



Northwest Scientific Association
82nd Annual Meeting,
Cascadia Prairie-Oak Partnership
Ecoregional Conference,
with **Northwest Lichenologists**

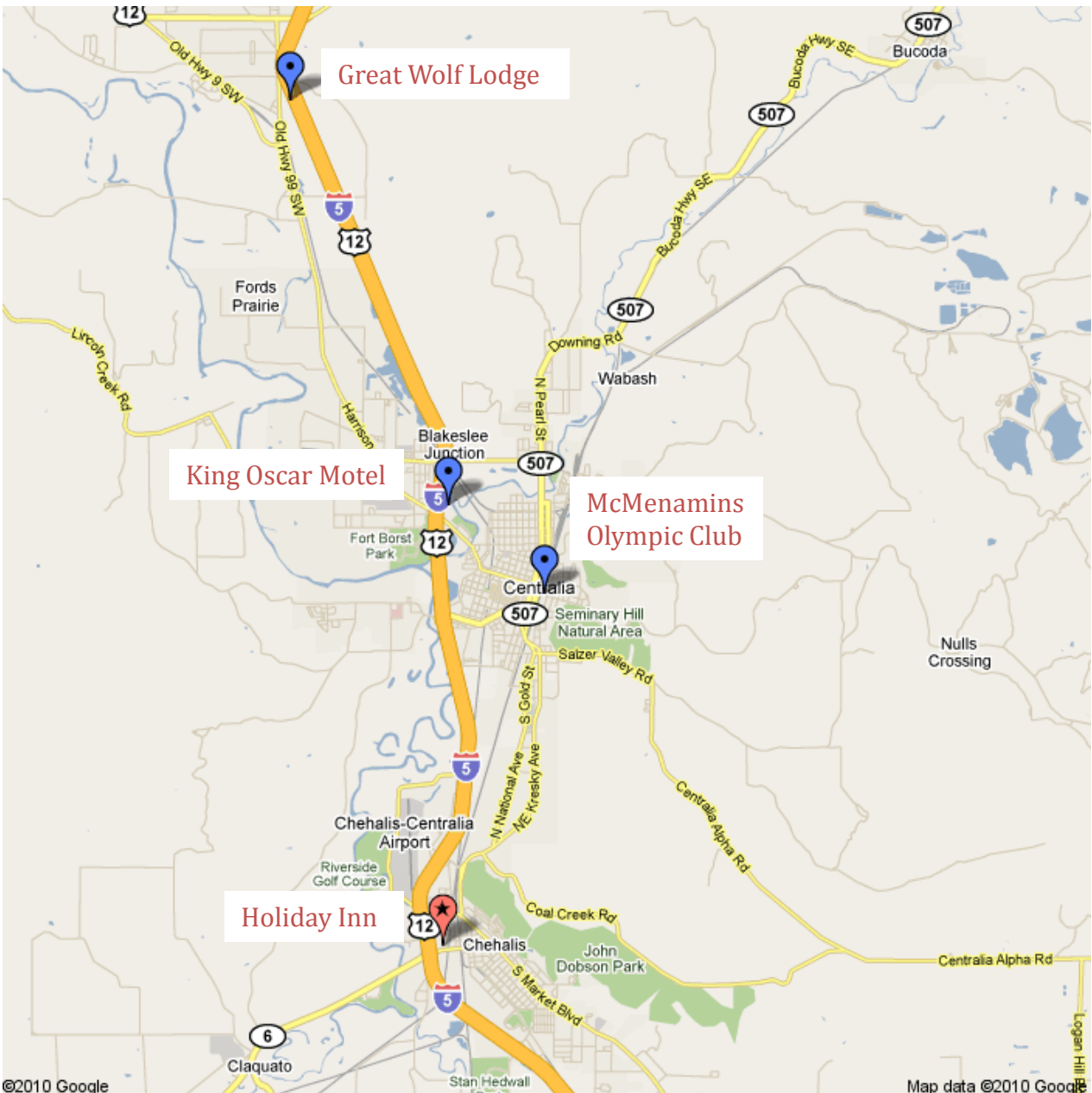


*From Mount St. Helens to Oak-Prairie Lowlands:
Disturbances, Biological Legacies, and Conservation*



24–27 March 2010
Centralia College, Washington State

Lodging Options



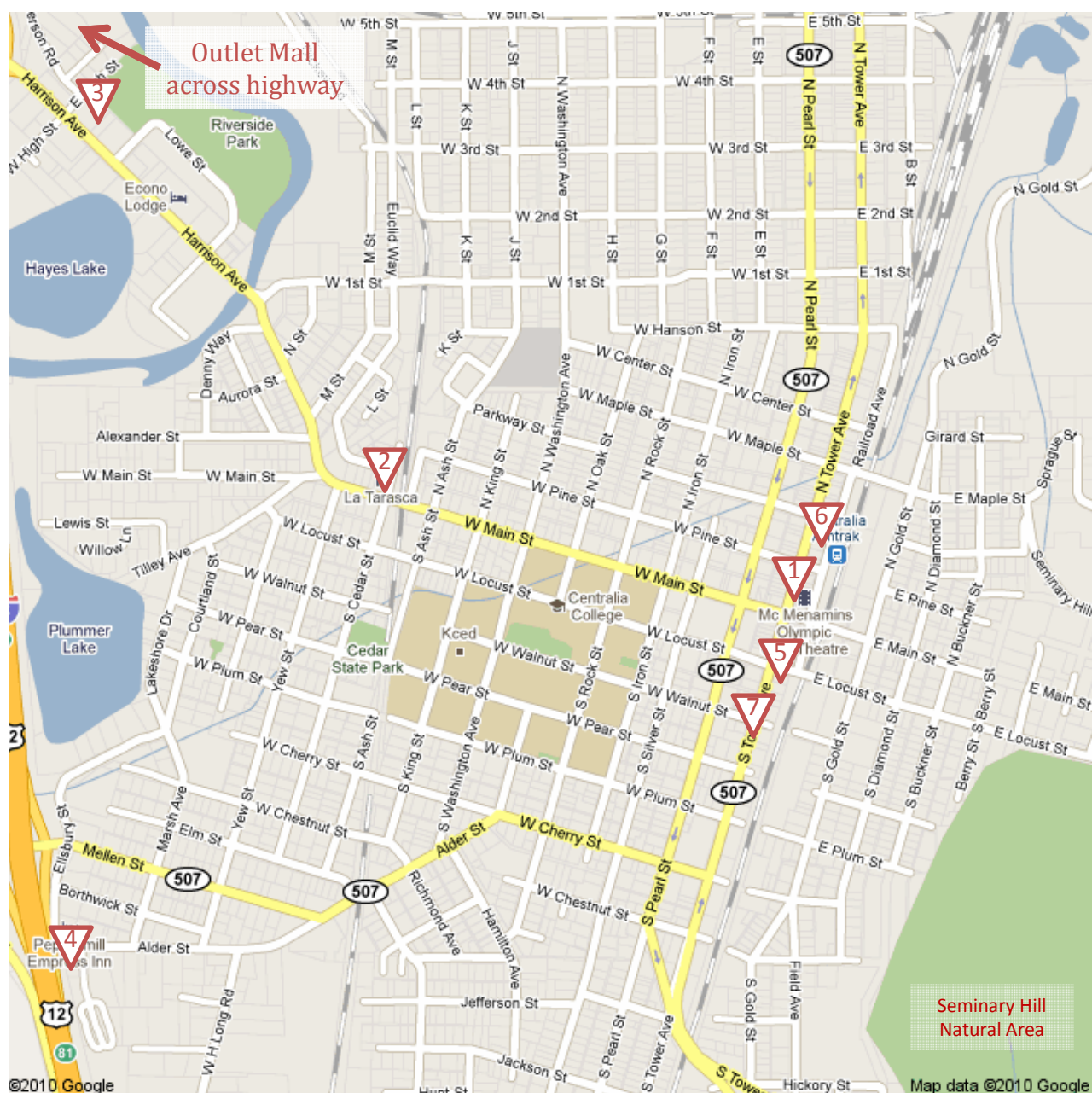
Holiday Inn Express - 730 NW Liberty Place Chehalis, WA 985032; 360-740-1800

McMenamins Olympic Club – 112 N Tower Avenue, Centralia, WA 98531; 360-736-5164

King Oscar Motel – 1049 Eckerson Road, Centralia, WA 98531; 360-736-1661

Great Wolf Lodge – 20500 Old Highway 99 SW, Centralia, WA 98531; 800-640-9653

While in Centralia



Lunch Spots

- 1 McMenamins Olympic Club – 112 N Tower Avenue; 360-736-5164
(also evening social 5:30 Wednesday 24 March 2010)
- 2 La Tarasca – 1001 W Main Street; 360-736-7756
- 3 Burgerville – 818 Harrison Avenue; 360-736-5212
- 4 PJ's Pizza – 1232 Alder Street; 360-736-0101
- 5 Santa Lucia Coffee Co. – 202 South Tower Avenue; 360-807-9600
- 6 Catty Wampus Coffee & Bakery – 208 N Tower Avenue; 360-623-1391

