4th NRIPC Conference 17-20 October, 2016, Boise Centre, Boise, ID		
Monday, October 17		
7:00am	10:00am	NRIPC Registration (East Hall)
8:30am	**12:00pm**	**Invasive Mustards Symposium (Summit Auditorium)**
8:30am	8:40am	Welcome, *Joey Milan (USDI BLM, Boise, ID)*
8:40am	9:00am	**1** Biology of Invasive Mustards, *Tim Prather (University of Idaho, Moscow, ID)*
9:00am	9:20am	**2** Extent of the Problem on BLM Lands, *Lonnie Huter (USDI BLM, Boise, ID)*
9:20am	9:40am	**3** Dealing with Invasive Mustards From a County Perspective But Where's the "Catch-up"?, *Desiree Keeney (Ada County Weed Control, Boise, ID)*
9:40am	10:00am	**4** Genetics of the Mustards, *John Gaskin (USDA ARS NAPRL, Sidney, MT)*
10:00am	**10:20am**	**COFFEE BREAK (East Hall)**
10:20am	10:40am	**5** *Hoary allysum, Jane Mangold (Montana State University, Bozeman, MT)*
10:40am	11:00am	**6** Foreign Research Activities on Perennial Pepperweed (Lepidium latifolium L.) During 2016, *Massimo Cristofaro (BBCA, Rome, Italy)*
11:00am	11:20am	**7** Giving Dyer's Woad the Blues, *Hariet Hinz (CABI, Del é mont, Switzerland)*
11:20am	11:40am	**8** Prospects for the Biological Control of Hoary Cress, *Philip Weyl (CABI, Delémont, Switzerland)*
11:40am	12:00pm	**9** Biolgocial Control Situation Stateside, *Mark Schwarzlaender (University of Idaho, Moscow, ID)*
12:00pm		**SYMPOSIUM ADJOURN**
12:00pm	**1:00pm**	**LUNCH (on your own)**
1:00pm	**5:00pm**	**Russian Olive Symposium (Summit Auditorium)**
1:00pm	1:20pm	Welcome, *Dan Bean (CO Dept of Ag, Palisade, CO)*
1:20pm	1:40pm	**10** Russian Olive Alters Nutrient Cycling in Riparian Ecosystem, *Andrew Norton (Colorado State University, Ft. Collins, CO)*
1:40pm	2:00pm	**11** Russian Olive Biocontrol Prospects in the Post-Tamarish Biocontrol Era, *Dan Bean (CO Dept of Ag, Palisade, CO)*
2:00pm	2:20pm	**12** Russian Olive Invasion, Removal and Restoration in the Northern Great Plains, A 5-Year Report, *Natalie West (USDA ARS NAPRL, Sidney, MT)*
2:20pm	2:40pm	**13** Can a Tiny Mite Slow Down the Invasion of a Tree? Host Specificity and Impact of *Aceria angustifoliae* , *Urs Schaffner (CABI, Delémont, Switzerland)*
2:40pm	**3:20pm**	**BREAK (East Hall)**
3:20pm	3:40pm	**14** Managing Phreatophytes in Colorado: Russian-Olive, *Steve Ryder (CO Dept of Ag, Broomfield, CO)*
3:40pm	4:00pm	**15** Russian Olive as Wildfire Habitat and Potential Conflicts with Biological Control, *Matt Johnson (Northern Arizona University, Flagstaff, AZ)*
4:00pm	4:20pm	**16** Removal Thresholds and Spatial Configurations for Implementing Control of Russian Olive (*Elaeagnus angustifolia*) While Preserving Habitat for Seasonal Bird Communities, *Michael Guilfoyle (US Army Engineer R&D Center, Vicksburg, MS)*
4:20pm	4:40pm	**17** Russian Olive Removal and Restoration Affect Insect Community Dynamics, *Natalie West (USDA ARS NAPRL, Sidney, MT)*
4:40pm	5:00pm	**18** Endangered Species and Critical Habitat in the Context of Russian Olive Control, *Bob Kibler (USFWS, Boise, ID)*
5:00pm		**SYMPOSIUM ADJOURN**

5:00pm	**7:00pm**	**Biocontrol Consortium: Invasive Mustards**, *Mark Schwarzlaender (University of Idaho, Moscow, ID) and Joey Milan (USDI BLM/ISDA, Boise, ID)* (Summit Auditorium)

Tuesday, October 18

7:00am	**8:00am**	**Biocontrol Consortium: Flowering Rush (*Butomus umbellatus*)**, *Jennifer Andreas (Washington State University, Puyallup, WA)* (Summit Auditorium)
7:00am	10:00am	NRIPC Registration (East Hall)
8:00am	**12:00pm**	**Rush Skeletonweed Symposium I (Summit Auditorium)**
8:00am	8:20am	Welcome: J*oey Milan Joey Milan (USDI BLM) and Mark Schwarzländer (Univ. of Idaho)*
		Theme 1: Ecology & Biology
8:20am	8:40am	**19** The Biology of Rush Skeletonweed in Western North America, *Tim Prather (University of Idaho, Moscow, ID)*
8:40am	9:00am	**20** Genetic Population Structure of Rush Skeletonweed in North America and Effects on Biological Control Agent Attack, *John Gaskin (USDA ARS NAPRL, Sidney, MT)*
9:00am	9:20am	**21** A Dispersal and Susceptibility Model for Rush Skeletonweed in Western Rangelands, *Tim Prather (University of Idaho, Moscow, ID)*
		Theme 2: Biological Control and Integrated Weed Management
9:20am	9:40am	**22** A Weed Risk Assessment for Rush Skeletonweed (*Chondrilla juncea*), a Significant U.S. Invader, *Anthony Koop (USDA APHIS CPHST, Raleigh, NC)*
9:40am	**10:20am**	**COFFEE BREAK (East Hall)**
10:20am	10:40am	**23** Implementation of the Rush Skeletonweed Moth, Braddyrhoa gilveolella and Research on the Candidate Biocontrol Agent *Opropsamma wertheimsteini* , *Jeff Littlefield (Montana State University, Bozeman, MT)*
10:40am	11:00am	**24** Rearing and Redistribution of Rush Skeletonweed Biocontrol Agents, *Paul Brusven (NPBC, Lapwai, ID)*
11:00am	11:20am	**25** Foreign research activities on RSW (Chondrilla juncea) during 2015-2016, *Massimo Cristofaro (BBCA, Rome, Italy)*
11:20am	11:40am	**26** Host Plant Resistance in Rush Skeletonweed to the Rush Skeletonweed Rust *Puccinia chondrillinae* , *Mark Schwarzländer (University of Idaho, Moscow, ID)*
11:40am	12:00pm	**27** Effective Treatment Using Herbicides, *Ian Burke (Washington State University, Pullman, WA)*
12:00pm	**1:00pm**	**LUNCH (on your own)**
1:00pm	**5:20pm**	**Rush Skeletonweed Symposium II (Summit Auditorium)**
		Theme 3: Agency Perspecitives
1:00pm	1:20pm	**28** The Montana Perspective, *Dave Burch (MT Dept. of Ag., Helena, MT)*
1:20pm	1:40pm	**29** Lincoln County and the Montana Task Force, MT, *Dan Williams (Lincoln County Weed District, Libby, MT)*
1:40pm	2:00pm	**30** Managing Rush Skeletonweed in the Lemhi Cooperative Weed Management Area in Eastern Idaho, *Jeremy Varley (Lemhi County Weed, Salmon, ID)*
2:00pm	2:20pm	**31** Oregon's Skeletonweed Battle, *Mark Porter (OR Dept. of Ag., Enterprise, OR)*
2:20pm	2:40pm	**32** Rush Skeletonweed: The Idaho Perspective, *Joey Milan (USDI BLM, Boise, ID)*
2:40pm	3:00pm	**33** Rush Skeletonweed: The Washington Perspective, *Jennifer Andreas (Washington State University, Puyallup, WA)*
3:00pm	**3:40pm**	**BREAK (East Hall)**
3:40pm	4:00pm	**34** The Management of Rush Skeletonweed on BLM Lands, *Dr. Richard Lee (USDI BLM, Denver, CO)*
4:00pm	4:20pm	**35** The Management on FS Lands, *Gil Gale (USDA FS, Hamilton, MT)*

		Theme 4: Synthesis and Next Steps
4:20pm	4:40pm	**36** History of the Rush Skeletonweed Task Force and the Revitialized Multi-Stakeholder Rush Skeletonweed Task Force, *Joey Milan (USDA BLM/ISDA, Boise, ID)*
4:40pm	5:00pm	**37** Developing a Multi-Agency Pest Management Strategic Plan (PMSP), *Mark Schwarzländer (University of Idaho, Moscow, ID)*
5:00pm		**SYMPOSIUM ADJOURN**
5:00pm	**6:00pm**	**Biocontrol Consortium: Oxeye Daisy (*Leucanthemum vulgare*)**, *Alec McClay (Ecoscience, Sherwood Park, Alberta)* (Summit Auditorium)
6:00pm	**7:00pm**	**Biocontrol Consortium: Common Tansy (*Tanacetum vulgare*)**, *Alec McClay (Ecoscience, Sherwood Park, Alberta)* (Summit Auditorium)

Wednesday, October 19

6:00am	12:00pm	NRIPC Registration (East Hall)
6:00am	12:00pm	Vendor Setup (400 D)
7:00am	**8:00am**	**Biocontrol Consortium: Houndstongue (*Cynoglossum officinale*)**, *Mark Schwarzlaender (University of Idaho, Moscow, ID)* (Summit Auditorium)
8:00am	8:30am	**NRIPC Welcome:** *Jane Mangold (Montana State Univ., Bozeman, MT)* (Summit Audit.) **Conference Welcome:** Idaho Representative Mr. Thomas Dayley, District 21 B
8:30am	**9:00am**	**38 Keynote: Invasive Plant Management in the Western US: A Scientific Assessment**, *Roger Sheley (USDA ARS EOARC, Burns, OR)*
9:00am	**9:30am**	**39 Keynote: Using Resilience and Resistance Concepts to Assess Invasive Annual Grass and Wildfire Threats to Sagebrush Ecosystems and Sage-Grouse and Prioritize Conservation and Restoration Actions**, *Jeanne Chambers (USDA FS RMRS, Reno, NV)*
9:30am	**10:00am**	**40 Keynote: Conceptual Framework for Assessing Ecological Impacts of Invasive Plants**, *Daniel Tekiela (University of Wyoming, Laramie, WY)*
10:00am	**10:30am**	**41 Keynote: Climate Change and Invasive Plants - Feedbacks and Feedforwards**, *Matt Germino (USGS, Boise, ID)*
10:30am	**11:00am**	**COFFEE BREAK (400 D)**

11:00am	**12:00pm**	**Session A1: Genetic Variability of Invasive Plants (400 A)** Dr. *John Gaskin (Moderator)*	**Session B1: Re-thinking Integrated Weed Management (400 B)** *Dr. Sharlene Sing & Carol Randall (Moderators)*
11:00am	11:20am	**42** Genetics Variation and Management of Eurasium Watermilfoil, *Ryan Thum (Montana State University, Bozeman, MT)*	**43** The Economic Costs of Noxious Weeds on Private Rangeland in Montana, *Jane Mangold (Montana State University, Bozeman, MT)*
11:20am	11:40am	**44** Invasion Genetics of Diffuse Knapweed, *Kathryn Turner (Colorado State University, Ft. Collins, CO)*	**45** The Potential for the Use of Civilian Dog/Handler Teams in Invasive Species Detection, *Denise McLean (Prince George, BC, Canada)*
11:40am	12:00pm	**46** The Role of Multiple Introduction, Hybridization and Polyploidy in Biologcial Invasions: Evidence from the Tragopogon Species Complex, *Steve Novak (Boise State University, Boise, ID)*	**47** A Meta-Analysis of Canada Thistle (Cirsium arvense) Management in Organic Perennial Systems, *Noelle Orloff (Montana State University, Bozeman, MT)*
12:00pm	**1:00pm**	**LUNCH (provided 400 C)**	

1:00pm	**1:40pm**	**Session A1: Genetic Variability of Invasive Plants Cont. (400 A)**	**Session B1: Re-thinking Integrated Weed Managmeent Cont. (400 B)**
1:00pm	1:20pm	**48** Genetic Analysis of Native and Invasive Populations of Ventenata dubia (Poaceae): Identification of Geographic Origins and Estimation of Propagule Pressure, *Inna Pervukhina-Smith (Boise State University, Boise, ID)*	**49** Invasion Curve as a Marketing Tool for Integrated Weed Management for Invasive Plants, *Carol Randall (USDA FS, Coeur d'Alene, ID)*
1:20pm	1:40pm	**50** Amplified Fragment Length Polymorphism (AFLP) Analysis of Native and Invasive Populations of *Taeniatherum caput-medusae* subspecies *asperum* (medusahead): insights into the invasion process, *Steve Novak (Boise State University, Boise, ID)*	**51** Sheep, Insects, and Herbicide: Exploiting the Life Cycle of Spotted Knapweed as a Means of Control, *Chris Carlson (City of Missoula, Missoula, MT)*
1:40pm	**3:00pm**	**Session A2: Annual Grasses (400 A)** *Bryce Christiaens (Moderator)*	**Session B2: New Invaders (400 B)** *Joey Milan (Moderator)*
1:40pm	2:00pm	**52** Esplanade® 200 SC Herbicide for Invasive Annual Grass Control, *Harry Quicke (Bayer Environmental Science, Ft Collins, CO)*	**53** PPQ's Tiered Weed Evaluation Process and Weeds of Concern to the Northern Rockies, Anthony Koop (USDA APHIS CPHST, Raleigh, NC)
2:00pm	2:20pm	**54** The Invasion of *Taeniatherum caput-medusae* subspecies *asperum* in the Western United States is Associated with a Climatic Niche Shift: Evidence for Post-Introduction Evolution, *Eli Frazier (Boise State University, Boise, ID)*	**55** Narrow-leaf Hawksbeard (*Crepis tectorum*): a New Invasive Plant to Northeastern Montana, *Shelley Mills (Montana State University, Bozeman, MT)*
2:20pm	2:40pm	**56** Pseudomonas fluorescens strains D7 and ACK55: Bureau of Land Management Program Update, *Richard Lee (USDI BLM, Denver, CO)*	**57** Common Buckthorn: Looking Closely Reveals a New (Old) Invader, *Morgan Valliant (City of Missoula, Missoula, MT)*
			Session B3:Wet and Wild - Aquatic Invasive Plants (400 B) *Jenifer Parsons (Moderator)*
2:40pm	3:00pm	**58** An Integrative Approach to Understand the Introduction and Invasion of *Ventenata dubia* (Poaceae) in the Western U.S., *René Sforza (USDA ARS EBCL, Montpellier, France)*	**59** Documenting Environmental Changes in Flowering Rush, *Virgil Dupuis (Salish Kootenai College, Ronan, MT)*
3:00pm	**3:20pm**	**BREAK Sponsored by Bayer Crop Science (400 D)**	
3:20pm	**5:00pm**	**Session A3: Weeds and Sage-Grouse Management (400 A)** *Dr. Sharlene Sing (Moderator)*	**Session B3:Wet and Wild - Aquatic Invasive Plants (400 B)** *Jenifer Parsons (Moderator)*

