and wrongly maligned, despite being benign often rare plants that provide incredible value to wildlife. Numerous wild bees, butterflies, and songbirds feed on and even prefer native thistles over other wildflowers. For example, a long-term study from eastern Nebraska shows that monarch butterflies nectar on native tall thistle more than any other wildflower. Native thistles also help suppress invasive thistles. In the Great Plains, tall thistle hosts a reservoir of thistle-feeding insects that spillover onto the non-native bull thistle causing decline in this otherwise invasive plant. Despite these ecosystem benefits and the rarity of many native thistles, they have been targeted for eradication along with their invasive relatives. Several biological control insects released for invasive thistles are now feeding on native thistles with significant impacts on several rare populations. These pressures on native thistles come at a time when many native thistles are listed as threatened or endangered, and even widespread species are showing signs of decline. Many native thistles are short-lived monocarps persisting in periodically disturbed environments. Locally adapted, genetically diverse seed supplies are critical to reintroducing and conserving native thistles. However, native thistles have been virtually absent from restoration seed mixes. We will present on our novel working partnership with the native seed industry to source wild thistle foundation seed, develop production systems, market, and use native thistles in large-scale habitat restorations. We will also tell the story of native thistles including their unique natural history, ecology, and conservation status.

Tuesday 11:20 a.m. - Cabinet

From the wild to farm and back again: a strategy for native plant material development and utilization

Kevin Gunnell and Danny Summers*

Due to the research and seed procurement provided by the Utah Division of Wildlife Resources (UDWR) Great Basin Research Center, and through the proactive restoration work of Utah's Watershed Restoration Initiative (WRI) the state of Utah is in a unique position to play a role in all aspects of plant material development and utilization in wildland seeding efforts. We review the multiple strategies and efforts of plant material development that the UDWR uses to increase the availability of materials for use in landscape scale restoration and rehabilitation projects throughout the state. We discuss the prioritization and selection of species and ecotypes to meet restoration objectives, the development and testing required for establishment and growth of plant materials in both agronomic

and rangeland settings, and the strategy and role of the UDWR in the establishment and maintenance of a commercial market for the procurement and utilization of plant materials in landscape scale restoration efforts. All of these strategies and efforts are integral to the successful use of native plant materials in rangeland restoration in Utah.

Kevin Gunnell is the Utah Division of Wildlife Resources (UDWR) Great Basin Research Center (GBRC) Coordinator based in Ephraim, Utah. His work oversees the planning and implementation of multiple projects for different aspects of rangeland and habitat restoration throughout the state.

Tuesday 11:40 a.m. - Cabinet

Discussion Session (20 minutes)

TUESDAY 1:20 P.M. – 3:00 P.M. PALLADIAN PANEL DISCUSSION

Tuesday 1:20 p.m. - Palladian

Panel: Public/Private Partnerships in Conservation Plantings: Past Successes and Future Opportunities

Organizer: *Virginia Houston, American Seed Trade Association*

Panelists: *Kreig Rasmussen, US Forest Service; Danny Summers, Utah Department of Wildlife; Scott Uhrig, Bureau of Land Management; Rob Wendell, Granite Seed Company*

Success in conservation and restoration projects requires a variety of individuals and organizations working together to achieve this common goal. Federal initiatives such as the administration's Greater Sage-Grouse Conservation Strategy and the National Seed Strategy could not be carried out without the support and input of private entities like the seed industry and other allied partners. There are a broad range of issues facing conservation plantings, and each panelist will discuss their unique point of view when it comes to successful land management projects.

This panel will explore the wide range of issues facing land managers, from wildfires to seed sourcing and availability. It will also highlight specific examples of success in both public and private conservation plantings. Finally, the panel will look toward the future and discuss issues and opportunities for conservation and reclamation plantings at the local, state, and federal levels.

TUESDAY 1:20 P.M.– 3:00 P.M. BLUE SYMPOSIUM

Tuesday 1:20 p.m. - Blue

Symposium: NRCS Plant Materials Program (PMP) Plant Development Efforts for Revegetating Landscapes: History, Successes, Challenges, and Future Directions

John Englert

The USDA NRCS Plant Materials Program has a long history of plant development stretching back to the 1930's. The symposium will discuss the progression of the Plant Materials Program's plant development process, a history

of the program, and case studies from around the country illustrating challenges and accomplishments faced in revegetating landscapes to address our nation's natural resource concerns. The complexities and opportunities faced by private, public, and commercial concerns to ensure the sustained availability of native plant materials for landscape revegetation are highlighted.

The NRCS PMP: An 80-Year History of Plant Development

John Englert

Native Plant Selection to Improve Rangeland Health in the Northern Great Plains Panelist:

Robert Kilian

Cooperative Plant Development in the Southwest US

Heather Dial

Partners in Plant Solutions: Collaborative Approaches to Resource Management in South Texas

John Reilley and Forrest Smith

Future Plant Development Activities in the NRCS Plant Materials Program

Joel Douglas

TUESDAY 1:20 P.M. – 3:00 P.M. CONGRESSIONAL COLLECTION STRATEGY

Tuesday 1:20 p.m. - Congressional

Distributions and Collecting Priorities for Crop Wild Relatives in the United States

Colin K Khoury, Stephanie L. Greene, Karen A. Williams, and Chrystian C. Sosa*

Our native crop wild relatives have proved useful as genetic resources in breeding more productive, nutritious, and resilient crops. Their utilization is expected only to increase with better information on the species and improving breeding tools, but may well be constrained by their limited representation in seedbanks and the ongoing loss of wild populations due to habitat modification, invasive species, climate change and other impacts. An urgent collecting effort for native crop genetic resources is therefore warranted. We present foundational information needed to guide this effort. An inventory of U.S. crop wild relatives has prioritized taxa related to a broad range of important food, forage and feed, medicinal, ornamental, and industrial crops. Utilizing occurrence data gathered from herbaria and genebanks, resulting potential distribution models are enabling the identification of hotspots of taxonomic diversity of wild relatives in the country, and a 'gap analysis' methodology is facilitating efforts to identify those taxa and geographic areas of particular conservation concern. Results indicate that a broad range of wild relative diversity remains to be collected, and that considerable high priority taxa are distributed in areas without long-term habitat protection.

Colin Khoury works on strategies aimed at improving the conservation of crop wild relatives at the USDA ARS National Laboratory for Genetic Resources Preservation in Fort Collins, Colorado, and at the International Center for Tropical Agriculture (CIAT), Colombia.

Tuesday 1:40 p.m. - Congressional

How much seed is needed for ex situ collections: ash as a case study

Sean Hoban, Simon Kallow, Clare Trivedi*

Ex situ seed collections from natural plant populations are an important conservation strategy, in addition to providing material for habitat restoration and breeding. It is beneficial that these collections capture as much phenotypic and genetic diversity from the natural populations as possible. Recent work using simulations has suggested new guidelines for tailoring the size of a collection to a species' reproductive and dispersal modes, and population structure. However, as yet, simulations are rarely used to design customized protocols for particular species of concern. For well-studied species, such customized protocols may help yield optimized and genetically robust seed collections. Here we present a case study using *Fraxinus excelsior,* an ash species threatened with catastrophic loss due to an introduced pathogen. In the past three years, the UK National Tree Seed Project has collected more than 750,000 seed from more than 50 locations. We used spatial-referenced survey data, previous genetic studies, and a fine scale simulation model to quantitatively estimate the genetic capture of already collected seed accessions, locate the best sites to collect from next, and determine optimal numbers of seeds and maternal plants to collect from for each site. We demonstrate that this framework can be used to design collection strategies for other high priority species, and may be a useful tool for optimal, effective ex situ seed conservation.

As Tree Conservation Biologist at the Morton Arboretum, Sean Hoban works to understand, document, and conserve the genetic variation of trees species, both rare and common. His particular interests are in seed banking, seed dispersal, forest regeneration, and hybridization.

Tuesday 2:00 p.m. - Congressional

Using Climate Change Vulnerability Assessments for Rare Plant Conservation in the Western United States

Shannon Still, Kayri Havens, and Pati Vitt*

Rapidly changing global land surface temperature and precipitation patterns are altering conditions where plants grow. Many species are predicted to respond to climate change by shifting their ranges. Those unable to adapt to changing conditions or migrate to new areas may be extirpated in parts of their ranges or, in extreme cases, go extinct. We calculated distributional response to climate change, for three points in the future, for 565 rare plants in the western United States, an area with high topographic heterogeneity and varied patterns of predicted species distributional change. Using several measures for vulnerability to climate change, these models can be used to identify species that are more vulnerable and forecast areas of their range that are predicted to be less suitable in the future. Using a combined approach to aggregate results, we found that 45.0% of the rare species are predicted to be at highest risk by the 2080s while only 9.6% are presumed to have little to no risk by the 2080s. The results illustrate that current conservation status may not reflect future vulnerability. Differences in direction and magnitude of distributional change will require that each species be managed differently. As patterns of loss may not be correlated with current conservation status, such as Global Rank, endangered species status, or rare plant rank, we should not rely solely on these to prioritize conservation. These results can be helpful for focusing on the most vulnerable species, deciding where to collect seed, or whether to aid in assisted migration.

Shannon Still is Director of Plant Conservation and Curator at the UC Davis Arboretum & Public Garden. Still studies issues related to rare plant conservation, plant taxonomy, and in situ and ex situ conservation.

Tuesday 2:20 p.m. - Congressional

Bi-state Strategic Native Forb Seed Collection and Increase Efforts

Susan Fritts, Anne Halford, Berta Youtie, Nancy Shaw, and Mark Mousseaux*

Implementing a strategic and geographically explicit native seed collection process begins with coordinated efforts between Great Basin regions and states. Since 2015 Idaho and Oregon BLM offices in cooperation with the Deschutes Basin Native Plant Seedbank and the Great Basin Native Plant Project have targeted seed collection of native forb species by Provisional Seed Zones. Target species are beneficial to Greater sage-grouse and have some cultivation research completed to show how they will perform in an agricultural setting. The objective is to obtain collections within key Provisional Seed Zones where the bulk of anticipated restoration project based seed needs are and will be in the future. Once enough collections are obtained by seed zone a range of financial instruments will be used to work with the seed industry to obtain enough stock seed to further establish larger scale seed increase efforts to supply the BLM Regional Seed Warehouse with genetically appropriate seed that can be requested by seed zone. This project provides a framework for pro-actively planning to meet restoration needs for seed zones and tiers directly to National Seed Strategy Objectives such as 1.3.2 (Improve agency and partner capability to plan for seed needs by seed zone). A long-term objective is to develop a management plan for stock seed of restoration species used within each Provisional Seed Zone that would consolidate information on species quantity needed per year, appropriate species production methods, as well help refine the amount of seed required based on seed collection and quality characteristics.

Susan Fritts serves as District botanist for the BLM Vale District and has worked for the USFS and the BLM for 22 years. Earning her B.S. from Washington State University she studied botany, ecology, and entomology. Currently Susan's work includes post fire rehabilitation and sagebrush habitat restoration.

TUESDAY 1:20 P.M. – 3:00 P.M. CABINET POLICY AND OPPORTUNITIES

Tuesday 1:20 p.m. - Cabinet

The Roles of Seed Science and Restoration in the Integrated Rangeland Fire Management Strategy

Deborah Finch and Kenneth Berg*

The Integrated Rangeland Fire Management Strategy (DOI 2015) outlined the need for coordinated, science-based adaptive management to achieve long-term protection, conservation, and restoration of the sagebrush ecosystem. A key component of this approach is the identification of knowledge gaps that limit implementation of effective strategies to meet current management challenges. The Strategy calls for the development of an actionable science plan (Plan hereafter) with prioritized research needs. The priority science needs identified in this Plan represent a shared vision of the near-term science needed to inform another generation of management strategies and tools. Needs were developed by considering science planning efforts by diverse Federal and State agencies and prioritizing results in open sessions using input from managers and researchers. A team of experts then developed narratives describing the selected highest-priority needs. Each narrative describes the science need, explores recent science and syntheses, discusses science gaps that remain, and outlines a series of short-term and long-term actions for developing new knowledge, syntheses, or decision-support tools. The resulting 37 priority science needs are classified into five topics: fire, invasive plant species, restoration, sagebrush and greater sage-grouse, and climate and weather. This presentation will discuss those in the restoration topic. These priorities include the need to improve application of restoration actions, determine the factors that lead to success of those actions, understand the effects

of those actions, and develop strategic sourcing for acquiring, storing, and utilizing genetically appropriate seeds and other plant materials native to the sagebrush ecosystem for use in restoration projects.

Deborah Finch is a science program manager with the USDA Forest Service Rocky Mountain Research Station. Her research interests include ecosystem restoration, climate change, bird-habitat relationships, invasive plants, and at-risk species. She oversees a team of scientists who conduct research on restoration methods, fire ecology, invasive species, wildlife, and climate.

Tuesday 1:40 p.m. - Cabinet

National Park Service policies for seed collections and use

Gregory E. Eckert

Participation in the National Seed Strategy by multiple agencies and partners will be shaped by the mission and policies of those groups. There has been confusion regarding the National Park Service's (NPS) role in the National Seed Strategy and other plant material-related work. This talk will present NPS policy structure, but in addition provide the context for a range of policy interpretations across 400 plus units of a bottom-up organization. This will be compared against key seed-use programs and needs for NPS. I will also present emerging issues and policy direction will be presented as the NPS moves past its centennial year.

Greg Eckert is the service wide restoration ecologist for the NPS. Greg has worked across a range of ecosystem and management scenarios with the US EPA Superfund Program and The Nature Conservancy. Greg provides technical assistance and planning and policy guidance NPS units, and is the NPS representative to the Plant Conservation Alliance.

Tuesday 2:00 p.m. - Cabinet

Native Plant Use and Ecosystem Services Considerations at Superfund Sites

Jewel Lipps and Michele Mahoney*

Contaminated site remediation projects often provide the opportunity for ecological revitalization, reuse, and provision of ecosystem services. Ecological revitalization of a Superfund site is the technical process of returning contaminated land to one that supports functioning and sustainable habitat, as a complement to remediation activities. The Superfund program promotes the use of native plant species during site remediation as a natural method for providing soil cover and reducing erosion. Planting native vegetation is recommended as a best management practice (BMP) under the EPA's Green Remediation Strategy, to protect ecosystem services during cleanup and improve them for future land use. Many Superfund sites in ecological reuse relied on the use of native plant species during cleanup, for instance, Palmerton Zinc in Pennsylvania and the former Chemical Commodities Inc. in Kansas. Improving ecosystem services at sites also depends on community involvement and reuse planning. To better integrate consideration of ecosystem services during cleanup and to improve BMPs, like native plant selection, the Superfund program is developing an ecosystem services evaluation for the Green Remediation Strategy. The evaluation will be a replicable tool for identifying and quantifying ecosystem services at Superfund cleanup sites, and for communicating the ecosystem services provided by BMPs. It is anticipated that the ecosystem services evaluation will encourage the selection of native plant species during cleanup, and will promote the ecological reuse of sites. As more remediation projects incorporate native vegetation, particularly at large acreage sites, the Superfund program will need to identify sources of native plant seeds.

Jewel Lipps is an ORISE research fellow at US EPA, where she is engaged in a research collaboration project in the Office of Superfund Remediation & Technology Innovation focusing on tools for understanding, protecting and revitalizing ecosystem services at contaminated sites.

Tuesday 2:20 p.m. - Cabinet

Invasive Species Management, Restoration and the Use of Native Seeds and Plants

Stanley Burgiel

The invasive species community has long espoused prevention, eradication and control as the key tenets of effective management. However, proper restoration of invaded and other degraded habitats is critical to prevent re-invasion and to build their resilience to other stressors. Such restoration efforts rely on the provision of native seed and plants to help stabilize ecosystems and the range of services they provide. This presentation will discuss the restoration component of invasive species management, some of the challenges for operating at a landscape scale, as well as the need to maintain quality control in native seed provisioning to avoid contamination and the further spread of invasive plants. It will close with a review and solicitation for input on policy guidance related to the use of native seeds and plants in invasive species restoration programs and activities. [Note: topics in the presentation touch upon a number of the categories in the National Seed Strategy, but don't seem to be a perfect fit for any single category.

Stanley W. Burgiel ("Stas") serves as the Assistant Director for Policy and Program Coordination with the National Invasive Species Council (NISC) Secretariat, where he manages a portfolio activities related to early detection and rapid response, applications of modern biotechnology, international trade and environmental policy, and the National Environmental Policy Act.

Tuesday 2:40 p.m. - Cabinet

The use of Native Species in assessing and implementing Bonn Challenge commitments to Forest Landscape Restoration

Craig Beatty

The Bonn Challenge is an international challenge for nations to restore 150 million hectares of degraded and deforested land by 2020 and 350 million hectares by 2030. Currently over 100 million hectares have been committed to forest landscape restoration by over two dozen nations including the USA, Mexico, Rwanda, Malawi, India, and many more. There are significant botanical implications of such large-scale restoration efforts that, in some cases, seek to restore entire national land areas. One of the central challenges in this effort is retaining and restoring ecological integrity of landscapes while supporting human livelihoods and one of the most common limitations is the availability of native seed and seedlings for restoration effort. This session will explore these challenges and some of the unique nature-based solutions that the use of native species can provide in forest landscape restoration throughout the world.

Craig Beatty is a Programme Officer for the IUCN Global Forest and Climate Change Programme where he helps assess the geographic and biodiversity components of national-level assessments of Forest Landscape Restoration opportunity in support of the Bonn Challenge. He holds a Bachelor of Science Degree in Biology from the University of South Florida, and a research-based Master of Science Degree and Graduate Certificate in Environmental Science & Policy and Geographic Information Science from George Mason University.

TUESDAY 3:20 P.M. – 5:00 P.M. PALLADIAN SEED QUALITY

Tuesday 3:30 p.m. - Palladian

A bottom-up approach to seed quality and certification: a survey of the native seed community

Holly Abbandonato, Simone Pedrini, Marcello De Vitis, Costantino Bonomi, and Hugh Pritchard*

To be successful in restoring habitats, it is important to consider not only their ecological value, but also their socioeconomic and cultural value since today ecosystem-based restoration often takes a pluralist view. To meet global and European restoration targets, native seed production is essential to meet highly ambitious goals since we cannot rely solely on wild collected seeds. A recent study showed a positive economic net benefit after restoring most degraded habitats in addition to preserving biodiversity and ecosystem services. Currently, the use and production of agricultural seeds is highly regulated and strictly monitored. However, the native seed market in much of Europe and abroad is unregulated as native seed policies are either too restrictive or not nationally enforced. Thus important aspects of seed quality are not always ensured or labelled such as origin, germination or purity. A lack of quality control can have implications on transparency for buyers and sellers, presence of weed seed, genetic conservation, plant establishment, etc. We have taken a bottom-up approach to better understand the challenges associated with produced native seeds used for restoration, by sending out a survey globally to investigate the needs of native seed users (producers, researchers, practitioners). We will summarize the results on an international and intersectoral level on seed quality and certification as part of a NASSTEC (NAtive Seed Science, TEchnology and Conservation network) PhD project.

Holly completed a Bachelor of Science in Biology, and a Bachelor of Science in Environment and Natural Resource at the University of New Brunswick, Canada. She attained her Masters of Science in Biology from UiT the Arctic University of Norway studying autumn senescence in High Arctic plants. She is currently a Marie Curie Early Stage Researcher and PhD student based at the Science Museum in Trento, Italy as part of the NASSTEC (NAtive Seed Science, TEchnology and Conservation) network. This network contains 10 other PhD students and seven main partners spread throughout Europe and Australia.