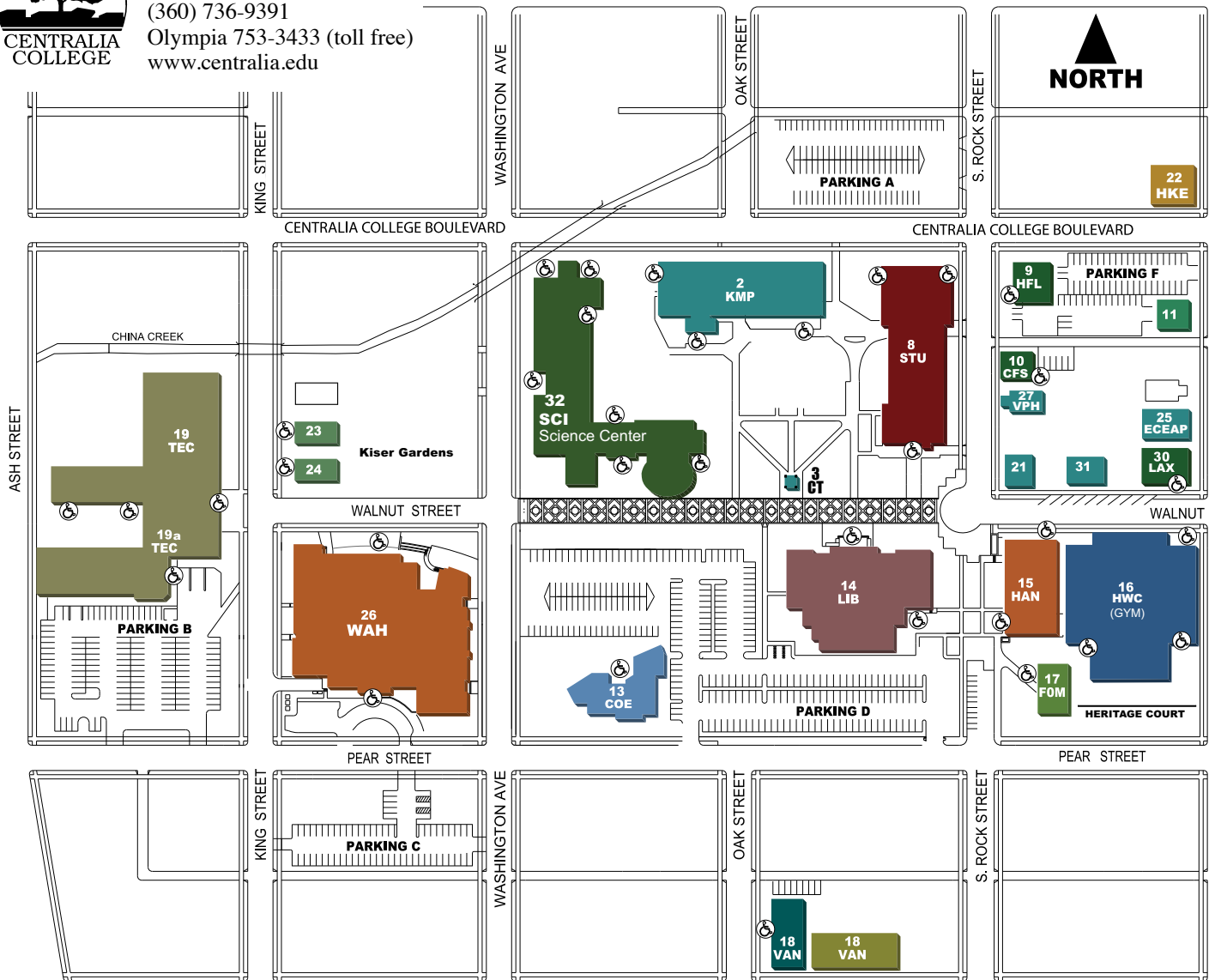
Banquet – 6:30 Thursday 25 March 2010

- 7 The Aerie Ballroom - 219 S Tower Avenue; 360-807-1212



600 Centralia College Blvd
Centralia WA 98531
(360) 736-9391
Olympia 753-3433 (toll free)
www.centralia.edu

Centralia College Campus Map



NAME	BUILDING NO.
Accounting (Instruction).....	WAH26
Accounting (Operations)	HAN15
Administration	HAN15
Admission and Records Services.....	STU8
Alumni Office	HKE22
Art	WAH26
Assessment & Testing	LIB14
Board Room.....	HAN15
Bookstore.....	STU8
Business (Instruction).....	WAH26
Business Occupations.....	WAH26
Business Development Center.....	TEC19
Business Office (Operations).....	HAN15
Cafeteria	STU8
Career Center.....	STU8
Cashier	STU8
Center of Excellence	COE13
Center for Disability Services.....	STU8
Central Services	TEC19a
CHILD & FAMILY STUDIES PROGRAM	CFS10
CHILD DEVELOPMENT CENTER	VAN18
Civil Engineering Technology	TEC19
CLOCKTOWER	CT3
College Relations	HKE22
Computer Lab (General Use).....	LIB14
Computer Labs (Instructional).....	WAH26
Computer Services.....	WAH26
Corbet Theatre.....	WAH26
Counseling/Career Center	STU8

NAME	BUILDING NO.
Dean of Professional/Tech Instruction	TEC19
Diesel Technology	TEC19
Dramatic Arts	WAH26
Early Childhood Education (ECEAP).....	STU25
Educational Talent Search.....	STU8
Enrollment Services	STU8
Facilities Operations/Maintenance	FOM17
Financial Aid/Student Employment	STU8
Foundation.....	HKE22
Gymnasium.....	HWC16
HANKE HOUSE.....	HKE22
HANSON ADMINISTRATION BUILDING.....	HAN15
HEALTH SCIENCE ANNEX.....	HSA13
HEALTH & WELLNESS CENTER.....	HWC16
Human Resources	HAN15
Instruction Office	SCI32
International Student Housing	11, 21
Journalism	WAH26
KEMP HALL	KMP2
KIRK LIBRARY.....	LIB14
LABORATORY ANNEX	LAX30
Media Studies	WAH26
Music	WAH26
Nursing.....	SCI32
Parent Education/ECE Classroom	HFL9
Phoenix Center	LIB14
President	HAN15
Printing & Duplicating.....	TEC19
Receiving.....	TEC19

NAME	BUILDING NO.
Registration.....	STU8
Research & External Funding	HAN15
SCIENCE CENTER.....	SCI32
SECURITY	31
Small Business Management.....	TEC19
Social Science	KMP2
Sports Programs	HWC16
Student Activities & Admissions Team	STU8
STUDENT CENTER	STU8
Student Employment.....	STU8
Student Government.....	STU8
Student Life.....	STU8
Student Support Services.....	STU8
TECHNOLOGY CENTER	TEC19
T.E.E.N. Offices	KNG23
T.E.E.N. Classroom.....	KNG24
Veterans' Services.....	STU8
Visiting Professor House.....	27
WorkFirst/Worker Retraining Intake Center	KMP2
VP of Finance/Administration	HAN15
VP of Instruction	SCI32
VP of Student Services	STU8
WASHINGTON HALL	WAH26
Welding Technology	TEC19
Wickstrom Studio Theatre	WAH26
E.C.E.A.P. Program	IRN25
WorkFirst Resource Center	KMP2

CAPS = Building Name

Thank You!

This event would not have been possible without the generous support of our sponsors, planners, and volunteers.

Our sincere gratitude to the following for their support:

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Department of Defense, Legacy Program
Centralia College

Supporting Donors

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Patrick Pringle, Centralia College
Hannah Anderson, The Nature Conservancy

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Robin Leshar – US Forest Service

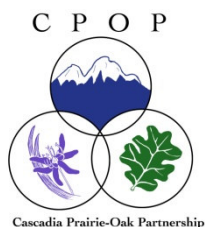
Michael Meagher, Shyanne Smith – Garry Oak Ecosystem Recovery Team
Michelle Tirhi – Washington Department of Fish and Wildlife
David Wilderman – Washington Department of Natural Resources

Volunteers

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Kari Anderson
Stuart Cavness
Meagan Heiden
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Jeff Lowdermilk
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Collete MeShel Wilson
Michelle Wilson
Molly Yoder

Need a Computer or Wireless Connection?

Conference attendees are invited to use the computer lab in the Centralia College Science Center (room 103) or connect to the College Wireless.



Northwest Scientific Association

...promoting scientific research and disseminating scientific knowledge since 1923.

http://www.vetmed.wsu.edu/org_NWS/NWSci_Home.htm

Cascadia Prairie-Oak Partnership

<http://www.southsoundprairies.org/>



Welcome to the 82nd Annual Meeting of Northwest Scientific Association (NWSA), co-hosted this year by the Cascadia Prairie-Oak Partnership (CPOP) and Northwest Lichenologists. Thank you for supporting these organizations and science communication in the Pacific Northwest by attending. This letter has typically been a missive from the President of the NWSA, but this year's joint meeting calls for a broader welcome. The high level of participation, with a record 130+ abstracts submitted, demonstrates the power of joining forces. We are excited about our symposia focusing on prairie ecology and on the 30th anniversary of the beginning of the modern eruptive period at Mount St. Helens.

Northwest Scientific Association

Since its inception in 1923, the Northwest Scientific Association has been dedicated to serving the scientific community of the northwestern United States and western Canada through three primary activities: (1) convening an annual meeting which offers scientists opportunity to share research findings, (2) supporting student research through a small grant competition, and (3) disseminating scientific knowledge through publication of its quarterly journal, *Northwest Science*. The work of the Association is entirely supported by its members, who volunteer their time. The NWSA gives honorary awards that recognize excellence in science and service—it's our way of thanking these teachers, mentors, and regional scientists for their excellence and leadership!

The annual meeting is a natural time of transition—Members of the NWSA Board of Directors rotate in and out and form a new team. Please join us in thanking all those that have served on this year's NWSA Board: Bax Barton, University of Washington; Doug Call, Washington State University; Lori Daniels, University of British Columbia; Jeff Duda, US Geological Survey; Nancy Grunewald, Washington State University Press; Mark Harmon, Oregon State University; Judy Harpel, University of Washington; Robin Leshner, USDA Forest Service; Elizabeth Nesbitt, University of Washington; Allen Sullivan, Yakima Training Center; Kathy Goetz Troost, University of Washington; Julie Heath, Boise State University, and Andrea Pipp, of PBS & J Consultants. We welcome Lana D'Souza of Weyerhaeuser who has recently joined the Board.

Further we thank the NWSA Officers, Editors and editorial staff, and members of the NWSA's Program, Awards, Student Grants, Nominating, and Membership Committees for their hard work! Please consider joining NWSA if you are not a member, and also consider serving on the Association's Board of Directors and on committees. These positions are open to all members of the NWSA. If this (or other volunteer opportunities) interests you, contact any member of the current board to find out more.

Starting in January 2009, thanks in large part to the diligent efforts of Editor Jeff Duda, our journal *Northwest Science* is now listed on the BioOne nonprofit publishing collective website (<http://www.bioone.org/loi/nwsc>). This means *Northwest Science* is now web searchable from anywhere in the world starting with the January 2007 issue. More than 17,000 abstracts and 5,000 full-text articles have been accessed since we've gone online! So there are even better reasons now to publish your work in *Northwest Science*!

Cascadia Prairie-Oak Partnership

We are excited to have the large number of practitioners, researchers, managers, and scientists from throughout the ecoregion who are interested in prairie and oak woodland conservation come together and share their work and ideas. We are also so pleased to be producing a special edition of the peer-reviewed journal *Northwest Science* that will document the state-of-knowledge on the ecology and conservation of prairies and oak woodlands in our ecoregion.

The burning questions on everyone's mind are: Who makes up this Cascadia Prairie-Oak Partnership and what is it exactly? The answers are: You do and it is an umbrella entity designed to link together individuals and working groups who are working to preserve, restore, and conserve our rare and fragile system. The idea of CPOP evolved from discussions during the planning process for this conference. Partners from throughout the Willamette Valley – Puget Trough – Georgia Basin ecoregion got together to frame and scope the conference. While there are local/regional prairie-oak working groups from each portion of the ecoregion, there is no umbrella entity that represents the whole. Therefore, the Cascadia Prairie-Oak Partnership was initiated. CPOP is not intended to replace any regional working group, but rather is intended to operate at a larger scale and link each regional group together.

Beyond this conference and the resulting journal special edition, the specific functions for CPOP in the future are yet to be determined. Please join us at the CPOP Business Lunch (yes, free lunch!) to share your ideas about how an entity that links together local and regional working groups could function and how it can help move forward prairie and oak woodland research, protection, restoration, and conservation.

2010 Joint Meeting at Centralia College

We offer special thanks to all who have helped plan, prepare for, and sponsor this year's joint annual meeting. Special thanks are extended to President Jim Walton and the faculty and staff of Centralia College, who is cosponsoring the meeting. In particular we thank Cheryl Williams, Candy Lunke, Shelley Bannish, Terri Perez, Bonnie Myer, Dottie Guy, Georgia McKinley, Debbie Walker, Dick Lamb, Pat Johnson, Brenda Novarra, Melissa Wilke, Ruby Nagelkerke, and many others. We are most grateful to the volunteers that have served a critical role in the meeting include members of Centralia College Phi Theta Kappa honorary society, science students, Friends of Puget Prairies, and interns and volunteers from the Nature Conservancy of Washington. A hearty thank you to The US Department of Defense Legacy Program who is supporting the production of this event and production of the prairie-oak special edition of *Northwest Science*. We are so grateful to our program sponsors for their support. As should be expected there are many others to thank as well: planning committee members, symposia organizers, session moderators, and the many presenters.