3:20	3:40pm	**60** Does Management for High Ecological Condition in Sagebrush Communities Generate Optimal Brood Rearing Habitat?, *Clayton Marlow (Montana State University, Bozeman,*	**61** Are Native Macrophyte Communities Different in the Presence of an Invasive Alien Species?, *Darren Reidy (University of College, Cork, Ireland)*
3:40pm	4:00pm	**62** Understanding the Role of Resource Limitation in Restoration of Cold Desert Shrublands Invaded by Cheatgrass (Bromus tectorum L.), *Jeanne Chambers (USDA FS RMRS, Reno, NV)*	**63** Light-Related Phenotypic Plasticity of Invasive, Submerged Macrophytes, *Darren Reidy (University of College, Cork, Ireland)*
4:00pm	4:20pm	**64** Indirect Effects of Invasive Plants and Their Management on Sage-Grouse Habitat, *Sharlene Sing (USDA FS RMRS, Bozeman, MT)*	**65** Unravelling the Biogeographic Origins of *Myriophyllum spicatum* , *Philp Weyl (CABI, Delémont, Switzerland)*
4:20pm	4:40pm	**66** Invasive Plant Management: A Western Action Plan Update, *Ken Mayer (K. E. Mayer & Associates, LLC. Reno, NV)*	**67** Curlyleaf Pondweed Management in Montana: Where Are We At and Where Do We Go?, *Craig McLane (Montana Fish, Wildlife and Parks, Helena, MT)*
4:40pm	5:00pm	**68** Sage-grouse Food or Just Another Pretty Weed? *Roger Rosentreter (Retired USDI BLM, Boise, ID)*	**69** An Update on Flowering Rush Distribution and Control Efforts in the Columbia River Watershed, *Jenifer Parsons (WA Dept of Ecology, Yakima, WA)*
5:00pm	**7:00pm**	**HAPPY HOUR & HORS D'OEUVRES PROVIDED (*CASH ONLY for beverages* , SW Foyer BC East)**	

Thursday, October 20

7:00am	**8:00am**	**NRIPC Business Meeting & HOT BREAKFAST (400 C)**	
8:00am	**8:30am**	**70 Keynote: Biological Invasions in the Developing World: Woody Weeds in East Africa,** *Urs Schaffner (CABI, Delémont, Switzerland)*	
8:30am	**9:00am**	**71 Keynote: Presidential Memorandum on Pollinators - What It Means for Restoration and Reclamation Projects**, *John Proctor (USDA FS, Ogden, UT)*	
9:00am	**10:00am**	**COFFEE BREAK (400 D)**	
10:00am	**12:00pm**	**Session A4: Biocontrol (400 A)** *Carol Randall (Moderator)*	**Session B4: Restoration and Revegetation (400 B)** *Dr. Jane Mangold (Moderator)*
10:00am	10:20am	**72** USDA APHIS PPQ Policies Regarding Biological Weed Control and Subsequent Interactions, *Greg Goodman, APHIS PPQ, Riverdale, MD*	**73** Mitigating Priority Effects of Invasive Plants During Revegetation by Altering Perennial Grass Planting Date, *Stacy Davis (Montana State University, Bozeman, MT)*
10:20am	10:40am	**74** The Nagoya Protocol: Implications for Classical Biological Control and Recent Initiatives for its Implementation, *Philp Weyl (CABI, Delémont, CH)*	**75** Restoration as Assisted Succession – A Data-Driven Approach, *Zach Sylvain (USDA ARS NAPRL, Sidney, MT)*
10:40am	11:00am	**76** Monitoring and Mapping Weed Biocontrol: Standardized Impact Monitoring Protocol and EDDMapS's i-Biocontrol App, *Carol Randall (USDA FS, Coeur d'Alene, ID)*	**77** Using Cover Crops in Revegetation after Energy Development, *Natalie West (USDA ARS NAPRL, Sidney, MT)*

11:00am	11:20am	**78** Role of plant volatile cues in the host finding and environmental safety assessment of the weevil Mogulones crucifer, a biological control agent of Cynoglossum officinale, *Basu Kafle (University of Idaho, Moscow, ID)*	**79** Best Management Practices for Improving Pollinator Habitat During Integrated Pest Management, *John Proctor (USDA FS, Ogden, UT)*
11:20am	11:40am	**80** Simple Citizen Science Monitoring Programs Generate a Wealth of Data to Assess Weed Biocontrol Effects, *Mark Schwarzländer (University of Idaho, Moscow, ID)*	**81** Update on Medusahead Restoration in Montana, *Virgil Dupuis (Salish & Kootenai College, Ronan, MT)*
11:40am	12:00pm	**82** Update on Yellow Toadflax (*Mecinus janthinus*), *Sharlene Sing (USDA FS RMRS, Bozeman, MT)*	**83** The Changing Face of Plant Materials, Can a New Approach Improve Restoration Success? *Scott Jensen (USDA FS RMRS, Provo, UT)*
12:00pm		**NRIPC CONFERENCE ADJOURN**	

2016 NRIPC Conference – Boise Centre, Idaho

Abstracts

1

Biology of Invasive Mustards

Tim Prather

University of Idaho, Moscow, ID

Our list of invasive mustards in the Northern Rockies is considerable. They range from annuals (Hoary Allysum) to biennial (Dyer's Woad) to perennial (Hoary Cress). An introduction to their respective biology will set the stage in support of presentations to follow as part of the Invasive Mustards Symposium.

2

Extent of Invasive Mustard Problem on BLM Lands

Lonnie Huter

USDI BLM, Boise, ID

There are about 12 million acres of public lands managed by the BLM in Idaho across 12 field offices in 4 districts. Noxious weed management is an integral priority for each region. Noxious mustard species including whitetop (*Cardaria draba*), perennial pepperweed (*Lepidium latifolium*) and dyers woad (Isatis tinctoria) occur in varying densities across BLM lands in Idaho. In this presentation, the extent of the infestations and management actions will be summarized.

3

Dealing With Invasive Mustards from a County Perspective…But where's the 'Catch-up'?

Desireé Keeney

Ada County Weed Control, Pest and Mosquito Abatement Districts, Meridian, Idaho

Dealing with invasive mustards from a county perspective can be broken down in two categories, nuisance versus noxious. In Ada County, we deal with noxious weeds more than nuisance due to state legislation and county/city ordinances and primarily our invasive mustard problems are Cardaria draba, Hoary cress or Whitetop and Lepidium latifolium, Perennial pepperweed, and some Isatis tinctoria, Dyer's Woad. Ada County is the largest urban area of Idaho with over 440,000+ residents and dealing with private landowners and some public land agencies presents some challenges. While we do have other invasive nuisance mustards within Ada County, we are limited in some aspects on controlling them. In this presentation, we will discuss problems with invasive mustards from a county perspective and what we are looking at in the future for better ways to control these noxious weeds.

4

Genetics of Invasive Mustards

John Gaskin[1], Mark Schwarzländer[2], Hariet Hinz[3], Rob Gibson[2], Livy Williams[4], Esther Gerber[3], Brian Rector[5], Dao Yuan Zhang[6]

1USDA ARS Sidney, MT, 2University of Idaho, Moscow, ID, 3CABI Europe-Switzerland, 4USDA ARS Charleston, SC, 5USDA ARS Reno, NV, 6Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, Urumqi 830011, China

Invasive plants can differ in the way they invade, including strategies such as hybridization, reproductive method, number of introductions and genetic diversity. Here we discuss the genetics of three invasive mustards in the western USA; perennial pepperweed (*Lepidium latifolium*), hoary cress (*Lepidium draba*) and dyer's woad (*Isatis tinctoria*). Major points include the following: 1) the perennial pepperweed invasion in the USA is mostly dominated by a single genotype, despite its ability to outcross. Our invasion originates from Kazakhstan and China, not Turkey as was hypothesized earlier, 2) hoary cress grows in large patches, and single individuals usually dominate the patch and can be up to 38m across, 3) dyer's woad invasions in CA/OR are genetically distinct from the invasion in the eastern Great Basin, WY, ID, UT, and MT. Our USA invasions originate from France, Germany, Italy, Morocco, Switzerland, and Ukraine.

5

Hoary Alyssum (*Berteroa incana*)

Jane Mangold[1]

[1]*Montana State University, Bozeman, MT*

Hoary alyssum (*Berteroa incana*) is a perennial invasive mustard that was added to the Montana noxious weed list in 2008 and since then, it has continued to spread. Hoary alyssum decreases forage value for wildlife and livestock as the woody stems of mature plants are low in crude protein and digestible carbohydrates. In hay fields, contamination of 30 percent or more of forage with hoary alyssum is toxic to horses. Anecdotal evidence shows that desirable vegetation decreases as hoary alyssum increases, thus further expansion of this species could result in displacement of native plants and the wildlife and pollinators that rely on them. Land managers are expressing difficulties managing hoary alyssum. Difficulties appear to be related to hoary alyssum's prolonged flowering period when populations are simultaneously flowering and producing seeds, often on the same individuals. Another reported management constraint is that hoary alyssum often grows on coarsely-textured soils where chemical control may be compromised. This presentation will cover our current understanding of hoary alyssum as well as some preliminary data from a research project investigating hoary alyssum seed production and seed viability as influenced by herbicides applied when hoary alyssum is simultaneously flowering and forming seed.

6

Foreign Research Activities on Perennial Pepperweed (*Lepidium latifolium L.*) During 2016

Cristofaro[1,2], F. Marini[2], M. Augé[2], F. Di Cristina[2], S. Stutz[3], H. Hinz[3], R. Petanović[4], B. Vidović[4], D. Smiljanić[4], B. G. Rector[5] and J. F. Gaskin[6]

[1] *ENEA, CR Casaccia, Rome, Italy;* [2] *BBCA onlus, Rome, Italy;* [3] *CABI, Delémont, Switzerland;* [4] *University of Belgrade, Zemun, Serbia;* [5] *USDA ARS PWA GBRRU, Reno, NV, USA;* [6] *USDA ARS NPARL, Sidney, MT, USA*

Perennial pepperweed (PPW), *Lepidium latifolium L.*, Brassicaceae is a highly invasive mustard plant of Eurasian origin that spreads both by creeping roots and by seed. It is currently recorded as a noxious weed in 15 US states.

BBCA and CABI started opportunistic field surveys for the selection of new biological control agents for L. latifolium in 2003. Numerous associated organisms were found and five of them were preliminarily selected (*Phyllotreta reitteri, Melanobaris sp., Ceutorhynchus marginellus, Lasiosina deviata, and Metaculus lepidifolii*). In 2016, studies of PPW natural enemies have focused on open-field tests and field observations on the eriophyid mite *Metaculus lepidifolii*.

In 2015, several visits were made to PPW sites in central Turkey to find out more about the biology and phenology of *M. lepididifolii* and to perform an open-field test with a selection of critical test plants, as well as PPW from the US and Turkey. The results clearly indicated a narrow host range of this eriophyid mite, associated with the Turkish biotype of PPW and suggested an irrelevant attack on US biotype. Molecular analysis has shown a very low genetic diversity of PPW in US, with the most prevalent genotype from Kazakhstan and China. We therefore decided to concentrate our efforts during 2016 in two ways: i) find a mite strain potentially better adapted to invasive PPW in the US, carrying out foreign explorations in South-East Kazakhstan, where we previously recorded PPW populations similar to the most common genotype present in the US; ii) repeat the open-field test in Turkey with all four known US PPW biotypes and the Turkish population as control.

Among the 16 sites where we recorded PPW in Kazakhstan, eriophyid mites have been recorded and collected on eight. The plant samples from these eight sites will be genotyped at USDA ARS NPARL, Sidney, MT. The eriophyid mites from Kazakhstan and from the Turkish open-field test are currently being analyzed at the Faculty of Agriculture of the University of Belgrade, Serbia and results will be presented at the Conference.

7

Giving Dyer's Woad the Blues

Hariet L. Hinz[1], Cornelia Closca[1], Philip Weyl[1], Massimo Cristofaro[2], and Radmila Petanovic[3]

[1] CABI Switzerland, [2] Biotechnology and Biological Control Agency, Italy, [3] University of Belgrade, Serbia

Dyer's woad is an ancient source of blue dye and was grown as a textile dye crop in Europe and Asia for centuries. It was introduced to North America by early colonists, but escaped cultivation. Today, it is recognized as a declared noxious weed in 11 western US states. CABI in Switzerland has started conducting investigations on potential biological control agents for dyer's woad in 2004. In 2016, we concentrated our work on the root-crown mining weevil, *Ceutorhynchus rusticus*, the seed-feeding weevil, *C. peyerimhoffi,* and an eriophyid mite in the genus Metaculus. Work on the latter is done in co-operation with Massimo Cristofaro (BBCA, Italy) and Radmila Petanovic (University of Belgrade, Serbia).
Tests with both weevils are well advanced, with over 100 plant taxa tested under no-choice conditions, more than half native to North America (NA), including five federally listed threatened or endangered species (T&E). *Ceutorhynchus rusticus* has so far developed to adult in eight NA plant species. However, under open-field conditions, attack on non-targets was extremely rare. Development to mature larva of *C. peyerimhoffi* occurred so far on only three native NA species, unfortunately also on one T&E, *Boechera hoffmannii* from California. Additional tests have been conducted with this species results of which will be presented. We are planning additional tests with both species in 2017.
The eriophyid mite was first found in central Turkey in 2006 on dyer's woad rosettes with shrivelled and deformed leaves. First identified as an oligophagous species, additional morphological and molecular studies indicate that it is a species new to science, most probably specific to dyer's woad.

8

Prospects for the Biological Control of Hoary Cress

Hariet L. Hinz[1], Cornelia Closca[1], Philip Weyl[1], and Marie-Claude Bon[2]

[1] CABI Switzerland, 2 USDA ARS European Biological Control Laboratory (EBCL), France

Whitetops or hoary cresses (*Lepidium draba, L. chalepense and L. appelianum*) are deep-rooted, creeping, perennial mustard plants. They were introduced to the USA as contaminants of seed shipments from Eurasia in the late 19th century and have since spread throughout western and northeastern states. They are difficult to control and are declared noxious weeds in 14 US states and three Canadian provinces.

In 2001, Mark Schwarzländer (University of Idaho, USA) established a consortium to investigate the scope for classical biological control of these weeds. Our work at CABI is coordinated with USDA, ARS, EBCL in Montpellier, France, and with Jeff Littlefield, Montana State University, USA. We are focusing on L. draba because it is the most prevalent whitetop species in North America.
In 2016, we concentrated our work on three weevils, the seed feeder *Ceutorhynchus turbatus*, and the two gall formers *C. cardariae* and *C. assimilis.* The seed feeder is so far the most specific agent with development restricted to our main target L. draba, and some development on *L. chalepense* and the European *L. campestre*. In December 2011, a petition for field release for C. cardariae had been submitted to the Technical Advisory Group (TAG). In response to TAG comments, additional tests have been conducted with C. cardariae. We are planning to update the petition for field release this winter for re-submission. Since the specialist strain of the second gall former, *C. assimilis*, is restricted to the Mediterranean region, we investigated its phenology, temperature thresholds and cold hardiness. Although the species appears to have some potential to adapt to continental climates, temperature extremes, especially without snow cover and over prolonged periods, will likely limit its establishment and survival. We so far conducted tests with about 80 different taxa, over half native to North America. Despite the fact that development occurred on several species under no-choice conditions, hardly any attack occurred in multiple-choice cage tests.

10

Russian Olive Alters Nutrient Cycling and Plant Communities in Riparian Ecosystems

Andrew Norton[12], Graham Tuttle[12], Gabrielle Katz[3] and Jonathan Friedman[4]

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Russian olive is the fourth most common tree species along Western US rivers. This non-native species forms a symbiotic association with bacteria in the genus Frankia that allows it to fix atmospheric nitrogen, a trait that is rare in tree species native to this region. From 2010 to 2014 we measured the impact of Russian olive on soil N, photosynthetically active radiation (PAR) and plant abundance and diversity using paired plots located

underneath of nearby individual Russian olive trees. In 2012 , Russian olive was mechanically removed from one half of our study plots, allowing us to compare soil N, PAR and plant community responses between reference plots, plots under Russian olive and plots where Russian olive had been removed.

Russian olive reduced PAR to a greater degree than native cottonwood stands and, on average, more than doubled plant available N in plots located under the tree. N availability varied dramatically within each year and between years of the study, most likely in response to changes in moisture availability within and between years. The plant community underneath Russian olive canopy had lower cover of native perennial grasses and higher coverage of annual grasses and annual and perennial forbs. More than 50% of the plant cover located underneath Russian olive was comprised of exotic species, compared to less than 30% in sites located away from the tree.