Tuesday 3:50 p.m. - Palladian

Panel: Weed contaminant in native seed - challenges of meeting reliable seed demand

Organizer: *Steve Popovich, US Forest Service*

Panelists: *Steve Popovich, Botanist and Noxious Weed Program Manager, Arapaho-Roosevelt National Forests, Supervisor's Office Christine Taliga, NRCS Revegetation Technical Advisor to NPS; Jerry Benson, BFI Native Seeds; Randy Crowl, Seed Lab Analyst and AOSA President, CSU Seed Lab; Patricia Roller, National Seed Coordinator, BLM; Moderator: Adrienne Pilmanis, BLM Colorado Plateau Native Plant Program Coordinator*

Weed contaminant in seed is becoming increasingly problematic. With increasing awareness by end-users of the presence of weed in commercially-available seed, industry is challenged to provide tighter levels of acceptable weed presence in native seed at a time when contamination is becoming more difficult to control. Many users are unable to secure the seed they need due to weed presence, or use seed known to contain undesirable weeds. This is particularly important with national ramp-up of non-profit and local and federal government agency demand stemming from policy stressing use of native plant materials in revegetation, such as increasing landscape-level resiliency, sage grouse habitat restoration, and incorporation of pollinator-friendly host plants. The panel will offer

perspectives and insights from producer to quality control to end user on the magnitude and challenges of the issue, tolerances currently accepted by major government agencies, and impacts to growers and users. The panel's goal is to raise awareness and brainstorm ideas on how all stakeholders can work together to better address the issue. Join this session to share your views and engage in what is sure to be a lively group discussion.

TUESDAY 3:20 P.M. – 5:00 P.M. BLUE INNOVATIONS IN SEED TECHNOLOGY

Tuesday 3:30 p.m. - Blue

New 'flash flaming' technique improves seed handling and coating potential of difficult-to-handle grass species

Todd E. Erickson, Andrew L. Guzzomi, Miriam Muñoz-Rojas, Shane R. Turner, David J. Merritt*

Poor rehabilitation outcomes in the mined drylands of northern Western Australia have recently been highlighted by the state's EPA, stating that the required biodiversity values of undisturbed ecosystems are not being reinstated to the agreed upon standards. In this region, for example, rehabilitation has been reported to achieve less than 15% of the pre-mined plant cover and density values. This alarming scenario is repeated across most Australian and overseas landscapes that have been degraded by intense human land-use. These rehabilitation shortfalls result from a poor understanding of native seed biology and the inability to effectively deliver seeds at scale. Under current practices over 90% of seeds fail to establish into a mature plant. In recent years, we have focused on seed enhancement technologies to overcome these shortfalls which involve novel, biologically-guided engineering solutions for precision delivery of seeds that are tailored to site-specific conditions to improve plant survival. Such improved, large scale machine seeding and engineering solutions have direct application to the rehabilitation of degraded lands. In this presentation we will demonstrate the benefits of our Australian 'flash flaming' invention that removes unwanted seed appendages that impede automated seeding at large scales. This invention delivers significant seed volume and weight reduction, and improved application of artificial seed coatings that are used extensively in agriculture. Such coatings can be adapted to native seeds to facilitate precision, machine sowing and increase germination and survival, and overcome many aspects limiting the use of difficult to handle seeds in global rehabilitation

Todd received a PhD at the University of Western Australia investigating seed dormancy and germination patterns in the dryland deserts of Western Australia focused on mine site restoration and is now the Project Manager for the Restoration Seed Bank (RSB) Initiative working on an integrated research program in the same arid biome

Tuesday 3:50 p.m. - Blue

Seed-based Approaches to Improving Restoration of Dryland Systems

Olga A. Kildisheva, Matthew M. Madsen, David J. Merritt, Todd E. Erickson, and Kingsley W. Dixon

Climate change, intensive land management, and industrial-scale disturbances such as mining have led to the degradation of up to 20% of global dryland systems. Current efforts to re-establish biodiverse plant communities at a landscape-scale rely on the use of large quantities of native plant seed. Despite the substantial investment, restoration has historically had limited success in drylands because plant recruitment windows in these systems are spatially and temporally irregular and decrease with the degree and scale of ecosystem disturbance. Furthermore, seed germination and seedling emergence have been identified as the key bottlenecks to plant establishment. Limited knowledge of species requirements during these demographic stages thwarts recovery of native plant communities. For example, 80% of dryland flora is estimated to exhibit dormancy traits, many of which have not

been identified at the species level. Furthermore, of the seeds that germinate, up to 95% are lost in the emergence phase. Thus, developing an understanding of seed germination requirements can help to align in situ germination with conditions most suitable for plant survival and is key to improving the success and efficiency of seed-based restoration. This presentation outlines a practical three-step approach used to optimize germination timing and post-germination plant establishment by 1.) Classifying seed dormancy among species of restoration interest, 2.) Identifying best dormancy alleviation treatments, and 3.) Applying site- and species-specific seed enhancement technologies. We provide examples from two parallel dryland systems – cold deserts of the Great Basin Ecoregion of North America and the hot, semi-arid Pilbara Bioregion of Western Australia.

Olga Kildisheva is pursuing a Ph.D. program at the University of Western Australia in partnership with the Kings Park and the Chicago Botanic Gardens. Olga's research addresses questions surrounding seed-based restoration in dryland ecosystems of the Great Basin (North America) and the Pilbara (Western Australia).

Tuesday 4:10 p.m. - Blue

Enhancing Native Forb Establishment in the Great Basin Using Snow Fences, N-sulate Fabric, and Seed Coatings

Adam Fund, Kristin Hulvey, Douglas Johnson, Matt Madsen, Scott Jensen, Derek Tilley*

Public land management agencies, conservation organizations, and landowners are interested in expanding the biodiversity of rangeland plantings. While the establishment of native grasses and shrubs on Great Basin sage-steppe sites is increasingly successful, the establishment of native forbs remains notoriously low. In the Great Basin, low soil water and fluctuating soil temperature conditions are thought to contribute to poor forb establishment. We compared the efficacy of two main treatments for enhancing native forb establishment: snow fences and N-sulate fabric. Treatments were selected based on their potential to improve soil water and soil temperature conditions. We replicated these treatments plus a no-treatment control across three sites in the Great Basin; two in Utah and one in Idaho in a randomized complete block design. Sites spanned a latitudinal gradient to encompass different precipitation and temperature regimes. Within main treatments, we additionally examined whether three fungicide and two hydrophobic seed coatings enhanced seed germination and establishment. We measured establishment and survival monthly from March to July 2016. The effects of snow fence and N-sulate treatments varied by site, with snow fences increasing establishment at the most southerly site, and N-sulate increasing establishment at one of the two northerly sites. Seed coatings significantly increased establishment at all sites, suggesting that these coatings provided an advantage that is sustained across latitudinal gradients. Our findings suggest that restoration treatments that alter abiotic conditions and enhance seed germination can increase native forb establishment in the Great Basin.

Adam Fund is an M.S. student in Ecology in the Department of Wildland Resources at Utah State University. His research interests include: restoration ecology, plant-soil interactions, and utilizing novel techniques for increasing native plant establishment.

Tuesday 4:30 p.m. - Blue

Soils rehabilitation with biocrusts: a review of current technologies

Kyle Doherty, Matthew Bowker, Anita Antoninka, Henry Grover, Rebecca Durham*

Biocrust restoration is a growing field that provides practitioners with new tools to achieve management objectives of soil stabilization, increased ecosystem functionality, and carbon sequestration. Mosses are an important component of biocrust and we have developed techniques to propagate and reintroduce a variety of species to

dryland and forested systems. In drylands we have focused our efforts on a dominant moss genus, *Syntrichia,* which is highly drought tolerant and adept at soil stabilization. We investigated greenhouse propagation techniques for *Syntrichia* spp. to optimize increase, found evidence of local adaptation, explored the importance of hardening prior to inoculation, and present findings on the success of field establishment, achieving doubling of cover after one year. In *Pinus ponderosa* and mixed-conifer systems of the western United States, a community of mosses follow fire and have potential as a post-fire soil stabilization measure. We have demonstrated rapid increase of fire moss components in the greenhouse, achieving 250% increase in cover over the course of nine weeks. We also present our work in progress of adapting existing technologies, such as seed drilling, to biocrust restoration so that they can be cost-effectively integrated into existing management strategies. While much work remains to return biocrusts to the landscape at large scales, our efforts demonstrate the unique opportunity of rapid response to disturbance with these organisms, which can complement existing strategies to rehabilitate degraded systems.

Kyle Doherty is a PhD student at the Northern Arizona University School of Forestry. He investigates novel techniques to restore soils in drylands and develops web-based statistical and decision support tools for scientists and land managers.

TUESDAY 3:20 P.M. – 5:00 P.M. CONGRESSIONAL MOLECULAR GENETICS

Tuesday 3:30p.m. - Congressional

Beyond Climate: Incorporating Novel Factors into Seed Transfer Guidelines

Alexis Gibson, Cara Nelson, Lila Fishman, Susan Rinehart*

Climate is an important driver of adaptive population differentiation. It is currently the best studied factor in local adaptation research, and has been used to develop both provisional and species-specific seed transfer guidelines. While climate may be critical for broad-scale germplasm movement, other population-level and environmental factors could impact restoration success. Using two restoration relevant grass species as case studies, we will discuss how two of these factors – polyploidy and soil – could be incorporated into seed transfer guidelines. Polyploidy is difficult to incorporate into seed transfer zone maps, but combining multiple cytotypes during restoration could have long-term impacts on population fitness. In contrast, soil variables have been incorporated into transfer zone guidelines for trees, but have not currently been included in transfer zones for herbaceous or grass species. While there are potential limitations to using these two factors to guide germplasm movement, they could ultimately improve restoration outcomes when multiple seed sources are used.

Alexis Gibson is a postdoctoral researcher in the Department of Ecosystem and Conservation Sciences at the University of Montana. She is interested in innovating science into practice, especially in the area of native plant materials and restoration.

Tuesday 3:50 p.m. - Congressional

Integrating Molecular Genetics into Seed Management Programs

Valerie Hipkins

The United States Forest Service has been committed to using molecular genetic markers to achieve productive and resilient forests and grasslands for over a quarter of a century. The National Forest Genetics Laboratory (NFGEL) was established in 1988 with the purpose of providing genetic testing and information for integrated solutions to on-the-ground problems faced by natural resource managers and policy makers. NFGEL uses state-of-the-art technology to address genetic conservation and management of all plant species using various laboratory

techniques including advanced DNA technologies. We use genetic markers to investigate genetic diversity and structure for a variety of purposes, from questions of individualization (addressing plant theft, identifying clonal lines, and providing information to support breeding programs) to assessing differences among populations and species (maintaining species and genetic diversity in revegetation programs, and identifying genetic variation in climatic tolerances of restoration species). Because genetic and genomic tools are constantly changing and evolving, we use the technique that is the most appropriate to resolve the genetic question asked, whether that is allozymes, microsatellites, or 'next-generation' sequencing platforms. I will discuss the rationale we use when choosing a marker system or technology with the aim of balancing characteristics of the marker, cost of applying the marker, time of data collection and analysis, and ability of the resulting data to further management program goals for the collection, storage, and deployment of native seed.

Valerie joined the US Forest Service in 1993 and is the Director of the National Forest Genetics Laboratory (NFGEL) located at the Institute of Forest Genetics in Placerville, California, USA. As Director of NFGEL, Valerie is responsible for project development, client relations, scientific reporting, and administrative duties including budget planning for the unit. NFGEL provides genetic testing and information for integrated solutions to on-the-ground problems faced by natural resource managers and policy makers. Valerie received her B.S. in Forestry from Humboldt State University, and her M.S. in Forest Science (tree physiology) and Ph.D. in Genetics and Forestry from Oregon State University.

Tuesday 4:10 p.m. - Congressional

The applicability of next-generation sequencing to native plant materials development

Rob Massatti

A fundamental question when developing conservation and restoration plans is how best to match plant materials to target site conditions. Selecting propagules that are locally adapted to the biotic and abiotic conditions they will encounter ensures that resources are used effectively, thereby broadening the reach of restoration and conservation activities. However, for most restoration species, information to guide propagule-site matching is limited. Next-generation sequencing (NGS) may prove to be a fundamental tool to assist plant material selection and development. NGS data have become cost-effective to generate, and the tools to process, analyze, and interpret them are becoming more accessible. I will present examples to illustrate how these data have been used to elucidate historical and contemporary factors influencing the geographic patterns of species' genetic variation, and I will explore how such inferences can impact conservation strategies, such as the development of seed transfer guidelines. Finally, I will describe ongoing NGS work at the Colorado Plateau Native Plant Program, where the goal is to provide the BLM actionable information on restoration species important to the Colorado Plateau.

Tuesday 4:30 p.m. - Congressional

Genetic and cytotypic variability in a dominant southwestern grass (*Bouteloua gracilis*): Implications for restoration and seed sourcing

Katrina Tso, Gerard Allan, Troy Wood*

With the increasing frequency of large-scale restoration efforts, the need to understand the adaptive genetic structure of natural populations and their relation to heavily-utilized cultivated surrogates is critical. *Bouteloua gracilis*, or blue grama grass, is a wind-dispersed, perennial grass with a wide-spread distribution in western North America. The species is often locally dominant and is used regularly in restoration treatments. Environmental variation, which has been shown to influence functional trait characteristics in blue grama, also is often correlated with patterns of genetic variation in plants in ways that can be inferred to be adaptive. We report initial results from

AFLP (Amplified Fragment Length Polymorphism) analysis of blue grama samples representative of the species' habitat diversity on the Colorado Plateau and adjacent regions. These results, along with data on ploidy variation, are being used to guide the selection of new blue grama sources that best complement those currently available on the commercial market.

Katrina is a graduate student at Northern Arizona University. She has previously worked for the Forest Service for 10 seasons, has greatly enjoyed her recent immersion into research, and is honored to be contributing to the wealth of knowledge that may one-day lead to true human stewardship of our world.

TUESDAY 5:00 P.M. – 7:00 P.M. DIPLOMAT POSTER AND EXHIBIT SESSION

Tuesday 5:00 - Diplomat

Poster and Exhibit session

Workshop: Challenges of Sampling and Testing Seed of Native Species

Poster abstracts are presented beginning on page 66 of this document, in alphabetical order by the presenting author.

WEDNESDAY 8:00 P.M. – 9:30 PALLADIAN PLENARY

Wednesday 8:00 - Palladian

Plenary:

Cristina Eisenberg, Chief Scientist, Earthwatch Institute

Ann Bartuska, Acting Under Secretary for Research, Education and Economics, USDA

Tom Kaye, Executive Director, Institute for Applied Ecology

WEDNESDAY 10:00 – 12:00 PALLADIAN PANEL DISCUSSION

Wednesday 10:00 – Palladian

Panel: Implementing the Pollinator Friendly Native Seed Reserve

Organizer: *Carol Spurrier, Bureau of Land Management*

Panelists: *Eric Lee-Mader, Xerces Society; Andy Ernst, Ernst Conservation Seed; Cynthia Martinez, Chief of Refuge System, USFWS; <more to come>*

In May of 2015 the White House released A Federal Strategy to Promote the Health of Honeybees and Other Pollinators. The Strategy includes three overarching goals including one to enhance or restore 7 million acres of habitat for pollinators through public private partnerships. The strategy outlines creating a native seed reserve of pollinator friendly (nectar and pollen producing forb, shrub and tree) species to use in restoration projects. During this session members of the staff for the Pollinator Task Force would discuss agency seed needs and accomplishments related to pollinators as well as White House expectations for the seed reserve. We would ask for a perspective from seed growers and one representing nongovernmental groups that have been working to restore habitat for pollinators. We will discuss seed needed to support migrating monarch butterfly populations. We would

discuss what can be done through the goals and objectives of the Seed Strategy to accomplish the on the ground habitat restoration goals associated with the White House Pollinator Strategy and how to move forward ensuring that the necessary pollinator friendly seed is available.

WEDNESDAY 10:00 – 12:00 BLUE ECOLOGICAL RESTORATION

Wednesday 10:00 - Blue

Evidence for Long-term Persistence of Cultivars in Ecological Restoration

*Mary E. Poelman, Adrienne M. Pilmanis and Kristina M. Hufford**

Restoration practitioners often rely on seeds of widely available cultivars representing native species but non-local germplasm. Cultivation improves the supply of native plant materials and minimizes revegetation costs, but can also favor agronomic traits, and resulting vigor may affect the competitive ability and long-term persistence of cultivated genotypes at restoration sites. We compared cultivated, restored, and wild populations of western wheatgrass in a greenhouse study to test whether cultivars outcompete local plants and to determine if differences among cultivated and wild populations persist at restoration sites over time. We found evidence of vigor and greater competitive ability of cultivars in seed mass, growth rate, plant height and biomass and this advantage occurred when plants were grown alone or in competition with other seed sources. Cultivar vigor persisted at restoration sites over three decades, but restored populations more closely resembled wild, local populations when cultivars were planted in closer proximity to undisturbed sites. This study supports the cultivar vigor hypothesis and provides evidence for the long-term persistence of cultivated traits in the environment. We discuss these findings in light of restoration practice and regulatory policy for public lands.

Kristina Hufford is an Associate Professor of Restoration Ecology in the Department of Ecosystem Science and Management at the University of Wyoming. She has worked in variety of environments and restoration sites, and is dedicated to study of the natural environment and real-world applications of research

Wednesday 10:20 - Blue

Use of Native Grasses and Forbs for Diversification of Crested Wheatgrass Stands

Jerry Benson and Mel Asher*

The process of bringing about the conversion of degraded landscapes dominated by crested wheatgrass and other introduced species, is a long term multi-step technique. These steps require many disciplines and intuitive insights to come together to establish the foundation of a successful project. The early phases are often a radical process to get control of the introduced species and begin moving towards establishing a native community that can be competitive and resist re-invasion. Establishment of a continuing monitoring schedule is also very important, though an end product is a dynamic long term ongoing process of succession.

Jerry has been a botanist and wildlife biologist for over 30 years and has integrated the two careers to the establishment of BFI Native Seeds Co. the combination of these endeavors has created a start to finish restoration firm that specializes in the step by step processes of converting degraded habitats to functional native communities.

Wednesday 10:40 - Blue

The South Texas Approach to Restoring Native Vegetation on Exotic Invaded Landscapes

John Reilley, Forrest Smith and Shelly Maher*

To provide a strategy for restoring native vegetation and compete with exotic species in south Texas, we have developed the "The South Texas Approach". Prior to the development of this approach, there were no successful native species restoration plantings in south Texas. It had become common to hear," you can't plant natives in south Texas". The exotic grass, buffelgrass, [*Pennisetum ciliare* (L.) Link], was King. Use of The South Texas Approach for over two decades, has proven this is not the case. The methods used in the development of seed mixes for a successful restoration project will be outlined. It is the development of the appropriate seed mixes that makes our approach unique. Seed mixes contain 8-12 different native species with early successional species making up half of the species mix. The mixes consist of perennial grasses along with forbs and legumes. Every species used in a mix is a South Texas ecotype that has been tested, selected, and commercialized for its adaptation to South Texas conditions. Results from over 30 field plantings shows this approach produces an overall 70% success rate in restoring native vegetation on exotic invaded landscapes.

John Reilley has been the manager at the USDA Natural Resources Conservation Service, E. "Kika" de la Garza Plant Materials Center in Kingsville, Texas for over 20 years. The Center evaluates native plant materials as well as methods to restore degraded habitats, increase plant diversity, improve water quality and stabilize erosion. Under John's leadership, the Center has released or co-released 32 different plant species to the commercial seed trade.

Wednesday 11:00 - Blue

Manipulating Cheatgrass Seed Dispersal to Benefit Native Plants

Danielle Johnston, Phillip Chapman

Establishing native plants often requires controlling cheatgrass (*Bromus tectorum* L.) propagule pressure. Tools such as herbicides and tillage can help by reducing viable cheatgrass seeds in the seed bank. Less understood is the role of cheatgrass seeds dispersing during early restoration. Is it important to control their dispersal, and if so, how? Large holes have been shown in prior work to impede movement of many kinds of seeds. Restoration outcomes were compared for typical flat surface drill seeding and 'pothole seeding' (seeding over a roughened surface of 20cm high mounds and 20-cm deep holes). Cheatgrass established at 4 sites ranging from 1700 to 2400m. At all but the highest elevation site, cheatgrass cover or biomass 2 to 4 years post treatment was reduced 6-fold to 10-fold with pothole seeding. Potholing's effectiveness may be due to a combination of factors: some cheatgrass seeds are buried, remaining seeds become entrapped at the bottom of the holes, and cheatgrass seeds in holes experience mesic conditions where native plants compete more effectively. A disker was modified to produce the pothole surface efficiently. A 2.8ha area at 1400m which had been a near-monoculture of cheatgrass was treated with 70 g ai/ha imazapic in early fall, and then pothole seeded in early winter. Three years post-treatment, the area is dominated by a diverse mixture of native grasses, forbs, and shrubs.