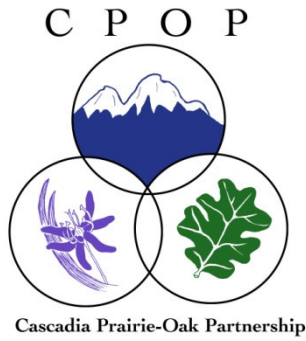
We hope you enjoy exploring the Centralia College campus, our New Science Center, and historic downtown Centralia. Please stop by the tables or posters sponsored by local volunteers from Mount St. Helens Institute, Seminary Hill Natural Area, Friends of Puget Prairies, North Puget Prairie Working Group, Chehalis River Council, and others. Enjoy the company of old friends and new acquaintances. And if you are attending a local field trip, enjoy the spring splendor of our unique natural setting at the southern margins of the great Puget Lowland.

Sincerely,

Patrick Pringle,
President, Northwest Scientific Assoc.
Earth Science, Centralia College

Hannah Anderson
Cascadia Prairie-Oak Partnership
The Nature Conservancy of Washington

Program and Abstracts



**Northwest Scientific
Association**
82nd Annual Meeting,
**Cascadia Prairie-Oak
Partnership**
Ecoregional Conference,
**and Northwest
Lichenologists**



24–27 March 2010
Centralia College Campus
Washington State

Meeting Theme:

*From Mount St. Helens to Oak-Prairie Lowlands:
Disturbances, Biological Legacies, and Conservation*

Table of Contents

Program at a Glance	2-3
Plenary Session	4-14
Session Schedule: Thursday 25 March 2010.....	4-14
Mount St. Helens Symposium	6-7
Prairie Restoration Research Symposium	8
Climate Change Technical Session.....	9
Management of PNW Forests Technical Session.....	10
Floristic Quality Assessment Symposium.....	11
Garry Oak Ecology and Restoration Technical Session	12
Lichenology Technical Session.....	13
Banquet.....	14
Session Schedule: Friday, 26 March 2010.....	15-23
Prairies and Oak Woodland History and Inventory Technical Session.....	15
Prairies and Oak Woodland Protection and Restoration Technical Session	16
Geology and Paleontology Technical Session	17
<i>Usnea</i> Workshop	18
Prairie and Oak Woodland Vertebrates Technical Session.....	18
Prairie and Oak Woodland Native Plant Materials Production Technical Session	19
Pacific Northwest Ecology Technical Session.....	19
Prairie and Oak Woodland Invertebrates Technical Session	20
Prairie and Oak Woodland Invasive Control and Prescribed Fire Technical Session..	21
Railroad Logging Symposium.....	22-23
Field Trips.....	24-25
Abstracts.....	26-93
Session Overview Table.....	94

Program at a Glance

Wednesday, 24 March 2010

- 9:00–4:00 **Field Trip:** Strategies for Restoring Degraded Prairies
Led by Amanda Stanley, Institute for Applied Ecology
Box Lunch Included
- 3:00–5:00 **Registration Table Open:** Centralia College, Science Center Lobby
- 5:30–9:00 **Evening Social and Registration Table Open:**
McMenamins Olympic Club, Downtown Centralia–Complementary appetizers

Thursday, 25 March 2010

- 7:30–4:00 **Registration Table Open:** Science Center Lobby, Centralia College
- 8:00–8:20 **Welcome & Introduction:** Corbet Theatre, Washington Hall
Patrick Pringle, NWSA, Hannah Anderson, TNC, & Jim Walton, Centralia College
- 8:20–10:00 **Plenary Sessions:** Corbet Theatre, Washington Hall
Fred Swanson, US Forest Service, Pacific Northwest Research Station
Gerould Wilhelm, Conservation Design Forum
- 10:00–10:20 **Break:** Refreshments, Science Center Lobby, Centralia College
- 10:20 - 12:00 **Concurrent Sessions:**
Symposium: Prairie Restoration Research–Combining Tools for Success–SCI 121
Symposium: 30 Years of Research at Mount St. Helens–Lessons of Local and
Global Importance–WAH103
Technical Session: Climate Change–SCI 111
Technical Session: Management of Pacific Northwest Forests–SCI 107
- 12:00–1:30 **Lunch** (on your own)
- 1:30–4:10 **Concurrent Sessions:**
Symposium: Floristic Quality Assessment–Potential for Application in the PNW
–SCI 121
Symposium: 30 Years of Research at Mount St. Helens–Lessons of Local and
Global Importance–WAH103
Technical Session: Garry Oak Ecology and Restoration–SCI 111
Technical Session: Lichenology–SCI 107
- 4:10–5:40 **Poster Session:** Science Center, 3rd Floor
Beer, Wine and Cheese Social (complimentary beverages and appetizers)
- 5:40–6:30 **Break** (on your own)
- 6:30–9:30 **Banquet:** The Aerie Ballroom, downtown Centralia
Greg Retallack, University of Oregon

Program at a Glance

Friday, 26 March 2010

7:30–4:00 Registration Table Open: Science Center Lobby, Centralia College

8:00–10:20 Concurrent Sessions:

Technical Session: Prairies and Oak Woodlands–History and Inventory–SCI 111

Technical Session: Prairies and Oak Woodlands—Protection and Restoration
—SCI 121

Technical Session: Geology and Paleontology–SCI 107

Technical Session: Lichen Workshop-SCI 307

10:20–10:40 **Break:** Refreshments, Science Center Lobby, Centralia College

10:40-12:20 Concurrent Sessions:

Technical Session: Prairies and Oak Woodlands-Vertebrate Wildlife-SCI 111

Technical Session: Prairies and Oak Woodlands–Native Plant Materials
Production–SCI 121

Technical Session: Pacific Northwest Ecology–SCI 107

Technical Session: Lichen Workshop-SCI 307

12:20-1:30 **NWSA and CPOP Business Lunches:** Cafeteria, Student Center
Complementary Lunch

1:30–3:50 Concurrent Sessions:

Symposium: Biological, Landscape, and Disturbance Legacies of Railroad
Logging (1:30–4:30) –SCI 107

Technical Session: Prairies and Oak Woodlands-Invertebrate Wildlife-SCI 111

Technical Session: Prairie and Oak Woodlands–Invasive Control and Prescribed Fire–SCI 121

Saturday, 27 March 2010

8:30-4:00 **Field Trip:** Comparing Washington's Willamette and Puget Prairies
Led by Rex Crawford and Joe Arnett, WA Dept of Natural Resources
Box Lunch Included

8:30–4:00 Field Trip: Garry Oak Restoration in the South Puget Sound
Led by David Wilderman, WA Dept of Natural Resources, Mason McKinley, The
Nature Conservancy, and Dave Hays, WA Dept of Fish and Wildlife
Box Lunch Included

8:30–2:00 **Field Trip:** Lichens in the Mima Mounds
Led by Katherine Glew, University of Washington

Session Schedule

Thursday, 25 March 2010

Plenary Session

Time: 8:00–10:20

Room: Corbet Theatre, Washington Hall

Moderators: Patrick Pringle and Hannah Anderson

8:00–8:20 **WELCOME AND INTRODUCTION**

Patrick Pringle, NWSA, Hannah Anderson, TNC, & Jim Walton, Centralia College

8:20–9:10 **30 YEARS OF LEARNING AT MOUNT ST. HELENS:—GEOLOGY, ECOLOGY, AND HUMAN DIMENSIONS.** Fred Swanson, Oregon State University.

The eruption of Mount St. Helens on May 18, 1980, was a globally-transformative event for volcanology, ecosystem science, and human engagement with volcanoes. Public interest in the volcano, its ever-changing landscape, and the broader societal context tell us that, even after 30 years, this is a vibrant place for learning and teaching. The 1980 and subsequent geophysical events have taught us a great deal about many poorly-known processes and deposits—the keys to understanding a volcano's past eruptions and behavior. This set the stage for a new phase of growth in basic volcanology and its application at sites of volcanic unrest throughout the world, most notable through the US Geological Survey's Volcano Disaster Assistance Program. Technological advances made it possible obtain a near-real-time record of earthquakes, ground deformation, and gas emissions before, during, and after eruptions. Ecological responses to the physical processes have been stunning in their diversity, richness, and vigor across a range of meadow, forest, lake, and river environments. In the human dimension, Mount St. Helens displaced, impoverished, and killed many people; but she has also inspired many—from grade school children to seasoned mountain scientists, poets, and philosophers. Continuing geological, ecological, and humanities inquiry at Mount St. Helens constantly adds to the rich legacy of knowledge from this place. Those of us who have had the good fortune to work at Mount St. Helens wish to encourage new work and new workers in this volcanic landscape; we have so much more to learn from this compelling teacher.

Fred Swanson is a Research Geologist and ecosystem scientist with the USDA Forest Service, Pacific Northwest Research Station. For many years he has studied the interactions of physical processes, such as fire, flood, landslides, volcanic eruptions, and forestry operations, including roads, with forest and stream ecosystems. Much of this work has taken place at the H.J. Andrews Experimental Forest in the Oregon Cascades, Mount St. Helens, and elsewhere in the Pacific Northwest.

Session Schedule

Thursday, 25 March 2010 (cont)

Plenary Session

Time: 8:00–10:20

Room: Corbet Theatre, Washington Hall

Moderators: Patrick Pringle and Hannah Anderson

9:10–10:00 **CONSILIENCE AND CONCINNITY.**

Gerould Wilhelm, Conservation Design Forum.

Consilience means “jumping together” and is typified when all the elements of an ecosystem are working in harmony. The health of an ecosystem is directly related to consilience. If one acknowledges that plants and animals grow in habitats to which they are adapted, then one must accept the corollary: Change the habitat and the inhabitants change. All elements in an ecosystem must be in consilience if the system is to remain stable enough to endure changes at the rates at which mountains rise and fall. As an ecosystem’s elements dropout, the ability for all other elements to jump together is accordingly and progressively diminished. Consilience includes, crucially, the Holocene-aged relationship that the system has had with any sustainable human cultures that depended on the system for critical, life-sustaining resources.

Most of the World’s ecosystems have had such a relationship with human cultures. The implications for ecosystem collapse when this is abrogated are evident everywhere around us. The challenge for contemporary restoration ecologists is to discover the aboriginal relationships and help our people re-engage appropriately. Concinnity is the beautiful harmony between people and place as humans understand their role in “jumping together.”

Dr. Gerould Wilhelm will be using native prairie, woodland, and riverbank landscapes to illustrate consilience and concinnity.

Gerould Wilhelm is a foremost botanist, research taxonomist, and educator. He co-authored, through years of collaboration with Floyd Swink, at the Morton Arboretum in Lisle, Illinois, the definitive flora “Plants of the Chicago Region.” Jerry is also noted for his development of the Floristic Quality Assessment (FQA) methodology, which has become widely adapted for use in 20 states and provinces. Currently, he is developing an expanded, illustrated, innovative “Flora of the Chicago Region,” to include insects and other animals that have direct relationships with the 2800 local plant species. His recent research effort on Timber Hill Savanna increases our understanding and awareness of the critical cultural relationships involved in the evolution of North American landscapes and ecosystems. He is an owner of Conservation Design Forum, the pioneer company in changing the water doctrine in the United States.

Session Schedule

Thursday, 25 March 2010 (cont.)

Symposium: 30 Years of Research at Mount St. Helens—Lessons of Local and Global Importance

Time: 10:20–4:10 (break for lunch on your own)

Room: Washington Hall 103

Moderator: Charlie Crisafulli and John Bishop

This symposium highlights several long-term geological and biological studies that have transformed our current understanding of volcanic processes and hazard assessment and ecosystem responses to large, intense natural disturbance. Thirty years after its monumental eruption, Mount St. Helens' significance to geologists and biologists grows ever larger. This symposium highlights several long-term, ongoing, geological and biological studies as well as more recently developed approaches to understanding eruptive processes and ecological reassembly for a variety of system types and taxa, and across a range of spatial and temporal scales. In geology, speakers will highlight how Mount St. Helens has become the test bed for volcano monitoring technology to apply around the world, and what was learned from the 2004–2008 eruption. Biologists will describe several unexpected impacts of tephra fall on forest understory plants, the surprising roles of insects in community reassembly, the recovery and ongoing development of riverine fish communities and their habitats, the stunning re-colonization of amphibians across the volcanic landscape, and nutrient dynamics and productivity of Spirit Lake.