In winter 2012 Russian olive was mechanically removed from one half of our study plots, and this process created substantial soil disturbance. Removal of Russian olive had little effect on soil N in the two years following treatment. Over all study plots the cover of exotic and annual forb species increased after removal, and this effect was stronger for plots located underneath Russian olive and for plots located underneath removed Russian olive than for plots located away from the trees. Our results suggest that the effects of Russian olive on soil N and plant community composition will persist for several years following removal.

11

Russian Olive Biocontrol Prospects in the Post-Tamarisk Biocontrol Era

Dan Bean

Colorado Department of Agriculture, Palisades, CO

Steps in the pathway to approval for a new weed biocontrol agent include evaluation of the target to determine the need for biocontrol, overseas exploration and evaluation of potential control agents and release permitting which includes evaluation of the safety of a potential new agent. These are sometimes seen as sequential fixed steps when they are actually parallel, ongoing and subject to changing views of the target as well as advances in the science supporting the practice and need for biocontrol. This is nowhere more visible than in the tamarisk biocontrol program which began in the late 1980s and has been conspicuous for both the successes and controversies

the program has generated. Prospects for a successful Russian olive biocontrol program will depend largely upon addressing and avoiding the problems encountered with the tamarisk program. These include minimizing the potential for indirect effects on a listed species, the yellow billed cuckoo, through selection of agents that leave existing trees intact and working to enable restoration of riparian areas degraded by Russian olive. It will also be necessary to understand and articulate the impacts of Russian olive on ecosystem services and stability, a process which is ongoing with tamarisk program.

12

Russian Olive Invasion, Removal and Restoration in the Northern Great Plains: a 5-Year Report

Erin K. Espeland[1,] Jennifer M. Muscha[2], Merilynn Schantz[3], Robert W. Kilian[3], Joseph D. Scianna[3,] and Mark K. Petersen[2]

11USDA-ARS Northern Plains Agriculture Research Laboratory, Sidney, MT, 2 USDA-ARS Fort Keogh Livestock and Range Research Laboratory, 3 Red Rock Resources LLC, Miles City MT, 4 USDA-NRCS Plant Materials Center, Bridger, MT4

Rivers, streams and drainage ditches across Montana have been converted to dense Russian olive stands, reducing their agricultural and ecological value. Controlling Russian olive is a multi-year commitment, with stump resprouting occurring up to two years post-removal and massive recruitment from seed after that. Restoration of grasses, forbs, trees and shrubs after Russian olive removal can take years to establish and return ecosystem function, and may eventually result in reduced weed abundance. Surveys along the Yellowstone River suggest that some shrub species are associated with decreased invasibility in this landscape.

13

Can a Tiny Mite slow down the Invasion of a Tree? Host Specificity and Impact of *Aceria angustifoliae*, the first Biocontrol Candidate against Russian Olive

Urs Schaffner and Philip Weyl1

1CABI, Delémont, Switzerland

Because of the potential benefits of planting Russian olive near human settlements, developing a classical biological control programme against it could give rise to a conflict of interests. Initial efforts to assess the prospects of classical biological control of Russian olive therefore focused on identifying and studying biological control candidates that reduce the seed output and hence the spread of this invader, without killing established trees. The mite *Aceria angustifoliae* attacks leaves, inflorescences and young fruits of Russian olive. Pre-release studies have almost been completed with this first candidate for the biological control of Russian olive and a petition for field release is in preparation. We will provide an overview of the results obtained and will discuss the potential impacts of this biological control candidate on the reproductive output of Russian olive, on established Russian olive trees as well as the likelihood of non-target effects on native or cultivated plants in North America.

14

Managing Phreatophytes in Colorado: Russian-Olive

Steve Ryder[1]

[1] *Colorado Department of Agriculture, Broomfield, CO*

The use of Russian-olive for erosion control and as an ornamental has been substantial in Colorado, with a current estimated coverage of over 100,000 acres. Russian-olive is challenging to control due to its considerable biomass, the added risk due to use of power equipment, and high per-acre cost, especially with competing priorities for limited funds.

Initial research focused on removal and disposal options to organizational needs and motivations. The outcomes and recommendations from the Missouri Watershed Coalition Conservation Innovation Grant were employed on-the-ground, along with many “best practices” borrowed from tamarisk control and revegetation research completed by universities, Colorado Department of Agriculture (CDA) and Denver Botanic Gardens.

A funding surge followed the 2013 flood that impacted primarily the South Platte basin. Nearly $2 million in grant funds to local and regional entities was made available by the Colorado General Assembly in 2015-16, and CDA continues to fund phreatophyte removal projects, along with other priority noxious weeds.

CDA's strategy for controlling Russian-olive is to first focus attention on riparian waterways where removal and restoration can occur over a period of years, followed by the development of ornamental removal and replacement efforts on private properties adjacent to these riparian areas. The overall goals are to restore native riparian plant and animal communities, reduce seed availability and educate landowners to remove Russian-olive shoots while young.

15

Wildlife Communities Interaction in Russian Olive: A literature Review and Initial Observations on the San Juan River, UT

Matthew Johnson, Sean Mahoney and Jennifer Holmes

Colorado Plateau Research Station, Northern Arizona University

Globally, non-native species contribute to trillion of dollars in economic losses, as well as threaten the existence of native species. Understanding the interactions between non-native and native species have become increasingly important for land managers as more non-natives are introduced to novel areas. Sensitive ecosystems, such as riparian areas, are hypothesized to be particularly vulnerable to ecological changes caused by non-native species. Russian olive (*Elaeangnus angustifolia*) is a wide-spread, non-native riparian-obligate tree in the Western US hypothesized to alter riparian habitats. Russian olive may particularly impact native birds that use riparian areas for stopover and nesting habitat. During the summer 2016, we conducted bird foraging observations along the San Juan River, UT where Russian olive is prevalent to assess the use of this non-native by native birds. I will present bird community analyses, and foraging data from sites dominated by Russian olive and from native dominated sites.

16

Removal Thresholds and Spatial Configurations for Implementing Control of Russian Olive (*Elaeagnus angustifolia*) while preserving habitat for Seasonal Bird Communities

Michael P. Guilfoyle[1], and Richard A. Fischer[1]

1U.S. Army Engineer Research and Development Center, Vicksburg, MS

Russian olive (*Elaeagnus angustifolia*) is a woody invasive tree species that forms dense monoculture thickets that compromise integrity of native riparian plant communities in the western United States. While extensive guidance is available on mechanical removal and chemical treatment options, large-scale efforts are often cost-prohibitive. Rehabilitation of riparian habitat is an important focus on USACE project lands, but in cases where complete Russian olive eradication is untenable, there is little or no guidance on removal thresholds and spatial configurations that may promote restoration efforts while preserving important habitat for seasonal bird communities. We performed experimental removal on 27 1-acre circular plots on 4 USACE Habitat Management Units along the Snake River in southeast Washington. Plots with >65% Russian olive cover were identified and a subset were randomly selected for experimental treatments. Experimental units included 9 plots each of 50% half-circle removal, 50% "hour-glass" removal, and 50% selection-cut tree removals. An additional 27 plots of variable Russian olive cover classes were selected for control. Russian olive cover on each plot was measure pre- and post-removal using ArcGIS Feature Analyst applied to satellite imagery. Winter and breeding bird community surveys were conducted for 3 years post-treatment to measure seasonal habitat occupancy of bird species. While the group selection cuts had higher post-removal abundance and diversity of bird communities in both winter and breeding seasons, the results did not differ significantly from other experimental treatments. The 50% half-circle configuration provided the best option for both preserving seasonal bird community abundance and diversity, while providing the best conditions for restoration success of the native plant community.

17

Russian Olive Removal and Restoration Affect Insect Community Dynamics

Natalie M. West[1], David H. Branson[1], Merilynn C. Schantz[2], Jennifer M. Muscha[3], Erin K. Espeland[1]

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Russian olive invasion changes the structure of habitat and soil (e.g., denser understories and greater soil N), leading to large ecosystem effects that likely influence trophic dynamics in associated communities. Research has shown that insects are an indicator of restoration's success in rehabilitating ecosystems. We examined variability in insect community assembly and

vegetation change over time after Russian Olive tree removal and plant community restoration along the Yellowstone River in eastern Montana, USA. Insects and vegetation data were collected yearly (2010-2016). The insect community was composed of 148 families from 14 different orders, and spanned a range of functional guilds (such as herbivores and predators) providing different ecosystem services. We will discuss how the insect community varied among and within restoration treatments over time.

19

The Biology of Rush Skeletonweed in Western North America

Tim Prather

University of Idaho, Moscow, ID.

Rush skeletonweed is an interesting perennial species that can go from seed to flowering in a single year, a very unusual accomplishment among perennial plants. It is one of our wildland invasive species that also has a strong history as a cropland weed. The biology of rush skeletonweed will be discussed as an introduction to a range of symposium topics on this intriguing invasive plant species.

20

Genetic Population Structure of Rush Skeletonweed in North America and Effects on Biological Control Agent Attack

[1]John F. Gaskin, [2]Mark Schwarzlaender, [3]C. Lynn Kinter, [4]James F. Smith, [4]Stephen J. Novak

[1]USDA ARS Sidney, MT, [2]University of Idaho, Moscow, ID, [3]Idaho Department of Fish and Game, Idaho Natural Heritage Program, Boise, ID, [4]Idaho State University Boise, ID

Rush skeletonweed (*Chondrilla juncea*) is an apomictic, perennial plant that is invasive in Australia, South America (Argentina), and North America (Canada and the United States). This study comprehensively compares propagule pressure and geographic structure of genotypes to improve our understanding of a clonal invasion and enhance management strategies. We found 682 unique genotypes in the native range, but only 13 in the invaded regions. Each invaded region contained distinct genotypes, suggesting independent introduction events, probably with different geographic origins.

We found exact AFLP genotype matches between the native and invaded ranges for five of the 13 invasive genotypes.

21

A Dispersal and Susceptibility Model for Rush Skeletonweed in Western Rangelands

Tim Prather

University of Idaho, Moscow, ID

Rush skeletonweed typically inhabits dryer wildland habitats and characteristics of plant communities that are susceptible to invasion are fairly consistent within the Northern Rockies. Part of integrated pest management for invasive plants in wildlands involves detection surveys that can be daunting when we consider the vast landscapes where rush skeletonweed weed might occur. Models that predict plant community susceptibility aid in focusing for detection surveys and also provide perspective on the potential scope of the problem for land managers. Many landscapes have considerable areas susceptible to invasion and so understanding wind patterns can further focus detection surveys to areas downwind of existing infestations for this wind-dispersed plant species. Finally, through analysis of patterns of infestations, we gain insight into the relationship among infested areas and the distance between related infestations.

22

A Weed Risk Assessment for Rush Skeleton Weed (*Chondrilla juncea*), a Significant U.S. Invader

Lisa Kohl, Anthony L. Koop, Jonathan Jones

USDA APHIS CPHST, Raleigh, NC

The Animal and Plant Health Inspection Service received a market access request for wheat seeds for planting from Italy and determined that seeds of rush skeleton weed may be associated with this commodity. Consequently, we analyzed this species' risk to the United States using the PPQ Weed Risk Assessment (WRA) process. Rush skeleton weed is a perennial herb that invades crops, pasture, rangeland, and some natural areas. It has been introduced to Australia, Argentina, and the United States and has rapidly spread over thousands of acres in these countries. It can spread to new

areas as a contaminant of nursery plants and hay, and the seeds can adhere to clothing, bags, and animal fur, and spread in mud on vehicles and equipment. The seeds are also dispersed by wind. While rush skeleton weed is only a minor weed in its native range, it is considered one of the most economically significant weeds elsewhere because it reduces yield of grain crops, interferes with harvesting equipment, and increases grower costs. In the United States, rush skeleton weed is now beginning to invade natural areas as well. Not surprisingly, our evaluation determined it to be a high risk species. Furthermore, results from our uncertainty analysis indicate this conclusion is fairly robust. Although rush skeleton weed is not new to the United States, because of its significant impacts and because of wide stakeholder concern over its invasive behavior, APHIS will be proposing that this species be listed as a Federal Noxious Weed. Listing this species will not only help to prevent the introduction of additional biotypes, but it should also raise awareness of this significant weed.

23

Implementation of the Rush Skeletonweed Root Moth, *Bradyrrhoa gilveolella* and Screening of the Candidate Biocontrol Agent *Oporopsamma wertheimsteini*

1. Littlefield [1], A. deMeij [1], J. Runyon [2], C. Jorgensen [3], J. Milan [4], R. Progar [5], M. Cristofaro [6], M. Augé [6], M. Dolgorskaya [7], M. Volkovich [7] and J. Birdsall [1]

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In 2010 a population the rush skeletonweed root moth, *Bradyrrhoa gilveolella*, was observed at one site in southern Idaho. This was thought to be the largest collectable population of the moth outside its native range. Collection and monitoring techniques were investigated to determine the feasibility of large scale redistributions; and to justify this effort, the potential impact of the moth was also

evaluated. Although *Bradyrrhoa* populations initially increased, they subsequently declined. Adults were difficult to collect in-mass, and collections consisted primarily of males. Although moth populations have declined we have observed a slight deceased in skeletonweed density, cover and size; thus leading us to believe there is a possible impact on the plant. To supplement the potential control by *Bradyrrhoa*, the rush skeletonweed crown moth, *Oporopsamma wertheimsteini* is currently being screened. *Oporopsamma* is a tortricid moth found in parts of Eastern Europe and the Caucasus, and is reported as being specific to *Chondrilla*. Larvae feed within tubes in the root crown or upper root during spring and early summer. Individuals remain as pupae until September when adults emerge. No-choice host specificity testing has been ongoing at Montana State University since 2011. To date 81 species plus several cultivars of economic plants have been tested. Although the moth appears to be host specific, limited larval development did occurred on one native and two exotic species. Larval feeding often severs the root crown of rush skeletonweed, but plants may respond by sending up new rosettes from the root system. *Oporopsamma* appears to be a promising and damaging agent that would complement the impact caused by *Bradyrrhoa* by feeding on smaller diameter roots.

24

Rearing and Redistribution of Rush Skeletonweed Biocontrol Agent

Paul Brusven

NPBC, Lapwai, ID

Biological control of invasive weeds is a control option that has proven to be effective in Idaho and west. Over the years, several releases of biological control agents have been made throughout the state and we are poised well to be recipients of some new agents once they have been approved. This presentation will focus on Rush skeletonweed approved agents and some of the newer agents being reared specifically at the Nez Perce Bio-control Center and where the releases are going in the state of Idaho setting the stage to continue research and monitoring efforts within the state of Idaho and beyond.

25

Foreign Research Activities on RSW (*Chondrilla juncea*) during 2015-2016

Cristofaro[1,2], F. Marini[2], M. Augé[2], F. Di Cristina[2], M. Dolgovskaya[3], M. Volkovitsh[3],Reznik[3], V. Harizanova[4], A. Stoeva[4], J. Littlefield[5], M. Schwarzlaender[6] and J. F. Gaskin[7]

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Rush skeletonweed, *Chondrilla juncea* L. (Asteraceae), is an invasive plant native of Central Asia and the Mediterranean Basin area of Europe; this species has spread into several countries around the world, including United States, where the first small infestations of this weed were discovered in Washington State in 1938, Idaho in 1960, and Oregon in 1971. Rush skeletonweed infests rangelands, semi-arid pastures, side-ways and occasionally croplands.

Three organisms have been studied and released in the US against rush skeleton weed (RSW): the gall midge Cystiphora schmidti, the eriophyid mite *Aceria chondrillae* and the plant pathogenic rust *Puccinia chondrillina*. However, the ability of the complex of natural enemies introduced to be established and to achieve a suitable control of RSW in the US has been uncertain.