Danielle Johnston has studied restoration and habitat improvement techniques for Colorado Parks and Wildlife since 2007, when she completed her Ph.D. in Ecology at Colorado State University.

Wednesday 11:20 - Blue

Functional diversity in prairie plant communities: a barrier to invasion modulated by nitrogen

Jacob Zeldin

Plant functional diversity is an important contributor to ecosystem functioning and should be prioritized in seed selection for restorations. Invasive plants present a major challenge to restoration efforts as they substantially affect recipient ecosystems and plant community structure. Functional diversity in plant communities may act as a biotic barrier to invasion, with the complementary traits of resident species pre-empting resources and preventing the establishment of invasive species. Because nitrogen is often a limiting resource, high nitrogen levels may break down the functional diversity-invasion resistance relationship by limiting the ability of resident species to pre-empt resources required for invasive species establishment. In the present study, I investigate functional diversity as a barrier to invasion in prairie plant communities and nitrogen's role in modulating this relationship. I hypothesize that high functional diversity enhances community resistance to invasion and that the effect of functional diversity on invasion resistance is less pronounced or absent in high nitrogen conditions. I test this hypothesis with a greenhouse experiment where the success of two exotic plant species common to prairies are evaluated in plant communities of varying functional diversity. I also explore how increased nitrogen levels modulate this mechanism of invasion resistance by including nitrogen addition treatments. The results of this study will be discussed in the context of why and when increasing functional diversity in restoration seed mixes can contribute to invasion resistance in restored habitats. This study will also highlight issues of anthropogenic nutrient additions and how they act to reduce biotic resistance to invasion.

Jacob Zeldin is a master's student at Northwestern University and the Chicago Botanic garden studying plant biology and conservation. Jacob's research focuses on plant community ecology and functional diversity in the context of habitat restoration. His work aims to contribute to ecological theory while informing restoration and plant conservation.

Wednesday 11:40 - Blue

Using past restoration treatments to inform future seed sourcing in the Colorado Plateau

Andrea Kramer, Shannon Still, Nora Talkington, Troy Wood*

Investigating how plant materials used in past restoration activities perform over time can provide valuable information to inform future restoration efforts. For example, are there species that consistently perform better in certain situations? To begin to answer this question at an eco-regional scale and support adaptive management activities, we compiled data from a wide range of sources on more than 600 seeding treatments in the Colorado Plateau between 1999 and 2014. While many treatments had to be excluded due to lack of complete seeding or monitoring data, detailed information was available for more than 1,000 records of over 100 plant species. We summarize use and performance results for the most commonly used species in this dataset, assessing whether the species, seed source, restoration method, climate, or environmental conditions at the restoration site influence the likelihood of establishment and survival two or more years after seeding. Results show significant variation in performance among species, and sources within species, across the region. This variation is determined by diverse predictors. By synthesizing data on how plant materials used in restoration perform in the short and long term under restoration site conditions across the Colorado Plateau eco-region, study results support adaptive management and inform seed sourcing decisions in the region, and our approach provides a model for future work in other regions.

Andrea Kramer is a Conservation Scientist at Chicago Botanic Garden interested in restoration ecology research related to the identification, development, and use of genetically appropriate native plant materials for restoration.

WEDNESDAY 10:00 – 12:00 CONGRESSIONAL SEED SELECTION TOOLS

Wednesday 10:00 - Congressional

Symposium: The Emergence of Seed Networks as an Effective Strategy in Building Regional Cooperation to Improve Native Seed and Plant Material Development and Delivery

Organizer: *Ed Toth, City of New York; Megan Haidet, Seeds of Success*

Wednesday 10:00 - Congressional

Introduction to symposium

Ed Toth, Megan Haidet

Wednesday 10:10 - Congressional

The Great Basin Native Plant Project: a plant material development partnership

Francis Kilkenny, Fred Edwards

Restoring native plant communities can be challenging, and many of these challenges are unique to the region where restoration is being attempted. The Great Basin of the United States is an arid and semiarid biome that is under threat from fire, invasive species, and human caused disturbances. A major bottleneck in Great Basin restoration is the lack of available native seed that can establish and thrive in arid conditions. The Great Basin Native Plant project was founded in 2001 as a partnership between the US Forest Service and the Bureau of Land Management to develop native plant materials for restoration, and has worked with a large number of cooperators over the years. The project has supported research on seed transfer guidelines, seed collection, seed storage, seed ecology, cultivation practices and restoration techniques. This talk will discuss successes and lessons learned over the 15 years that the project has been ongoing.

Dr. Kilkenny is a USFS research biologist and lead of the Great Basin Native Plant Project, an interagency project between the BLM Plant Conservation Program and the USFS Rocky Mountain Research Station. His research interests include the ecological and evolutionary impacts of climate change on native and invasive plant species, the evolution of local adaptation in native and invasive species, and the use of ecological genetics in restoration practice.

Wednesday 10:30 - Congressional

Colorado Plateau Native Plant Program

Adrienne Pilmanis, Troy Wood and Rachel Hosna*

The Colorado Plateau Native Plant Program (CPNPP) was created in 2009 as a result of BLM and USFS interest in expanding the success of the Uncompahgre Plateau native plant material efforts into a larger region. The CPNPP functions in three EPA Level III Ecoregions: Colorado Plateau, AZ & NM Plateaus, and AZ & NM Mountains. We'll present an overview of CPNPP vision, history, structure, goals & objectives, partners, research, accomplishments and plans. We'll point out ways CPNPP is unique from other programs (database tracking seed testing, inventories and uses; influence of fluid mineral development) as well as challenges we must overcome to meet our goals.

Adrienne is the Coordinator for the CPNPP and an Ecologist at the BLM Utah State Office. She has worked for BLM for 12 years in the Utah, Oregon and Wyoming State Offices. Prior to joining BLM her research focused primarily on global change issues in the U.S. southwest, including nitrogen deposition, temperature increase and precipitation variability effects in arid ecosystems. Adrienne's academic degrees are from CU Boulder and Duke Universities.

Wednesday 10:50 - Congressional

Creating a Southwest Seed Partnership to Implement the National Seed Strategy in New Mexico and Arizona

Melanie Gisler, Kathryn Kennedy, Zoe Davidson, and Cameron Weber*

Native plant materials are vitally needed for rehabilitating millions of acres of land impacted by wildfire, erosion, and mineral and gas extraction in New Mexico and Arizona; and they are in demand for countless public and private restoration projects attempting to improve habitat for wildlife, promote the health of pollinators, and offset exotic species invasions. The limited supply of native plant materials available on the open market is mostly non-local and genetically and ecologically inappropriate for these southwest states. Commercial sources for forbs are rare or nonexistent, as are producers prepared to grow these native species for seed production. In response to the National Seed Strategy and this pressing need for native seed in the region, the Southwest Seed Partnership was formed in 2015 by the Institute for Applied Ecology, Forest Service Region 3, NM Bureau of Land Management, and the National Park Service. The Partnership is dedicated to improving the supply and diversity of native seed for NM and AZ and implementing the National Strategy. Developing locally adapted, ecologically appropriate native seed is a priority. This presentation will describe the growing partnership, the methods used to prioritize species for production and to begin to define seed transfer zones, as well as a strategy for moving from wild collected seed to small and large scale production.

Melanie Gisler is the director for the new Southwest Program of the Institute for Applied Ecology (IAE) located in Santa Fe, NM. She received her Master of Science degree in Botany from the University of British Columbia and Bachelor's in Biology from the University of New Mexico. For the last 15 years at IAE she has led regional native plant materials development programs as well as recovery projects for rare plants and butterflies and was the former director for the Habitat Restoration Program. Prior to joining IAE, Melanie worked in botany and restoration ecology for several public agencies including the Bureau of Land Management, Pacific Northwest Research Station of the Forest Service, NRCS Los Lunas Plant Materials Center, and the City of Austin's Zilker Botanical Garden.

Wednesday 11:10 - Congressional

Expanding Seeds of Success to Build a Sustainable Seed Network in the Eastern United States

Shanyn Siegel

Commercial shortages of genetically appropriate native plants and seeds are common in the Eastern United States and are a recurring obstacle to restoration, reclamation, roadside, water quality, pollinator-habitat, and landscaping projects. To address this problem, the eastern partners of Seeds of Success— New England Wild Flower Society, Mid-Atlantic Regional Seed Bank, North Carolina Botanical Garden, and the Chicago Botanic Garden—are working together to develop a Native Plant Material Development Program similar to those that have been successful in the West. In accordance with the National Seed Strategy, which calls for a more coordinated approach among stakeholders, we have started expanding the Seeds of Success partnerships in the Eastern United States to demonstrate a model of a broad-based Seeds of Success membership that is inclusive of both federal and non-federal partners. Our team is developing a toolkit that will aid other groups in forming partnerships to create regional seed networks in the East. Working with University of Maryland Extension, we have developed assessment tools to better understand overall native plant material needs, production capacity of both private and public producers, and capacity for requisite research and development. And, using the mid-Atlantic region as a pilot

area, the Mid-Atlantic Regional Seed Bank is forging new partnerships to expand native seed collecting efforts and embark on the development of a mid-Atlantic native plant network. This presentation will discuss our process as we transition from a local concept to a working collaborative network.

Shanyn Siegel, Communications Coordinator for the Mid-Atlantic Regional Seed Bank, conducts outreach in support of MARSB's efforts to expand the scale and scope of native seed collection in the Eastern U.S. and to increase Native Plant Materials Development in the mid-Atlantic region.Prior to working with MARSB, Shanyn was Seed Bank Manager at Seeds Savers Exchange, where she led the organization's work in genetic resources preservation.

Wednesday 11:30 - Congressional

Discussion Session (30 Minutes)

WEDNESDAY 10:00 – 12:00 CABINET NATIVE SEED COLLECTION TOOLS

Wednesday 10:00 - Cabinet

Weather and Climate Tools for Rangeland Restoration Planning and Management

Stuart Hardegree, Corey Moffet, John Abatzoglou, Katherine Hegewisch, Roger Sheley, and Mark Brunson*

Rangeland restoration in the Great Basin has historically been implemented as single-year seeding treatments, primarily in the year immediately following wildfire. This effectively links restoration and rehabilitation success to the low probability of a single year having a sufficiently favorable micro-climate for desirable plant establishment. Field research on specific rangeland restoration practices is also typically conducted over only 1 or 2 years and published results may be biased toward better than average site conditions. Location-specific and temporal weather-analysis may enhance the interpretation of historical planting data, support expanded inferences from short-term field studies, and facilitate meta-analysis of diverse field studies in rangeland restoration. We describe access and use of new databases and tools that can be used for this purpose, and suggest some standard graphs and weather metrics to establish an historical perspective for the interpretation of rangeland restoration field results. We also provide a framework for using knowledge of weather variability in support of contingency-based adaptive-management planning for longer-term restoration objectives.

Stuart is a plant physiologist with USDA-ARS in Boise, ID. His scientific interest is primarily in the area of seedbed ecology and plant establishment in the Intermountain western US.

Wednesday 10:20 - Cabinet

Matching seed to site by climate similarity: tools to prioritize plant materials development and use

Kyle Doherty, Troy Wood, Bradley Butterfield*

Climate similarity analyses are techniques to predict performance of source identified plant materials by contrasting home conditions with those of potential growout sites. We can compare predicted performance maps of candidate seed sources across a region to identify those expected to have highest chances of success without empirical data on local adaptation. When used in conjunction with cluster analysis algorithms, climate similarity analyses can also aid plant materials development by guiding collectors to sites that differ in climate. This strategy is useful for efficiently sampling across multiple environmental gradients simultaneously to explore local adaptation. We have produced a suite of web-based tools, or apps, that allow practitioners to conduct these analyses. In the Seed Selector app (http://seedmapper.shinyapps.io/seed_selector), users upload a spreadsheet containing the coordinates of candidate plant materials, then the app generates an interactive map in which they can explore the predicted performance of each candidate across a region of interest. By clicking on the map, Seed Selector produces a ranked list of climate match from the uploaded candidates. In the Climate Partitioning app (https://seedmapper.shinyapps.io/climate_partitioning_app), a user defines a region of interests and specifies the number of samples they are interested in collecting. The app then suggests sampling locations and produces summaries of climate attributes for these areas. In both apps, users can download the underlying spatial data to explore the analyses in their personal GIS offline. Together these apps represent intuitive and agile decision support tools to inform native seed use and development.

Kyle Doherty is a PhD student at the Northern Arizona University School of Forestry. He investigates novel techniques to restore soils in drylands and develops web-based statistical and decision support tools for scientists and land managers.

Wednesday 10:40 - Cabinet

How do I find seeds?!: Using AIM and other datasets to locate viable collection populations

Jessa Davis

AIM and other publicly available data can provide direction for locating seed populations for use in SOS, local project work, fire rehabilitation or identifying potential treatment areas. Topics of discussion will include: using TerraDat, Database for Inventory, Monitoring and Assessment (DIMA), digitized herbaria or other geospatial datasets, and how to develop assessment and prioritization criteria for population selection. This information can be used for long term collection strategies and diversify not only the types of species collected, but collection distribution within seed zones, ecological sites, etc.

Wednesday 11:00 - Cabinet

Elements of an Ecologically Designed Seed Mix for Tallgrass Prairie Plantings

Greg Houseal

Planting a diverse, sustainable, ecologically functioning plant community requires more than just 'seeding a mix'. A major challenge of restoring native plant communities to the landscape is often the limited availability of seed of appropriate plant material's (seed and sources). More efficient use of these limited supplies would extend the number of acres that could be planted. Tools such as seed calculators can facilitate a systematic approach of selecting geographically appropriate and sourced species, representative of the native plant community guilds (graminoids, forbs, legumes, shrubs), appropriate for the planting site conditions (soil and sunlight), and seeded at reasonable and affordable seeding rates. The Tallgrass Prairie Center's Iowa Seed Calculator will be featured as a point of departure for demonstrating concepts/approaches to designing seed mixes based on these ecological considerations.

Greg Houseal has been the Program Manager for Natural Selections Seed at the Tallgrass Prairie Center at the University of Northern Iowa since 1997, developing Source Identified seed as foundation stock for commercial growers in Iowa. He has a B.A. in Botany from the University of Iowa, and an M.S. in Range Science from Montana State University.

Wednesday 11:20 - Cabinet

Mixing and matching: Composition and diversity of commercially available seed mixes compared with remnant and restored tallgrass prairies

Rebecca S. Barak, Eric V Lonsdorf, and Daniel J. Larkin*

Commercially available seed mixes are an important tool for restoring degraded habitats, such as tallgrass prairie, one of the most endangered habitats on earth. However, little is known about how commercial mixes compare to existing remnant and restored plant communities in terms of composition and diversity. Using data from companies across the Midwestern United States, we quantified biodiversity of commercially available mixes. We calculated several diversity metrics for each mix, including species richness, conservatism, bloom-time coverage, and the degree of evolutionary relatedness between species (phylogenetic diversity). Studying multiple measures of diversity allows us to draw connections between mixes and potential ecosystem functions of their resultant prairies. Through these analyses we identified gaps in currently available seed mixes in terms of underrepresented species, clades, and bloom periods. In addition, we used machine learning to design seed mixes that maximize diversity metrics with cost as a constraint, and compared these designed mixes to commercially available mixes. In all, we studied 87 seed mixes from 18 companies, comprising 248 species from 37 families. Three species—*Rudbeckia hirta, Schizachyrium scoparium*, and *Bouteloua curtipendula*—were found in more than two thirds of all seed mixes. Richness of restored mixes ranged from 5-93 species (mean 30 spp.). Commercial seed mixes were less diverse than existing remnant and restored prairies. Our analyses can aid in identifying priority species for inclusion in future restoration seed mixes. We are developing a "scientist/manager/practitioner" tool to aid in species selection for restoration under multiple objectives and constraints (National Seed Strategy, Action 3.3.3).

Becky Barak is a community ecologist studying biodiversity and restoration in the trallgrass prairie, and a PhD candidate in Plant Biology and Conservation at Northwestern University and Chicago Botanic Garden.

Wednesday 11:40 - Cabinet

Discussion

WEDNESDAY 1:20 – 3:00 PALLADIAN PANEL DISCUSSION

Wednesday 1:20 - Palladian

Panel: Seed Industry Perspectives

Organizer: *Robby Henes, Southwest Seed*

Panelists: *Robby Henes, Southwest Seed; Mark Mustoe, Clearwater Seed; Steve Parr, Upper Colorado Environmental Plant Center; Blake Curtis, Curtis & Curtis Seed; Ed Kleiner, Comstock Seed; Jerry Benson, BFI Native Seed*

The 'Seed Industry' is often invoked as a vital cog in the wheel for having the right seed at the right time. The impetus for more native and local ecotypes as embodied in the National Seed Strategy will strengthen the demand for regionally specific seed from the Seed Industry. Often, however, the realities of having this seed are far more complex and difficult than might be expected. This panel brings experts from different parts of the Seed Industry to share insights into the challenges and realities of getting your seed needs addressed. Panelists will share experience and lessons learned from past efforts to grow out and/or collect local ecotypes and provide perspectives on the hopes and needs embodied in the National Seed Strategy. There will be ample time for questions from the audience.

WEDNESDAY 1:20 – 3:00 BLUE PLANT ESTABLISHMENT

Wednesday 1:20 - Blue

The Role of Germination in Early Plant Establishment: Characterization of Germination Syndromes in a Highly Variable Field Environment

Stuart Hardegree, Corey Moffet, Christine Walters, Roger Sheley*

Western rangelands exhibit high variability in annual and seasonal weather. An individual plant must successfully navigate this variability through multiple life stages and over many years to become successfully established. Seed germination is generally assumed to be a critical life-stage transition, but it is difficult to characterize potential response in a variable environment using traditional, static, germination indices. We used hydrothermal germination models to simulate the impact of weather variability and planting date on cumulative germination response of both native perennial bunchgrasses and cheatgrass (*Bromus tectorum*). Long-term field simulations revealed alternative germination syndromes that may play an important role in avoidance of post-germination mortality, primarily from soil freezing events in the winter. We also found that planting date differences of only a few weeks may have a significant effect on avoidance of pre-emergent seedling death.

Stuart is a plant physiologist with USDA-ARS in Boise, ID. His scientific interest is primarily in the area of seedbed ecology and plant establishment in the Intermountain western US.

Wednesday 1:40 - Blue

When and Where to Seed? Effects of Sowing Time and Relative Prairie Quality on First Year Establishment of 23 Native Prairie Species

Sarah Krock, Sarah Hamman*

The restoration of south Puget Sound prairie ecosystems requires a considerable input of time and resources. A full-factorial randomized block design was used to test direct seed sowing efforts in September, October, December,

and March against an unsown control across three prairies that were designated High, Medium, and Low quality relative to each other. A Shannon-Wiener diversity index of 16 sown species suggests richness and abundance increase when sowing occurs in September or October, regardless of prairie quality. Thirteen species were analyzed independently using generalized regression, while nine were excluded from this analysis, due to extremely low germination. Four species were significantly influenced by sowing time: *Collinsia* spp. (includes *C. grandiflora* and *C. parviflora*), *Lupinus albicaulis*, *Lupinus bicolor,* and *Plectritis congesta*. Four species were significantly influenced by relative prairie quality: *Achillea millefolium, Danthonia californica, Eriophyllum lanatum,* and *Ranunculus occidentalis*. No species responded significantly to both sowing time and relative prairie quality at α=0.05. Five species did not show a significant response to any treatment: *Cerastium arvense, Festuca roemeri, Koeleria macrantha, Microseris laciniata*, and *Sericocarpus rigidus*. Five species were excluded from generalized linear model analysis due to low abundances: *Balsamorhiza deltoidea, Clarkia amoena, Lomatium utriculatum, Potentilla gracilis*, and *Sisyrinchium idahoense*. Four species were not found in any treatment or quality combination: *Armeria maritima, Erigeron speciosus, Solidago simplex*, and *Viola adunca*. Overall, first year establishment rates were very low, but these results suggest that fall sowing times and higher quality prairie sites result in higher establishment rates for some native prairie species.