**10:20–10:50 30 YEARS OF VOLCANOLOGICAL RESEARCH AT MOUNT ST. HELENS THE
WORLDWIDE LEGACY OF THE 18 MAY 1980 ERUPTION.**

Cynthia A. Gardner, U.S. Geological Survey, Vancouver, WA

**10:50–11:20 DOME EXTRUSION THROUGH THE CRATER GLACIER AT MOUNT ST. HELENS
FROM 2004 TO 2008.**

James W. Vallance, U.S. Geological Survey, Vancouver, WA.

**11:20–11:50 UNDERSTORY PLANT MORTALITY AND RECOVERY: LEARNING FROM THE
TEPHRA.** Donald B. Zobel, Oregon State University, Corvallis, OR; Joseph A. Antos,
University of Victoria, Victoria, BC Canada

11:50–12:20 FACILITATED DISCUSSION

12:20–1:30 LUNCH (on your own)

Session Schedule

Thursday, 25 March 2010 (cont.)

Symposium: 30 Years of Research at Mount St. Helens—Lessons of Local and Global Importance (cont)

Time: 10:20–4:10 (break for lunch on your own)

Room: Washington Hall 103

Moderator: Charlie Crisafulli and John Bishop

- 1:30–2:00 **THE SURPRISING EFFECTS OF INSECT CONSUMERS ON PRIMARY SUCCESSION AT MOUNT ST. HELENS.**
John G. Bishop. Washington State University, Vancouver, WA
- 2:00–2:30 **LONG-TERM MONITORING OF FISH, STREAM TEMPERATURE, AND CHANNEL CHARACTERISTICS FOLLOWING THE 1980 ERUPTION OF MOUNT ST. HELENS.**
Brian Fransen, Jason Walter, Weyerhaeuser Timberlands Technology, Federal Way, WA
- 2:30–3:00 **SURVIVAL AND COLONIZATION OF AMPHIBIANS: LESSONS FROM THE 1980 ERUPTION OF MOUNT ST. HELENS.** Charlie Crisafulli, U. S. Forest Service, Olympia, WA ; Charles P. Hawkins, Utah State University, Logan, UT
- 3:00–3:30 **CONSTRUCTING A NUTRIENT MASS BALANCE MODEL FOR POST-ERUPTION SPIRIT LAKE, MOUNT ST. HELENS NATIONAL VOLCANIC MONUMENT, WASHINGTON.** James E. Gawel, Nicole Butcher, Ashley Datema, Heather Jennings, Cameron Marshall, Bridget Mason, Mindy Roberts, Tiffany Wax, University of Washington Tacoma, WA; Meghan Blanchet and AJ Joseph, Bellarmine High School, Tacoma, WA ; and Charlie Crisafulli, US Forest Service, Olympia, WA.
- 3:33–4:10 **FACILITATED DISCUSSION**

Session Schedule

Thursday, 25 March 2010 (cont.)

Symposium: Combining techniques for success: lessons in prairie management and restoration

Time: 10:20–12:20

Room: Science Center 121

Moderator: Amanda Stanley

This session will combine presentations and a facilitated group discussion to synthesize the latest research on prairie restoration and what these results mean for on-the-ground management. The focus of our discussion will be on integrating research studies that test multiple techniques in combination (fire, herbicide, seeding, etc) with experience from land managers. We will emphasize results from a recently completed eco-region wide research study. For more information about the study go to <http://appliedeco.org/conservation-research/prairie-restoration-research>.

10:20–10:40 **MANAGEMENT RECOMMENDATIONS FOR RESTORING PACIFIC NORTHWEST PRAIRIES FROM A LARGE-SCALE, LONG-TERM COLLABORATIVE RESEARCH PROJECT**

Amanda Stanley, Institute for Applied Ecology, Corvallis, OR

10:40–11:00 **STRONG SEED LIMITATION IN PRAIRIE GRASSLANDS OF THE GARRY OAK ECOSYSTEM** - Karen Reagan, University of Washington, Seattle, WA

11:00–11:20 **RESTORING HIGHLY DEGRADED HABITATS FOR RARE SPECIES IN PUGET LOWLAND PRAIRIES**–Eric Delvin, University of Washington and The Nature Conservancy, Seattle, WA

11:20–12:20 **FACILITATED DISCUSSION**

Session Schedule

Thursday, 25 March 2010 (cont.)

Technical Session: Climate Change

Time: 10:20–12:20

Room: Science Center 111

Moderator: Dominique Bachelet

10:20–10:40 GLOBAL WARMING

Mohammad Sharraf Moghaddasi, Islamic Azad University, Iran

10:40–11:00 CLIMATE CHANGE IMPACTS ON SOUTH PUGET LOWLAND PRAIRIES

Dominique Bachelet, Conservation Biology Institute, Olympia, WA

11:00–11:20 EXAMINING RELATIONSHIPS BETWEEN TREE GROWTH AND CLIMATE IN THE PACIFIC NORTHWEST: AN ANALYSIS OF CHANGING GROWTH ENVIRONMENTS.

Whitney Albright, University of Washington, Seattle, WA; David L. Peterson, U.S. Forest Service, Seattle, WA

11:20–11:40 CLIMATE DOES NOT ALWAYS DETERMINE ELEVATIONAL RANGE LIMITS IN CONIFERS AT MOUNT RAINIER NATIONAL PARK.

Ailene Kane Ettinger, Kevin Ford, and Janneke HilleRisLambers, University of Washington, Seattle, WA

11:40–12:00 ASSESSING CLIMATE CHANGE VULNERABILITIES ON THE OLYMPIC PENINSULA.

Jessica E. Halofsky, David L. Peterson, U.S. Forest Service, Seattle, WA

12:00–12:20 ADAPTING NATURAL RESOURCE MANAGEMENT TO CLIMATE CHANGE ON THE OLYMPIC PENINSULA.

David L. Peterson, Jessica E. Halofsky, U.S. Forest Service, Seattle, WA

Session Schedule

Thursday, 25 March 2010 (cont.)

Technical Session: Management of Pacific Northwest Forests

Time: 10 :20–12:20

Room: Science Center 107

Moderator: Lana D'Souza

10:20–10:40 RESPONSE OF UNDERSTORY VEGETATION TO VARIABLE-DENSITY THINNING ON THE OLYMPIC PENINSULA.

Leslie Chandler Brodie, U.S. Forest Service, Olympia, WA

10:40–11:00 BACKCOUNTRY CAMPSITES AT WAPTUS LAKE, ALPINE LAKES WILDERNESS, WASHINGTON: CHANGES IN SPATIAL DISTRIBUTION, IMPACTED AREAS, AND USE OVER TIME. Darcy Batura, Karl Lillquist, Central Washington University, Ellensburg, WA.

11:00–11:20 DRY FOREST RESTORATION, CARBON POOLS, AND BIOMASS IN EASTERN WASHINGTON: TRENDS AND OPPORTUNITIES UNDER CURRENT MANAGEMENT. Joshua S. Halofsky, , Washington State Department of Natural Resources, Olympia, WA; Miles Hemstrom, Portland Forestry Sciences Lab, Portland, OR; Eric Watrud, Washington State Department of Natural Resources, Ellensburg, WA; M. Reese Lolley, The Nature Conservancy, Yakima, WA.

11:20–11:40 RIPARIAN PLANT COMMUNITIES ON SMALL MOUNTAIN STREAMS IN MANAGED FORESTS. Lana D'Souza, Laura Six, Bob Bilby, Weyerhaeuser, Federal Way, WA 98001; Jonathan D. Bakker, University of Washington, Seattle, WA,

11:40-12:00 A MULTIVARIATE ANALYSIS EXAMINING THE EFFECT OF LANDFORM ON THE DISTRIBUTION OF RIPARIAN PLANT COMMUNITIES IN THE CASCADE MOUNTAINS OF WESTERN WASHINGTON, USA. Lauren A. Villarin (was Mollot), University of Washington, Seattle, WA; Robert E. Bilby, Weyerhaeuser Co. Federal Way, WA ; David E. Chapin, Seattle Public Utilities, North Bend, WA .

12:00-12:20 PONDEROSA PINE IN WESTERN WASHINGTON. Jeffrey R. Foster, Joint Base Lewis-McChord, WA.

Session Schedule

Thursday, 25 March 2010 (cont.)

Symposium: Floristic Quality Assessment–Opportunities for Application in the Pacific Northwest

Time: 1:30–4:10

Room: Science Center 121

Moderators: Joe Rocchio, Peter Dunwiddie, and Gerould Wilhelm

The Floristic Quality Assessment (FQA) method, originally developed for the Chicago region by Dr. Gerould Wilhelm, has been widely adopted in ecological monitoring and assessment programs nationwide. The FQA is used to assess the degree of naturalness of an area based on the presence of conservative plant species. Conservative plants are those that evolved with, and thus are adapted to, a specific set of biotic and abiotic processes. Contemporary anthropogenic impacts to natural processes have occurred over a spatial and temporal scale that conservative plants are unable to adapt to. In contrast, species with low conservatism are tolerant of a broad range of ecological conditions, including those associated with human impacts. As such, the FQA assumes that if underlying ecological processes and biotic interactions are intact, then a site will have a high proportion of conservative species. The FQA provides a unique approach to ecological monitoring and assessment that moves beyond common measures of species richness and abundance and provides an estimate of the quality of native plants at a site. In this workshop, Dr. Gerould Wilhelm will join us to provide an introduction to the FQA. Applications of the FQA will also be discussed. Thereafter, we will have an open discussion for attendees to explore how the FQA could be applied in the Pacific Northwest for various monitoring and assessment objectives. Further, we will discuss strategies for developing the FQA in the Pacific Northwest region, and focus on developing a pilot FQA for the prairie-oak ecosystem in the Willamette Valley/Puget Trough/Georgia Basin ecoregion.

- 1:30–2:10 **INTRODUCTION TO THE FLORISTIC QUALITY ASSESSMENT: CONCEPT, ORIGIN, AND UTILITY.**
Gerould Wilhelm, Conservation Design Forum, Elmhurst, IL.
- 2:10–2:50 **APPLICATIONS OF THE FLORISTIC QUALITY ASSESSMENT METHOD: LEARNING FROM EXAMPLES FROM THE MIDWEST AND ROCKY MOUNTAIN STATES.** Gerould Wilhelm, Conservation Design Forum, Elmhurst, IL; Denny Albert, Oregon State University, Corvallis, OR; Joe Rocchio, Washington Natural Heritage Program, Olympia, WA
- 2:50–4:10 **OPEN DISCUSSION ABOUT STRATEGIES FOR DEVELOPING THE FLORISTIC QUALITY ASSESSMENT IN THE PACIFIC NORTHWEST, INCLUDING A PILOT EFFORT FOR CASACADIA PRAIRIE-OAK ECOSYSTEMS.** All attendees are encouraged to participate in this discussion.

The remainder of this workshop will be spent discussing how the Floristic Quality Assessment could be applied in the Pacific Northwest for various monitoring and assessment objectives. Further, we will discuss strategies for developing the FQA in the Pacific Northwest region, and focus on developing a pilot FQA for the prairie-oak ecosystem in the Willamette Valley/Puget Trough/Georgia Basin ecoregion.