After preliminary literature and field surveys, three insect species and one plant pathogen were prioritized as potential biological control agents: the root-feeding buprestid beetles *Sphenoptera* spp., the moths *Oporopsamma* sp. and *Schinia cognata*, respectively a root-borer and a flower feeder, have showed a very promising narrow host range during the preliminary host-specificity tests, mainly in quarantine and laboratory conditions.In addition, a sampling of different *Puccinia chondrillina* rust strains was included in the research activities, in combination with a genetic screening of the individual plants.

Collections have been performed in Turkey, Armenia, Uzbekistan and Kazakhstan for *Sphenoptera* spp. and *Oporopsamma* spp,; samples of RSW and *Puccinia chondrillina* rust have been collected in all the above countries, plus Italy and France. Host range tests have been carried out in Bulgaria, St. Petersburg, and at the quarantine of the Montana State University (for Oporopsamma only). The field work on Schinia cognata will be postponed to next year.

BBCA and ZIN-RAS (Russian Academy of Sciences) carried out field surveys in Armenia (2015 and 2016) and Kazakhstan (2016), for the collections of *Sphenoptera* spp. and *Oporopsamma* spp, respectively. About 250 and 300 specimens of *Oporopsamma* have been collected in Armenia during the summers of 2015 and 2016, and submitted to Montana State University for host range testing in quarantine condition. Preliminary open field tests carried out in Bulgaria failed and they will be repeated next year in large field cages.

More than 200 specimens of Sphenoptera foveola have been collected and used for a large laboratory screening, which included biological observations and host range evaluations using RSW plants from Armenia, Kazakhstan, Volgograd (South Russia), and U.S.A. Results will be discussed at the Conference.

27

Timing of Application Affects Control of Rush Skeletonweed with Aminocyclopyrachlor, Aminopyralid, and Clopyralid

Ian Burke, Alan Raeder, Tara Lewis, and Joseph Yenish, and Jared Bell

Washington State University, Pullman, WA

Aminocyclopyrachlor, aminopyralid, and clopyralid are a growth regulator herbicide used for broadleaf weed control. Six field efficacy studies were conducted to evaluate application timing and surfactant effect on rush skeletonweed (*Chondrilla juncea*). Increased control of rush skeletonweed was observed for fall and early spring applications when compared to the late spring applications. A fall applied rate of aminocyclopyrachlor at 0.12 lb ai/A achieves similar control as a late spring or early spring application of aminocyclopyrachlor at twice the rate. Rush skeletonweed control was evident at 3 yrs after fall treatment with aminocyclopyrachlor at 0.17 lb ai/A. In separate studies, control of rush skeletonweed with aminopyralid was similar to picloram and greater than clopyralid at 1 yr after treatment. But by 2 yrs after treatment, control had diminished in aminopyralid and clopyralid treatments. Picloram and aminocyclopyrachlor appear to control rush skeletonweed for a similar length of time, often as much as 3 yrs. Each herbicide has activity on rush skeletonweed, and choosing the herbicide should be based on tolerance for injury to nontarget vegetation and the long-term management plan for rush skeletonweed.

30

Managing Rush Skeleton Weed in the Lemhi Cooperative Weed Management Area in Eastern Idaho

Jeremy Varley

Lemhi County Weed District, Salmon, ID

For the past 17 years Lemhi County has had Rush skeletonweed within its borders. As this species has made its steady march east Lemhi County and its CWMA have tried to have a proactive approach to controlling this species. With Lemhi County being the 4th largest in the state it has presented several unique obstacles to overcome to ensure a successful treatment plan including inventory, chemical treatments, biocontrol and infestation monitoring. Going forward from our current infestations we are not ready to waive the white flag just yet.

28

Rush Skeletonweed - Montana's Perspective

Dave Burch

Montana Department of Agriculture, Helena, MT

Montana has been actively managing RSW since 1994. We have reduced ingestions and kept it contained to specific areas in Montana which has been very beneficial to our agriculture community. We have a RSW Task Force that is very active and dedicated professionals who have and are willing to help others identify and manage RWS.

31

Oregon's Skeletonwed Battle

Mark Porter

Oregon Department of Agriculture, Enterprise, OR

The presentation will cover Oregon’s recent efforts (2007 - 2016) in managing rush skeletonweed including: know distribution of the plant; biocontrol distribution and impact; herbicide treatment projects - location,

scale ($'s and acres) and results; some observations about the plant from the field.

32

Rush Skeletonweed: The Idaho Perspective

Joseph Milan

Bureau of Land Management, USDI, Boise, ID

Idaho is the epicenter of the rush skeletonweed (Chondrilla juncea) infestation in the United States. While this invasive is established in several surrounding states and Canadian provinces, the scope and rate of spread by this inconspicuous plant into new areas continues to thwart management efforts despite our best intentions. This presentation will outline Idaho's perspective as it pertains to the management of rush skeletonweed from an historical point of view and looking forward.

34

The Management of Rush Skeletonweed on BLM Lands

Richard D. Lee[1] and Gina Ramos[2]

[1]*USDI Bureau of Land Management, National Operations Center, Denver, Colorado and* [2]*USDI Bureau of Land Management, Washington, D.C.*

Rush skeletonweed (*Chondrilla juncea*) is an increasing problem on lands management by the Bureau of Land Management (BLM). While rush skeletonweed is not a federally listed noxious weed, it is listed as a noxious weed in 75% of the western states, including all of the states that make up the Northern Rockies. Management of this species can be difficult due to the morphology and the scope of the rush skeletonweed infestation across wide-ranging landscapes. The BLM relies on the integration of all the management tools available, including, prevention, mechanical, cultural, biological, and chemical for the management of this invasive on BLM managed lands. Recently, the BLM signed the Record of Decision for the Programmatic Vegetation Management Environmental Impact Statement

(PEIS) which added aminopyralid, fluroxypyr, and rimsulfuron to the eighteen active ingredients approved for use on lands the BLM administers.

35

Forest Service Perspective on Management of Rush Skeletonweed: Prioritizing Actions Across Diverse Landscapes and Ecological Conditions

Gil Gale

U.S. Forest Service,Bitterroot National Forest,Montana

National Forests in the Northern Rocky Mountains encompass a diverse range of land types and ecological conditions. Priorities for invasive species management differ, sometimes dramatically, within the dozen or so Forests located on either side of the Continental Divide in Montana and Idaho. The potential for continued expansion of rush skeletonweed poses an extremely high risk to open canopy, non-forested and wildifire impacted habitats in the region, especially in Montana where the species is designated as a high priority new invader. The agency thus recognizes the need for shared prioritization, close coordination and productive communication between units. However, significant challenges persist that slow down the effort to build a consistent, sustained and effective program across jurisdictional boundaries. The Forests generally agree on the high priority need to consolidate funding in a focused way that will accelerate the research and permitted release of new promising biocontrol organisms against this invasive plant.

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History of the Rush Skeletonweed Task Force and the Revitalized Multi-Stakeholder Rush Skeletonweed Task Force

Joseph Milan

Bureau of Land Management, USDI, Boise, ID

The Rush Skeletonweed Task Force (RSWTF) was created in the 90's to get all stakeholders at the table in an effort to curtail the expansion of rush skeletonweed throughout the west with a focus on Idaho. While support has fluctuated due to a number of factors, the problem of dealing with this invasive remains. In 2007, the RSWTF sponsored a summit which resulted

in Rush Skeletonweed (Chondrilla juncea) Management Plan for the Western United States. This management plan put forth a number of action items including filling data gaps and gathering a consensus for addressing prevalent issues with available resources. This presentation will discuss the history of the RSWTF along with steps to move the group forward going into the future.

38

Invasive Plant Management in the West-A Scientific Assessment

Dr. Roger Sheley

USDA ARS EOARC, Burns, OR

Assessing the influence of conservation practices on perceived benefits to ecosystem properties is critical to understanding their value toward establishing and maintaining sustainable ecological and economical systems. We used a comprehensive review of peer-reviewed literature to synthesize a summary discussion of the efficacy of various invasive plant strategies on several anticipated benefits. The literature documented only short-term vegetation responses to invasive plant management and rarely addressed secondary ecosystem responses to management. Our ability to protect not-infested lands is encumbered by the lack of early detection techniques and lack of effective eradication efforts once new infestations are identified. Some strategies for maintaining invasion resistant plant communities are beginning to emerge in the literature. Herbicides provided short term control of most invasive weeds, but without additional management, weeds returned rapidly. Documentation of biological control's influence on plant development is robust, but positive effects on control and vegetation dynamics are exceedingly rare. Grazing management is emerging as a useful method for directing vegetation dynamics, but the timing, intensity and frequency of grazing, as well as the class of livestock are only known for a few invasive weed species. Restoration of invasive plant infested rangeland is difficult and only successful about 20% of the time when non-native plant material is seeded and less where native species are seeded. There are cases where invasive plant management strategies can be effective, and in those cases, they appear to favorably affect wildlife and other important ecological attributes of the ecosystem. However, most strategies are associated with high ecological risks and high risk of failure in the long-term. It is clear from the literature that more research is necessary if the anticipated benefits of invasive plant management are to be achieved. This

review indicates that long-term invasive plant management is lacking for most situations, and the need for ecologically-based invasive plant management is substantial and unmet.

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Using Resilience and Resistance Concepts to Assess Invasive Annual Grass and Wildfire Threats to Sagebrush Ecosystems and Sage-Grouse and Prioritize Conservation and Restoration Actions

Jeanne C. Chambers

US Forest Service, Reno, NV

Effective management of sagebrush ecosystems and at-risk species such as sage-grouse requires a strategic, multiscale approach for addressing persistent ecosystem threats such as invasive plant species and altered disturbance regimes. An approach for addressing these persistent ecosystem threats is described that is based on ecological resilience and resistance concepts and is currently being used to conserve sagebrush ecosystems and greater sage-grouse (*Centrocercus urophasianus*). The approach links biophysical indicators of ecosystem resilience and resistance with species-specific population and habitat requisites in a risk-based framework to identify priority areas for management and guide allocation of resources to manage ecosystem-based threats. US federal land management and natural resource agencies have adopted this framework as a foundation for prioritizing sage-grouse conservation resources and determining effective restoration and management strategies.

40

Conceptual Framework for Assessing Ecological Impacts of Invasive Plants

Dan Tekiela and Jacob N. Barney

University of Wyoming, Laramie, WY, and Virginia Tech, Blacksburg, VA

Measuring ecological impacts of invasive plants is an inherently difficult task that nonetheless has become important to understand how invasive plants impact our ecosystems. However, finding an appropriate comparison in an

uninvaded landscape that is representative of an uninvaded state is difficult and can lead to inappropriate conclusions. Alternatively, removing the invader can create a problematic comparison due to potential legacy effects of the invader. In addition to the difficulty in correctly measuring ecological impact, biases in human perception can influence both the types of metrics measured, and how they are interpreted. Therefore, we propose a conceptual framework that attempts to remove human bias and better represent the ecological impact of an invasive plant. Using a multivariate method, we more holistically measure the impact of plant invaders and make inter-species impact comparisons possible which can aid in management prioritization.

41

Climate Change and Invasive Plants - Feedbacks and Feedforwards

Matt Germino

USGS, Boise, ID

Climate change is a major factor affecting invasiveness of undesirable exotics, invasibility of plant communities, and the impacts of invaders. Understanding the role of climate in invasions is essential for assessing whether action on a particular site should be prioritized, and how to select the most appropriate management actions. My presentation will review published knowledge from experiments and models about climate effects on exotic invasive herbs and key natives in shrub steppe, highlighting the actionable implications for land managers. Reciprocal interactions between the environment and exotics is increasingly important to recognize for creating land treatments that will be effective in the short and long run

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Genetic Variation and Management of Eurasian Watermilfoil

Ryan A. Thum

Montana State University, Bozeman, MT

Genetic variation has not historically been a focus of traditional aquatic plant management. There are few published studies of molecular or heritable phenotypic variation for widely managed aquatic plant species in the United States. Yet, the few studies that have been published reveal that managed aquatic plant taxa can exhibit cryptic taxonomic variation and heritable phenotypic variation, both of which can be relevant to management issues

such as potential for growth, spread, impact, and control. Here, I will present data on genetic variation in the widely distributed and managed invasive aquatic plant, Eurasian watermilfoil (Myriophyllum spicatum L.). I will show that what is considered Eurasian watermilfoil sensu lato by aquatic plant managers is actually a cryptic complex of at least two distinct biotypes of pure Eurasian watermilfoil and numerous genotypes of hybrids with native northern watermilfoil (Myriophyllum sibiricum Komarov). I will also show that hybrid watermilfoil can grow and respond to herbicides differently than pure Eurasian watermilfoil, and that the relative abundance of pure and hybrid watermilfoil can change over time in managed lakes. In addition, I will show that vegetative growth rate is heritable among distinct genotypes of hybrid watermilfoil, which in turn may influence dynamics of growth, spread, and control of populations over time. There is much more to learn about the degree and relevance of genetic variation in invasive (and native) aquatic plants. I encourage aquatic plant managers to include studies of genetic variation whenever possible, including detailed temporal monitoring of molecular and phenotypic variation.

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Invasion Genetics of Diffuse Knapweed

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Though rapid evolution has been observed in numerous invasive plant species, less is known about the genetic mechanisms underlying the observed phenotypic changes. Some hypotheses invoke the evolution of trade-offs in resource allocation to explain differences between the native and invaded ranges of a species. Alternately, rather than adapt to specific novel selection pressures, invasive species may instead benefit from a generalist strategy and perform well in many environments. Identification of the molecular changes associated with successful invasions may offer clues regarding the importance and mechanistic basis of such hypotheses. Here we use phenotypic data from multiple common garden experiments, gene expression data, and occurrence data, to ask, 1) How has invasive diffuse knapweed (*Centaurea diffusa*) evolved since its introduction to North America? 2) What can we learn about the evolution of environmental tolerances and invasion?

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The Role of Multiple Introduction, Hybridization and Polyploidy in Biological Invasions: Evidence from the *Tragopogon* Species Complex

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High propagule pressure increases the likelihood of establishment and range expansion, and it can contribute to invasion through other processes: 1) it can lead to the introduction of individuals that possess prior adaptations to a species' new range, and/or 2) it can increase the potential for post-introduction through hybridization and polyploidy. These factors have contributed to the invasion and occurrence of *Tragopogon* (Asteraceae) species in the western United States, especially in the Palouse region of eastern Washington and northern Idaho. Members of the genus Tragopogon are mostly biennial diploid plants native to Eurasia where approximately 150 species have been reported. Through human activities, as many as six *Tragopogon* species have been introduced into the US and Canada, but by far the three most abundant and widely distributed of these six are the diploids T. dubius, T. pratensis and T. porrifolius. By 1928 all three diploid species had been collected in the Palouse; and although T. dubius was collected after the other two species, it is now the most common of the three species. Populations of T. dubius from the Palouse have higher genetic diversity compared with populations of the other two, suggesting higher propagule pressure for the introduction of T. dubius in this region. In 1949, Marion Ownbey discovered and described two newly formed Tragopogon species and named them T. mirus and T. miscellus. Multiple lines of evidence indicate that both these species are allotetraploids: formed through hybridization and chromosome doubling events. The dipoid parents of *T. mirus* are *T. dubius* and *T. porrifolius*, and *T. dubius* and *T. pratensis* are the diploid parents of *T. miscellus*. The origin of these two alltetraploid plants in the Palouse not only occurred rapidly and recently, it also happened multiple times. The results of numerous studies, using a variety of approaches, indicate that both *T. mirus* and *T. miscellus* have originated multiple times in the Palouse. These origins occurred independently in various localities, wherever both of the diploid progenitors for each of the allotetraploid species co-occurred. The hybridization and polyploidy events described here have occurred elsewhere in the western US, and T. mirus and/or *T. miscellus* have been reported from Flagstaff, Arizona, Gardiner, Montana, Sheridan, Wyoming and the state of Oregon. Ironically, while these two allotetraploid *Tragopogon* species might be considered "native" to the

western US, they do have negative ecological consequences, especially in the Palouse region of eastern Washing and northern Idaho.