Sarah has a Bachelors of Biology from Kent State University and a Masters of Environmental Studies from the Evergreen State College. She works as a Wildlife Biologist contractor for Joint Base Lewis-McChord Fish and Wildlife near Olympia Washington.

Wednesday 2:00 - Blue

Comparing Seeding Rates and Timing of Big Sagebrush (*Artemisia tridentata*) in Utah

Danny Summers and Kevin Gunnell*

Big sagebrush (*Artemisia tridentata* Nutt.) has been seeded on rangeland treatments and wildfires throughout Utah for the enhancement of watersheds and wildlife habitat. Examination of vegetation data collected from across Utah has shown limited success from seeding of big sagebrush when seeded following a rangeland treatments or wildfire. In the winter of 2015-2016, we seeded Wyoming big sagebrush at 12 different rates every two weeks from November 7 through March 21 at two locations. Seedlings were counted in the spring and fall. Initial results will be discussed and how seeding rates, seeding methodology, and timing may influence big sagebrush seeding establishment and success.

Danny Summers is the habitat restoration coordinator for the Utah Division of Wildlife Resources in Ephraim, Utah.

Wednesday 2:20 – Blue

Use of abscisic acid to enhance the survival of fall sown seeds

Matthew Madsen, William Richardson, Ryan Call, Bruce Roundy*

In the sagebrush steppe ecosystem, after a high-intensity wildfire or another disturbance that removes native plant species, it is common practice to seed the affected area in the fall. Recent evidence suggests that up to 80% of fall-seeded perennial grasses, such as Pseudoroegneria spicata (bluebunch wheatgrass) can germinate prior to winter, which will likely lead to high mortality from freezing temperatures. The plant hormone abscisic acid (ABA) can cause non-deep physical dormancy in water permeable seeds. Our objective was to see if ABA could be applied within a coating to P. spicata seed to induce seed dormancy and delay germination until spring. Wet thermal accumulation models were developed for seeds that were either left untreated or treated with 6 different rates of ABA ranging from 0.5-12 g•kg seed-1. Simulations were run to estimate the date of seed germination using soil moisture and

temperature data collected for four years at six different Wyoming big sagebrush sites within the Great Basin region. Models estimated that for most years and sites, untreated seed planted in October would have up to 90% germination prior to January. Application rates of 2.0 g or greater of ABA•kg-1 of seed was typically sufficient to delay germination until March. This preliminary analysis suggests that ABA seed coatings should produce a sufficient delay to allow fall planted seeds to germinate in spring. Research is needed to verify these results in the field.

Dr. Madsen is an assistant professor in the Department of Plant and Wildlife Sciences at Brigham Young University, where he teaches classes on rangeland restoration and improvement. His research is focused on developing seed enhancement technologies to overcome the limiting factors impairing native plant establishment.

Wednesday 2:40 – Blue

Comparing competition intensity between heterospecific and conspecific seedling pairings: what story do the roots have to tell?

Alicia Foxx

Restoration is critically important for returning native plants to communities and reinstating the ecosystem services they provide such as productivity, carbon storage, and erosion control. Restorations in arid and semi-arid locales in the western US are often undermined by the impacts of invasive species such as highly competitive behavior and promotion of intense wildfires to which native plants are not adapted. Restoration efforts in this region can also be hindered by another major factor: seedlings of some western species are limited more severely by post-germination processes that reduce survival. So understanding factors that may impact establishment is extremely important. Furthermore, interactions with other living entities tend to impact young plants more so than adults, and competition is thought to strongly influence diversity in plant communities. Coupled with the resource poor nature of arid regions and interactions of seedlings in restorations, elucidating how individuals of some accessions interact with one another, and what implication root traits have, can have implications for species diversity in restorations. Using a growth chamber experiment, the 1:1 interactions of nine western species was evaluated for 60 days. The following questions were addressed: 1) How does competition with a conspecific or heterospecific seedling impact establishment? 2) Are there differences in competitive intensity when the neighbor is a conspecific or heterospecific seedling? And 3) Are root traits related to competitive ability with neighbors? These results will illuminate the relationship of competition between some western heterospecific and conspecific species, and help identify traits important to plant performance.

Alicia Foxx is a PhD student in the joint program in Plant Biology and Conservation partnered between Northwestern University and The Chicago Botanic Garden. Alicia researches native plant species commonly used in restoration in the Colorado Plateau, by typifying root traits, and how both competition and plasticity impact coexistence.

WEDNESDAY 1:20 – 3:00 CONGRESSIONAL SEED SELECTION TOOLS

Wednesday 1:20 – Congressional

Symposium: Selecting the Right Seed: New Decision-support Tools for Selecting Taxa and Seed Sources for Current and Future Site Conditions

Organizer: *Nancy Shaw, USDA Forest Service, Rocky Mountain Research Station (Emeritus), Boise, ID, and Society for Ecological Restoration*

The National Seed Strategy and recent federal directives, including DOI Secretarial Order 3336 (fire and invasives) and the Presidential Memorandum on pollinator health, highlight concerns regarding the effects of climate change

and other human activities on native ecosystems and emphasize the need for increased revegetation efforts to repair degraded ecosystems. Prerequisite to all such efforts is the need identify native taxa appropriate for specific site conditions and from that list to select those taxa known to be feasible and economical for use in restoration, namely those with established protocols for seed collection, seed increase, and seedling production as well as strategies for establishing them on disturbed sites. Whether seeds or seedlings are used, identification of genetically appropriate seed sources for maintaining genetic diversity required to meet current and predicted future conditions is essential. Practitioners developing seeding or planting mixes based on site conditions, reference area inventories, and specific restoration goals require decision support tools that will allow them to incorporate current knowledge of restoration species, seed source selection, and consideration of future climates into development of their planting mixes. This session will introduce new resources and protocols that will aid users in making sound decisions when selecting and purchasing native plant materials for revegetation.

Wednesday 1:20 – Congressional

Climate-smart Seedlot Selection Tool: Seed sources for restoration in the 21st Century

Brad St.Clair, Glenn Howe, and Dominique Bachelet*

Populations of native plants are genetically different from one another and are adapted to different climatic conditions. Therefore, natural resource managers must match the climatic adaptability of their plant materials to the climatic conditions of their restoration sites. For forest trees, and increasingly for other native plants, this has typically been done using geographically defined seed zones or seed transfer rules that specify a geographic or climatic distance beyond which populations should not be moved. However, these recommendations assume that climates are stable over the long-term—an assumption that is unlikely given projected climate change. Because plant populations are generally considered to be locally adapted, climate change will likely lead to declines in health and productivity of native ecosystems. Climate-interpolation models are now available that can be used to define zones and transfer limits based on climate rather than geography. We present a web-based mapping application, called the Seedlot Selection Tool, which can be used to map either current or future climates based on selected climate change scenarios. It allows users to select a transfer limit method (using an established seed zone or creating a customized one), a climate scenario, and a set of relevant climate variables, to map either seedlots that are appropriate for planting on a particular site or sites that are appropriate for a particular seedlot. When future climate scenarios are chosen, the tool allows consideration of seedlots that may be adapted to future climates, a management option often referred to as assisted migration.

Brad St.Clair is a Research Geneticist with the US Forest Service Pacific Northwest Research Station in Corvallis, Oregon. His research interests are primarily concerned with understanding how plants are adapted to their environments, and implications for management including reforestation, restoration, tree improvement, gene conservation, and responding to climate change.

Wednesday 1:40 – Congressional

Techniques to determine subspecies composition of *Artemisia tridentata* from seed and seed chaff

Bryce Richardson, Alicia Boyd, Tanner Tobiasson and Nancy Shaw

Successful restoration begins by selecting the right plant taxa and population for a suitable environment. Big sagebrush (*Artemisia tridentata*) occupies a highly heterogeneous environment. Three subspecies are adapted to different environments within the sagebrush ecosystem. Therefore, restoring big sagebrush must rely on correctly

identifying and collecting appropriately adapted big sagebrush seed. To date, no reliable, cost-efficient method has been developed to differentiate subspecies of big sagebrush from seed collections. In this study, we show that seed weight and UV fluorescence quantified by a microplate spectrophotometer can reliably differentiate Wyoming, basin and mountain big sagebrush seed collections. To assess environmental effects on seed weight and UV fluorescence, seed and tissue were collected from > 40 populations growing in two climatically distinct common gardens. For seed weights, eight random samples of 100 cleaned seeds were weighed with an analytical scale. For UV fluorescence, plant leaves and seed chaff were collected, chopped and eluted in distilled water. The water was then analyzed using absorbance on a microplate spectrophotometer. Seed weight of Wyoming big sagebrush was significantly heavier than basin big sagebrush. UV absorbance was significantly lower for mountain big sagebrush between wavelengths of 300 nm and 360 nm. These two techniques can quickly assess the subspecies composition of big sagebrush seed collections from seed and chaff. Implementing these techniques into seed certification can ensure placing the right seed in the right place.

Bryce Richardson is a research geneticist with the US Forest Service, Rocky Mountain Research Station in Provo, Utah. His research involves ecological and population genetics of native plants, particularly shrub species. Currently, his research is focused on understanding climatic adaptation and climate change impacts to sagebrush and blackbrush species.

Wednesday 2:00 – Congressional

Suitability for seed farming as part of a traits-based selection tool for promoting native cover crops in Mediterranean agroecosystems: A case study from Spanish olive orchards

Stephanie Frischie, Borja Jimenez-Alfaro, Cándido Galvez Ramirez*

A key step in seed-based restoration is determining which species to sow. Primary considerations for species selection are historical reference communities, restoration objectives (habitat, conservation, function, ecosystem services), site conditions, disturbance regimes and cost or availability of seeds. The availability of quality seeds in sufficient quantities and at accessible prices is crucial for the success of landscape-scale restoration, yet the feasibility of seed increase for target species is often overlooked when planning restoration projects. An emerging need and demand for native seeds in the Mediterranean Basin is the use of native species as cover crops to restore biodiversity and increase sustainable production in perennial agroecosystems of olive, citrus, almond and vineyard. With over 2.6 million hectares of land under olive production in southern Spain, there is great potential for native cover crops to integrate conservation and agricultural production within the Mediterranean Basin. In our research to identify, prioritize and develop native species as cover crops, we evaluated 30 forbs for seed farming traits: field establishment, crop phenology, fruit height, fruit maturation and dispersal window. We present our species selection methodology and the results using criteria for 1) compatibility with olive production, 2) biodiversity and ecosytem services and 3) feasibility for seed increase. A future output is a species selection tool for matching native cover crops to vineyards and olive, citrus and almond orchards.

Stephanie Frischie researches native seeds and cover crops in the Mediterranean as part of her PhD through the University of Pavia and NASSTEC (NAtive Seed Science, TEchnology and Conservation Initial Training Network), a Marie Skłodowska-Curie Action of the European Union. Previously she was Plant Materials and Conservation Programs Manager for eleven years at the Nature Conservancy's Kankakee Sands Restoration in northwest Indiana

Wednesday 2:20 – Congressional

Nativerevegetation.org: new comprehensive online resources for revegetation practitioners

Matt Horning

In 2007 the US Forest Service (USFS) and Federal Highways Administration (FHWA) published the report "Roadside revegetation: an integrated approach to establishing native plants" as a technical resource for project designers and revegetation specialists aimed to increase the success of FHWA roadside revegetation projects in the Pacific Northwest, USA. Importantly, the integrated approach and information in this report is applicable on highly disturbed sites outside the context of roadsides and is broadly relevant to a diverse array of revegetation projects. Currently this document is being updated to include pollinator-specific guidance and new content including an expanded scope to include all of the US. The new report will be hosted on the website nativerevegtation.org along with additional information including a resource library and other training aides. In addition to this document, the USFS and FWHA along with other partners are producing a nationwide online ecoregional workhorse and pollinator-friendly plant list utility. This utility should aid practitioners in selecting and sourcing appropriate native plant materials for various revegetation objectives including pollinator conservation through habitat creation. This presentation will highlight this integrated approach to revegetation and describe these resources for restoration practitioners.

Matt Horning is a geneticist with the US Forest Service Pacific Northwest Region stationed on the Deschutes National Forest in Bend, Oregon. His primary responsibility is to provide guidance to land managers on the use of genetically appropriate plant materials in restoration activities. Matt consults and trains natural resource specialists throughout the US and the Mideast on numerous aspects of revegetation and reforestation practices. In addition to technology transfer and outreach, much of his work is focused on creating seed transfer guidelines for native grasses and shrubs planted on arid lands in cooperation with multiple collaborators.

Wednesday 2:40 – Congressional

Discussion session (20 minutes)

WEDNESDAY 1:20 – 3:00 CABINET COMMUNICATION AND PARTNERSHIPS

Wednesday 1:20 - Cabinet

The #OhiaLove Project: Banking Seeds of a Hawaiian Keystone Species during the Rapid ʻŌhiʻa Death Crisis

Marian M. Chau, Matthew Keir, Timothy Kroessig, Jill Wagner*

In the state of Hawaiʻi, a newly identified fungal disease called Rapid ʻŌhiʻa Death (ROD) has killed hundreds of thousands of ʻōhiʻa (*Metrosideros polymorpha*) trees on Hawaiʻi Island, affecting over 38,000 acres. ʻŌhiʻa are the keystone tree species of our native forests, covering 865,000 acres statewide. They serve as habitat for native birds, insects, snails, and understory plants, and they create the watershed that feeds our streams and recharges our water supply. This tree also has immense cultural significance in Hawaiʻi. Since spores of the ROD fungus (*Ceratocystis fimbriata*) may spread via beetle frass in wind, the disease may eventually spread to all islands, endangering all of our native forests. While several agencies are conducting research, no treatments are yet forthcoming. In the face of this crisis, the University of Hawaiʻi Lyon Arboretum's Seed Conservation Laboratory launched a crowdfunding campaign to collect and preserve ʻōhiʻa seeds, which are abundant, small, and orthodox, for resistance testing and future forest restoration. The #OhiaLove Campaign raised $50,000 and public awareness of ROD and plant conservation. Since then, nearly a million ʻōhiʻa seeds have been collected and banked from the islands of Oʻahu, Kauaʻi, and Hawaiʻi - the latter in collaboration with Hawaiʻi Island Seed Bank to prevent spread of ROD. Collections are ongoing, and efforts are now underway to expand this project statewide to numerous collaborating agencies via

the Laukahi Hawai'i Plant Conservation Network and the Hawai'i Seed Bank Partnership, including development of seed transfer zones and collection strategies, goals, and protocols.

Marian Chau is the Seed Conservation Laboratory Manager at Lyon Arboretum's Hawaiian Rare Plant Program, where she curates the largest collection of seeds of native Hawaiian plants for ex situ conservation, active restoration, and research. Through close partnerships, she helps prevent extinction of Hawai'i's critically endangered plant species. She holds a PhD in Botany from the University of Hawai'i at Mānoa.

Wednesday 1:40 - Cabinet

Trained Extension Volunteers Produce High-Quality Native Seed

Sara Tangren

In Maryland, a lack of commercially available, genetically-appropriate plants and seeds has been a recurring obstacle to conservation landscaping efforts. In 2014, the University of Maryland Extension developed a curriculum for teaching Master Gardeners and Master Naturalists how to make genetically diverse wild seed collections, and how to use those collections to create foundation-seed production plots. Graduating Master Gardeners and Master Naturalists established foundation plots for *Carex glaucodea, Chrysopsis mariana, Liatris pilosa, Rudbeckia hirta, Solidago nemoralis*, and *Vernonia noveboracensis*. In 2016, they harvested the first seed, and through a partnership with the Maryland Department of Agriculture, the seed will receive source-identified status. The foundation seed harvest will be shared with growers interested in improving Maryland's commercial supply of ecoregion-specific native plants and seeds. This presentation will provide an overview of the curriculum and its results.

Sara Tangren is an Educator for the Master Gardener Program, Home & Garden Information Center, University of Maryland Extension. She teaches sustainable landscaping with native plants. Her native seed production experience goes back to 1996, when she began the first native seed production company in Maryland.

Wednesday 2:00 - Cabinet

Enhancing the Edibility of New England's Landscapes with Native Species

Russ Cohen

Since my retirement in June, 2015, after 27+ years with the Mass. Dept. of Fish and Game, I am aspiring to become a "Johnny Appleseed" of sorts for the 100+ species of edible wild plants that are native to New England. I have been gathering the seeds, nuts and fruits of edible native species and then sharing them with others, as well as propagating them myself. I now have seeds of over three dozen species, many of which I have stored in my stratification fridge in my basement. I have also been supplying native plant propagators and nurseries in this region with nuts and seeds for propagating, which they then grow into seedling plants, some of which they sell to the public and some to me, which I then distribute to public and private entities for planting. In the meantime - I have set up an edible native plant nursery near my home to hold the more than 400 plants I have propagated from seed, as well as obtained from other trusted sources (such as the New England Wild Flower Society), and am establishing partnerships with land trusts, municipalities, state and federal agencies, schools and colleges, and other landowners and land managers to plant edible native species from my inventory on appropriate places on their property. This presentation will share stories and photos of my efforts to date: successful native edible species' seed gathering, storage and propagation techniques, as well as the projects where edible native species have been planted.

Naturalist and wild edibles enthusiast Russ Cohen has been teaching people how to connect to nature by nibbling on it for over four decades. His book, Wild Plants I Have Known...and Eaten, published in 2004 by the Essex County Greenbelt Association, is now in its sixth printing.

Wednesday 2:20 - Cabinet

Madrean Archipelago Plant Propagation Initiative: A Strategy in Regional Plant Material Availability and Resiliency

Francesca Claverie and Allegra Mount*

Borderlands Restoration L3C is a company centered on community-based ecological restoration in the U.S.-Mexico borderlands of southern Arizona. Through federal funding from BLM, USFS, NPS, and others, Borderlands Restoration founded the Madrean Archipelago Plant Propagation Initiative (MAPP Initiative), an innovative solution to issues of fluctuating supply and demand in an uncertain market, connecting commercial production capabilities with agency needs on multiple scales, and designed in response to recognition of a regional need for locally-sourced native seed and plants. The institutional, eco-region specific knowledge gained over 4 years of operation has positioned the MAPP Initiative as leaders in developing regional strategy, including the Seed Strategy for the Madrean Archipelago released in October of 2016 and creation of responsive communication networks. The model presented by the MAPP Initiative is one of maximum collaboration, generosity, and network value, and is gaining attention as a viable solution for plant materials needs in regions lacking an equivalent production industry or commercial capacity. The MAPP Initiative partnership provides the highest quality and most regionally appropriate plant material to support a wide range of restoration work from a flexible and growing base that provides direct responses to the potential effects of climate change. These include combined research and practice through extensive erosion control work; fire effects mitigation; seed collection, native plant grow-out, and plantings of native pollinator-supporting plants not currently under production; youth programs with local schools; and a new Restoration Leadership Institute that will strengthen both social and ecological resilience in the face of uncertain futures.

Francesca graduated from UC Davis with degrees in Native American Studies and International Agricultural Development, working for the UC Davis Arboretum as a propagation specialist and nursery manager. Moving to Patagonia, Arizona Francesca became the first manager of the Borderlands Restoration native plant nursery and helped develop the MAPP Initiative.