Session Schedule

Thursday, 25 March 2010 (cont.)

Technical Session: Garry Oak Ecology and Restoration

Time: 1:30–4:10

Room: Science Center 111

Moderator: Ann Kreager

- 1:30–1:50 **GARRY OAK STAND HISTORY IN SOUTHERN COASTAL BRITISH COLUMBIA.**
Shyanne J Smith, Quercus Consulting, Sooke, BC, Canada
- 1:50–2:10 **OAK WOODLAND MONITORING AT JOINT BASE LEWIS-MCCHORD, WASHINGTON.** Jeffrey R. Foster, US Army, Joint Base Lewis-McChord, WA
- 2:10–2:30 **OREGON WHITE OAK WOODLAND STAND STRUCTURES IN SOUTHWESTERN OREGON: INSIGHTS INTO RECRUITMENT TRENDS AND IMPLICATIONS FOR RESTORATION AND MANAGEMENT.** Laurie A. Gilligan, Patricia S. Muir, Oregon State University, Corvallis, OR.
- 2:30–2:50 **EFFECTS OF COMPETITION ON SEASONAL PATTERNS OF DIAMETER GROWTH IN OREGON WHITE OAK.** Peter Gould, Constance Harrington, and Warren Devine. U.S. Forest Service, Olympia, WA.
- 2:50–3:10 **OAKS BELOWGROUND: INTERACTIONS AMONG MYCORRHIZAS, TRUFFLES, AND SMALL MAMMALS.** Jonathan L. Frank, David S. Taylor, Darlene Southworth, Southern Oregon University, Ashland, OR
- 3:10–3:30 **PLANTING OREGON WHITE OAK IN THE PACIFIC NORTHWEST.**
Warren D. Devine, Constance A. Harrington, USDA Forest Service, Olympia, WA.
- 3:30–3:50 **TECHNIQUES TO PROMOTE GARRY OAK SEEDLING SURVIVAL IN AREAS WITH HIGH LEVELS OF HERBIVORY AND COMPETITION.** David R. Clements, Seth Luginbill, Trinity Western University, Langley, BC, Canada; Randy Van Calvin College, Grand Rapids, MI; Robert Pelant, Pacific Rim Institute of Environmental Stewardship, Coupeville, WA.
- 3:50–4:10 **ECOLOGY AND MANAGEMENT OF PRAIRIE-OAK COMMUNITY ON AMERICA'S NORTHWEST TRIBAL LANDS.** Melody A. Steele, Bureau of Indian Affairs, Portland, OR.

Session Schedule

Thursday, 25 March 2010 (cont.)

Technical Session: Lichenology

Time: 1:30–4:10

Room: Science Center 107

Moderator: Katherine Glew

- 1:30–1:50 **TRACKING RARE NONVASCULAR PLANTS IN OREGON: 30 YEARS OF CHANGE.** John A. Christy, Oregon Natural Heritage Information Center, Oregon State University, Portland, OR.
- 1:50–2:10 **LICHEN ECOLOGY AND DIVERSITY OF A SAGEBRUSH STEPPE IN OREGON: 1977 TO THE PRESENT.** Jesse Miller, Eugene, OR; Jeanne Ponzetti, Olympia, WA; Roger Rosentreter, U.S. Bureau of Land Management, Boise, ID.
- 2:10–2:30 **A NEW SPECIES OF PARMELINA (PARMELIACEAE) FROM THE NORTHERN HEMISPHERE.** Peter Nelson and Ryan Kepler, Oregon State University, Corvallis, OR; James Walton, National Park Service, Fairbanks, AK.
- 2:30–2:50 **CLARIFICATION OF THE LICHEN *UMBILICARIA ANGULATA* AND ITS RELATIVES.** Bruce McCune, Oregon State University, Corvallis OR.
- 2:50–3:10 **ASSESSING THE EFFICACY OF BUFFER STRIPS IN SUSTAINING BRYOPHYTE DIVERSITY IN BC INTERIOR FORESTS.** Christine Petersen, Dr. Lyn Baldwin, Dr. John Karakatsoulis, Thompson Rivers University, Kamloops BC, Canada; Scott Black, Dr. Gary E. Bradfield, University of British Columbia, Vancouver, BC, Canada.
- 3:10–3:30 **LICHEN HABITAT MAY BE ENHANCED BY THINNING TREATMENTS IN YOUNG *TSUGA HETEROPHYLLA*-*PSEUDOTSUGA MENZIESII* FORESTS.** Heather T. Root; Bruce McCune, Oregon State University Corvallis, OR; Peter Neitlich, National Park Service, Winthrop, WA.
- 3:30–3:50 **INFLUENCE OF *BROMUS TECTORUM* LITTER ON THE PHOTOSYNTHETIC CAPACITY OF A MOSS DOMINATED BIOLOGICAL SOIL CRUST.** Tyler Osgood, Marcelo Serpe, Boise State University, Boise, ID; Roger Rosentreter, Bureau of Land Management, Boise, ID.
- 3:50–4:10 **EPIPHYTIC CRYPTOGRAM ECOLOGICAL CHARACTERISTICS IN EUROPEAN HEMIBOREAL FORESTS, LATVIA.** Anna Mežaka, Guntis Brūmelis, Alfons Piterāns, University of Latvia, Latvia.

Session Schedule

Thursday, 25 March 2010 (cont)

Banquet

Time: 6:30-9:30

Room: The Aerie Ballroom, Centralia

Moderator: Patrick Pringle

7:30-8:30 THE WORLD'S GREATEST MIDLIFE CRISIS IN ANTARCTICA: THE PERMIAN-TRIASSIC EXTINCTIONS. Gregory Retallack, University of Oregon

The Permian-Triassic mass extinction is the largest known discontinuity in the history of life. New studies of superbly exposed sequences in Antarctica now demonstrate two separate but geologically abrupt mass extinctions on land. One mass extinction during the Middle Permian (260 Ma) extinguished as many species as the one that destroyed the dinosaurs at 65 Ma, and was followed by an even a bigger mass extinction during the Late Permian (253 Ma). Both Middle and Late Permian extinctions have long been apparent among marine invertebrates, and were also times of warm-wet greenhouse climatic transients, marked soil erosion, switch from high to low sinuosity and braided streams, soil stagnation in wetlands, and profound negative carbon isotope anomalies. Both mass extinctions may have resulted from catastrophic methane outbursts to the atmosphere from coal intruded by feeder dikes to flood basalts, such as the Middle Permian Emeishan Basalt and Late Permian Siberian Traps. These fatal greenhouse crises of the past are worst-case scenarios for greenhouse crises of the future.

Gregory Retallack is a Professor of Geological Sciences at the University of Oregon, where he has taught since 1981. His undergraduate studies at Macquarie University were followed by a PhD awarded from the University of New England, also in Australia, in 1978, and then postdoctoral studies at Indiana University from 1978 to 1981. His early career as a paleobotanist was derailed by discovery that fossil soils could reveal much about past vegetation. Most of his research has been devoted to development of the new field of paleopedology, including two textbooks "Soils of the past (1990, 2001)" and "A colour guide to paleosols (1997)". His research is dedicated to the proposition that soils have a fossil record, like other living things. Past studies have considered the role of soils in ape and human evolution in Kenya, grassland evolution in North America, dinosaur extinction in Montana, angiosperm evolution in Kansas and the Late Permian extinction in Antarctica. Current and future studies concern Devonian evolution of trees, Cambrian explosion on land, Precambrian atmospheres, and origin of life, with fieldwork in Pennsylvania, New York, Newfoundland, and Australia.

Session Schedule

Friday, 26 March 2010

Technical Session: Prairies and Oak Woodlands–History and Inventory

Time: 8:00–10:00

Room: Science Center 111

Moderator: Shyanne Smith

- 8:00–8:20 **PEOPLE, PLANTS AND PRAIRIES: RECONSTRUCTING THE LONG-TERM HISTORY OF UPPER CHEHALIS BASIN PRAIRIE LANDSCAPES.** Linda E. Storm, University of Washington, Seattle, WA
- 8:20–8:40 **FIRE HISTORY OF A DOUGLAS-FIR—OREGON WHITE OAK WOODLAND, WALDRON ISLAND, WASHINGTON.** Carson B. Sprenger, Rain Shadow Consulting, Shaw Island, WA 98286; Peter W. Dunwiddie, University of Washington, Seattle, WA.
- 8:40–9:00 **DID NATIVE AMERICANS BURN THE WILLAMETTE VALLEY? INSIGHT FROM THE PALEOECOLOGICAL RECORD INTO CLIMATIC AND ANTHROPOGENIC INFLUENCES ON FIRE ACTIVITY OVER THE PAST 1200 YEARS.** Megan K. Walsh, University of Oregon, Eugene, OR; Cathy Whitlock, Montana State University, Bozeman, MT; Patrick J. Bartlein, University of Oregon, Eugene, OR.
- 9:00–9:20 **HISTORICAL VEGETATION OF THE WILLAMETTE VALLEY, OREGON.** Edward R. Alverson, The Nature Conservancy, Eugene OR 97402; John A. Christy, Oregon Natural Heritage Information Center, Oregon State University, Portland, OR.
- 9:20–9:40 **MONITORING NATIVE GRASSLAND HABITAT QUALITY IN THE SOUTHERN PUGET LOWLAND.** Jeffrey R. Foster, US Army, Joint Base Lewis-McChord, WA; Gail S. Olson, Washington Department of Fish and Wildlife, Olympia, WA.
- 9:40–10:00 **WET PRAIRIE SWALES OF THE SOUTH PUGET LOWLAND, WASHINGTON.** Richard Easterly, Debra Salstrom, SEE Botanical Consulting, Bellingham, WA ; Chris Chappell, Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA.

Session Schedule

Friday, 26 March 2010 (cont)

Technical Session: Prairies and Oak Woodlands–Protection and Restoration

Time: 8:00–10:20

Room: Science Center 121

Moderator: Ted Thomas

- 8:00–8:20 **CONSERVATION OF SOUTH PUGET LOWLAND PRAIRIES—STATUS AND PROGRESS: 1995 TO 2010.**
Patrick Dunn, The Nature Conservancy, Olympia, WA.
- 8:20–8:40 **A PRAIRIE RESERVE DESIGN MODEL FOR PUGET TROUGH LOWLAND PRAIRIES; PRELIMINARY RESULTS TO PRIORITIZE PRAIRIE PATCHES.**
Theodore Thomas and Jodi Bush, U. S. Fish and Wildlife Service, Lacey, WA.
- 8:40–9:00 **CREATING A MARKET FOR PRAIRIE HABITAT IN THE WILLAMETTE BASIN.**
Bobby Cochran, Willamette Partnership, Hillsboro, OR 97123; Paul Adamus, Oregon State University and Adamus Resource Assessment.
- 9:00–9:20 **THE EFFECTS OF FIRE, HERBICIDE, AND INVASIVE SPECIES LEGACY IN A PACIFIC NORTHWEST PRAIRIE.** E. Rook, R. Seyferth, J. Kirsch, C. LeRoy, D.G. Fischer, The Evergreen State College, Olympia, WA.
- 9:20–9:40 **GOLDEN PAINTBRUSH (CASTILLEJA LEVISECTA) RECOVERY EFFORTS AT THE NAAS NATURAL AREA PRESERVE ON WHIDBEY ISLAND, WASHINGTON.** Cheryl B. Lowe; Mark Sheehan, Whidbey Camano Land Trust, Greenbank, WA.
- 9:40–10:00 **OVERVIEW OF RESTORATION ACTIVITIES UNDERWAY AT ROCKY POINT, BC.**
James Miskelly, Tracy Cornforth, Formation Safety and Environment, CFB Esquimalt, Victoria, BC, Canada
- 10:00–10:20 **APPLYING ECOLOGICAL PRINCIPLES TO ACHIEVE A SELF-SUSTAINING WET PRAIRIE RESTORATION.** Eric Wold, Trevor Taylor, City of Eugene, Eugene, OR; Jean Jancaitis, The Nature Conservancy, Eugene, OR.