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Genetic Analysis of Native and Invasive Populations of *Ventenata dubia* (Poaceae): Identification of Geographic Origins and Estimation of Propagule Pressure

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Propagule pressure (introduction effort) is now recognized as a factor contributing to establishment success and range expansion of invasive species. Propagule pressure also can influence the genetic diversity of invasive populations. The combined analysis of native and invasive populations using molecular markers allows for a better understanding of the invasion process, especially propagule pressure. *Ventenata dubia* (Leers) Coss. (Aveneae; ventenata, wiregrass, North Africa grass) is a diploid, primarily self-pollinating winter annual grass native to Eurasia and Northern Africa. Since it was first collected in the western United States (US) in 1952, Ventenata has rapidly spread across parts of Idaho, Washington, Oregon and California. In this project we are conducting a genetic analysis of native and invasive populations of ventenata to identify the geographic origins of this invasion. These data also allow us to estimate propagule pressure, and determine the genetic consequences (e.g., founder effects) associated with the introduction of ventenata into the western US. To date, we have analyzed 32 native and invasive populations of ventenata using enzyme electrophoresis. Among 23 invasive populations, seven multilocus genotypes have been detected. A single multilocus genotype, referred to as the most common genotype (MCG) was found in 16 of 23 (70%) invasive populations in Idaho, Montana, Oregon and Washington. The MCG was detected in only a single native population, Kamenica nad Hronom, Slovakia. Three other genotypes observed among invasive populations have been detected in three native populations, two from Slovakia and one from the Czech Republic. These results suggest that the geographic origins for the introduction of ventenata in the western US are located in central Europe. While more polymorphic loci (5) were detected among invasive populations compared with native populations (3), the alleleic richness of invasive and native was quite similar (33 and 32 alleles, respectively). In addition, the level of genetic diversity, on average, within invasive and native populations

(Hexp = 0.007 and Hexp = 0.008, respectively) is also similar. Native populations exhibited higher genetic structure (GST= 0.84) compared to invasive populations (GST = 0.70). These results are consistent with the genetic signature of multiple introductions, indicating moderate propagule pressure for the invasion of ventenata into the western US. Additionally, our findings do not provide evidence that invasive populations have experienced severe founder effects. Finally, the analysis of additional populations, especially native populations, will be required to confirm the results and conclusions presented here.

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Amplified Fragment Length Polymorphism (AFLP) Analysis of Native and Invasive Populations of *Taeniatherum caput-medusae* subspecies *asperum* (medusahead): Insights into the Invasion Process

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Biological invasions are one of the main drivers of global change, and thus one of the main factors contributing to the loss of biodiversity world-wide. *Taeniatherum caput-medusae* subsp. *asperum* (medusahead) is a winter-annual grass native to Eurasia and invasive in the western United States US. Medusahead dominates one million hectares in its invasive range and causes a reduction in forage quality for livestock, an increase in the frequency of rangefires, and an alteration of the composition and structure of native plant communities. Previously, allozyme analyses have suggested this highly selfing species exhibits low genetic diversity within populations and high differentiation among populations in the invasive range. In this study, we used a dominant, multilocus molecular marker, amplified fragment length polymorphisms (AFLPs), to assess the genetic diversity and structure of 52 invasive populations of medusahead, evaluate the influence of propagule pressure and founder events during establishment, and identify putative source populations or regions. Using 110 AFLP loci, 15 multilocus genotypes (utilizing an error rate of 3 loci) were detected among invasive populations, and we estimated that the number of independent introductions ranged from eight to 11. These data suggest moderate propagule pressure for the introduction of medusahead into the western US. Despite moderate

propagule pressure, my data revealed that invasive populations had relatively low genetic diversity and high genetic structure, compared to plants with similar life-history traits (e.g., a highly selfing, gravity-dispersed, annual plant species). Moreover, the lower level of genetic diversity of invasive populations, compared with native populations, provides evidence that founder effects have influenced the diversity of invasive populations of medusahead. Putative source regions were narrowed to southern France and southeastern Europe. However, several lines of evidence clearly pinpoint seven populations (four from eastern Bulgaria, one from the Crimean peninsula, one from Russia, and one from Greece) as the most likely source populations for this invasion. Our findings are generally similar to that of previous allozyme studies; although our estimates of genetic diversity using AFLPs are higher than the estimates using allozymes. Results of this study point to the additional insights into the invasion process that can be gained by using a more polymorphic molecular marker.

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The Economic Costs of Noxious Weeds on Private Rangeland in Montana

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Several studies in the 1990s evaluated the economic effect of noxious weeds on a statewide basis in Montana as well as other states. To update our understanding of these economic impacts, in winter 2015-16 we distributed a 16-question survey concerning noxious weed management and associated costs to livestock producers who were grazing their livestock on privately owned rangeland in Montana. We received 113 usable responses from 45 (out of 56 total) counties within Montana, with the majority of respondents grazing cattle, followed by sheep and horses. The average size of a grazing unit was 5,055 acres. The three noxious weeds reported as having the most effect on stocking rates were leafy spurge, Canada thistle, and knapweeds (spotted and diffuse). Seventy-four percent of respondents were directly responsible for noxious weed management on their grazing unit, whether they owned or leased the land. Using methods described in Rinella and

Luschei (2007), we estimated an average loss in forage biomass of 0.7% resulting from spotted knapweed, and 0.8% from leafy spurge. We estimated the corresponding value of the reduction in stocking rate to be $0.40 per acre, or $1,997 annually for the average size of a respondent's grazing unit. Using respondent-reported material costs and labor hours, we estimated that the average total cost of noxious weed prevention and control, including labor and materials, is $1.69 per acre, or $8,535 for the 5,055-acre average grazing unit size. The total cost, including the value of the foregone grazing, is $2.09 per acre per year, or $10,557 annually for an average grazing unit; this translates to $714,296 for all of the grazing land reported in our sample.

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The Potential For The Use Of Civilian Dog/Handler Teams In Invasive Species Detection

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Dogs have been used for the detection of invasive species such as Zebra/Quagga mussels (*Dreissena polymorpha/Dreissena bugensis*) and spotted knapweed (*Centaurea stoebe* L.) for many years. This work has been completed by specially trained professional dog handler teams. A possible untapped resource to use in the detection of invasive species is the sport detection dog community. Across North America and Europe, civilians are training their pet dogs to detect and indicate scent as a hobby and in competition. Sport scent detection uses target odours produced from essential oils and all breeds and mixes of dogs are able to participate. Dogs that are trained to the top levels of the sport have the skills to detect odour equivalent to professionally trained dogs. Once trained in scent detection, these dogs can switch to a new odour, such as that of an invasive species, with minimal difficulty. The Province of British Columbia piloted the use of civilian sport detection teams in 2015 to test their possibly utility for detecting Zebra/Quagga mussels on watercraft, and select invasive plant species that are difficult to find through normal field survey approaches. While training of the dogs was successful, certification, administration and legislation (in the case of invasive mussels) were challenges encountered in this project.

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A Meta-Analysis of Canada Thistle (*Cirsium arvense*) Management in Organic Perennial Systems

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The recent expansion of organic agriculture, where synthetic herbicides are not allowed, has resulted in an increase in perennial weed abundance, spread, impact, and management concerns in organic systems. Developing methods to reduce the spread and impact of perennial weeds is a research priority identified by researchers as well as organic grain and vegetable growers. We undertook meta-analyses of the existing literature to identify promising non-chemical management techniques in perennial and annual systems for two perennial weeds- field bindweed (*Convolvulus arvensis*) and Canada thistle (*Cirsium arvense*). For this presentation, we will focus on the analysis of organic Canada thistle management in perennial systems such as pasture, rangeland, and hay fields. We found 46 studies published between 1959 and 2012 that investigated non-chemical control methods in these types of systems. The results of our analysis indicated that in general, management actions that increased resource availability (i.e. burning, increased irrigation, and soil amendments) did not have an impact on Canada thistle abundance. In contrast, grazing, techniques focused on increasing competitive ability of desired plants, biocontrol, mowing, and integrated management all decreased Canada thistle abundance. Overall, our results broadly outline opportunities to reduce Canada thistle abundance in organic perennial agricultural systems. Specifically, we found that management techniques that favor desired vegetation over perennial weeds hold the most promise, while methods that increase resource availability may not be effective for decreasing Canada thistle abundance.

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Invasion Curve as a Marketing Tool for Integrated Weed Management for Invasive Plants

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In the spring of 2016 “Safeguarding America’s Lands and Waters from Invasive Species: A National Framework for Early Detection and Rapid

Response" was released and introduced the invasion curve to U.S. at a national level. The invasion curve was developed in Australia (2010) as a tool for understanding invasive species management. The invasion curve shows that eradication of an invasive species becomes less likely and control costs increase as an invasive species spreads over time. Prevention is the most cost-effective solution, followed by eradication. If a species is not detected and removed early, intense and long-term control efforts will be unavoidable. The invasion curve provides a conceptual basis for developing response strategies to deal with invasions. As invasion progress beyond the eradication stage, management strategies shift from prevention and early detection and rapid response (EDRR) to long term control- including biological control.

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Sheep, Insects, and Herbicide: Exploiting the Life Cycle of Spotted Knapweed as a means of Control

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We will present preliminary results from a project investigating the integrated management of spotted knapweed (*Centaurea maculosa*) using sheep, biocontrols, and herbicide. After 6 years of sheep grazing targeting knapweed in flower at a site where insect biocontrols are well-established, we observed reductions in the extent and density of spotted knapweed, as compared to ungrazed areas. Subsequent seed bank and age-class surveys suggest that this decline was linked to reduced knapweed seed production resulting from the combined impact of sheep grazing and biocontrol insects, which seems to have limited the recruitment of new knapweed seedlings. Therefore, in the hope to better understand knapweed population dynamics, and develop an "exit strategy" from a long-term grazing project, we initiated an experiment designed to answer the question: Can applying herbicide once following a long-term grazing program result in longer lasting, and more complete spotted knapweed control than only grazing, or only spraying?

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Esplanade® 200 SC Herbicide for Invasive Annual Grass Control

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Managing invasive winter annual grasses is a challenge in many regions of the US. During the winter and early spring, these species exploit moisture and nutrients before native plant communities break dormancy. This results in dense stands of winter annual grasses invading disturbed areas and significant reductions or elimination of desirable perennial grass, forb and shrub species. Currently, there are limited management options for controlling winter annual grasses that work consistently, provide multiple years of control, and do not injure desirable plant communities. This presentation covers research conducted at Colorado State University demonstrating that Esplanade herbicide provides long-term residual control of winter annual grasses allowing for the release or re-establishment of desirable species. Field studies compared downy brome and feral rye control with Esplanade to currently recommended herbicides. A greenhouse study compared Esplanade and Plateau® herbicide for pre-emergence control of downy brome, feral rye, jointed goatgrass, Japanese brome, medusahead and ventenata. This research provides the first evidence of a new option for residual invasive winter annual grass control.

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The Invasion of *Taeniatherum caput-medusae* subspecies *asperum* in the Western United States is Associated with a Alimatic Niche Shift: Evidence for Post-Introduction Evolution

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The ecological properties of organisms, their ecological niche, life-history traits and demographic properties, influence the establishment and range expansion of introduced species in their new locations. Niche-based studies have shown that the majority of terrestrial plant invaders exhibit niche conservatism (i.e., invasive plants retain their ancestral native niches). Conversely, when a niche shift occurs the ancestral native niche may expand and/or contract; thus, predictions of the geographical distribution of invasive populations must be based on their new niche requirements. Such studies commonly use the climatic niche to predict the spatial distribution of an organism through climate matching.
The aim of this study was to compare the climatic niches of native and

invasive populations of the Eurasian annual grass, *Taeniatherum caput-medusae* ssp. *asperum* (medusahead). Based on the results of this comparison we will be able to determine whether the invasion of medusahead in the western United States is associated with climate niche conservatism, or whether this invasion is associated with a climatic niche shift. Because medusahead possesses a primarily self-pollinating mating system and exhibits low levels of genetic diversity due to founder effects, we predicted that the invasion of this grass will exhibit climatic niche conservatism. Our climatic niche models were based on the analysis of distinct occurrences from the native (n = 88) and invasive (n = 42) range using climate parameters from the WORLDCLIM dataset representing the minimums, maximums and means for both temperature and precipitation. Our results revealed that invasive populations of medusahead exhibit a significant climatic niche shift. These findings suggest that the climatic niche shift associated with this invasion occurred through post-introduction evolution. Thus, the potential distribution of medusahead in the western US can only be calibrated using the climatic niche associated with invasive occurrences. The climatic niche of native populations, however, can be used to assess the establishment success of new introductions of medusahead.

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Pseudomonas fluorescens strains D7 and ACK55: Bureau of Land Management Program Update

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In November-December of 2015 the Bureau of Land Management (BLM) established 15 demonstration areas to evaluate the management potential of the rhizobacteria *Pseudomonas fluorescens* strain D7, sold under the trade name D7®, on targeted invasive annual grasses, downy brome/cheatgrass (*Bromus tectorum L.*), medusahead rye (*Taeniatherum caput-medusae* [L.] Nevski), and Japanese brome (*Bromus japonicas* Thunb.). Seven additional areas were established in April of 2016 with the D7®, targeting downy brome, medusahead rye, Japanese brome, and one location having North Africa grass (*Ventenata dubia* (Leers) Coss.) in the treated area. Twelve of the locations involved a broadcast application of the biopesticide alone, five locations were treated with D7® + imazapic at two different rates (0.047 and 0.078 lb. a.e./acre), one location had D7® applied over an area treated earlier in the year with imazapic (0.109 lb.

a.e./acre), and four locations involved D7® being coated on seed and either drilled or broadcast over the demonstration area. In addition to presenting the summary of the current effort of the BLM involving the D7 strain of the *Pseudomonas fluorescens*, the presentation will also include a summary of the second strain of Pseudomonas fluorescens, ACK55, and the current registration status of this biopesticide.

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An Integrative Approach to Understand the Introduction and Invasion of *Ventenata dubia* (Poaceae) in the Western United States

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Ventenata dubia (common name: ventenata) is a winter annual grass that has become highly invasive in the western United States (US). The species was firstly reported in the western US in eastern Washington, in 1952. Native to Eurasia, its geographic distribution includes Europe, the arid northern rim of Africa, southwest Asia and into central Asia. The specific objectives of this research were to: 1) conduct foreign exploration for potential biological control agents and collect plant material, in order to 2) conduct a genetic analysis to assess the introduction dynamics and pattern of range expansion of ventenata in its invasive range, 3) use ecological, climatic and geographic data to model the factors that have contributed to the current and future distribution of ventenata in the western US, and 4) create an interactive website to continue monitoring the spread of the species across western North America.
Results of exploration in the native range will be presented describing how difficult it is to find and collect this species in Europe over a two-year survey. Preliminary results of our genetic analysis of invasive populations indicates that the geographic origins of this invasion are located in central Europe. In addition, several factors appear to have influenced the distribution of this species in its native range and in the U.S. First, the northward shift in its range over time suggests climate change could be an important factor. Second, ventenata has historically been found in areas with frequent low intensity disturbance, therefore land use change may also play an important role. Thus, several biogeographical factors (e.g. climate and land use change) appear to explain the apparent range shift of *Ventenata dubia* across its native range, and these data will be used to construct species distribution models. These models, plus results from our genetic analysis, will shed light on the factors that have contributed to the invasion

of ventenata in the western US. They will help to understand how fast and how far ventenata is currently spreading within the US based on the interactive website grassmapper.org.