Wednesday 2:40 - Cabinet

Sage Grouse Habitat Conservation through Prisons

*Stacy Moore, Shannon Swim**

The purpose of "Sage Grouse Habitat Conservation through Prisons," is to improve habitat for Greater sage-grouse by engaging state prison systems in production of sagebrush for habitat restoration. Greater sage-grouse has been a candidate for listing by the US Fish and Wildlife Service as a threatened or endangered species, but due to extraordinary conservation efforts by many federal, state, and local entities the bird has been removed from candidacy. However, conservation efforts must continue to maintain the integrity of these populations. Loss of sagebrush habitat is the primary driver of the decline of this species in the western United States. Production of sagebrush within state prison systems represents an opportunity to provide urgently needed plant materials as well as providing information to incarcerated men and women concerning sagebrush habitat importance and conservation. The Institute for Applied Ecology (IAE) is a nonprofit organization based in Oregon and is working with three prisons in the state of Nevada, Northern Nevada Correctional Center, Warm Springs Correctional Center and Lovelock Correctional Center, to propagate sagebrush for restoration projects. IAE staff are overseeing plant production at the facility, from seed germination through growth and outplanting. IAE has been developing a protocol for large scale engagement of prisons in sagebrush plant production that will cover all aspects of launching and maintaining a plant production partnership for sagebrush systems in partnership with a correctional facility. In

2016, 11 prisons in 6 different states participated in this program and grew approximately 400,000 sagebrush plugs.

Shannon Swim works for the Institute for Applied Ecology as the Sagebrush in Prisons Project Coordinator for Nevada. Through this work she has witnessed the profound impact outreach can have on the community. Prior to this position, she received her Master of Science in Natural Resource and Environmental Science from the University of Nevada, Reno.

WEDNESDAY 3:30 – 5:00 PALLADIAN ROUNDTABLE SESSIONS

Wednesday 3:20 p.m. – 5:00 p.m. - Palladian

The Right Seed in the Right Place at the Right Time: Working Together on the National Seed Strategy

You are invited to join in small group discussions on subjects that are important to you and that will advance the aims of the National Seed Strategy. This session, organized by the federal and nonfederal committees of the Plant Conservation Alliance, will begin with a call to action from Kay Havens (Chicago Botanic Garden) and Noreen Walsh (U.S. Fish and Wildlife Service). Participants then move into Task Force groups.

Participants will choose from a list of twelve topics that will benefit from your expertise and generate ideas for discrete, short-term tasks to address specific needs, such as generating a report, a set of guidelines, a gap analysis, or a grant proposal. The top three task ideas from each group will be summarized during the closing session on Thursday, February 16. The alliances forged in the process are themselves valuable. We are aiming for broad participation in this interactive session to harness your collective wisdom and diverse input to turn discussion into action!

As conference attendees collect their name tags and registration packets during the conference registration process, they will also self-select a Task Force to participate on and receive a color-coded sticker for their name tag. Everyone at the conference is welcome and urged to participate.

2017 NATIONAL SEED STRATEGY TASK FORCES

POLICY & FUNDING

Before the Storm – The Need for Seed as a Component of Emergency Preparedness

This Task Force will build off of Tuesday's Emergency Preparedness symposium. It will discuss the need for native seed to ensure resilient native plant communities in response to increasing frequency and intensity of extreme weather events resulting from a changing climate. Strategizing ways to incorporate ecological restoration as an adaptation mechanism and insurance policy in response to wildfires, hurricanes, and other extreme weather events will be an objective of this Task Force.

Farm Bill Programs for Native Plants

Throughout the United States, Farm Bill programs have traditionally relied on introduced plant material for vegetation projects. The Environmental Quality Incentives Program and Conservation Reserve Program alone are responsible for an estimated 2.0 million acres annually, with a majority of that planted to non-native, introduced, or exotic species. But there are opportunities in the next Farm Bill to create more support for research and development of native plant materials. In the eastern United States, the National Bobwhite Conservation Initiative (NBCI) is leading an effort for the U.S. Department of Agriculture to establish a native vegetation standard which specifies that native vegetation be considered first in all technical or financial assistance and the cost-share assistance be eliminated for all aggressive species. The National Institute for Food and Agriculture makes grants related to plant health and natural resources that could be used to promote the use of native plants. This Task Force will explore opportunities to utilize the Farm Bill to fund native plant research and development for ecological restoration and rehabilitation.

Identification of Existing Federal Seed and Restoration Policies and Guidance

Also known as Action 1.1.3 in the National Seed Strategy, this Task Force will help ensure that all Federal policies related to the development and use of plant materials and restoration are identified. Once identified, compatibilities, gaps, and challenges across Federal agencies can be addressed. Additionally, outputs can be used to inform Action 4.2.3, which is to make existing agency plant material policy available to the public.

RESEARCH & TOOLS

Coordinating Soil-Related Activities under the National Seed Strategy

The National Seed Strategy identifies needs for soil-related research and decision tools. These include degradation assessments, amendments and site preparation, soil water assessments, and soil factors related to seed germination and establishment. This Task Force will prompt discussions of how to coordinate and promote these efforts for reporting and sharing under the Strategy. We will identify key organizational contacts, researchers and available research, and establish further communications to advance these parts of the Strategy

Seeing is Believing: Demonstration Sites for Native Plants

Also known as Action 3.1.2 in the National Seed Strategy, this Task Force will plan, implement, and help publicize native plant demonstration sites in different ecoregions across the United States. Demonstration sites will show how to restore habitat with native seed and plant materials.

Selecting the Right Seed for the Right Place Right Now

As National Seed Strategy partners collaborate to improve the availability of genetically appropriate seed materials for restoration, what advice can we provide to land managers RIGHT NOW to help them make the best decisions given what is currently available. This Task Force will work together to develop basic guidance and communication for land managers who may not yet be accustomed to taking native species into account.

Tools for Seed Collectors

Seed collection is the first step of native plant materials development. It is also conducted by a wide range of individuals across multiple agencies (Federal, state, tribal, and local), nongovernmental organizations, private sector industries, and universities. This Task Force will build off of Monday's Native Seed symposium and focus on successes and challenges faced when designing and implementing effective seed collection.

Training Tools for Practitioners, Producers, and Stakeholders on the Use of Native Seed

Training programs should be utilized to promote and strengthen professional standards in all activities devoted to the use of native seed and ecological restoration. This Task Force will focus on Action 3.1.1. in the National Seed Strategy and identify gaps between training courses offered and training needed to increase the understanding of restoration principles and the use of native seed across multiple agencies (Federal, state, tribal, and local), nongovernmental organizations, private sector industries, and universities.

COMMUNICATION

Communicating the National Seed Strategy

The aim of the National Seed Strategy is to help land managers select and obtain appropriate plant materials to use in public and private ecological restoration efforts by developing a coordinated, nationwide network of native seed collectors, farmers, growers, nurseries, storage facilities, and restoration ecologists. Communication and information sharing with the public, among strategy partners, and with land managers are integral to these aims. This Task Force will discuss various deliverables of the Strategy and provide recommendations on mechanisms and opportunities for communicating and disseminating information in a coordinated way.

Native Plant Advocacy (nonfederal partners only)

We need an organized effort to advocate for support of native plant programs. There will be strong pressures from this Congress to cut agency budgets. If advocates for native plants don't make their voices heard, programs that promote native plant material development, research, and restoration will likely suffer. Likewise, there is a need for native plant advocates to convince semi-public and private funding sources (NFWF, other foundations) to elevate plants among their funding priorities. Join us to discuss how PCA Non-Federal Members can coalesce around a pro-natives message and deliver it to the appropriate decision-makers.

Native Plants Support Native Wildlife

Plant species are the foundation of habitat and ecosystems – when we say that wildlife species are declining due to a loss of habitat, this means that the loss of native plant diversity is central to the problem. However, wildlife species tend to be much more charismatic than plants and get much more support and attention. This Task Force will strategize ways to utilize momentum behind wildlife species to support the use and development of native plant materials in habitat management decisions.

Public/Private Partnerships in Native Seed Development

This Task Force will build off of Wednesday's Seed Industry symposium. Federal, state, and private land managers

often work directly with private seed growers to develop genetically appropriate native seeds into commercially available plant materials for restoration projects. This Task Force will bring together public and private sector land managers with private sector seed growers to learn how to improve seed development partnerships that can serve all parties' needs.

WEDNESDAY 6:00 – 8:00 U.S. BOTANIC GARDEN RECEPTION

Bus departures at 5:15 p.m., 5:30 p.m., 5:45 p.m. - Blue Room Prefunction Room

THURSDAY 8:00 – 9:30 PALLADIAN SYMPOSIUM

Thursday 8:00 - Palladian

Overcoming the effects of plant blindness with education and outreach

Organizer: Andrea Kramer & Kay Havens, Chicago Botanic Garden

Plant blindness, or the inability to recognize the importance of plants in the biosphere and in human affairs, is a documented phenomenon. The effects of plant blindness on the botanical community and its efforts to conserve, restore, and sustainably use plants are wide-ranging. Yet research also shows that plant blindness is not inevitable. Attend this symposium to learn about: 1) the causes of plant blindness, 2) how plant blindness may be impacting you and the work you do to conserve and manage native plants, and 3) tools you can use to help overcome plant blindness through education and outreach.

Seventeen years of plant blindness: Is our vision improving?

Elisabeth Schussler

The tendency for people not to notice plants in their everyday lives has been termed "plant blindness." We will review the root causes of plant blindness and the research plant educators have done over the last seventeen years to determine whether there may be hope for a cure.

Visibility of plants under the Endangered Species Act: Causes and Implications

Vivian Negrón-Ortiz

Plants are the most listed taxon under the Endangered Species Act, but receive less funding. This talk will cover the causes of underestimating the value of plants and its implications for recovery, Fish and Wildlife Service resources for plant conservation, and current initiatives to overcome these limitations.

Influencing the Federal Budget Process: How to Advocate for Conservation Funding

Cameron Witten

An overview of the federal budget and appropriations process, focusing on conservation funding. This discussion will focus on opportunities for engagement throughout the annual budget and appropriations cycle, key committees and targets, and how to advocate for increased conservation funding.

Federal policies and funding for plants

Rob Bradner

Learn the specifics of how federal policies and funding for plant-based research, restoration, and conservation programs work and how decisions are made. This session will also discuss recent proposed federal legislation that hopes remedy some of the impacts of plant blindness on these processes.

THURSDAY 8:00 – 9:30 BLUE SEED AROUND THE WORLD

Thursday 8:00 - Blue

Symposium: Get Smart in Using Native Seed – the International Network for Seed-based Restoration

Organizer: *Olga Kildisheva, University of Western Australia; Nancy Shaw*

According to a 2010 United Nations Environment Programme Rapid Assessment, nearly two-thirds of the world's ecosystems are degraded. There is a critical need for a strategic, multinational approach to advancing ecological recovery on this growing scale. On highly degraded sites or when rapid recovery is needed, restoration using native plant seed is the most feasible solution toward accomplishing this goal. Despite significant efforts of land management agencies, restoration practitioners and landowners there remains a wide range of challenges that must be addressed to ensure that native plant community recovery can be successfully achieved in a repeatable and cost-effective manner. The need to build a cohesive way forward in managing native seed through directed, multi-stakeholder, and cross disciplinary approaches has lead the creation of tactical initiatives such as the U.S. Native Seed Strategy and the formation of linked organizations that include: the International Network for Seed-based Restoration (INSR), Native Seed Science Technology and Conservation Initial Training Network (NASSTEC), Australian National Centre for Mining Restoration (ITTCMR), and the Plant Conservation Alliance (PCA). If we are to be effective in moving forward with the use of native seed, active communication between networks is critical to the goal of accelerating the pace and effectiveness of restoration efforts worldwide. This session brings together representatives from a suite of international organizations and individuals engaged in seed-based restoration in an effort to enhance collaboration, communication, knowledge, and technology transfer across research institutions, industry partners, practitioners, as well as community and land managers.

Thursday 8:00 - Blue

Introduction to the International Network for Seed-based Restoration (INSR)

Kingsley Dixon

The concept of the INSR arose out of the emerging need to 'internationalise' the principles underpinning this Native Seed Conference series. This newly formed international network is the newest section of the Society for Ecological Restoration, with the Society providing a strong and vibrant membership base upon which the INSR draws its participants. The Network covers all continents and, with over 300 members, is the only group that links international efforts to improve the use and efficiency of native seed in global restoration.

Professor Kingsley Dixon is a seed scientist and ecologist working in global restoration programs with a focus on the biodiversity hotspot of southwest Western Australia. His broad interests include ecology and biology of natural ecosystems and native plants.

Thursday 8:10 - Blue

Challenges and opportunities for seed-based restoration strategies in Chile

Cara Nelson, Marcela A. Bustamante-Sanchez*

Chile has been designated as a hotspot for biodiversity, with 34% of plant genera listed as endemic. Like many countries across the globe, Chile has a history of ecosystem degradation due to the combined forces of land-use change, intensive forestry, grazing, and wildfires. Recently, Chile has increased investments in ecological restoration, including pledging to restore 500,000 hectares of forest land under the 20x20 agreement for Latin America. We review current challenges and opportunities in Chile to implement effective seed-based restoration, including available information on local adaptation and seed transfer zones and the extent to which native plant materials are available to meet restoration needs. There is currently only limited genetic information on most native plant species of concern in Chile, and information that does exist is primarily limited to tree species. Native plants make up only 3% of all plant materials produced in greenhouses in Chile, and 90% of the native plants produced are represented by 13 tree species. These results suggest an urgent need for Chile to invest in additional studies on and development of native plant materials for a wider variety of species. Groups such as the Red Chilena de Restauración Ecológica will play an important role in developing partnerships for seed-based restoration in Chile.

Cara is an Associate Professor of Restoration Ecology in the Ecosystem Sciences and Conservation Department at University of Montana, Chair of the International Union for the Conservation of Nature's (IUCN) Ecological Restoration Thematic Group, and immediate Past Chair of the international Society for Ecological Restoration. Cara's research group focuses on: 1) the effects of large-scale disturbance on vegetation, 2) the efficacy and ecological impacts of restoration, and 3) the science behind the selection of native plant materials for restoration. These topics are explored at landscape, population, and organism scales, through field experiments, retrospective, common garden and greenhouse studies, and meta-analyses.

Thursday 8:30 - Blue

Addressing Seed Challenges in Lebanon and Jordan

Karma Bouazza, Khaled Sleem, Mohammad Nsour, and Anthony S. Davis*

For the past few decades, Lebanon and Jordan have been facing an ongoing, and rapid, decrease in their natural spaces, with only 13% and 1% of forest cover remaining respectively. Several factors contribute to this rapid loss, including urbanization, grazing, climate change and unmanaged natural resources. One of the major challenges facing successful landscape restoration is the proper use of native genetic resources successfully and sustainably. The U.S. Forest Service International Programs' has developed two major projects, the Lebanon Reforestation Initiative and Sustainable Economic and Environmental Development – Jordan to work at the national and regional levels to develop and expand the sharing of best practices to promote sustainable landscape restoration approaches. In Lebanon, efforts are focusing on managing native genetic resources and improving propagation and field protocols to sustain restoration efforts. With regional collaboration increasing, practices are being disseminated both within-Lebanon and to Jordan, where there is a prioritized the use of native genetic material for native seedling propagation and landscape restoration. Both countries face some limitations, in large part due to a previously non-existing central/national management of native seed sources and seed collection, lack of developed practices, and the inability to share best practices in a timely manner. Through implemented research and collaborative partnerships on local and regional levels, between public and private sectors, a data platform is being developed that integrates all related efforts with resources made public for all involved stakeholders. This presentation outlines the approaches taken in Lebanon and Jordan in order to address seed challenges in landscape restoration, highlighting the major limitations faced and how collaborative partnerships on the local levels and between the

two countries have helped in establishing a baseline for a more sustainable native genetic resource management in landscape restoration.

Karma Bouazza is a Nursery Component Manager at the Lebanon Reforestation Initiative, a project implemented by U.S. Forest Service and funded by USAID. She is also contributing to the Sustainable Environment and Economic Development project in Jordan, currently implemented by the U.S. Forest Service, as a nursery specialist.

Thursday 8:50 - Blue

Agroforestry and Citizen Science in Togo, West Africa

Becca Lieberg, Anthony S. Davis*

The native forests of Togo, West Africa have seen widespread deforestation, resulting in erosion, depletion of organic matter from the soil, and the loss of diversity, habitat, and cultural provisions across the country. These issues present an urgent series of problems facing the health of its land and residents, including the indigenous peoples that call the area home, as a loss of ecological stability will continue to deplete remaining natural elements of the forests, and forest products represent a potentially sustainable source of building materials, fuel, and food. A local non-profit group, the Institute for Community Partnerships and Sustainable Development (ICPSD), is collaborating with staff, faculty and students from the University of Idaho's Center for Forest Nursery and Seedling Research (CFNSR) to develop a native plant nursery in the town of Notsé, Togo. A local women's cooperative is being trained to staff the nursery, which will serve as both a demonstration site, and an area in which to host educational opportunities.

This collaboration with ICPSD and related partners in Togo aims to exchange sustainable growing practices, target species identification, and provide educational opportunities to growers and agriculture students. Seed procurement remains a significant challenge, due to both the absence of accurate species literature and the lack of proper seed storage facilities. This presentation will focus on the successes and challenges that have emerged in the first year of the project, including nursery construction, species identification, training, overcoming language barriers, seed procurement and propagation protocols, and on-going project financing.

Becca Lieberg is a graduate student with the College of Natural Resources at the University of Idaho. Her research interests center around native plant restoration and greenhouse management, especially in the international arena. She has had extensive experience with managing restoration programs, projects and greenhouse crops, in nurseries throughout Utah, Arizona, Idaho, Washington, as well as in the Philippines and Togo. Becca also loves everything outdoors and generally tries to get dirty on a daily basis.

Thursday 9:10 - Blue

Native plant propagation for restoring rangelands

Alicia Melgoza, Carlos Morales, Otilia Rivera*

Our project of native plant propagation is a long-term program composed of different research projects that have been developed with a common goal: restoration of degraded ecosystems. These research projects include plant species with phytoremediation capacities, species for livestock production, and selected species with potential to succeed under the global environmental change. The material evaluated in the projects included about 95% of native and 5% of exotic species. At the beginning, the program had a strong livestock production approach. However, due to the changing needs of the society, native species in general represent not only a forage source but also the continuity of ecological services. Among of the limitations for the program is that, even though establishing native vegetation has been successful, the main cause of degradation has not been removed, i.e. overgrazing. Other

limitations include the lack of continuity on the funding granted by financial agencies, as well as the periods of the granted projects, which is usually one or two years. This period is not enough for seeds collection, germination tests, and fieldwork. In addition, some years with extreme droughts had been reflected in low seed production. The previous work performed on this program permitted to identify some strategies on germination in over 60 species. Moreover, about 12 grass ecotypes have been selected for forage production, soil stabilization, and seed production. Also, survival at the field has been accounted in about 20 plant species. All these achievements have been possible thanks to a group of individuals as well as institutions, which demand the restauration of the ecosystems. However, diffusion of this program between the society and institutional organizations is needed in order to succeed in this program of native plant propagation.

Alicia Melgoza pursued her Ph.D. on range management at New Mexico State University. During thirty years, she worked for the federal government of Mexico developing research and extension projects on plant taxonomy and plant ecophysiology. Currently at UACH, her main research is related to the evaluation and selection of wild plants for restoration purposes, especially for dryland ecosystems.

THURSDAY 8:00 – 9:30 CONGRESSIONAL SYMPOSIUM

Thursday 8:00 - Congressional

Texas Ecotype Approach to Commercial Native Seed Provision and Ecosystem Restoration

Organizer: *Forrest Smith, South Texas Natives*

Panelists: *Forrest S. Smith, South Texas Natives and Texas Native Seeds Projects; John Reilley, USDA NRCS E. "Kika" de la Garza Plant Materials Center; Keith A. Pawelek, South Texas Natives and Texas Native Seeds Projects; Anthony D. Falk, South Texas Natives and Texas Native Seeds Projects; Colin S. Shackelford, West Texas Native Seeds Project; John R. Bow, Central Texas Native Seeds Project*

Commercial native seed supply is a limiting factor to successful native plant restoration in Texas. In 2001, the South Texas Natives Project began work to address this limitation, and in recent years, similar efforts have begun in Central and Western Texas. These ecotype projects have collected, increased, and commercialized over 30 ecotypic native seed selections, and enabled commercial seed provision on an annual basis of over 60,000lbs of native seed. This work has resulted in tens of thousands of acres of restoration plantings on primarily private lands. We will present 6 important aspects of these efforts. First we will address estimating native seed needs and building capacity of seed markets through careful seed selection, creative commercialization, and stimulating seed use by agencies and consumers. Second we will present methods to rapidly increase seed supply in order to allow commercial growers to meet emerging demands. Next will present information on genetic variation from our region, and outline decisions regarding ecotype selection allowing for logical areas of adaptation, and commercial success. Then we will discuss collection, evaluation, and management considerations that have resulted in successful ecotypic seed selections. We will also present information from demonstrations and field trials with specific information on seed mix composition, planting methods, and restoration outcomes. Finally, we will present how our multi-agency and stakeholder projects have been managed for success, and outline how we have been able to work toward common goals to provide native seed sources in amounts needed to enable large scale restoration.