Session Schedule

Friday, 26 March 2010 (cont)

Technical Session: Geology and Paleontology

Time: 8:00–10:20

Room: Science Center 107

Moderator: Michael Wilson

- 8:00–8:20 **LATE PLEISTOCENE MEGAFUNA AND THE HISTORY OF EARLY POSTGLACIAL VEGETATION ON THE SAN JUAN ISLANDS, WASHINGTON, AND VANCOUVER ISLAND, BRITISH COLUMBIA.** Michael C. Wilson, Douglas College, New Westminster, BC, Canada.
- 8:20–8:40 **SPATIOTEMPORAL PATTERN AND PROCESS IN ISOTOPIC RECORDS COLLECTED FROM ALASKAN RIVER WOLVES 50,000 YEARS AGO TO PRESENT.** Kena Fox-Dobbs, University of Puget Sound, Tacoma, WA; Justin Yeakel, University of California Santa Cruz, Santa Cruz, CA.
- 8:40–9:00 **SOME RECENT DISCOVERIES PERTAINING TO SUBFOSSIL FORESTS IN THE PACIFIC NORTHWEST—EXAMPLES FROM LAKE CRESCENT AND LOWER DRY BED LAKES, OLYMPIC MOUNTAINS, WASHINGTON.** Patrick Pringle, Centralia College, Centralia WA, Karl Wegmann, North Carolina State University; Raleigh, NC; Dan Pontbriand, National Park Service, Houghton, MI, William Westlake Walker, Burien, WA
- 9:00–9:20 **NEW BASAL CAMBRIAN LICHENS FROM MONTANA.** Gregory J. Retallack, University of Oregon, Eugene, OR.
- 9:20–9:40 **MASS WASTING IN THE YAKIMA RIVER CANYON, WASHINGTON.** Tom Winter, Karl Lillquist, Central Washington University Ellensburg WA.
- 9:40–10:00 **INTERDECADAL PATTERNS OF TOTAL SEDIMENT YIELD FROM A MONTANE CATCHMENT, SOUTHERN COAST MOUNTAINS, BRITISH COLUMBIA, CANADA.** Erik Schiefer, Northern Arizona University, Flagstaff, AZ; Brian Menounos, University of Northern British Columbia, Prince George, BC, Canada; Channa Pelpola, Stantec Consulting Ltd., Burnaby, BC Canada; Marwan Hassan, Olav Slaymaker, University of British Columbia, Vancouver, BC, Canada.
- 10:00–10:20 **CLOSED-BASIN WETLAND POND FLUCTUATIONS AND THEIR CAUSES OVER TIME, WATERVILLE PLATEAU, WASHINGTON.** Karl Lillquist, Anthony Gabriel, Ben Sainsbury, Thomas Winter, Central Washington University, Ellensburg, WA.

Session Schedule

Friday, 26 March 2010 (cont)

Workshop: *Usnea*

Time: 8:00–12:20 (break 10:20–10:40)

Room: Science Center 307

Leaders: Bruce McCune, Peter Nelson.

Assisting: Daphne Stone.

The lichen workshop will focus on the genus *Usnea*. Participants should bring a few selected *Usnea* specimens. We will discuss and share taxonomic knowledge. Please limit your collections. Please also bring a copy of McCune & Geiser (2009) and/or other sources. Chemicals and some tools will be provided. If you have your own tools, bring them to the workshop. Dissecting microscopes and a few compound microscopes will be available for us to use.

As an added feature, Bruce and Peter will introduce the **Usnoku Game**. This will be an introduction to the genus and help us focus on the morphology and chemistry. The lichen foray to the Mima Mounds on Saturday and fall foray will be discussed at the Lichen Workshop.

Technical Session: Prairie and Oak Woodland Wildlife - Vertebrates

Time: 10:40–12:20

Room: Science Center 111

Moderator: Cat Brown

10:40–11:00 **BIRD CONSERVATION IN OAK-PRAIRIE HABITATS: TOOLS AND STRATEGIES FOR BRINGING BACK DECLINING AND EXTIRPATED POPULATIONS.** Bob Altman, American Bird Conservancy, Corvallis, OR.

11:00–11:20 **REINTRODUCTION OF WESTERN BLUEBIRD TO THE SAN JUAN ISLANDS.** Gary Slater, Ecostudies Institute, Mount Vernon, WA; Bob Altman, American Bird Conservancy, Corvallis, OR.

11:20–11:40 **THE EFFECTS OF PREDATION, EGG VIABILITY, AND NEST SITE HABITAT ON STREAKED HORNED LARK REPRODUCTIVE SUCCESS AT FORT LEWIS, WASHINGTON.** Jeff K. Anderson, Seattle, WA; Scott F. Pearson, Washington Department of Fish and Wildlife, Olympia, WA.

11:40–12:00 **STREAKED HORNED LARK COLUMBIA RIVER ISLAND HABITAT ANALYSIS AND RESTORATION TRIAL.** Hannah Anderson, Sarah Hamman, The Nature Conservancy, Olympia, WA; Scott F. Pearson, Washington Department of Fish and Wildlife, Olympia, WA; Matt Stevenson, Core GIS, Seattle, WA.

12:00–12:20 **INVASIVE SQUIRREL CONTROL; A TRIAL ON FORT LEWIS, WASHINGTON.** Sanders Freed, Cheryl Fimbel, The Nature Conservancy of Washington, Olympia, WA.

Session Schedule

Friday, 26 March 2010 (cont)

Technical Session: Prairie and Oak Woodlands–Native Plant Production

Time: 10:40–12:20

Room: Science Center 121

Moderator: Jean Jancaitis

- 10:40–11:00 **SOUTH PUGET LOWLAND PRAIRIES NATIVE PLANT PRODUCTION; LESSONS LEARNED AND FUTURE CHALLENGES.** Grace Diehl and Anita Goodrich, The Nature Conservancy of Washington, Olympia, WA.
- 11:00–11:20 **PLANT PROPAGATION FOR GARRY OAK ECOSYSTEMS RESTORATION IN BRITISH COLUMBIA.** Fred Hook, City of Victoria, Victoria, BC, Canada
- 11:20–11:40 **PROPAGATING SENSITIVE HERBACEOUS NATIVE SPECIES FOR REINTRODUCTION IN URBAN NATURAL AREAS.** Marsha Holt-Kingsley, Metro Native Plant Center, Metro Regional Government, Portland, OR.
- 11:40–12:00 **DORMANCY AND GERMINATION IN PACIFIC NORTHWEST PRAIRIE PLANTS.** Michael Russell, Oregon State University, Corvallis, OR.
- 12:00–12:20 **GERMINATION STUDIES TO EXAMINE THE SEED ECOLOGY OF *LUPINUS LEPIDUS* VAR. *LEPIDUS*, *LUPINUS POLYPHYLLUS* AND *LUPINUS ALBICAULIS* (FABACEAE).**
Carl Elliott and Dylan Fischer, The Evergreen State College, Olympia, WA.

Technical Session: Pacific Northwest Ecology

Time: 10:40–12:20

Room: Science Center 107

Moderator: Jesse Ford

- 10:40–11:00 **URBANIZING FLORA OF PORTLAND, OREGON, 1806–2008.** John A. Christy, Oregon Natural Heritage Information Center, Oregon State University, Portland, OR; Angela Kimpo, Portland Water Bureau, Portland, OR.
- 11:00–11:20 **COYOTE (*CANIS LATRANS*) ABUNDANCE ACROSS AN URBAN-WILDLAND GRADIENT IN NORTHEASTERN WASHINGTON.** Candace D. Bennett, Margaret A. O'Connell; Eastern Washington University, Cheney, WA 99004.
- 11:20–11:40 **CONVERGENCE AND DIVERGENCE OF NUTRIENT STOICHIOMETRY IN DECOMPOSING FOREST DETRITUS.** Peter Homann, Western Washington University, Bellingham, WA.
- 11:40–12:00 **EVIDENCE FOR HISTORICAL ANADROMY IN THE DAM-OBSTRUCTED LAKE CHELAN (WA) WATERSHED.** J. Ford, Oregon State University, Corvallis, OR; B. Finney, Idaho State University, Pocatello, ID; H. Kling, Algal Taxonomy and Ecology, Inc., Winnipeg, Manitoba, Canada; G. Clarke, University College, London, UK; R. Heinith, Columbia River Intertribal Fish Commission, Portland, OR.

Session Schedule

Friday, 26 March 2010 (cont)

Technical Session: Prairie and Oak Woodland Wildlife - Invertebrates

Time: 1:30–3:50

Room: Science Center 111

Moderator: Lisa Lantz

- 1:30–1:50 **CONSERVATION OF PRAIRIE-OAK BUTTERFLIES IN OREGON, WASHINGTON AND BRITISH COLUMBIA.** Cheryl Schultz, Alexa Carleton, Erica Henry, Tyler Hicks and Rhiannon Thomas, Washington State University Vancouver, Vancouver, WA.
- 1:50–2:10 **EGG DROP SOUP: OVIPOSITION SELECTION OF THE MARDON SKIPPER (*POLITES MARDON*) IN PUGET LOWLAND PRAIRIES.** Erica Henry, Cheryl Schultz, Washington State University Vancouver, Vancouver, WA.
- 2:10–2:30 **MEASURING SUCCESS OF A BUTTERFLY REINTRODUCTION: A CASE STUDY OF *EUPHYDRYAS EDITHA TAYLORI*.** Mary Linders and Gail Olson, Washington Department of Fish and Wildlife, Olympia, WA.
- 2:30–2:50 **POLLINATORS ON NATIVE AND DEGRADED PUGET LOWLAND PRAIRIES IN WESTERN WASHINGTON,** Cheryl Fimbel, The Nature Conservancy, Olympia, WA; Laurence Packer, York University, Toronto, Ontario, Canada.
- 2:50–3:10 **TO BEE OR NOT TO BEE: HOW EMERGENCE TIME AND POLLEN LIMITATION AFFECT THE REPRODUCTIVE MODE OF AN EARLY-FLOWERING BUTTERCUP.** Hazel Cameron-Inglis, Anita Percell, Lyn Baldwin, Thompson Rivers University, Kamloops, BC.
- 3:10–3:30 **BUTTERFLY HABITAT ENHANCEMENT IN PUGET LOWLAND PRAIRIES OF WESTERN WASHINGTON.** Cheryl Fimbel, Hannah Anderson, Grace Diehl, Sarah Hamman, The Nature Conservancy, Olympia, WA; Birdie Davenport, Washington Department of Natural Resources, Castle Rock, Washington; Rod Gilbert, Jeff Foster, Fort Lewis, WA; Dave Hays, Ann Potter, Washington Department of Fish and Wildlife; Mary Linders, Washington Department of Fish and Wildlife, Olympia, WA and Fort Lewis Fish and Wildlife, Fort Lewis, Washington 98433; David Wilderman, Washington Department of Natural Resources, PO Box 47014, Olympia, WA.
- 3:30–3:50 **ENHANCING TAYLOR'S CHECKERSPOT HABITAT IN A GRASSLAND BALD SYSTEM OF WASHINGTON'S SOUTHERN PUGET TROUGH.** David Wilderman, Deborah Nemens, Washington Department of Natural Resources, Olympia, WA; Roberta Davenport, Washington Department of Natural Resources, Castle Rock, WA.