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PPQ's Tiered Weed Evaluation Process and Weeds of Concern to the Northern Rockies

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USDA APHIS CPHST, Raleigh, NC

Out of more than 300,000 species of vascular plants, over 22,000 species have been identified to have naturalized outside of their native range and/or become weedy somewhere in the world. Weed Risk Assessments (WRAs) are a valuable tool that regulatory agencies can use to identify potential invaders before they are introduced. Resource managers can also use the results of WRAs to prioritize species for management. We have developed a tiered weed evaluation process to evaluate as many of these known weeds as possible. Species that pose the greatest risk and that fall within the agency's scope are subjected to the deepest level of analysis, which corresponds to PPQ's predictive weed risk assessment. Since our team formed in 2010, we have considered over 1200 species, and analyzed 114 with our WRA process. In this presentation we will describe our tiered weed evaluation process and review the results for several species that may be of concern in the northern Rockies.

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Narrow-leaf Hawksbeard (*Crepis tectorum*): a New Invasive Plant to Northeastern Montana

Shelley Mills[1], Jane Mangold[2], Bobbie Roos[3]

Montana State University Extension, Glasgow, MT[1], Montana State University Extension, Bozeman, MT[2], Montana State University Extension, Scobey, MT[3]

Crepis tectorum, also known as Narrow-leaf Hawksbeard is a facultative winter annual introduced to the United States from Siberia as early as 1890. This plant has become an invasive weed in northeastern Montana, where it was presumably introduced with alfalfa seed. Widespread use of no-till and conservation tillage techniques along with continuous cropping and

Conservation Reserve Program (CRP) acres have advanced the spread of *C. tectorum*. Traditional weed management practices have failed to control this plant sufficiently to limit its spread. Management techniques are being researched in field crop situations, however little has been done in terms of researching the control and management of *C. tectorum* in CRP, native range, pasture, and waste sites. A project to study the effect of mowing alone and in combination with various chemical treatments applied in the fall and the spring is currently being conducted at two locations in northeastern Montana. This presentation will cover the basic information about *C. tectorum*, its invasiveness, an overview of the current research in crop and CRP, and will suggest future courses of study.

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Common Buckthorn: Looking Closely Reveals a New (old) Invader

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Common Buckthorn (*Rhamnus cathartica*) is a well-known invasive shrub in central and eastern North America. It is on a noxious weed list in 10+ states, and has been planted in Montana as an ornamental and windbreak for over 100 years. Starting in 2014, managers and researchers in Missoula have documented dozens of acres of naturalized multi-age class Buckthorn populations in riparian areas throughout the state. Increased awareness of this plant has prompted Missoula County to list the plant as a noxious weed, and led to state-funded research to better understand the biology, distribution and threat of this species in Montana. We will present updated information on buckthorn in Montana, and discuss biological and anthropological features of this invasion that forestalled earlier awareness or action.

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Documenting Environmental Changes in Flowering Rush Invasions

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The quantification of the environmental impacts of flowering rush has not been done. Observations of flowering rush indicate invasion leads to colonization of formerly open water to a vegetation dominated habitat that creates habitats conducive for invasive fish, sedimentation appears accelerated, and flowering rush acts as an algae trap likely impacting water quality. Recreational impacts include degraded recreational opportunities and lakeshore values. Salish Kootenai College and the University of Montana are undertaking studies to document fish, macroinvertebrate, and vegetative changes in flowering rush invasions in Flathead Lake and the Upper Flathead River.

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Are Native Macrophyte Communities Different in the Presence of an Invasive Alien Species?

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Freshwater habitats are vulnerable to invasion by exotic species, including many submerged and floating macrophyte species. A number of macrophyte species native to N. America (*including Elodea canadensis & E. nuttallii*) have invaded European freshwater systems and currently co-occur with a number of native species which are considered invasive in N. America (including *Myriophyllum spicatum*). Invasive plant species are often said to have a negative impact on freshwater communities, though evidence of impacts on the composition and structure of submerged and floating macrophyte communities is sometimes anecdotal or unmeasured. This study compares the structure and diversity of botanical communities in invaded and uninvaded standing freshwater habitats. This study aimed to identify if native macrophyte communities differ in the presence or absence of an invasive alien species.
Seventy standing waterbodies were surveyed. Physicochemical properties and macrophyte assemblages were quantified. Community species richness, plant biomass and Shannon-Wiener diversity indices were calculated for each macrophyte community. Surveyed waterbodies occurred primarily in agricultural landscapes. Hydrochemical analysis revealed that almost all surveyed waterbodies had poor, eutrophic, water quality. Overall, 61% of surveyed habitats were found to contain at least one invasive species. Native plant communities of invaded habitats did not differ from uninvaded

communities in species richness, diversity or biomass. When invasive alien species were included in the analysis invaded habitats were more species rich, more diverse and produced significantly more plant biomass. Three distinct native macrophyte assemblages were identified among waterbodies, the species composition of which did not differ between invaded and uninvaded habitats, though the relative abundance of each species differed with invasion status.
It is hypothesised that eutrophic conditions may negatively impact native aquatic plant communities to the extent that the potential impacts invasive alien macrophytes are not seen. Such results imply that habitats with high water quality (oligotrophic-mesotrophic) should be prioritised for management of invasive alien species, in order to minimise their impacts on native biodiversity.

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Light-related Phenotypic Plasticity of Invasive, Submerged Macrophytes

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Many submerged aquatic plant species have been documented as being invasive outside of their native range. Two species which are native to N. America (*Elodea canadensis & E. nuttallii*) are invasive in Europe and a native European species (*Myriophyllum spicatum*) is invasive in N. America, while a further two species from the southern hemisphere are invasive on both continents (*M. aquaticum* & *Lagarosiphon major*). These species primarily reproduce asexually in their invasive range, thus a high level of phenotypic plasticity would be expected in order to facilitate invasion success. This comparative study aims to identify the optimum light conditions for the growth of all six species and to assess the level of morphological plasticity of invasive species at different stages in their development, with a view to informing control strategies.
In aquatic environments light intensity controls primary production and submerged plant distribution. Research has shown species-specific morphological plasticity and physiological tolerance in macrophytes exposed to different light levels. Light-related plasticity may offer competitive advantages to invasive species.
A combination of controlled laboratory and outdoor mesocosm experiments were employed. Plant allofragments and established plants were investigated separately, in order to compare strategies at different stages of the lifecycle. In controlled lab-studies, light-response curves showed that Myriophyllum

species favoured low light (<100µmol.m-2.s-1) conditions for biomass production. L. major and both Elodea species favoured moderate light (200-400µmol.m-2.s-1) conditions. In mesocosms, allofragment relative growth rate (RGR) was greatest in low light conditions (<25% ambient light), though once established some species favoured moderate (50%-75% ambient light) light conditions. Established plants of some species exhibited no difference in RGR across various light levels, though morphological differences were observed. Different strategies were identified for each species, with respect to light-dependent adjustment of root & shoot morphology, leaf area, internode length and biomass allocation. It is hypothesised that morphological plasticity may facilitate success in different light environments.
Understanding the responses of invasive and native plants to a range of light intensities furthers knowledge of their habitat requirements and informs management of freshwater systems through light exclusion, management of riparian shade and water clarity.

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Unravelling the Biogeographic Origins of *Myriophyllum spicatum*

Weyl, P.[1,2], Moody, M.[3], Thum, R.[4], Newman, R.[5] & Coetzee, J.[2]

[1]CABI, Switzerland, [2]Rhodes University, Grahamstown, South Africa, [3]University of Texas, El Paso, TX, [4]Montana State University, Bozeman, MT, [5]University of Minnesota, St. Paul, MN

Understanding the origins and potential pathways of introduction are key components when developing a management strategy for an invasive weed. Eurasian watermilfoil (*Myriophyllum spicatum*) is considered one of the most economically costly aquatic weeds in its invaded range. It has a wide distribution worldwide, including Europe, Africa, Asia and North America. Until recently, the origin of M. spicatum invading North America was unknown and there was debate around the status (either native or exotic) of the southern African populations, some of which were becoming weedy. In this study we present population genetic data (cpDNA intron and the nrDNA ITS region) to shed light on the origins of the North American and southern African M. spicatum. Over 100 populations worldwide, throughout the native and invaded range, were sampled. The data suggest that the North American Eurasian milfoil was introduced from southern China and South Korea, while there is no evidence to suggest that the southern African Eurasian milfoil was anthropogenically introduced. This provides important information on potential management strategies which include: 1) where to direct surveys for potential biological control agents in the case of North

America, and 2) what management strategies are appropriate for a native weedy species as in the case of southern Africa.

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Curlyleaf Pondweed Management in Montana: Where Are We At and Where Do We Go?

Craig McLane

Montana Department of Fish, Wildlife and Parks, Helena, MT

In this presentation, I will provide the current distribution and spread of curlyleaf pondweed in Montana since the State of Montana began actively monitoring for invasive macrophytes starting in 2011. I will also elucidate how differences of opinions, funding limitations, political pressures, and available resources can muddle prioritization for aquatic invasive species management including curlyleaf pondweed. As such, the State of Montana is struggling with best management strategies in different portions of the state, emphasizing the need for a statewide management plan specifically for curlyleaf pondweed.

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An Update on Flowering Rush Distribution and Control Efforts in the Columbia River Watershed

Jennifer Parsons

Washington Dept of Ecology, Yakima, WA

Flowering rush (*Butomus umbellatus*) invades many aquatic habitats, from deep water to emergent shorelines, still to flowing water, and muck to rocky substrate. Once established, its stout rhizomes form dense mats that can change the nature of aquatic ecosystems. The Columbia River basin provides miles of ideal habitat, starting in the upper watershed where flowering rush is well established on down to the mouth where no flowering rush has yet been found. In between, its distribution is increasing, with rapid colonization of Lake Pend Oreille in Idaho and the Pend Oreille River in Washington. Additional colonies have been found in central Washington portions of the River and tributaries, as well as two of the reservoirs that are shared by Washington and Oregon. Management has been stymied by a lack of efficacious ways to kill it or curtail its spread. The use of the herbicide

imazapyr on emergent plants in early spring holds some promise for future containment of established populations in lakes and reservoirs with low water in the spring months. In situations where flowering rush still consists of small patches, diver hand pulling will control it at least some of the time, but at significant expense. This plant stands to provide challenges to salmon and other endangered fish recovery efforts into the future without significant effort soon to curtail its spread.

69

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Understanding the Role of Resource Limitation in Restoration of Cold Desert Shrubland Invaded by Cheatgrasss (*Bromus tectorum* L.)

Jeanne C. Chambers[1] and Rachel O. Jones[2]

[1]U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Reno, NV 89512, [2]Department of Natural Resources and Environmental Science, University of Nevada, Reno

Invasion of cheatgrass (*Bromus tectorum* L.) and other invasive annuals into cold desert ecosystems of the U.S. is often linked to increased resources. Restoration ecologists suggest that decreasing nitrogen (N) availability and restoring more conservative nitrogen cycles should decrease competition from cheatgrass and facilitate native plant establishment. We asked how restoration treatments aimed at resource reduction (repeated burning, litter manipulation, seeding an annual competitor) affect soil N availability and cheatgrass success in a 5-yr experiment in a Wyoming big sagebrush ecosystem. We found that in cheatgrass dominated areas, burn temperatures for the annual grass were too cool to volatilize N from soils or aboveground biomass. Repeated burning did result in progressive loss of litter. Litter removal had negative effects on cheatgrass success largely due to seed bank and plant establishment effects rather than N mineralization. Seeding a competitor, common wheat, had little direct effect on available N, but greatly reduced cheatgrass density, growth, and survival. Annual precipitation and temperature significantly affected outcomes in this semi-arid system. Integrated restoration approaches that decrease litter and seed banks and increase competition will likely be more effective at reducing cheatgrass and facilitating native establishment than attempts to directly manipulate N.

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Invasive Plant Management: A Western Action Plan Update

Kenneth E. Mayer

K. E. Mayer & Associates, LLC. Reno, NV

The sagebrush ecosystem is among the largest and most imperiled ecosystems in North America. One of the most significant stressors to the sagebrush biome is the expanding invasion and dominance of ecosystem-transforming invasive plants, particularly exotic annual grasses and high-risk perennial forbs. The loss of sagebrush, and associated habitat for the Greater Sage-grouse (GRSG) and other sagebrush obligate species is due primarily to the widespread proliferation of invasive plant infestations, and the resulting increases in fuel-loading that increases the intensity, scale, and

frequency of wildfires in sagebrush ecosystems. Moreover, the establishment of invasive plants also alters ecosystem function that exacerbates the negative effect on sagebrush related wildlife. This coupled with the predictions of increased drought conditions and temperatures across the West, these invasive plant-driven catastrophic wildfires and systemic alteration of sagebrush habitats are expected to continue to destroy and/or alter massive areas of sagebrush, facilitating a rapid decline in habitat for a large number of associated native plants and animals, including the GRSG. Throughout the West, local, state and federal government agencies are the principal entities responding to invasive plant threats, from both a regulatory and management perspective. Unfortunately, this response lacks coordination. Overall, there is a lack of a consistent, comprehensive policy that has resulted in the creation of fundamentality different regulatory approaches among land management agencies and states. This presentation will address a collaborative effort to develop an Invasive Plant Management Action Plan that will hopefully serve as a “blue print” for coordinated actions to address the existence and expansion of invasive plants in the west.

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Biological Invasions in the Developing World: WoodyWeeds in Eastern Africa

Urs Schaffner

CABI, Delémont, Switzerland

Trees and shrubs were repeatedly introduced in areas beyond their native range as they can provide firewood, charcoal, fodder or soil erosion control. Over the years, several of these woody species have escaped cultivation and become some of the most important invasive alien species (IAS) worldwide, with significant negative impacts on biodiversity, grassland productivity or water household. Upper income countries have implemented multi-million-dollar programs to develop technologies and policies aiming to mitigate the negative impacts of woody IAS on ecosystem services and human well-being. In contrast, there is a serious lack of coordinated and sustainable management of woody IAS in low-income countries, including the heavily affected countries in Eastern Africa.

The aim of the recently launched ‘Woody Weeds’ project is to assess the impacts of selected woody IAS on biodiversity, ecosystem services and human well-being in Eastern Africa and to mitigate their negative effects on rural livelihoods. To achieve this goal, the ‘Woody Weeds’ project brings together experts in ecology, forestry, remote sensing, economy and social

sciences to generate and share knowledge on invasion processes and on context-dependent effects of woody IAS in case study areas in Tanzania, Kenya and Ethiopia, elaborate sustainable control measures and develop and test, in collaboration with local and national stakeholders, sustainable land management strategies that mitigate the negative effects of woody IAS. When presenting the general approach and first results of the 'Woody Weeds' project, I will try to elaborate on aspects that are comparable to invasions of woody IAS in North America and on aspects specific to low-income countries in the developing world.

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Presidential Memorandum on Pollinators - What It Means for Restoration and Reclamation Projects

John Proctor

USDA FS, Ogden, UT

John Proctor will speak on how the 2014 Presidential Memorandum on pollinators will be a component of all future Forest Service restoration and reclamation projects. He will discuss how the Forest Service is working with partners, including the seed industry, to establish a reserve of native seed mixes, including pollinator-friendly plants, for use on post-fire rehabilitation projects and other restoration activities to increase the quantity and quality of habitat.

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USDA APHIS PPQ Policies Regarding Biological Weed Control

Greg Goodman

CSFP APHIS PPQ, Riverdale, MD

In addition to corresponding with an overview of our policy with regards to approvals required and subsequent permitting processes, I also plan to provide an overview of our 2015 reorganization and expansion of our previously known unit (Pest Permitting Branch) into the 2 current units: Containment, Soil, and Federal Noxious Weed Permits (CSFP) Branch and Pest,

Pathogens, and Biocontrol Permits (PPBP) Branch. I'm also hoping to provide a status update on our new permitting system; although, we are still in the development stages.

Changes are also forthcoming in our regulations at 7 CFR 330 and I'm hoping to provide an overview of our proposed rulemaking. This proposed rule is due to be published in the Federal Register any day now. Unfortunately once it's published, I will not be able to discuss it. I plan to continue to monitor its publication and include this information if not published by the date you schedule me to present. I plan to provide conceptual information and key themes to stakeholders. I also plan to communicate how this will or will not impact applicants and permit holders. Once published, all will be able to review this information in the proposed rule.