THURSDAY 8:00 – 9:30 CABINET SEED STORAGE

Thursday 8:10 - Cabinet

Does Frozen Storage Change the Germination Performance of Native Southwestern Forb Species?

Alexandra Seglias and Andrea Kramer*

In the face of climate change and habitat destruction, plant biodiversity is being lost at an unprecedented rate, and many species face the threat of extinction. In order to conserve native plant species, many institutions are turning towards ex situ conservation when in situ conservation is not feasible or sufficient for the long-term. Seed banks have become a primary method of ex situ conservation of many plant species worldwide. However, seed bank storage conditions are not identical to the conditions of natural soil seed banks to which seeds are adapted. In this respect, understanding how ex situ storage conditions affect dormancy and germination patterns is essential to effectively using stored seeds in restorations. To examine the influence of frozen storage on dormancy and germination, I used frozen and non-frozen seeds from multiple populations of six native, restoration-relevant forb species from the southwest U.S. Seeds were dried to 15% rH and stored in the seed bank freezer (-20°C) at Chicago Botanic Garden for at least 3 months. Frozen and fresh seeds were subjected to three stratification temperatures, six stratification lengths, and two incubation temperatures to closely examine dormancy break and germination under many conditions. Results from the study showed that short-term frozen storage did not alter germination performance in these six forb species, as patterns of dormancy and germination were similar across all stratification and incubation treatments for fresh and frozen seeds. Implications of these results, and potential applications to restoration and native plant materials development will be discussed.

Alex Seglias is a master's student in the program of Plant Biology and Conservation at Northwestern University and The Chicago Botanic Garden. Her research has focused on dormancy and germination of native, restoration-relevant forb species from the southwestern United States.

Thursday 8:30 - Cabinet

Maternal Habitat Environment Influences of Storageability and Germination Response of Desert Seeds

Narayana R. Bhat, Majda K. Suleiman, Laila Al-Mulla and Thomas M. Thomas*

Kuwait's desert plants are exposed to severe environmental stresses, such as extremely high temperatures, very low erratic rainfall and high salinity. The environmental and edaphic conditions experienced by maternal plants during the growing season as well as the conditions under which seeds develop and mature on a maternal plant influence their storage behavior and germination response (longevity, dormancy and level and rate of seed germination) which in turn, play an important role in the restoration of native vegetation. The morphology, viability and germination of representative samples of seeds of (*Rhanterium eppapposum* Oliv., *Farsetia aegyptia* Turra., and *Calligonum polygonoides* L.) collected between 2004 and 2015 was assessed under laboratory conditions (25± 2C; light) and were correlated with environmental conditions during development and maturation of these seeds. The germination percentage ranged between 0.5 (in 2006 collection) and 72.8 (in 2004 collection), 63.7 (in 2014 collection) and 85.8 (in 2013 collection) and 9.0 (in 2014 collection) and 54.3 (in 2004 collection) in *Rhanterium epapposum, Farsetia aegyptia* and *Calligonum polygonoides*, respectively. In a series of experiments, the germination behavior of seeds of these species in terms of germination percentage, germination rate, mean time to full germination and seedling quality (seedling length and biomass) in response to various presowing seed treatments, such as water stress, salinity and dormancy regulating compounds were determined and compared to those soaked

in distilled water (control). Results of these experiments will be discussed in this presentation.

Dr. Narayana R. Bhat is the Senior Research Scientist in the Desert Agriculture and Ecosystems Program at Kuwait Institute for Scientific Research (KISR). He was the project leader/ activity leader/ principal investigator of several client-funded projects and research activities. Prior to joining KISR, Dr. Bhat served on the faculties of a number of universities where he taught undergraduate and graduate courses in different aspects of horticulture.

Thursday 8:50 - Cabinet

The Effect of Seed Storage and Water Balance Characteristics on Seed Germination Success in 26 Ficus Species from Tropical and Subtropical South China

*Huayang Chen, Imeña Valdes, Ying Chen, Xiaoyin Wang and Uromi M. Goodale**

Ficus species, which are mostly tropical, are considered keystone species that provide valuable food and habitats for wildlife and are good candidates for restoration programs. While obtaining adequate amounts of seeds for restoration is feasible in most species, the effect of seed characteristics and seed storage conditions on seed viability and vigor are not well understood. We assessed the effect of storage time, storage humidity and temperature, germination water availability and temperature, and seed water balance characteristics (water content, water loss rate, activation energy, and equilibrium humidity), on germination of 26 *Ficus* species from tropical and subtropical South China. *Ficus* species that are from tropical habitats were more resilient to storage and germination environmental conditions and species that were found in high elevation and subtropical environments were more sensitive to higher storage temperatures and were less resilient to water loss through seed coat permeability. There was a significant temperature effect on germination. While water availability in the growth media did not have a significant effect of final germination percentage lower water conditions prolonged time for 50% germination (T50). In contrast, relative humidity in the air had a very significant effect on both final percentage germination and T50 and convoluted seed surface characteristics that could help with the seed attachment to substrate were observed in both hemiepiphytic and terrestrial species. In general, *Ficus* seeds can withstand long term storage and are good candidates for restoration from seed, especially in site conditions with depleted soil seed and barriers to seed rain.

Dr. Uromi Manage Goodale (Masters in Forest Science '01 and Ph.D. '09, Yale University, School of Forestry and Environmental Studies) is an Associate Professor at Guangxi University, College of Forestry. Her current research focuses on Regeneration Biophysiology and she is the Editor in Chief of the Journal of Sustainable Forestry.

Thursday 9:10 - Cabinet

Picking from the Past in Preparation for a Pest: Assessing the Potential for Herbarium Seeds to Combat ROD

Dustin Wolkis and Susan Deans*

Ceratocystis fimbriata, the pathogen causing rapid ohi'a death (ROD) has emerged as a serious threat against Hawai'i's most iconic, keystone forest tree, ohi'a (*Metrosideros polymorpha*). To assess their usefulness in restoration, we ask how seeds of *M. polymorpha* respond to 1) extreme climate conditions necessary for entry into herbaria (PTBG), and 2) long-term storage at ambient herbarium conditions. We collected fresh seeds from twelve individuals of *M. polymorpha* in spring 2016 on Kaua'i. Three replicates of 50 seeds each were either placed in an herbarium dryer (57°C/5% RH) for three days, frozen (-20°C/95% RH) for two weeks, or placed in a dryer then frozen, and compared against seeds kept at ambient laboratory conditions (control) (20°C/ 63% RH). Fifty *M. polymorpha* seeds were harvested from 20 herbarium specimens each originally collected from 5 to 38 years ago. All seeds were placed in a germination chamber at a 12/12 hour photoperiod and 30/20°C light/dark thermocycle for 12 weeks. There was no significant difference in percent germination among treatments testing for herbarium entry conditions

(p=0.465). Although no seeds from herbarium specimens germinated, freshly collected dried and frozen seeds germinated at a level equivalent to the control (p=0.971). This suggests that seeds can survive the extreme climate conditions necessary to enter herbaria, but lose viability after storage at ambient conditions in 5 years or less. Though *Metrosideros polymorpha* seeds may be plentiful in herbaria, we recommend using seeds deposited into optimal conditions in ex situ storage for post fire restoration, and to combat ROD.

After graduating from Arizona State University with a M.S. in Plant Biology and Conservation, I joined the Science and Conservation department at the National Tropical Botanical Garden on Kaua'I, HI. There I manage the Seed Bank and Laboratory where I study seed longevity, seed storage behavior, and germination and dormancy.

THURSDAY 10:00 – 11:00 PALLADIAN PROCUREMENT

Thursday 10:00 - Palladian

How can California Benefit from the National Seed Strategy for Rehabilitation and Restoration

David Gilpin

California and much of the Intermountain West is in the midst of an epic fire cycle with hundreds of thousands of acres burned and many thousands of homes destroyed each year. The ravages of fire and the prospects of excessive erosion downstream combined with growing weed infestations weigh greatly on the minds of land managers and home owners alike. So how could the newly enacted "National Seed Strategy for Rehabilitation and Restoration" benefit the State of California and the residents impacted by a major land disturbance? The Strategy could provide a more coordinated approach to stabilization, rehabilitation and restoration within California and throughout much of the west. Government agencies are challenged to step up and acquire local source materials once that material is available in the market place. If the National Seed Strategy is to reach its potential in California, the State of California and the federal agencies within will need to partner with private industry to make this a reality.

David Gilpin is founder and General Manager of Pacific Coast Seed, a native seed company specializing in the collection and sale of California native grasses, forbs and shrubs. Pacific Coast Seed was established in 1985 and David has been intimately involved in the company's growth since its inception. David has a B.S. in Environmental Planning and Management and M.S. in Environmental Horticulture both from the University of California, Davis.

Thursday 10:20 - Palladian

Procurement and Contracting Challenges for the Seed Industry

Ed Kleiner

The National Seed Strategy has placed an emphasis on the use of genetically appropriate seed. This Strategy is being reinforced with the development of Seed Transfer Zones that will encourage optimal matches of seed source and use. A significant but still insufficient amount of locally sourced seed is now being cultivated and collected. This presentation identifies shortcomings in the current supply chain and contractual issues across market sectors that are preventing optimal performance by all parties involved in native restoration. Although the bottlenecks discussed in this presentation are derived from working experience in California and Nevada, others in the seed industry have expressed similar issues.

Following an Arts Degree at the University of Nevada at Reno, Ed Kleiner began his business over 30 years ago. As a seed company president, he has worked in most sectors of the reclamation industry from traditional mining ventures to new age solar projects. For the last fifteen years he has also been applying much of his experience to developing his 43 acre seed farm in Gardnerville, NV.

Thursday 10:40 - Palladian

Natives First - A Native Vegetation Standard for the Conservation Title of the Farm Bill

Jef Hodges

Throughout the eastern United States Farm Bill programs have traditionally relied on introduced plant material for vegetation projects. The Environmental Quality Incentives Program and Conservation Reserve Program alone are responsible for an estimated 2.0 million acres annually, with a majority of that planted to non-native exotic introduced species. The National Bobwhite Conservation Initiative (NBCI) is leading an effort for the U.S. Department of Agriculture to establish a native vegetation standard which specifies that native vegetation be considered first in all technical or financial assistance and the cost-share assistance be eliminated for all aggressive species. NBCI is also seeking to form a Natives First Coalition to help advance the proposal and promote the concept through affiliated networks.

Jef has worked in the wildlife and plant community management industry since 1980 including experience with a native seed company and as a conservation contractor, specializing in prescribed fire and native vegetation plantings. He is a Certified Wildlife Biologist and USDA registered Technical Service Provider. Currently Grassland Coordinator for the NBCI.

THURSDAY 10:00 – 11:00 BLUE SYMPOSIUM

Thursday 10:00 - Blue

Just how well do we use native seed in ecological restoration?

Kingsley Dixon and Simone Pedrini*

Seeds drive most of the world's agricultural and horticultural industries, with native plant seed being the most broadly used 'propagule resource' in ecological restoration programs. But just how well is seed being used for this purpose? Is there a "technological toolkit" available to ensure that seed, particularly wild-sourced native seed, is used prudently and efficiently? Here we will discuss a recently published review in Trends in Plant Science that unpacks the technological impediments, myths, and promises that seed science and technology offer restoration globally.

Professor Kingsley Dixon is a seed scientist and ecologist working in global restoration programs with a focus on the biodiversity hotspot of southwest Western Australia. His broad interests include ecology and biology of natural ecosystems and native plants.

Thursday 10:20 - Blue

Native seed production - the role of botanic gardens

Sara Oldfield, Katherine O'Donnell and Xiangyin Wen*

Botanic gardens manage at least one-third of the world's flowering plants in their living collections and seed banks, representing a very significant potential resource for ecological restoration. Currently around 400 botanic gardens have seed banks. In the US, botanic gardens are actively engaged in the National Seed Strategy and are contributing to capacity building and development of seed banking in other parts of the world. Global initiatives, coordinated by Botanic Gardens Conservation International, are underway to increase the seed banking role of botanic gardens and to coordinate and scale up ecological restoration. These initiatives will be discussed with case studies from Europe, Africa and China demonstrating how botanic gardens are providing expertise and plant materials for restoration at

different geographical scales.

Sara Oldfield is a botanical consultant and writer working with international conservation organizations. She served as Secretary General of Botanic Gardens Conservation International (BGCI) for ten years until 2015 and continues to work with them on the Global Trees Assessment.

Thursday 10:40 - Blue

NASSTEC: an EU training initiative in native seeds production and use for grassland restoration

Marcello De Vitis, Giles Laverack, Costantino Bonomi

NASSTEC - the NAtive Seed Science, TEchnology and Conservation Initial Training Network is a Marie Curie project funded by the EU under FP7. It is training 11 PhD students and one post-doc researcher in native seed science adopting a cross-cutting approach that integrates academia and industry in an effort to conserve, produce and use sustainably and effectively native seeds for grassland restoration. NASSTEC partners include four academic institutions from Italy and the UK and three private companies from Spain, the UK and the Netherlands. The individual PhD projects are organized into 3 sub-programmes that mimic the plant reintroduction cycle: A. In situ seed sampling, B. Seed biology characterization, and C. Production and deployment of seeds. A special focus is on technology transfer from academia to industry within and outside the network reaching out to all interested stakeholders, especially native seed producers. The project outputs are driven and informed by the needs of the European native seed community that were specifically assessed through a survey. Project outputs will include an online platform to facilitate the species selection for restoration activities, handbooks and manuals, germination and production protocols on selected species as case studies, suggested standard procedures for certification, a policy whitepaper and a discussion forum to nurture a thriving native seed community.

THURSDAY 10:00 – 11:00 CONGRESSIONAL SYMPOSIUM

Thursday 10:00 - Congressional

Symposium continued: Texas Ecotype Approach to Commercial Native Seed Provision and Ecosystem Restoration

Texas Ecotype Approach to Commercial Native Seed Provision and Ecosystem Restoration

Organizer: *Forrest Smith, South Texas Natives*

Panelists: *Forrest S. Smith, John Reilley, Keith A. Pawelek, Anthony D. Falk, Colin S. Shackelford, John R. Bow*

THURSDAY 10:00 – 11:00 CABINET SYMPOSIUM

Thursday 10:00 - Cabinet

Seed Collections for Coastal Restorations in the East

Clara Holmes, Amanda Faucette, North Carolina Botanical Garden ; Michael Piantedosi, New England Wild Flower Society*

In 2012, Hurricane Sandy caused $71.4 billion (NOAA, 2013) worth of damage to coastlines from Maine to Virginia. In response to the need to restore and strengthen coastal ecosystems, the Department of Interior designated over

$200 million in funding and grants for recovery and resiliency projects throughout the region. The New England Wild Flower Society (NEWFS), the North Carolina Botanic Garden (NCBG) and the Mid-Atlantic Regional Seed Bank (MARSB), in partnership with the Chicago Botanic Garden (CBG), NRCS Cape May Plant Materials Center (CMPMC) and Seeds of Success (SOS) received $3.5M of DOI funding to initiate a seed collection program along the Eastern seaboard. The two-year goal was to make seed collections in coastal habitats to insure a source of genetically appropriate seed for plant material development in support of these projects. To accomplish this goal, the three SOS partner institutions hired 14 interns per year through CBG's Conservation and Land Management program to target 700 collections a year. The Cape May PMC cleaned all seed for the program. To date, a total of 1,113 collections representing 215 unique species in 7 different ecoregions were made. Eighteen projects have been provisioned with genetically appropriate seed and we continue to work with an additional seventeen projects to meet their needs. This presentation will highlight the logistics, successes and shortfalls of this program and the need for on-going support of seed collection throughout the East in anticipation of future catastrophic events such as sea level rise and climate change.

Clara Holmes has been the Seed Collection Coordinator for the Mid-Atlantic Regional Seed Bank (MARSB) since 2013. Splitting her time between the office and the field, Clara manages MARSB's various seed collection projects, oversees seed collectors throughout the region, and makes seed collections during the spring, summer and fall. Prior to working with MARSB, Clara worked with the New York City Department of Parks and Recreation, conducting vegetation surveys in NYC Parks. She holds a B.A from the College of Charleston and an M.S from Pace University.

Thursday 10:20 - Cabinet

Seeds of Success (SOS) Web Portal for Documenting Seed Collections

Michael O'Neal and Megan Haidet*

Seeds of Success (SOS) is the national native seed collection program, led by the Bureau of Land Management (BLM). A typical year includes 50 federal and non-federal collection teams making 1500-2000 collections. An integral part of the program involves maintaining thorough, accurate, and accessible data on the +18,500 seed collections that have been made since the program's inception in 2001. Historically this information has been sent to the national office for subsequent data entry into the SOS national database. 2016 marked the introduction of a web-based portal to facilitate the data entry of seed collection data directly by the collecting teams. This presentation will provide an overview of the capabilities of the portal as well as discuss future directions for its development and use.

Michael O'Neal has been developing and supporting databases throughout his career, working in that capacity at Chicago Botanic Garden, Center for Plant Conservation, Missouri Botanical Garden, and The Holden Arboretum. He is the co-founder and co-developer of BG-BASE Collections Management Software.

Thursday 10:40 - Cabinet

Looking to BLM Seeds of Success as a Model and Partner to Secure Native Crop Wild Relatives

Stephanie Greene, Colin Khoury, Karen Williams*

An important element of the National Seed Strategy is to expand the collection, conservation, and assessment of native plant genetic resources. The strategy recognizes that crop wild relatives contain unique properties. While these species may not be used for revegetation and restoration, they are critically important for food security. The U.S. ranks fifth in the world for the number of native wild cousins of our domesticated species. However, much work remains to collect and make available these valuable genetic resources. Strategies are being investigated to

determine the most effective and cost effective approach for collecting, maintaining and distributing these wild relatives. The Seeds of Success program has demonstrated that effective collecting efforts can occur on a national level and across agencies. The program serves as a model that can be used to guide the seed collecting efforts that would underpin a national crop wild relative initiative. Because the National Seed Strategy recognizes the value of conserving a diverse range of native species, it provides a framework that invites agencies such as BLM, that have been traditionally focused on revegetation and restoration to broaden efforts to secure and make available wild species useful for breeding crops.

Stephanie Greene is the Seed Curator at the USDA Agricultural Research Service, National Laboratory for Genetic Resources Preservation in Fort Collins, CO.