Session Schedule

Friday, 26 March 2010 (cont)

Technical Session: Prairie and Oak Woodland Restoration–Invasive Species Control and Prescribed Fire

Time: 1:30–3:50

Room: Science Center 121

Moderator: Sarah Hamman

- 1:30–1:50 **PATTERNS IN NATIVE AND INTRODUCED PLANT SPECIES IN GARRY OAK MEADOWS: IMPLICATIONS FOR FUTURE TRENDS AND EFFECTIVE MANAGEMENT.** Joseph R. Bennett, Peter Arcese, University of British Columbia, Vancouver BC Canada; Peter Dunwiddie, University of Washington, Seattle, WA
- 1:50–2:10 **INVASIVE PLANTS OF SOUTH PUGET LOWLAND PRAIRIES: SUCCESS STORIES, CONTROL EFFORTS AND FUTURE CHALLENGES.** Casey Dennehy, The Nature Conservancy, Olympia, WA.
- 2:10–2:30 **CARBON AMENDMENT AS A RESTORATION TOOL.** Rachel M. Mitchell, Jonathan D. Bakker, University of Washington, Seattle, WA.
- 2:30–2:50 **SUCROSE ADDITION IN PUGET PRAIRIE RESTORATION: THREE YEARS OF SOIL AND COVER RESPONSES.** H. Elizabeth Kirkpatrick, Kaitlin Luben, Alexander Titus, University of Puget Sound, Tacoma, WA.
- 2:50–3:10 **FIRE IN PACIFIC NORTHWEST PRAIRIES AND OAK WOODLANDS: A REVIEW.** Sarah Hamman, The Nature Conservancy, Olympia, WA; Peter Dunwiddie, University of Washington, Seattle, WA.
- 3:10–3:30 **DEVELOPMENT AND CURRENT STATUS OF THE SOUTH PUGET SOUND COOPERATIVE ECOLOGICAL BURN PROGRAM.** Mason McKinley, The Nature Conservancy, Olympia, WA.
- 3:30–3:50 **COMPARISON OF BURNING AND MOWING TREATMENTS IN A WILLAMETTE VALLEY WET PRAIRIE, OREGON, 2001–2007.** Jason Nuckols, Ed Alverson The Nature Conservancy; Nathan Rudd, The Nature Conservancy, Portland, OR.

Session Schedule

Friday, 26 March 2010 (cont)

Symposium: Biological, Landscape, and Disturbance Legacies of Railroad Logging

Time: 1:30–4:30

Room: Science Center 107

Moderator: Erik Piikkila

Centralia Washington is in the shadow of two cataclysmic events. One is still visible and seared into the collective consciousness of the Pacific Northwest, while the other is hidden and forgotten but dominated many landscapes, this region and other North American locations for almost 100 years. Both events were described as “moonscapes”. One event was geological while the other was terrestrial. The geologic event was a complex series of natural disturbances while the terrestrial event may be as complex with a primary and often a secondary anthropogenic disturbance followed by one or more natural disturbances. The geologic event covered 150,000 acres while the terrestrial event covered millions of acres. The geologic event has been called a large infrequent disturbance while the terrestrial event could be similarly categorized. Severity, a key disturbance measure, can be determined by quantifying remnant biological legacies. The geologic event left vast amounts of biological legacies such as blown over trees, intact snags, logs, and green trees while the terrestrial event left large springboard stumps, logs, snags and green trees. The geologic event has 30 spectacular years of post disturbance recovery acting as an unprecedented natural laboratory while the terrestrial event has 50 to 130 years of untapped post-disturbance recovery. The 1980 eruption of Mount St. Helens and railroad logging each contain many ecological messages and threads of continuity that need to be discovered, measured, and compared. Learning from railroad logging’s past will provide long term data and assist in creating a forestry for the 21st century.

Session Schedule

Friday, 26 March 2010 (cont)

Symposium: Biological, Landscape, and Disturbance Legacies of Railroad Logging (cont)

Time: 1:30–4:30

Room: Science Center 107

Moderator: Erik Piikkila

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| 1:30–1:50 | INTRODUCTION |
| 1:50–2:10 | RIPARIAN FOREST STRUCTURE AND SUCCESSION IN SECOND-GROWTH STANDS OF WASHINGTON. Lauren A. Villarin, University of Washington, Seattle, WA. |
| 2:10–2:30 | LOGGING RAILROADS TO TRUCK ROADS: THE CHANGING FACE OF TIMBER HARVEST ON WEYERHAEUSER'S VAIL-MCDONALD TREE FARMS 1928–2000. Frank W. Telewski and Scott Barrett, Michigan State University, East Lansing, MI. |
| 2:30–2:50 | LOGGING RAILROADS OF WEYERHAEUSER'S VAIL-MCDONALD OPERATION. Scott Barrett, Tenino, WA. |
| 2:50–3:10 | IS THE PAST PRESENT? HISTORICAL SPLASH DAM STREAM DISTURBANCE DETECTION IN THE OREGON COAST RANGE. Rebecca R. Miller, Oregon State University, Corvallis,; Kelly M. Burnett, USDA Forest Service, Corvallis, Oregon. |
| 3:10–3:30 | OLD-GROWTH LEGACIES: COARSE WOODY DEBRIS IN 21 HEADWATER CATCHMENTS IN THE WILLAPA HILLS, WA. Jack E. Janisch, William J. Ehinger, Washington Department of Ecology, Lacey, WA. |
| 3:30–3:50 | THE 1930s SURVEY OF FOREST RESOURCES IN WASHINGTON AND OREGON. Constance A. Harrington, US Forest Service, Olympia, WA. |
| 3:50–4:10 | A COMPARISON OF STAND STRUCTURE AND DEVELOPMENT OF DOUGLAS-FIR OLD-GROWTH, PLANTATIONS, AND YOUNG NATURAL FORESTS IN WESTERN OREGON. Chris Dowling, USDA Forest Service, Olympia, WA. |
| 4:10–4:30 | SUMMARY |

Field Trips

Regional Strategies for Restoring Invaded Prairies

Time/Date: Wednesday 24 March 2010, 9:00–4:00
Pick Up Location: Centralia College, Parking Area D (9:00).
Alternate: meet at Mima Mounds NAP Parking Lot (9:30).
Leader: Amanda Stanley, amanda 'at' appliedeco.org
Lunch: Box Lunch Included

Can degraded prairies be restored to native dominance? Which methods work best? Upland prairie restoration faces many challenges including invasive species control, limited reproduction from native species, and diverse conditions at different sites. The Nature Conservancy has partnered with the Institute for Applied Ecology to compare a variety of restoration methods such as burning, mowing, herbicide application and seeding. We will lead a field trip to three South Puget Sound sites to show trip participants first-hand the results of this 5-year regional experiment that has field sites in BC, Washington, and Oregon. (For more details of the study see our website www.appliedeco.org/conservation-research/prairie-restoration-research).

Comparing Washington's Willamette and Puget Prairies

Time/Date: Saturday 27 March 2010, 8:30–4:00
Pick Up Location: Centralia College, Parking Area D (8:30).
Leader: Rex Crawford, rex.crawford 'at' dnr.wa.gov
Lunch: Box Lunch Included

Prairies in western Washington are dominated Roemer's fescue (*Festuca idahoensis* var. *roemerii*), red fescue (*Festuca rubra*), or California oatgrass (*Danthonia californica*) with variety of forbs common to lowland grasslands in western Oregon and Washington that sometimes co-dominate or occasionally have greater total cover than the grasses. The Willamette and Puget prairies differ in a group of endemic, usually rare species more confined to northern, glacially-influenced landscapes and another species group with affinities to more southern environments. This field trip will visit remnant sites that display the transition from southern floristically aligned prairies west of Centralia to northern prairies near Olympia.

Field Trips (cont)

Garry Oak Restoration in South Puget Sound

Time/Date: Saturday 27 March 2010, 8:30–4:00
Pick Up Location: Centralia College, Parking Area D (8:30).
Leader: David Wilderman, david.wilderman 'at' dnr.wa.gov
Lunch: Box Lunch Included

Garry oak (*Quercus garryana*) communities historically covered over 40% of the lowland South Puget Sound region and were a significant habitat throughout much of the Puget Trough lowlands. A variety of plant and animal species are dependent on, or associated with, these communities, including a number that are considered rare or endangered at the state or Pacific Northwest regional scale. Only a small fraction of the original oak habitat in western Washington remains today, and much of this is threatened by conifer encroachment and the resulting suppression of oak trees and oak regeneration. This field trip will visit several sites near Olympia where different restoration methods, including mechanized conifer removal, hand removal, and prescribed fire, have recently been applied to help restore oak woodlands.

Garry Oak Restoration in South Puget Sound

Time/Date: Saturday 27 March 2010, 8:30–2:00
Pick Up Location: Centralia College, Parking Area D (8:30).
Leader: Daphne Stone, Jeanne Ponzetti, Katherine Glew
kglew 'at' u.washington.edu
Lunch: Bring your own lunch

The Mima Mounds Natural Area Preserve consists of an open grassland with low, evenly spaced mounds, lying on the outwash plain at the terminus of the Vashon Glacier. The mounds are dominated by grasses, *Cladonia* lichens and mosses, surrounded by coniferous forest. We will be looking at the lichens of the area and explore their distribution patterns and orientation on each mound. We will consider how the geology and soil affects the cryptograms found there. Forest encroachment and invasive weeds appear to be changing the vegetation patterns rapidly. We will address the problem of what effects different management strategies could have on different groups of organisms.

Abstracts

(Oral and poster presentations included,
arranged by last name of presenting author)

EXAMINING RELATIONSHIPS BETWEEN TREE GROWTH AND CLIMATE IN THE PACIFIC NORTHWEST: AN ANALYSIS OF CHANGING GROWTH ENVIRONMENTS. Whitney Albright, School of Forest Resources, University of Washington, Box 352100, Seattle, WA 98195-2100; David L. Peterson, U.S. Forest Service, 400 N. 34th Street, Suite 201, Seattle, WA 98103; *albriw 'at' u.washington.edu*

We are examining the effects of changing climate on the growth environments of Douglas-fir, mountain hemlock, ponderosa pine, and subalpine fir. Previous climate-growth studies are used to determine which climatic factors are most important to growth throughout each species distribution in Washington and Oregon. Based on the significance of these limiting factors, the current growth environment of each species is represented by a general water or energy limitation; these limitations are defined by specific energy balance variables such as potential evapotranspiration, actual evapotranspiration, precipitation, snowpack depth, snow water equivalent, and growing degree days. Energy variable values are obtained from Variable Infiltration Capacity (VIC) macroscale hydrologic model output for a historical time period. Projected values of energy variables are then used to describe the water or energy limitation environment of each species in 2020, 2040, and 2080. To generate projected values, VIC is driven by three different global climate model and emission scenario pairings, resulting in three growth environment possibilities for each projection year. Expected changes between current and future growth environments include an alleviation of limiting factors at high elevations in energy limited environments, and an increase in water stress at lower elevations, specifically in water limited environments. Results will allow scientists and resource managers to anticipate potential changes in species growth throughout the Pacific Northwest and inform decisions regarding management strategies.