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The Nagoya Protocol: Implications for Classical Biological Control and Recent Initiatives for its Implementation

Philip Weyl[1], Hariet L. Hinz[1], Urs Schaffner[1], and Massimo Cristofaro[2]

1 CABI Switzerland, 2 Biotechnology and Biological Control Agency, Italy

The Nagoya Protocol is a supplementary agreement to the Convention on Biological Diversity (CBD) with the aim to provide a legal framework for the Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS). The Protocol entered into force on 12 October 2014 and has been ratified by 78 countries so far. "Utilisation of genetic resources" is defined as "to conduct research and development on the genetic and/or biochemical composition of genetic resources". This therefore impacts our work when searching for, collecting and studying natural enemies in their native range, as potential biological control agents for invasive weeds in North America. Within Europe, most countries are not restricting access to genetic resources. However, in countries such as Turkey, Russia, Kazakhstan, China and Iran the situation has proven more complicated. Our presentation aims to give an overview of the issues arising for classical biological control through the Nagoya Protocol and the recent steps we took to try and find pragmatic solutions. We emphasize the growing importance to exercise due diligence when it comes to ABS to guarantee that classical biological control remains a viable tool for invasive plant management.

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Monitoring and Mapping weed Biological Control: Standardized Impact Monitoring Protocol and EDDMapS's i-Biocontrol App.

Carol Randall

US Forest Service, Coeur d'Alene, ID

For years biological control practitioners in Idaho and surrounding states have been using the Standardized Impact Monitoring Protocol (or SIMP) to monitor the impacts of weed biocontrol on the target weed species and associated plant community. Moving forward we are investigating combining the simplicity of SIMP with the power of EDDMapS to enable land managers to collect SIMP data on their smartphones/ tablets and make data gathering and analysis easier. In this presentation Carol will discuss the fundamentals of SIMP and the existing functionality of the EDDMapS i-biocontrol app and solicit input into how the two could be combined.

78

Role of Plant Volatile Cues in the Host Finding and Environmental Safety Assessment of the Weevil *Mogulones crucifer*, a Biological Control agent of *Cynoglossum officinale*

Basu D. Kafle and Mark Schwarzländer

University of Idaho, Moscow, ID

Current host specificity testing of weed biological control organisms relies on feeding and developmental tests. The assessment of the behavioral responses during host recognition and the sensory cues involved could provide important information on the relative attractiveness of non-target plant species and greatly improve pre-release predictions of the biological control agent's ecological host range. Using a four-armed olfactometer, we found that during host finding *Mogulones crucifer* (Coleoptera: Curculionidae), a root-mining weevil that was released in Canada in 1997 for the biological control of the invasive plant *Cynoglossum officinale* L. (Boraginaceae), however, not permitted for release in the United States due to concerns over potential non-target attack on threatened and endangered confamilial plant species, prefers *C. officinale* volatiles over volatiles from all tested non-target plant species. In addition, in electrophysiological

experiments using weevil antennae, we found that *M. crucifer* responded to a subset of chemical compounds in the foliar volatile blend of *C. officinale* with one species-specific compound, methyl isovalerate, that could explain to weevil's discrimination. In olfactometer bioassays, M. crucifer females were behaviorally attracted to methyl isovalerate when offered in ecologically relevant concentration indicating its role in host recognition by the weevil. The overall findings suggest that the weevil is unlikely to locate and therefore colonize any of the tested rare or threatened and endangered native confamilial plant species.

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Simple Citizen Science Monitoring Programs Generate aWealth of Data to Assess Weed Biocontrol Effects

Mark Schwarzländer, Aaron S. Weed, John Abatzoglou, Joey D. Milan

US National Park Service, University of Idaho, USDI BLM

Citizen-based science monitoring may provide a cost effective way to monitor weed populations and evaluate effects of biocontrol especially across broad geographic regions. In this study, we report results from a citizen-science monitoring programme initiated to evaluate the effects of the stem-mining weevil *Mecinus janthiniformis* (Curculionidae) on the Eurasian invasive weed Dalmatian toadflax Linaria dalmatica. Nearly 40 Dalmatian toadflax populations have been monitored across the state of Idaho since 2007. Our main study goals were to revaluate the factors affecting fluctuations in ramet density of L. dalmatica from 2007 to 2016 including the effect of M. janthiniformis as a follow-up to a previous study which evaluated monitoring from 2007-2011. Our results indicate that citizen-based monitoring not only provides important data for evaluating conditions conducive to biocontrol impact but also heightens awareness, training, and support of biocontrol activities in the local communities.

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Update on Yellow Toadflax (*Mecinus janthinus*)

Carol Randall

US Forest Service, Coeur d'Alene, ID

There are currently 7 approved classical biological control agents for yellow toadflax, and the most promising is the stem mining weevil Mecinus janthinus. In this presentation I will discuss the current weed biological control program for yellow toadflax, discuss additional biological control agents in development, and discuss the importance of taking an integrated weed management approach when dealing with populations of yellow toadflax.

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Mitigating Priority Effects of Invasive Plants during Revegetation by Altering Perennial Grass Planting Date

Stacy Davis[1] and Jane Mangold[1]

[1]*Montana State University, Bozeman, MT*

Revegetation of weed-infested rangeland typically involves applying herbicide to control weeds in the summer or fall; herbicide application is followed by seeding of native species, most often grasses, in fall of the same year. Modifying grass seeding date may be one ecologically-based management tool to increase establishment of seeded species by giving them an initial size advantage over weedy species that emerge later. We assessed eight seeding dates (late fall 2015 through mid-May 2016) for the native perennial grass bluebunch wheatgrass (Pseudoroegneria spicata), with the aim of manipulating perennial grass seedling size when they first encounter invasive plant seedlings that emerge later. The different perennial grass cohorts are being exposed to spotted knapweed (*Centaurea stoebe*) and cheatgrass (*Bromus tectorum*) competition. In this presentation, we will discuss how seeding date has affected perennial grass survival and size at the end of one growing season. Bluebunch wheatgrass, spotted knapweed, and cheatgrass biomass and density will be assessed during the following growing season. It is our hope that this research will improve efficacy of revegetation efforts on lands dominated by spotted knapweed and cheatgrass, as well as other non-native winter annual grasses and forbs in Montana and the Northern Rockies.

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Restoration as Assisted Succession – a Data-Driven Approach

Zachary Sylvain[1], Merilynn Schantz[2], Erin K. Espeland[1]

[1]USDA-ARS Northern Plains Agriculture Research Laboratory, Sidney, MT [2]Red Rock Resources LLC, Miles City MT

Historically, large scale restoration has been a practice akin to farming: plant seeds of forage grasses or seedlings of trees and watch them grow. With more ambitious restoration targets such as functioning ecosystems that house appropriate biodiversity, we need to use information gleaned from natural systems to guide us in (re)building sites ecologically. Soil and vegetation sampling over large scales combined with data-mining techniques allow us to generate hypotheses regarding invasibility and ecosystem function that can be tested in restoration plantings.

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Using Cover Crops in Revegetation after Energy Development

Natalie M. West[1], John Hendrickson[2], David Toledo[2], Tatyana A. Rand[1], Erin K. Espeland[1]

[1]USDA-ARS Northern Plains Agricultural Research Laboratory, Sidney, MT ,[2]USDA-ARS Northern Great Plains Research Laboratory, Mandan, ND

Cover crops have been shown to build soil health and provide ecosystem services in agricultural systems, but this has not been tested in restoration. We measured rangeland health and perennial grass establishment in twelve interim oil field reclamations. Sites at Ft. Berthold Indian Reservation in North Dakota were planted with perennial grasses, with and without an oat cover crop in late summer/fall of 2014, and with and without a cover crop cocktail in spring of 2015. Cover crop treatments were not significant determinants of perennial grass establishment, and cover crops established at low densities in reclamations due to stressful soil conditions. Rangeland health trended towards being greater when a cover crop was planted, but the effect was very small. If we can mitigate stressful soil conditions, we may eventually observe a long term benefit of cover crops in restoration.

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Best Management Practices for Improving Pollinator Habitat During Integrated Pest Management

John Proctor

USDA FS, Ogden, UT

John Proctor will speak on the Pollinator-Friendly Best Management Practices (BMP) for Federal Lands which is an Appendix to the National Pollinator Strategy. He will touch on the Key Considerations in developing BMPs for pollinator conservation and BMPs designed to improve pollinator habitat. He will close by discussing BMPs which protect pollinators when taking specific management actions such as pesticide use.

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Medusahead Wildrye Suppression and Restoration in Intermountain Western Montana Grasslands

Virgil Dupuis[1], Peter Rice[2]

[1]*Salish Kootenai College,* [2]*University of Montana*

Medusahead Wildrye is a newly discovered invader to the montane grasslands of the northern Rocky Mountains. Testing of suppression and restoration strategies have not been done in this biome where fall precipitation patterns, temperatures, winter dormancy, medusahead growth and thatch conditions, and competing invasive and relic species are different than previously tested. Containing and reducing the population, and re-vegetating to beneficial species is critical to preventing the spread to hundreds of thousands of acres of western Montana Palouse type grasslands.

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The changing face of plant materials, can a new approach improve restoration success?

Scott Jensen

USDA Forest Service Rocky Mountain Research Station, Provo, UT.

In recent decades as federal agencies have broadened management practices to meet multiple use objectives consideration of seed source for

restoration projects have become increasingly important. Current science offers evidence that local native seed sources may be the best plant materials to meet multiple use objectives. The traditional cultivar plant development model is challenged by the new approach of empirical and generalized provisional seed zones. I'll showcase several species to illustrate both the cultivar and seed zone models and demonstrate how plant materials are now being organized for stock seed supplies.

2016 NRIPC Conference – Boise Centre, Idaho
Speaker Biographies

Dr. Dan Bean, Director of Biological Pest Control

Conservation Services, Colorado Department of Agriculture

Dan has been director of Colorado's biological pest control program for 11 years. The program is centered at the Palisade Insectary in western Colorado and the mission is to provide safe and effective biological control agents for use against weeds and insect pests. Current projects include the biological control of tamarisk, field bindweed, Canada thistle, leafy spurge and Russian knapweed. Dan is particularly interested in the ecology, physiology and behavior of biocontrol agents and how these elements impact the safety and efficacy of biocontrol. Dan studied insect physiology and received a PhD in entomology from the University of Wisconsin, Madison.

Paul Brusvan is a North Central Idaho native and is currently serving as the Nez Perce Bio-control Center Coordinator for the Nez Perce Tribe. He works in Lapwai of north-central Idaho and on the Nez Perce Reservation where the Tribe's headquarters is located. For the past 26 years, Paul has worked for the Tribe and has been involved with many land management projects ranging from soil and water work to land use planning focusing on agriculture and pasture/rangelands management. For the past 13 years Paul focused his duties in coordinating efforts to rear and release approved bio-control agents that attack noxious and invasive weeds that persist across thousands of acres in Idaho and surrounding states. Paul received a Bachelor of Science degree from the College of Agriculture in 1990 from the University of Idaho.

Dr. Ian C. Burke is an Associate Professor in the WSU Department of Crop and Soil Sciences in Pullman, WA. He received his B.Sc. from Old Dominion University and his M.Sc. and Ph.D. from North Carolina State University. He finished his Ph.D. in 2005, was a post-doctoral research associate with the USDA-ARS in Stoneville, MS for a year before starting his appointment with WSU in the fall of 2006. His current research focuses on the effects of climate change on weed species. Burke's research program is directed at basic aspects of weed biology and ecology with the goal of integrating such information into practical and economical methods of managing weeds in the environment.

Chris Carlson, Research Program Specialist, City of Missoula, Conservation Lands Management M.S. Forestry, University of Montana, B.S. Geography, University of Oregon.

At work, I lead efforts to monitor the condition of natural and recreational resources on City Open Space, as well as conducting research projects into local ecology and restoration techniques. I currently have research projects investigating the use of sheep grazing for weed control, status of common

buckthorn in Montana, smooth brome biology and control, and re-surveys of historical vegetation plots. In the past, I have worked to understand the impact of thinning and wildfire on forest carbon budgets. I spend my free time gardening, brewing fruit and vegetable wines, and recreating around the West.

Jeanne Chambers is a research ecologist with Rocky Mountain Research Station, US Forest Service, located in Reno, NV. She has a Master's Degree in Range Science and a PhD in Biology/Ecology from Utah State University. Her research interests include global change processes, disturbance/restoration ecology, and invasive species. Her current work focuses on arid and semi-arid shrublands, woodlands and riparian ecosystems.

Virgil Dupuis has been the Extension Director at Salish Kootenai College in Pablo, MT for the past seventeen years. He has implemented projects addressing new invaders to the region, primarily flowering rush and medusahead wildrye. Extension programming includes formation of weed management groups, invasive plant education, and developing research to address these two invaders to western Montana and the Columbia River System.

Gil Gale currently serves as Forest Staff Officer/Program Leader for Invasive Species, Wildlife, Botany and Rangelands on the Bitterroot National Forest in Montana. He has worked in the Rocky Mountain West with the U.S. Forest Service as a biologist and land manager for 37 years.

John Gaskin received a bachelor's degree in botany at UC Santa Cruz, CA, and a PhD in Evolution and Population Biology from Washington University in St. Louis. He currently works for the USDA Agricultural Research Service in Sidney, MT. His research interests are population genetics of invasive plants, including where they come from, who they are related to, hybridization between invasive and other species, and determining if different regions of the invasive range contain genetically distinct invasions.

Matt Germino has served as a Supervisory Research Ecologist with the US Geological Survey's Forest and Rangeland Ecosystem Science Center in Boise Idaho since 2011. His research focuses on understanding the physical and biological elements of resistant and resilient landscapes in the western US, using a variety of approaches in soil, plant, and physiological ecology. He also serves on special assignment as scientist for the Great Basin Landscape Conservation Cooperative. Prior to joining the USGS, he was a Professor of Biology at Idaho State University, Pocatello.

Gregg Goodman In addition to my duties as the Technical Advisory Group for Biological Control Agents of Weeds (TAG-BCAW) Executive Secretary, I'm a Senior Agriculturalist in the CSFP Branch and serve as a SME/ permitting scientist for all Mollusk permit applications and movement/ import requests, plant growth enhancer/ soil amendment import/ movement requests, and all permit requests for EPA registered biopesticides (General Permits). I processed all phytophagous (weed) biocontrol release permit applications for 3 years. I also currently issue and respond to all periodic inspection requests for USDA APHIS inspected containment facilities. I've been with APHIS for 12 years: 2 with Biotechnology Regulatory Services and 10 with PPQ. Before joining APHIS, I worked for ARS for 3 years at the National Agricultural Library; 4 years at the National Institutes of Health; and 2 years for the Navy at the Uniformed Services University of the Health Sciences. Prior to Federal service, I worked for a small biotechnology company for 5 years.

Hariet Hinz My training is in horticulture, pest management, applied entomology and ecology, which provides an ideal background for my main research interest, classical biological weed control. I have over 20 years of experience in this area, including studies on the biology, host specificity and impact of herbivorous insects, the population biology of plants, and more recently, chemical aspects underlying the host-choice behaviour of insects. I am also interested in potential invasion mechanisms of invasive plants and have supervised several graduate projects on this subject, including biogeographic comparisons between the native and introduced ranges of invasive plant species.

Since 2006, I have led the Biological Weed Control Programme at CABI's centre in Switzerland, which involves managing 15 ongoing weed biological control projects for the USA and Canada. In October 2015 I was appointed Country Director of CABI's Swiss centre.

Lonnie Huter is the Weed Management Specialist for the Boise District BLM and has been in noxious weed control at the BLM since 2001. Lonnie grew up in southern Idaho and earned B.S. and M.S. degrees from the University of Idaho in Environmental Science and Soil Science. At his present post, Lonnie coordinates weed control activities across 4 million acres of public land with county weed departments, private landowners, state and federal agencies, and industry.