THURSDAY 11:00 A.M.– 1:00 P.M. PALLADIAN CLOSING PLENARY

Closing Plenary Session

Tom Kaye, Executive Director, Institute for Applied Ecology

Noreen Walsh, Regional Director, Mountain-Prairie Region, USFWS

Kay Havens, Chair, Plant Consevation Alliance Non-Federal Cooperator Committee

Rob Fiegener, Director, Native Seed Network, Institute for Applied Ecology

Listed in alphabetical order by first author name

1 Bringing the outdoors closer to home: Establishing a native plant materials program for landscape and indoor use in Hawaii

Orville C. Baldos and Aleta Corpuz

Promoting native plants in urban spaces is one approach for increasing public engagement in the conservation of local flora. In Hawaii, the use of native plants in urban spaces has increased due to the growing awareness of invasive species issues and due to state laws which advocate native plants in publicly funded landscapes. Developing native plants as ornamentals can minimize invasive species risks while promoting Hawaiian culture, the Hawaiian sense of place as well as the importance of conserving local biodiversity. While a number of native species have been successfully utilized in landscaping, lack of plant material availability, and limited information on care and maintenance continue to be a constraint. To address these issues, we initiated a research program to develop native Hawaiian plant materials for ornamental use. The objectives of the program are: 1) to develop a germplasm collection of native plants from across the state, 2) to evaluate, select and/or develop ornamental forms and develop propagation techniques, and 3) to evaluate suitability for landscape use as well as for novel ornamental uses. Currently, we are collecting seeds, cuttings or divisions of common and underutilized species (Sida fallax, Chenopodium oahuense, Carex spp., Eragrostis spp. and Peperomia spp.) to evaluate for landscape containers and houseplants. Propagation studies have also been initiated to obtain a critical mass of material for evaluation. In the next three years, field and indoor trials will be conducted to evaluate and release promising native plant selections.

Dr. Orville C. Baldos is an Assistant Researcher/Professor in sustainable ornamental production. His research interest include native Hawaiian plant materials development for landscape and ornamental use, screening and selection of non-invasive ornamental species, and development of sustainable ornamental plant production and landscape management practices.

2 Building a portable after-ripening bucket for relieving dormancy of small seed batches

Orville C. Baldos, Joseph DeFrank and Scott B. Lukas*

The control of both seed storage temperature and humidity is essential for optimizing dry after-ripening of seeds. Manipulating these factors to process small seed batches often require expensive equipment such as incubators and desiccators. To reduce cost, we have devised a portable after-ripening system made from readily accessible components, such as a 5-gallon (18.93 L) plastic bucket (with a screw top lid), bubble wrap insulation, silica gel-based desiccator and a seed germination heat mat (connected to a thermostat). To assess the storage conditions of the do-it-yourself after-ripening system, dried seeds and awns of piligrass (Heteropogon contortus) were placed inside the bucket and stored for 12 months at the 30°C setting of the seed germination heat mat. Temperature and relative humidity during the storage period was monitored using a datalogger (Onset HOBO® UH100). Records obtained from the datalogger indicate that the bucket can maintain an average temperature of 30.92°C (standard deviation = 0.96°C) and an average humidity of 30.81% (standard deviation = 1.89%). A previous study on after-ripening of piligrass indicates that this storage condition falls under the ideal range of storage temperature (30°C) and storage humidity (12% to 50% eRH). Results of the first year of evaluation suggest that the portable bucket can be used for small scale after-ripening of piligrass seeds. The potential exists for the modification of the desiccant type and temperature settings to facilitate after-ripening in a greater range of species.

3 Restoration of historic agricultural fields to shrub-steppe in Washington's Columbia Plateau

Molly Boyter, Chris Sheridan*

Less than 40-50% of Washington's shrub-steppe remains, and much of that is degraded, isolated, and fragmented. The state natural heritage program estimates that only 12% of functional shrub-steppe ecosystem remains in Washington and less than 1% are protected in ecological condition similar to the original vegetation. In the early 2000's, retired BLM Botanist Pam Camp identified the need to restore old agricultural wheat fields which had been acquired by the BLM after being seeded with non-native grasses as part of the Conservation Reserve Program in decades past. The BLM began native grass and forb collection in sagebrush steppe near Wenatchee, WA, and partnered with local growers in the emerging local native seed market to increase the seed. With funding from the BLM's Native Plant Materials Development Program, staff worked with Benson Farms Inc. and other partners to implement the restoration of several old fields using a variety of techniques. Monitoring of these efforts culminated in 2013 and results are presented in this poster. Re-entry efforts have occurred since in some fields to increase the shrub and forb diversity, and decrease annual grasses. Lessons learned include the difference in effectiveness of a variety of field preparation and planting techniques, as well as the need for re-entry to expand diversity and knock back invasive species. Recent increases in fire size and frequency, and subsequent emergency restoration funding, have allowed staff to expand and improve on efforts in Washington using new combinations of techniques and native plant materials.

Chris Sheridan joined the BLM's Wenatchee office in 2011 as the Spokane District Restoration Coordinator, and has a background in fisheries and riparian restoration. Molly Boyter became the Spokane District Botanist in 2010 and is also located in Wenatchee, WA.

4 Planting the seed: National Park Service offers opportunity to educate public about native plants and seeds

Kristy Burnett and Greg Eckert*

During the National Park Service's Centennial in 2016, excitement about national parks and visitation to parks are at an all-time high. More than 300 million people visited the 400+ park units in 2015, giving national parks a unique position to share information to the public about important conservation topics and challenges, including native plants and seed. This presentation at the Seed Strategy Conference will demonstrate how national parks discuss the importance of native plants and seed to visitors. Participants can learn how the NPS addresses this important issue, and it's a good step toward a unified effort toward communication about the seed strategy and importance of native plants and seed.

5 Consequences of phenological shifts in a spring ephemeral community

Rebecca M. Dalton

Biodiversity is critical for essential ecosystem functions and services to humans. Coexistence of many species requires a delicate between inter- and intraspecific competition. This will occur if one species is slightly better at obtaining a specific resources (e.g., acquiring nutrients vs. receiving pollinator visits), but, if changes in conditions due to global climate change or habitat fragmentation occur, this balance could be disturbed and some species to drive others extinct. For example, warming temperatures are causing some flowering species to emerge and reproduce earlier in the season, while others are germinating later. If species in a community respond unequally to the same environmental cues, populations might experience higher or lower levels of interspecific competition for shared resources than in the past, which could upset the balance of competition essential for coexistence. My research examines the relationship between phenology and the ability of two plant species to coexist. From 1978-1982 in Durham, NC, Alexander Motten and Diane Campbell studied the timing of flowering and competition for pollinators in two forest herbs, Claytonia virginica and Stellaria pubera. This year, I am returning to their old-field sites to determine if phenological shifts have occurred since the original study and if C. virginica and S. pubera compete for the same resources. With these preliminary data, I will be able to model how climate change will affect coexistence mediated by competition for biotic and abiotic resources.

Rebecca Dalton is a third year PhD student at Duke University in the University Program in Ecology. She is interested in how changes in phenology affect species interactions in native flowering communities.

6 From seeds to success

Eric Geisler, Justin Fulkerson, Jacob DeKraai*

The Seeds of Success (SOS) program in Alaska is focused on the collection of native seeds to support reclamation of disturbed sites. The BLM manages a wide variety of ecological conditions in Alaska and therefore broad arrays of species are needed to maintain ecological integrity. The Assessment, Inventory and Monitoring (AIM) protocols are used to evaluate disturbed sites to determine baseline reclamation needs. The BLM works with University of Alaska Anchorage, the Alaska Plant Materials Center (PMC), and others to collect and evaluate which regionally specific SOS species are the most promising for future reclamation and commercialization. However, currently there is insufficient demand from any particular region to have site specific seed mixes be a commercially viable option for seed growers. Seeds are increased from collection amounts to field level quantities at the PMC so that commercial growers can be engaged when the demand occurs. The PMC also provides plug seedlings of some species from the SOS collections for direct outplanting at some reclamation sites. Native seed mixes provide the best opportunity for reclamation of wildlife habitat after disturbance.

Eric Geisler, CF. is the BLM State Program Lead for the Seeds of Success program and several others. He has eight years of experience in Alaska and previously spent time in Idaho, Eastern Oregon, and Washington. He has worked with site reclamation for approximately 20 years and reforestation for over 40 years.

7 Genecology and seed transfer zones for pearly everlasting in the Intermountain West

Alexis Gibson, Susan Rinehart, Aram Eramian, Cara Nelson*

The choice of which germplasm to use where can impact restoration success. A growing number of seed transfer guidelines are available for managers, yet the majority of these transfer guidelines are for grass species. Pearly everlasting (Anaphalis margaritacea) is a perennial forb found across North America; the species is an important component in restoration seed mixes in the intermountain west. The focus of this study was to assess patterns of differentiation in potentially adaptive traits and develop guidelines for seed transfer. Data was collected over two years in a common garden established in Coeur d'Alene, ID, with seeds from 96 source populations spread across Idaho and Montana. Variation was assessed on traits related to survival, reproduction, and morphology; the relationship between traits and source population climatic factors was explored. Creating seed transfer zones for forb species will assist managers in developing more diverse and functional seed mixes for restoration.

Alexis Gibson is a postdoctoral researcher in the Department of Ecosystem and Conservation Sciences at the University of Montana. She is interested in innovating science into practice, especially in the area of native plant materials and restoration.

8 National Park Service roadside revegetation practices

*Robin Gregory, Ken Stella**

Roads in the National Park Service (NPS) travel through some of the nation's most scenic and ecologically diverse landscapes. The NPS has a dual mission of providing public access to park lands and managing those lands in an unimpaired state for future generations. Roads provide access and help the agency achieve the first portion of the mission. Revegetating road corridors with locally occurring, genetically appropriate, native species contributes to fulfilling the second part of the mission statement. In the mid 1980's the Denver Service Center (DSC) Transportation Division incorporated restoration principles into road projects. Initially revegetation was difficult due to a lack of available native seed and poor construction practices. NPS has developed ecologically based construction and revegetation methods and has partnered with the Natural Resource Conservation Service (NRCS) to increase native plant materials for revegetation. A model five year timeline: Year 1: Planning and compliance; identify revegetation species; seed collection; non-native control; initiate seed increase. Year 2: Design development; write specifications including topsoil salvage, replacement, and temporary erosion control; write revegetation plan; seed mix; continue treating non-natives and seed collection; continue seed increase. Year 3: Construction; topsoil management; erosion control; seed. Year 4: Seed; maintain temporary erosion control; plant; continue non-native control. Year 5: last non-native control treatment. Management implications: Engage project managers and designers early, enable communication across disciplines. Educate road contractors, emphasize practices that minimize non-native plants. Future emphasis: Shift seed mix design to focus on pollinators; incorporate climate change considerations in seed mix design; monitor.

Ken Stella has over 15 years of experience with botany and plant ecology. Currently he is working in the DSC Transportation Division in the revegetation group. Before DSC he served as a vegetation biologist at Grand Teton National Park working on revegetation, exotic species management, and ecological monitoring projects.

9 Collection, Evaluation, and Selection of a Central Region Little Bluestem (Schizachyrium scoparium)

Mollie Herget, Ron Cordsiemon*

Little bluestem, (Schizachyrium scoparium), is one of the primary warm season grasses throughout the tallgrass prairie region. There have been several varieties and cultivars developed, but there are no varieties that have an origin from Iowa, Illinois or Missouri. The NRCS (Natural Resources Conservation Service) Plant Materials Center at Elsberry has been in the process of collecting, evaluating and selecting an adapted and improved little bluestem for both the northern half and the southern half of the Elsberry Plant Materials Center service area. The collections from the northern half came from the state of Iowa, the northern half of Missouri, and the northern two thirds of Illinois. Collections from the southern half of the central region came from southern Missouri and the southern one third of Illinois. Evaluation criteria for two selections were based on quick establishment, late maturing seed, plant height, plant vigor, forage quality and forage regrowth. The two new varieties of little bluestem will address certain conservation issues such as wildlife plantings, prairie creations, critical area plantings, pasture and range mixtures for forage, recreational area development and other conservation uses.

Ron Cordsiemon is the Manager of the Plant Materials Center (PMC) in Elsberry, MO. Mollie Herget is the Agronomist of the Elsberry PMC. The Elsberry PMC develops plants and new planting technologies for areas of Illinois, Iowa, and Missouri.

10 Dedicated to Seed: the Bend Seed Extractory

Kayla Herriman

The USDA Forest Service Bend Seed Extractory processes more than 3,000 different species of plant material. We can guide you along every step of the way in regards to seed processing. This facility processes approximately 15,000 pounds of plant material each season for clients across the United States. Along with processing the extractory houses information on processing protocols as well as seed yields.

Kayla Herriman is the manager of the USDA Forest Service Bend Seed Extractory. She has been at the extractory for five years. Previously she worked in nurseries and in the field, focused on reforestation.

11 NatiVeg - A Planning Tool, Applications and Limitations

Jef Hodges

For one reason or another, native vegetation has been a hard sell in working agriculture lands. Despite years of effort, native vegetation still has limited acceptability. One reason for failure has been tried and failed stands due to misapplication of plant material from distant sources not adapted to local conditions. In an effort to address this informational shortcoming, the National Bobwhite Technical Committee has developed and released a mobile website to aid planners in selecting adapted plant material for their planning location. The application, NatiVeg combines GIS data layers for Major Land Resource Areas and Plant Hardiness Zones to filter the database for appropriate returns based upon the species area of adaptation. The database consists of releases by the Natural Resources Conservation Service Plant.

Jef Hodges is a Certifiable pyromaniac with over 35 years in the field.

12 Creation of a relational seed database using Microsoft Access – lessons learned

Angela Magnan

In 2012, the US National Arboretum began collecting native seed to be used in the production of plant materials for an ambitious stream restoration project. As the project progressed, the need for a system of data management to handle seed collection, seed storage, and seed propagation information in a relational format became apparent. Original data collection was begun using a combination of BG Base and Microsoft Excel, but the amount and complexity of data quickly outgrew the limitations of that software. In 2014, the author designed a new database using Microsoft Access that has increased the ease and efficiency of data input and retrieval increased the number of data parameters that can be tracked in association with one another, and made the data more accessible to multiple individuals. Microsoft Access is a useful, flexible, and underutilized tool for project management and the lessons we have learned in designing and using a database may help us and others to manage data more efficiently, thereby improving the art and science of seed processing and propagation and increasing the ability to share data across organizations.

Angela Magnan is an Agricultural Science Research Technician at the US National Arboretum in Washington, DC. She has been collecting seed and propagating plants for the Springhouse Run Restoration Project since 2013.

13 J. Herbert Stone Nursery

*John Justin; Cole grove, Lindsay; McNeal, Jason**

This poster discusses nursery operations at the USFS Region 6 nursery for the Forest Service, J. Herbert Stone Nursery. This includes seedling production and seed increase efforts that are happening in the northwest. J. Herbert Stone works with a variety of conifers, shrubs, forbs, and grasses for landscape restoration in collaboration with multiple agencies including the BLM and ODOT.

Jason McNeal is a horticulturalist at J. Herbert Stone Nursery. Jason participates in all aspects of the nursery, but specializes in native forb and grass seed increase.

14 Pollinator Week: State Governor Proclamations at State Capitols Across the Intermountain Region

John Proctor and Terry Padilla*

On January 18th, 2017 at the Idaho Noxious Weed Conference in Boise, ID. Governor Butch Otter will proclaim a week to be determined in June, 2017 to be Idaho Pollinator Week. The proclamation will be an inter-agency endeavor with the Intermountain Rangeland and Botany Program a key player along with the State of Idaho. The Lt. Governor of Idaho will kick off the conference with a brief ceremony inaugurating the Idaho Pollinator Week which will then be followed by a series of pollinator presentations delivered to an audience comprised of various federal, state, county, and private representatives. Finally a variety of pollinator posters and activities will presented in the lobby. In the next two years the Intermountain Range Program intends to pursue additional state governor pollinator and appreciating wildflower week proclamations in locations which include but are not limited to Salt Lake City, UT; Reno, NV; and Jackson, WY. Our intention is that these proclamations ultimately tier to the National Pollinator Week in Washington D.C. The outcome in mind is to 1) Raise awareness and increase education to the public on the causes of pollinator decline. 2) Generate support and partnerships to implement the new steps outlined in the National Pollinator Strategy to reverse pollinator loss and help restore populations to healthy levels. 3) Initiate a Memorandum of Understanding with partners and stakeholders which allows monies to be leveraged to conduct research to 1) Understand, prevent, and recover from pollinator losses. 2) Increase and improve pollinator habitat through increased native vegetation. 3) Expand public education and outreach and; 4) Develop public-private partnerships across all these activities.

John Proctor is the Regional Botanist, Native Plant Materials Coordinator, Pollinator Coordinator and Invasive Species Coordinator for the Intermountain Region in Ogden, UT. He has over 20 years' experience managing Botany and Native Plant Material Programs in the Forest Service John has spent much of his career working to promote the development and use of adapted native plant materials in revegetation projects to help maintain ecosystem health, resiliency and productivity of NFS and adjacent wildlands.

15 Practical climate change adaptations: how the Field Museum works in the Calumet Region to restore with climate change in mind

Izabella Redlinski

Being a new field Restoration Ecology faces many challenges, climate change arguably being the greatest one. Although restoration is being implemented throughout the country not much of it is done in a way that would pre-adapt the ecosystems for changing climate. This poster aims to present some ideas in which natural areas in the Calumet Region (region surrounding the southern tip of Lake Michigan) are being restored with this particular challenge in mind. Here, the types of action that practitioners can take are divided into resistance (practices that directly counter ecosystem changes associated with climate change), resilience (practices that maintain or restore an ecosystem's ability to bounce back to a previous stable state after a period of stress) and facilitation (practices that support the ongoing natural adaptive processes of an ecosystem). All three of these are strongly connected to native seed through seed origin, sourcing techniques, cultivation or redistribution which are the backbone of any restoration project aiming for a healthy and robust plant community.

Iza is a Conservation Ecologist with the Field Museum in Chicago working in the Calumet Region. She is interested in restoring and recreating local habitats and preparing them for the challenges of climate change. Her favorite ecosystems are wetlands and prairies.

16 Developing Seed Transfer Zones through partnerships and collaboration

Susan Rinehart, Aram Eramian, Jasmine Drapeau*

The USFS Northern Region Seed Transfer Zone (STZ) study begins its 10th year in 2017. Project goals include development of seed transfer zones for priority revegetation species for use by forests and grasslands in the Northern Rocky Mountain ecosystem. Seed transfer guidelines are considered critical information to Northern Region resource managers in determining species adaptability across ecological conditions found in this geographical area. The STZ study is an extended process involving multiple stages and numerous partners to be successful. Critical steps in seed transfer zone development include project organization and budgeting, wildland seed collection, acquisition of data through common garden studies, data analysis of common garden data, and spatial display of transfer guidelines. Once transfer guidelines have been developed, seed is provided to a native plant grower for grow-out and increase. As a result of STZ study, cost-effective supplies of native plant material are developed for wildland fire contingencies and project use. Each step involves extensive partnering and collaboration with each partner bringing specialized skills and contributions to the final product. Project partners include the USFS Coeur d'Alene Nursery, Northern Region forests and grasslands, regional Native Plant program and regional Geospatial Group. In 2016 the USFS initiated a partnership with the University of Montana, Department of Forestry and Conservation, for analysis of common garden data and development of transfer guidelines. The University will assist the USFS in data analysis for three species: Red osier dogwood (Cornus sericea ssp. sericea), white spirea (Spiraea betulifolia var. lucida), and western pearly everlasting (Anaphalis margaritacea).

Susan Rinehart is the Native Plant Program manager for USFS Northern Region in Missoula MT. Along with other project partners, she is committed to the development and use of locally adapted native plant materials for use on Northern Region forests and grasslands.

17 The southwest seed partnership and the ethos of seed conservation

Ella Samuel, Melanie Gisler, Laura Holloway, and Zoe Davidson*

Conservation biology, a discipline deeply rooted in concepts of change and adaptation, is increasingly pertinent in the face of anthropogenic environmental change and the current political climate. Seed conservation is essential in the southwest where issues like wildfire, overgrazing, mining, and energy development threaten plant populations. The Southwest Seed Partnership (SWSP), a dynamic collaboration between federal agencies, managers, farmers, and conservationists, emerged in 2015 in response to the growing need for native seed in New Mexico and Arizona. The vision of this collaborative effort to collect wild seed and increase the commercial availability of seed in the southwest supports a paradigm shift away from temporary, reactive restoration measures towards more sustainable, proactive restoration measures. The SWSP is not only developing a framework for improving native seed availability, but is also contributing to the genetic conservation of species. As the SWSP moves forward, we need to look back to the philosophical roots of restoration and consider issues ranging from the potential hazards of management to the anthropocentric value we ascribe to some species over others. In this presentation, I will discuss the SWSP and philosophical questions related to seed conservation.