Scott Jensen is a research botanist with the Rocky Mountain Research Station where he focuses on plant community restoration in the Great Basin through the development of native seed supplies. His research interests include wildlife habitat, invasive species biology, plant materials and restoration applications.

Desireé Keeney is the Field Operations Manager at Ada County Weed, Pest, and Mosquito Abatement District, where she has worked for the past 9+ years. Desireé received her Bachelors of Science Degree in Biology with an Ecology emphasis from Boise State University where she also completed field work in wildlife habitat management, plant habitat surveys and plant ecology and fire rehabilitation restoration with various agencies throughout the state of Idaho. She currently manages all of the field crews' day to day operations in accordance with the long term goals and missions of each department while maintaining three distinct budgets. Desireé also serves on the Idaho Mosquito and Vector Control Association board as the current Past President and is the newly appointed State of Idaho Representative for the Northwest Mosquito and Vector Control Association. In her off time, Desireé enjoys spending time in the outdoors camping, hiking, photography, volunteering, gardening, and hunting and fishing with family and friends.

Anthony Koop Tony is a risk analyst with the Plant Epidemiology and Risk Analysis Laboratory (PERAL) of the Animal and Plant Health Inspection Service. As the team lead for the PERAL Weed Team, he coordinates most day-to-day activities of the team, including weed prioritizations, pest plant datasheets, and weed risk assessments (WRA). Over the last five years he has prepared and reviewed dozens of WRAs, helped develop the foundation and structure of the team's processes, organized four WRA training workshops, and interfaced with other groups interested in weed issues. He also led the development of the predictive model of the new PPQ WRA and its guidelines. Prior to his work on weeds, Tony prepared commodity and pest risk assessments for PERAL. Tony is a botanist and plant

ecologist with degrees in biology. He has been working on invasive plant issues for over 20 years and is currently on the board of the North Carolina Invasive Plant Council.

Richard D. Lee is the Integrated Pest Management Specialist for the Bureau of Land Management, a position he has held for the past 14years. He is involved with National projects, such as the 2007 and 2016 Programmatic Vegetation Management Environmental Impact Statements, the National Invasive Species Information Management System (NISIMS), the Bureau's Pesticide Certification Program, and Field Office level projects which have national implications for the Bureau. Prior to coming to the BLM, he was the Extension Weed Specialist for the New Mexico State University Cooperative Extension Service for 18 years. He continues to organize and participate in the Southwest Noxious Weed Short Course; a course organized 23 years ago, and has assisted other State and Federal Agencies with IPM Training. Educational background consists of the family dairy farm in Northern Utah, B.S. and M.S. from Utah State University, majoring in Plant Science, with a focus on Weed Science during his Masters, and a Ph.D., in Weed Science, from The Ohio State University.

Sean Mahoney I am a PhD student working under Dr. Tad Theimer at Northern Arizona University. My research focuses on the complex and dynamic interactions between non-native and native species, particularly with birds, plants, and insects. My research uses a multi-species approach to inform best-practice management.

Jane Mangold is an Associate Professor and Extension Invasive Plant Specialist at Montana State University in Bozeman, MT. Her research and educational programs focus on ecologically-based invasive plant management on range and wildlands of the Northern Rockies and Northern Great Plains. She holds a B.S. in Biology from Iowa State University, an M.S. in Abused Land Rehabilitation from Montana State University, and a Ph.D. in Land Resources and Environmental Sciences from Montana State University.

Clayton B. Marlow

Animal and Range Sciences Department

Montana State University, Bozeman, MT

A. Education:

1. BS Range Sciences (1974) – University of Wyoming

2. MS Forest and Range Sciences (1976) – Washington State University

3. PhD Range Sciences (1978) – University of Wyoming

B. Teaching and Related Work Experience

2016 – 1980: Split appointment with the Montana State University College of Agriculture (teaching) and Montana Agriculture Experiment Station (research); served as Associate Dean for College of Agriculture, 1989-1999.

1980 – 1978: Staff Forester, Forestry, Fisheries and Wildlife Department, Tennessee Valley Authority, Casper, WY – responsible for rehabilitation of uranium exploration, mining and milling sites in 5 western states.

1978 – 1976: Research Associate, Plant Sciences Department, University of Wyoming; developed the environmental impact monitoring protocol for the WYODAK coal fired power plant, Gillette Wyoming.

C. Current Teaching and Research Activities

1. Teaching: Provide undergraduate and graduate instruction in small acreage management, riparian ecology and management, wildland fire ecology and livestock/wildlife habitat improvement

2. Research: Evaluating the interaction between sagebrush cover and groundwater recharge patterns in foothill rangelands; investigating the role of winter grazing on soil organic matter turnover and the effect of bison, elk and bighorn sheep on watershed function in the Gardiner Basin, Montana.

Ken Mayer holds a BS and MS in Natural Resources Management from Humboldt State University.

- He began his professional wildlife career with the California Department of Forestry (CDF), as their first Wildlife and Range Ecologist. While at CDF he co-founded the creation of the California Wildlife Habitat Relationship Program.

- He then moved to the California Department of Fish and Game (CDFG) in 1987, where he served for 12 years as the Statewide Deer Management Coordinator and then 7 years as the Chief Scientist for the Office of Spill Prevention and Response (OSPR), where he supervised spill response statewide.

- In 2007, Ken retired from the CDFG and accepted the Nevada Governor appointment as Director of the Nevada Department of Wildlife (NDOW), where he served nearly 7 years.

- As Director, Ken served on the Governor's Cabinet, as Executive Secretary of the Wildlife Commission and a member of the Nevada State Environmental Commission,

- He also served in an executive leadership role in both the Western Association of Fish and Wildlife Agencies (WAFWA) and Association of Fish and Wildlife Agencies (AFWA).

- As Director, Ken served as the first Chairman of the National Greater Sage-grouse Executive Oversight Committee for 3 years and as the Director Lead for the WAFWA Sage-grouse and Columbian Sharp-tail Technical Team.

- Since leaving NDOW in 2013, he started his own consulting business (K. E. Mayer & Associates, LLC), where he is continuing his work on Greater sage-grouse conservation as the Coordinator of the WAFWA Wildfire and Invasives Species Initiative.

Craig McLane works for Montana Fish, Wildlife, & Parks as part of the Aquatic Invasive Species Team. He has been with the State of Montana since 2011. Prior to working for the state, he has worked for the US

Army Corps of Engineers Threatened and Endangered Species Program in South Dakota. He received his Masters from Southern Illinois University in Plant Biology.

Denise McLean, BSc., MSc., PAg.

Denise received her Bachelor of Science in Agriculture and Master of Science in Agriculture from the University of Saskatchewan. She then worked for the Saskatchewan Forage Council before moving back to her home province of British Columbia and worked for the Ministry of Agriculture as a Regional Agrologist. Denise now works for the Ministry of Forests, Lands and Natural Resource Operations as the Invasive Plant Specialist for the Northern half of British Columbia. Based out of Prince George, Denise and her husband are long time breeders and trainers of Weimaraner dogs.

Joseph "Joey" Milan is a Boise, Idaho native. Joey graduated from the College of Idaho with a BS in Biology and the University of Idaho where he completed his MS in Entomology. Upon completion of his MS, Joey began working at his present position as a Biological Control Specialist with the BLM. At his present post, he serves as the interagency coordinator for biological control, assisting weed control practitioners in their Integrated Weed Management approach by providing technical assistance and monitoring of past releases as well as organizing new collections and additional potential release sites.

Shelley Mills has been the MSU Extension Agricultural agent for Valley County for over 6 years. Her areas of expertise are pesticides, recognizing herbicide injury, pulse crop production, horticulture and environmental risk.

Shelley is a 1986 graduate of Montana State University in Botany and is currently pursuing her Master's degree in Land Resource and Environmental Sciences from Montana State University. Her thesis work involves research in the management of the invasive weed species Crepis tectorum, known commonly as narrow-leaved hawksbeard. She is also engaged in research in fruit tree production, viticulture and small grain and pulse production within her county.

Noelle Orloff is currently an Associate Extension Specialist at Montana State University in Bozeman, Montana, where she works in the Schutter Diagnostic Lab. Her main role in the lab is identifying plants submitted by growers, ranchers and homeowners and providing management recommendations if needed. Current and past research pursuits have included investigating perennial weed control in organic and diversified cropping systems, and exploring rangeland plant community response to weed control measures. She received her master's degree in Land Resources and Environmental Sciences from MSU, where she focused on ecologically-based management of Bromus tectorum in a variety of agricultural ecosystems.

Jenifer Parsons has a BS in biology from Boise State University and an MS in aquatic ecology from Western Washington University. She has worked as an aquatic plant specialist for the Washington Department of Ecology since 1994. Duties with that position include monitoring aquatic plant and weed populations in lakes and large rivers throughout the state and conducting research on the effectiveness of various aquatic weed control methods.

Inna Pervukhina-Smith is a graduate student at Boise State University's Biology Department with an interest in population genetics. Before making her way to the great land of potatoes, she received her BS from Colorado State University, followed by additional study of Wildlife Conservation at Texas A&M Commerce. Inna's thesis research utilizes a molecular approach to identify putative source populations, number of introduction events, patterns of range expansion, as well as overall genetic diversity of the invasive annual grass Ventenata dubia (Leers) Coss. (Poaceae; Ventenata, North Africa grass). With whatever little free time available as a student, she enjoys birding, bird photography and taking care of her spoiled Chow Chow.

Mark Porter A native Oregonian, Mark earned a B.S. in wildlife biology from Oregon State University. Mark rounded out his schooling and by doing a wide variety of seasonal field work for the Forest Service and spending years cowboying in the Lower Imnaha. He combined his schooling and practical experience run and CWMA land stewardship program implementing forest and riparian health projects for Wallowa Resources in Enterprise OR. Mark served on several boards over the last decade including the Oregon Invasive Species Council, Wallowa County Weed Board, and the Tri-County CWMA Board. Mark has been Oregon Department of Agriculture's Integrated Weed Management Specialist in NE Oregon for nearly three years.

Tim Prather works as a professor in the Department of Plant, Soils and Entomological Sciences in the College of Agricultural and Life Sciences at University of Idaho. Tim enjoys researching the biology and ecology of plants that are emerging as new invaders. In addition, Tim studies the economic and ecological impact of invasive plant species. He evaluates and develops methods of weed control for species found in forest and range communities. His lab has developed ways to determine areas at risk to invasion by several weed species and they have combined weed data from several agencies into one database to assist in data sharing and continued mapping. He administers the UI weed diagnostic lab that identifies and track plant locations, and produces weed bulletins for weed species in Idaho, Washington and Oregon. In addition, Tim conducts research on restoration of plant communities in rangeland systems and teaches a restoration methods class as well as a senior and graduate student class on Invasive Plant Biology.

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 15 years' experience managing Botany and Native Plant Material Programs in the Forest Service including 6 years as Forest Botanist on the White River NF, 8 years as Forest Botanist on the Medicine Bow-Routt National Forest and Thunder Basin National Grassland and 2 years as the acting South Zone Botanist on the Rogue River National Forest. 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.

Harry Quicke

Western Stewardship and Development Manager

Industrial Vegetation Management, Forestry and Range

Harry Quicke Harry's US career started at Auburn University working on tree response to vegetation control. After graduating with a PhD in Forest Science, he spent 14 years with BASF responsible for US-wide development of vegetation management products. In 2010 he transitioned to a development role in agriculture covering Colorado and surrounding states. In June 2015 Harry accepted a position with Bayer CropScience as Western Stewardship and Development Manager covering industrial vegetation management, forestry and range.

Carol Randall is the weed biological control coordinator for the Northern and Intermountain Regions of the US Forest Service. She provides assistance to state and private cooperators in integrated weed management, forusing on classical biological control, across the five states of ID, MT, ND, UT, and NV. She has also worked with other authors on the development of a series of technical manuals which encourage land managers to take an integrated approach to dealing with their invasive plant problems. She is currently stationed in Coeur d'Alene, ID.

Darren Reidy is an ecologist with a keen interest in environmental conservation. He is currently completing the final year of his Ph.D. in the School of Biological, Earth & Environmental Sciences, University College Cork, Ireland and is funded by the Irish Environmental Protection Agency. His research interests are in the fields of conservation biology, invasion ecology and habitat management. His current research focuses on aspects of the ecology and ecophysiology of aquatic invasive plant species in Ireland. He Holds a B.Sc. (Hons) and M.Sc. in Ecology from UCC. Darren is passionate about sustainable development, community engagement and science communication. Prior to commencing his Ph.D. he worked as an education officer in Killarney National Park, Ireland, and as a science/nature broadcaster for a number of years. This autumn Darren will be conducting part of his PhD research in Prof. Ryan Thum's lab at Montana State University.

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René FH Sforza is a Research entomologist working at the USDA-ARS European Biological Control Laboratory in Montpellier, France. As a biocontroller he has expertise in foreign exploration for insect and plant pests introduced into the U.S. with Eurasian origins. His main focus is on permitting, collecting, rearing, and identifying herbivores as potential biocontrol agents for weeds of interest. Some of his targets are grasses, such as medusahead and ventenata, but also French broom. He is also working on bioocntrol of insect pests such as Bagrada bug, invasive in California but with a African-Asian origin. Invasion ecology, phylogeography, and insect-plant interactions are also parts of his fields of expertise.

Dr. Roger Sheley has developed an international reputation as a weed ecologist. He was an Extension Specialist for Invasive plants at Montana State University for about 10 years. He is currently a lead scientist for the Agricultural Research Service program in Burns, Oregon. During the past 10 to 12 years, Dr. Sheley has worked to provide a conceptual framework that would help integrate research, teaching and management associated with rangeland weed management. He received a B.S. and M.S. from Washington State University and Ph.D. from Oregon State University.

Daniel Tekiela My first exposure to invasive plants was during an internship with an invasive plant management company working along the Eastern coast. This practical exposure to managing invasive plants in a variety of ecosystems directed my professional interests toward better protecting our natural landscapes against invasion. My initial work focused on quantifying the ecological impacts of invasive plants and developing ecologically responsible management techniques with the intent to help develop scientifically based management prioritization techniques. This interest has led me to pursue a position focused on extension and outreach to be able to work directly with land managers. At my current position as the invasion extension specialist at the University of Wyoming, I am trying to develop better methods to detect invaders in the landscape, better prioritization protocols for what populations to manage and how to manage them, and identify control methods that reduce disturbance and likelihood of secondary invasion.

Dr. Ryan A Thum received his BS from Florida State University and his PhD from Dartmouth College. His research program focuses on the ecological genetics of invasive aquatic plants, with specific emphasis on invasiveness and herbicide response in Eurasian and hybrid watermilfoils. He is currently a Research Professor at Montana State University's Plant Sciences & Plant Pathology Department in Bozeman, Montana.

Jeremy Varley Moved to Salmon ID in 2006 as a River Guide after attending Idaho State University; filled a seasonal weed tech position in 2008 and would later become the assistant weed superintendent under Daniel Bertram (2010) during this time I developed an Aquatics program for Lemhi County as well as increasing the level of GPS and GIS information that was being collected at that time. In 2013 I was awarded the position of Weed Superintendent. During the 2014 Lemhi County was placed in charge of the Frank Church CWMA for the ISDA cost share grant. In February of 2015 I graduated Leadership Idaho Agriculture Class 35.

Phillip Weyl After completing my PhD at Rhodes University, South Africa in 2015, working on the origins of a submerged macrophyte Myriophyllum spicatum in southern Africa, I worked for 18 months in a post-doc position with the Rhodes University Biological Control Research Group, where my research was focused on post release evaluation of biological control agents on aquatic weeds in Africa. I started at CABI Switzerland in June 2016 where I am based in the weeds section and involved in field surveys in Europe and Asia as well as host range and impact studies of potential biological control agents on several target weeds.