Ella Samuel works for the Chicago Botanic Garden as a Conservation and Land Management Intern. As part of the Santa Fe Seeds of Success team she contributes to the New Mexico Plant Conservation Program and the Southwest Seed Partnership. Find out more at http://www.ellasamuel.com/.

18 EPA's National Wetland Condition Assessment: National-scale dataset of wetland plant species occurrence

Gregg Serenbetz

The National Wetland Condition Assessment is one in a series of National Aquatic Resource Surveys being conducted by the United States Environmental Protection Agency and its State, Tribal, and Federal Agency partners to assess and report on the ecological condition of water resources nationally. Over 1000 wetland sites were sampled during the first NWCA, conducted in 2011. At each site, field crews identified all vascular plant species present and recorded other information characterizing the plant community. Additional data collected included soil and water samples, hydrologic characteristics, and the occurrence of specific anthropogenic stressors (e.g., ditches, impervious surfaces). Data files from the national survey were released in 2016. Field sampling for the second NWCA was completed in October 2016. The poster will present background information on NWCA (e.g., survey design, site selection, data collection and analysis) and discuss applications of the data for wetland protection and restoration, with an emphasis on the collected plant data and how it can support restoration activities.

Gregg is an Environmental Protection Specialist with U.S. EPA's Wetlands Division, where he works on the development and implementation of wetland monitoring and assessment programs. He is the program lead for the National Wetland Condition Assessment, one of a series of National Aquatic Resource Surveys to assess and report on the ecological condition of water resources nationally.

19 A look into 40 years of germination testing at the Rancho Santa Ana Botanic Garden Seed Bank

Cheryl Sevilla

Most seeds possess some form of dormancy to prevent germination before seeds are dispersed, and in many cases to prevent germination when ecological conditions are not ideal and seedling survival rate is low. Whether this dormancy is physical or chemical, certain queues from the environment need to occur in order to break dormancy and trigger germination. When propagating plants from seed, the challenge is to simulate these environmental queues and break seed dormancy. This can be especially challenging for plants of arid environments, like California, where seed dormancy levels are high. Here we take a look into over 40 years of germination data from over 1700 California native species from the Rancho Santa Ana Botanic Garden seed bank. Our protocol for germinating California native seed, especially for those difficult to germinate species, is described along with relevant applications towards conservation and restoration of California native plants.

Cheryl is the Seed Conservation Program Manager at the Rancho Santa Ana Botanic Garden in Claremont, California.

20 The International Network for Seed-based Restoration

Nancy Shaw, Rob Fiegener, Olga Kildisheva, Kingsley Dixon, Stephanie Frishie, and Simone Pedrini*

The International Network for Seed-based Restoration (INSR, ser-insr.org), a new Section of the Society for Ecological Restoration, seeks to raise the profile of seed-based needs for ecosystem restoration. Ecological restoration is a growing sector with costs exceeding a trillion dollars annually and seed collection and cultivation industries as important components. Thus the need to develop standards for native plant seed collection, production testing, regulation and use is critical. INSR members include professionals, scientists, students, and representatives of industry, government and non-governmental organizations. Major goals are to; 1) advance public education, policy, and awareness of the global need for native plant seed research, conservation and use; 2) sponsor a forum for interchange of new ideas, approaches, data developed, and lessons learned relevant to planning, policy and science regarding native seed ecology technology and restoration; 3) foster collaboration to develop standards for native plant seed testing and regulation; and 4) serve as an emergency expert panel to address germplasm, biodiversity, conservation, seed farming and restoration issues. To accomplish these goals, INSR will sponsor conferences, workshops, field trips and forum discussions. In time we hope to provide funds to improve seed science and use in emerging economies by providing student scholarships and international grants

Nancy Shaw is Research Botanist (Emeritus), US Forest Service, Rocky Mountain Research Station, Boise, Idaho and member of the International Network for Seed-based Restoration Board of Directors.

21 The evolution and acquisition of the restoration collection at the Dixon National Tallgrass Prairie Seed Bank

David Sollenberger, Emily Yates, Pati Vitt

The Chicago Botanic Garden's early partnership with the Millennium Seed Bank and the BLM's Seeds of Success program were the stimulus for the advent of Botanic Garden's Dixon National Tallgrass Prairie Seed Bank. Since its inception, the Dixon National Tallgrass Prairie Seed Bank has carried out its mission to preserve the flora of the tallgrass prairie, a globally threatened ecosystem. Our primary action was to capture the genetic diversity of the tallgrass prairie by collecting 20 accessions of species considered regionally important for habitat restoration. Selection of species was based on a rating system we developed using NatureServe's comprehensive lists of species for the 12 ecoregions comprising the core of the tallgrass prairie ecosystem. From their compiled list of over 3000 native, vascular species for this region, our selection protocols resulted in our Restoration Collection targeting 545 species. Our goal is to collect at least one seed accession from all 12 ecoregions as well as an additional 8 ecoregions across each species geographic range for a total of 20 accessions. Over time, it became apparent that the protocols developed by the Millennium Seed Bank and adopted by Seeds of Success, were not appropriate for many species on our target list. As a result, we expanded our protocols to include species not present in large enough numbers or species that don't produce enough seed to fulfill the minimum requirements. With these new protocols in place we are better equipped to collect all of our targeted species.

David Sollenberger is currently the Manager of the Dixon National Tallgrass Prairie Seed Bank at the Chicago Botanic Garden. Before that he held the position of Naturalist for prairie and woodland habitats at the Garden and, as Ecologist in the Native Habitats department, was instrumental in developing the Dixon prairie.

22 Determining pollen and seed dispersal in prairies

Lauren L. Sullivan, David A. Moeller, Allison K. Shaw*

Pollen and seeds move by two major dispersal syndromes: abiotic (e.g.: wind) and biotic (e.g.: pollinators) means. While knowledge of this movement is invaluable to native seed producers who wish to maintain high genetic diversity of seeds, little is known about the spatial scale of this movement in natural systems. We are measuring how far plants disperse by pollen and seed, in order to determine if movement can be generalized based on dispersal syndromes (abiotic vs biotic), and if there are plant traits within these syndromes that predict movement ability and individual plant fitness. To conduct this work, we are mapping all individuals of 8 target species within a remnant prairie in Northwest Minnesota, collecting fitness and movement traits on these individuals, and determining their genetic identity to measure how far offspring are moving from parents via pollen (from the father) and seed (from the mother). We will use this information to analyze the connectivity of Minnesota prairie fragments, and inform managers on where new restoration should be placed to maintain connectivity. After our first field season (summer 2016) we have strong evidence to support that traits that increase dispersal ability (plant height) predict individual fitness (number of flowering heads). This indicates that plants producing more seeds also disperse these seeds farther. We are in the process of analyzing the movement distances of our individuals. By presenting these ideas at the Native Seed Network Conference, we can both expand and promote our ideas in the field of native seed production.

Lauren L. Sullivan is a postdoc at the University of Minnesota interested in how plant movement (e.g.: pollen and seed dispersal) influences native lands restoration and plant community dynamics. Previously, she conducted restoration experiments where she investigated how herbivore populations affect the movement and assembly of native plant communities in Ames, IA. She is looking forward to meeting folks from different areas related to native seeds at the National Native Seed Conference!

23 Multipurpose seeds: a second life for germination trials

*Ashly Trask, * Dustin Wolkis*

Germination Trials are an integral part of any seed bank operation. As a rule, the successful germinations produced through these trials are discarded. In many botanical gardens this means valuable, wild collected, and critically endangered seedlings are regularly thrown out. By working on the communication, protocols, and partnerships between our seed bank, our propagation nursery, and various private and State conservation organizations, we have successfully transitioned our seed trials from petri-dishes in our seed lab, to pots in our nursery, and finally to restoration sites for outplanting. This poster will demonstrate that discarded germination trials are valuable genetic material that has potential beyond the data they provide for our seedbanks.

Ashly Trask is the sole full time staff member in the National Tropical Botanical Garden (Kaua'i) nursery operation, and has been the nursery manager at NTBG since 2012. She has 15+ years of propagation experience at both botanical gardens/arboretums, as well as in commercial nursery operations.

24 Building a restoration economy in Northern Arizona with native plants

Kate Watters, Molly McCormick, and Anna Schrenk*

Regional efforts to restore the Verde River watershed are currently underway. However, successful watershed restoration is made possible by a reliable and affordable supply of native plant materials. Currently there is very little native seed production or native plant from local genotypes in Northern Arizona. This has been hindered more by economic and institutional inefficiencies than by biological constraints as multiple entities work independently to meet small-scale restoration needs. The Verde Native Plant Materials Partnership is a small cooperative of buyers and growers of native plant materials in the Arizona New Mexico mountains ecoregion consisting of local non-profit organizations, federal and state agencies, the University of Northern Arizona, environmental consulting companies, and the Yavapai-Apache tribe. These stakeholders are working together to identify and produce appropriate native plant materials in the region for public lands and riparian restoration, common garden research, and pollinator conservation. Coordinated production is expected to increase the availability and diversity of plant materials, stimulate the native seed industry, stabilize the seed market, reduce restoration costs, and ultimately improve restoration success. We are working to meet the demand for local seed while diversifying income for agricultural producers in our region, beginning in 2017 with a one acre pilot grow out for Tonto National Forest, in partnership with the Southwest Seed Partnership. The goal of our cooperative is to use science and seed transfer zones to reliably produce, clean, store, and ship enough weed-free seeds to meet the demand of small, regional restoration projects.

25 Use of the MSBP Data Warehouse and other tools to prioritize seed collecting of conifers from western United States

Michael Way and Andrew Bower*

Of the over 70 conifer collections held at the Millennium Seed Bank from the USA, many cannot currently be offered to research and restoration users as the collections do not meet desired thresholds for either sampling, viability or collection size. In addition, some species are represented by only one or two populations which are unlikely to have captured all significant genetic variation. We used risk ratings published by US Forest Service for trees in region 6, and from these we selected species for which MSB collections did not meet sampling, viability or size criteria. Outlying populations and those at the southern boundary of their distribution were prioritized for seed collection as climate change is expected to present a significant risk to such populations. Targeted seed collections were made during a remarkable seed mast season in September 2016, these have filled significant gaps in the collections and we draw conclusions on use of the online MSBP Data Warehouse and other tools used to target these activities.

Michael Way is an ecologist specializing in the collection of wild source seed for conservation purposes. At the Royal Botanic Gardens Kew, he coordinates the Millennium Seed Bank's Americas partnerships and is active in technical assessment of seed conservation facilities, and development of improved guidelines for sampling of seed.

26 Greenhouse germination trials with federally-protected Houghton's goldenrod: evaluating factors associated with population persistence

Justine E. Weber, Donald J. Leopold, and John J. Wiley, Jr.*

Houghton's goldenrod (Oligoneuron houghtonii) is a Great Lakes endemic perennial that is locally abundant but limited to a small region along the Niagara Escarpment. Approximately 80 populations occur in Michigan and Ontario, and one population occurs in western New York. This species is federally-listed as threatened, state-listed as threatened in Michigan and endangered in New York, and is a species of concern in Canada. While Houghton's goldenrod is generally uncommon, there may now be enough known and protected populations to meet the federal recovery criterion, and it may be appropriate to consider the species for delisting from federal protection. However, more data are needed on the probable long-term trends within and across populations. As part of a broader study on Houghton's goldenrod germination, establishment, and population stability, greenhouse germination trials were performed to evaluate the effects of moisture and substrate on germination success. Seeds were collected with permission from 27 populations (26 in MI and 1 in NY), and cold-moist stratified for approximately 120 days. Each population was exposed to four moisture treatments (volume [high and low] x frequency [frequent and infrequent]) and six substrate treatments (control [potting soil], sand, marl, gravel, litter, moss). Based on preliminary analyses, moderate moisture treatments (high x infrequent and low x frequent) and sand, marl, and control substrates produced higher germination rates.

Justine Weber is a PhD candidate at the State University of New York, College of Environmental Science and Forestry (SUNY-ESF) in Syracuse, NY. She works in Dr. Don Leopold's lab, researching plant communities in fens and other calcareous systems, with a special focus on the rare Oligoneuron houghtonii.

27 Dormancy and germination of globally critically imperiled Eryngium sparganophyllum Hemsl. (Apiaceae) Arizona Eryngo: Star of the Ciénega

Dustin Wolkis and Steven Blackwell*

Eryngium sparganophyllum, colloquially known as Arizona eryngo, is endemic to ciénegas (desert marshes) of southeastern Arizona. Now extirpated from all but two of its historic locations, prioritization in restoration is warranted, but knowledge of dormancy and germination ecology are lacking. We ask of E. sparganophyllum 1) is dormancy present? and if so 2) which class of dormancy? and 3) how dormancy may be artificially broken. We collected seeds from one population of E. sparganophyllum in fall of 2013. Three replicates of 16 seeds were used in each treatment. To test for dormancy break through cold stratification, seeds were imbibed and refrigerated at 5°C for 2 week intervals from 0-18 weeks. Gibberellic acid in increments of 250 ppm from 0-1000 were used to test for chemical release of dormancy. Seeds were placed in a germination chamber on a 12/12 hour photoperiod at 20/15°C light/dark thermocycle. Germinated seeds (radicle emergence) were counted every 2-3 days then terminated after 30 days. In cold stratified seeds a Tukey test revealed a significant difference between control (0 weeks) and all other treatments ($p=<0.001$). Gibberellic acid in concentrations of 1000 ppm showed a significant difference compared to Control (0 ppm) ($p= 0.015$). Consistent with other taxa within Apiaceae, E. sparganophyllum likely exhibits nondeep simple or intermediate complex morphophysiological dormancy, however, embryo growth relative to endosperm results are pending. The conservation of Eryngium sparganophyllum relies on adequate knowledge of dormancy and germination ecology, thus this study will have implications for restoration practitioners working to conserve this species.

PLENARY BIOS

Kristin Bail

Kristin Bail is the Acting Director of the Bureau of Land Management. In her most recent assignment, Bail served as Assistant Director for the BLM's Resources and Planning Directorate. She previously served as the agency's Assistant Director for National Conservation Lands and Community Partnerships. As Acting Director Bail oversees the nation's largest natural resources organization, with responsibility for more than ten percent of the land in the United States and one-third of the country's minerals. The Bureau of Land Management has nearly 10,000 employees and an annual budget of $1.3 billion.

Jean M. Franczyk

Jean M. Franczyk is president and CEO of the Chicago Botanic Garden. She comes to the Garden after serving as the deputy director of the Science Museum in London, the flagship museum within the United Kingdom's Science Museum Group (SMG). Across two continents and 15 years, she has held a series of leadership posts in museums and science education. In addition to her most recent role in London, she has also been director of the Museum of Science and Industry in Manchester, SMG's director of learning, and vice president of education and guest services at the Museum of Science and Industry in Chicago.

U.S. Representative Mike Quigley

Mike Quigley was elected to Congress to represent Illinois' 5th District on April 7, 2009. Congressman Quigley has consistently supported legislation that aims to protect our planet as well as the health of people around the world, while also supporting job growth and a strong and sustainable economy. He believes that innovative policies that address some of our most pressing environmental threats are critical to creating a more sustainable future. Today, climate change is a real threat to our land, water, air, animals, plants and future generations. A member of the Sierra Club since he was 16, Mike continues pushing for strong environmental policies that protect our natural resources and address the growing threat of climate change.

Dr. Ann Bartuska

Dr. Ann Bartuska is Deputy Under Secretary for USDA's Research, Education, and Economics (REE) mission area. She comes to REE from the USDA Forest Service, where she was Deputy Chief for Research & Development, a position she has held since January 2004. She recently served as Acting USDA Deputy Undersecretary for Natural Resources and Environment from January - October of 2009, and was the Executive Director of the Invasive Species Initiative in the Nature Conservancy. Prior to this, she was the Director of the Forest and Rangelands staff in the Forest Service in Washington, DC. She is an ecosystem ecologist with degrees from Wilkes College (B.S.), Ohio University (M.S.) and West Virginia University (Ph.D.).

Cristina Eisenberg

Cristina Eisenberg is an ecologist and the Chief Scientist at Earthwatch Institute, USA. Her responsibilities include developing strategic initiatives to explore key environmental sustainability issues and establishing partnerships with principal investigators. Her ecological research is focused on wolves and fire in Rocky Mountain ecosystems. She has a master's degree in conservation biology from Prescott College and a PhD in Forestry and Wildlife from Oregon State University. She is a Smithsonian Research Associate, a Boone and Crockett Club professional member, and a Black Earth Institute Scholar/Advisor. She is the author of The Wolf's Tooth (2010) and The Carnivore Way (2014) published by Island Press. For two decades Cristina lived with her family in a remote, wild corner of northwest Montana. She currently lives in Concord, Massachusetts, near Walden Pond.

Tom Kaye

Tom Kaye, PhD, is Executive Director and Senior Ecologist at the Institute for Applied Ecology. He specializes in habitat restoration, invasive species control, endangered species reintroduction, population dynamics of plants, population viability analysis, monitoring and conservation planning. In addition, his interests include plant-pollinator interactions and plant systematics. Tom graduated with a B.S. from The Evergreen State College (1984) and worked for the US Forest Service and National Park Service until 1987. He received a master's degree (1989) and PhD (2001) from Oregon State University. After working for Olympic National Park (1984-1987), he joined the Oregon Department of Agriculture's Plant Conservation Biology Program where he conducted research and contributed to policy on management of threatened and endangered plant species. He has served on the IUCN Species Survival Commission, Re-introduction Specialist Group. Tom currently serves on the Taylor's Checkerspot Butterfly Recovery Team for the US Fish and Wildlife Service, and the Sustainability in Prisons Project Network Steering Committee.

Noreen Walsh

Noreen Walsh is Regional Director of the Mountain – Prairie Region of the U.S. Fish & Wildlife Service. Walsh oversees Service activities for all 8 states in the Mountain-Prairie Region, including the protection and conservation of some of the last intact habitat for native species in the Region, such as grizzly bears, wolves, sage grouse, black-footed ferrets and millions of migratory birds who journey through and breed in the Region's Prairie Pothole landscape every year. She also leads the Service's role in a west-wide conservation initiative focused on greater sage-grouse and its sagebrush habitat, and has supported the "working landscape" conservation model under the America's Great Outdoors Initiative.

Institute for Applied Ecology

The Institute for Applied Ecology is a 501(c)(3) nonprofit organization with a mission to conserve native species and habitats through restoration, research, and education.

IAE accomplishes its mission via five programs:

Habitat Restoration Program

The Habitat Restoration Program is dedicated to the ecological restoration of Pacific Northwest habitats by: conducting on-the-ground restoration, developing ecologically appropriate seed mixes, cultivating partnerships that promote regional conservation, and advancing restoration science techniques.

Conservation Research Program

The goals of the Conservation Research Program are to (1) conduct research and monitoring of native species and ecosystems in order to determine population trends and effective methods for management and restoration, (2) conduct research on invasive species in order to determine effective control methods, and (3) develop plans for the management and restoration of native ecosystems.

Ecological Education Program

The Ecological Education Program at the Institute for Applied Ecology offers opportunities for K-12 students, teachers, and adult community members to engage in meaningful, place-based education through school-based programs, summer teacher workshops, Community Learning Courses, and volunteer work. In addition, we create curriculum to engage the future stewards of Oregon in the study of native plants and restoration.

Native Seed Network

The Native Seed Network is a resource for both the restoration community and the native seed industry, providing search tools and information on all aspects of native seed. The Native Seed Network advocates using native plant materials from appropriate genetic sources to conserve biological diversity and to maintain the adaptive capability of ecosystems, communities and plant populations.

Southwest Program

The Southwest Program is a branch of IAE located in Santa Fe, New Mexico. Our goal is to support the conservation, restoration, and recovery of New Mexico's diverse biological resources in collaboration with conservation leaders in the state. Improving the supply of ecologically appropriate native plant materials for restoration and recovery of rare plants and butterflies, including Monarch butterflies, is a central focus.

We work with public agencies, educators and private groups to increase the availability of affordable native plant materials from appropriate genetic sources

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