BIRD CONSERVATION IN OAK-PRAIRIE HABITATS: TOOLS AND STRATEGIES FOR BRINGING BACK DECLINING AND EXTIRPATED POPULATIONS. Bob Altman, American Bird Conservancy, 311 NE Mistletoe, Corvallis, OR 97330; *baltman 'at' abcbirds.org*

The loss and degradation of prairie-oak habitats in the Pacific Northwest has resulted in significant population effects on many bird species. At least 10 species highly associated with prairie-oak habitats are known to be experiencing population declines, approximately half of those have experienced local or regional extirpations and/or range retractions, and several have reached the point of threatened and endangered status. Limited species-specific habitat management and restoration has been directed at these priority species in some places (e.g., Streaked Honed Lark in Puget Lowlands and Willamette Valley and Oregon Vesper Sparrow on Vancouver Island). In addition to conservation actions for the priority species, management and restoration should emphasize conservation of suites of focal species to provide a more holistic assessment of the entire oak-prairie ecosystem, including benefits to priority species. Significant broad-scale ecosystem habitat restoration efforts over the last 10 years provide promise for future populations of these species. For some priority and focal species, standard restoration activities that expand and enhance the condition of prairie and oak savannah habitats or open up the canopy and understory of oak habitats may immediately provide suitable habitat. However, for the many cavity-nesting species, nest boxes may be necessary to at least maintain their populations until the long-term restoration targeted for the development of large, open-grown oak trees can be achieved. Lastly, reintroductions will likely be necessary for some species.

HISTORICAL VEGETATION OF THE WILLAMETTE VALLEY, OREGON. Edward R. Alverson, The Nature Conservancy, 87200 Rathbone Rd., Eugene OR 97402; John A. Christy, Oregon Natural Heritage Information Center, Oregon State University, 1322 SE Morrison St., Portland, OR 97214-2423; *ealverson 'at' tnc.org*

Ecosystems change over space and time on a variety of scales. By conventional measures of ecosystem change, the Willamette Valley has seen dramatic changes in the 160 years since 1850. Mapping the valley's historical vegetation ca. 1850 has been completed using maps and field notes from the General Land Office (GLO) surveys that established the existing survey grid of townships and sections. This data set constitutes a pre-settlement baseline ecological survey against which subsequent changes can be measured. The historical landscape of the Willamette Valley was a complex mosaic of open habitats (prairies, savannas, and woodlands), conifer-dominated habitats (fir woodlands and forests), and wetlands (riparian stands, marshes, and swamps). Prairie, savanna, and woodland habitats have been most heavily impacted by post settlement land use change, but riparian and wetland habitats also have been significantly reduced in extent. Conifer forests have changed greatly in terms of tree density and tree age class distribution. Knowledge of historical ecosystems is important for habitat restoration as well as understanding the implications of natural resource management practices. Understanding the composition, structure, and spatial scale of historical ecosystems is also important to understanding the species-habitat relationships of native wildlife and vegetation.

STREAKED HORNED LARK COLUMBIA RIVER ISLAND HABITAT ANALYSIS AND RESTORATION TRIAL. Hannah Anderson, Sarah Hamman, The Nature Conservancy, 120 E Union Ave #215, Olympia, WA, 98501; Scott F. Pearson, Washington Department of Fish and Wildlife, 1111 Washington Street SE, Olympia, WA, 98501; Matt Stevenson, Core GIS, 355 NW 47th St., Seattle, WA, 98107; *handerson 'at' tnc.org*

The streaked horned lark uses islands of the lower Columbia River for breeding and over-wintering. The Army Corps of Engineers maintains the depth of the navigation channel by dredging the river bottom. The deposition of dredge on these islands creates and maintains early successional habitats preferred by larks. The timing, location, and amount of deposited material can have dramatic effects on streaked horned larks and their habitat. We analyzed streaked horned lark occupancy and abundance data, existing vegetation, and digitized historic dredge material deposition locations to examine the relationship between these variables. We determined how long it takes newly deposited dredge material to become suitable lark habitat and how long it remains suitable. The results of this spatial analysis can determine the timing and location of deposition that minimizes the negative effects of this activity and potentially maximizes the positive effects by placing dredge material in areas that are covered in dense moss or vegetation, a state which precludes lark use. Because dredge placement is dictated by needs of the shipping lane, we are interested in alternate methods to create lark habitat on these islands that do not rely on the distribution of dredge material. We used the results of the habitat analysis to guide the spatial design of a restoration trial aimed at testing methods to create the preferred early successional habitat. In 2009 we mechanically treated patches of unsuitable habitat. We will share a summary of the habitat analysis and first year post-treatment results of the restoration trial.

ORAL

THE EFFECTS OF PREDATION, EGG VIABILITY, AND NEST SITE HABITAT ON STREAKED HORNED LARK REPRODUCTIVE SUCCESS AT FORT LEWIS, WASHINGTON. Jeff K. Anderson, 6908 30th Avenue South, Seattle, WA, 98108-3768; Scott F. Pearson, 1111 Washington Street Southeast, 5th Floor, Olympia, WA, 98501- 2283; *andjef26 'at' gmail.com*.

The Streaked Horned Lark (*Eremophila alpestris strigata*), is a state endangered species and federal candidate for listing that breeds on the prairies of the Pacific Northwest. We analyzed data collected over a two-year period (2007 and 2009) at Fort Lewis, Washington, to investigate concerns that several factors are negatively impacting reproductive success of Streaked Horned Larks. We examined three different variables, (1) predation, (2) egg viability, and (3) nest site habitat. We then compared the effects of these variables on Streaked Horned Lark productivity with their effects on the productivity of other species that share a similar ecology. Compared with other NW prairie nesting species, Streaked Horned Lark nests appear to be depredated at a higher rate (2007). In addition, Streaked Horned Lark eggs that have undergone full incubation have a much lower likelihood of hatching than the eggs of other prairie nesters (2009). The serious population decline in Streaked Horned Larks merits further study into the causes of their high rates of depredation and poor egg viability.

ORAL

CLIMATE CHANGE IMPACTS ON SOUTH PUGET LOWLAND PRAIRIES. Dominique Bachelet, Conservation Biology Institute, 2505 Vista Ave SE, Olympia WA 98501; *dominique'at'consbio.org*

Prairies and savannas were historically a dominant habitat of interior valleys along the Pacific coast from California to Canada. American Indians maintained the open landscape by burning the prairies, which prevented invasions by trees and maintained a good crop of Camas bulbs. Following Euro-American settlement, urbanization and agriculture have caused extensive habitat loss and degradation. Projected changes in climate may now exacerbate the continuing human pressure on these endangered ecosystems. Most species in the Pacific Northwest are already adapted to abrupt shifts in climate regimes caused by natural variability epitomized by El Nino-Southern Oscillation and Pacific Decadal Oscillation indices. However, warmer springs and associated shifts in stream peak flows, longer and drier summers, more intense rainfall events, may affect species composition and affect the balance between native and invasive species. While some of the impacts might be deleterious for vulnerable endemics, there might also be opportunities created for oak-woodland restoration efforts as climatic conditions for oak growth and development improve. Ecosystem services prairies naturally render to the region may become more valuable (flood mitigation potential, soil carbon sequestration and stabilization, resilience to frequent fires) as population centers expand. The regional development towards renewable sources of energy and new forms of more efficient public transport needs to take into account the true value of a landscape whose resilience and connectivity has already been greatly affected by road networks and pollution from transport emissions.

ORAL

LOGGING RAILROADS OF WEYERHAEUSER'S VAIL-MCDONALD OPERATION. Scott Barrett, Tenino, WA 98589-9745; cwrail@aol.com

Weyerhaeuser's logging railroad hauled logs harvested from a large area of southwest Washington ranging from Morton in Pierce County near Mount Rainier to Pe Ell, southwest of Chehalis. Weyerhaeuser's logging railroads also ran over track operated by the Northern Pacific Railway, which later became the Burlington Northern Railway and the Milwaukee Road and even parts of the Union Pacific Railroad. This presentation will examine the equipment and general practices of the logging railroad in the woods and advent of the sort yard where logs were processed and re-loaded onto rail cars.

POSTER

TEN YEARS OF FORB SEED INCREASE: WHAT WE'VE LEARNED. Amy Bartow, USDA NRCS Corvallis Plant Materials Center, 3415 NE Granger Ave, Corvallis OR, 97330; amy.bartow@at.or.usda.gov

The Plant Materials Center performs all functions related to seed increase: wild seed collection, germination trials, plant production, seed production, and seed cleaning. Over the past ten years, the demand for forb seed has grown considerably, but the technology available for seed production has been focused on grass seed. We turned our grass seed production towards forb seed production by modifying equipment and using passive harvest methods such as weed fabric. Serving the ecoregion of western Oregon and Washington, we have worked with over 100 species with plot sizes as small as a child's wading pool and as large as a half acre. Each year, the Plant Materials Center employs many different techniques for harvesting forb seed depending on the evenness of seed maturity across the field and how easily the seeds shatter.

ORAL

BACKCOUNTRY CAMPSITES AT WAPTUS LAKE, ALPINE LAKES WILDERNESS, WASHINGTON: CHANGES IN SPATIAL DISTRIBUTION, IMPACTED AREAS, AND USE OVER TIME. Darcy Batura, Karl Lillquist, Geography Department, Resource Management Program, 400 E. University Way, Central Washington University, Ellensburg, WA. 98926. baturad@at.cwu.edu

The Wilderness Act recognizes the value of recreation, protecting ecological systems, and opportunities for scientific inquiry. However, the cumulative impact of recreation on wilderness campsites is transforming landscapes to a degree that takes centuries to restore. Our research focused on changes in campsite spatial distribution, impacted areas, and use over time at Waptus Lake in the central region of the Alpine Lakes Wilderness, Washington. Impacts were assessed at 42 campsites located around the eastern and northern margins of the lake. A visitor use analysis identified declining visitation from 1996 to 2008. Despite decreased use, 34% of the campsites had a "severe" rating according to the Bob Marshall Rapid Estimation Procedure. Some campsites showed signs of improvement between 1985 and 2009; however, results also indicated that campsite soils are more susceptible to compaction due to texture and depletion of organic matter. Soils prone to compaction are less responsive to campsite rehabilitation efforts; therefore, it may be more effective to consider policy changes focused on curtailing the spatial distribution of impact. Recreation impacts campsites by decreasing the density and composition of vegetation and organic soil horizons, followed by soil compaction and erosion. This research is significant because absence of consistent campsite impact monitoring programs and reliable visitor estimates have led to irreversible environmental degradation. Waptus Lake and the Alpine Lakes Wilderness are particularly vulnerable to these threats due to proximity to the growing Seattle metropolitan area.

ORAL

COYOTE (*CANIS LATRANS*) ABUNDANCE ACROSS AN URBAN-WILDLAND GRADIENT IN NORTHEASTERN WASHINGTON. Candace D. Bennett, Margaret A. O'Connell; Department of Biology, Eastern Washington University, 258 Science Bldg, Cheney, WA 99004; *chultberg 'at' comcast.net*

Coyote abundance across the United States increased during the past century due in part to 1) the decline of large carnivores (e.g., wolves) and 2) coyotes' ability to adapt to human-modified habitats. However, the recent recolonization of wolves and increasing urbanization in parts of the west might have negative impacts on coyote abundance. To address this issue, we examined coyote abundance on an urban-wildland gradient in northeastern Washington. We used simulated wolf vocalizations to estimate coyote abundance from return vocalizations. Abundance was sampled in five land-use categories: urban center, low-density residential, close protected, unfarmed rural, and distant protected. To date we have analyzed 169 vocalizations with more than 40% of the return vocalization being from the close protected land-use category. In addition we measured eight natural and human-altered landscape characteristics using ArcGIS. Multiple regression revealed that coyote abundance was negatively associated with proximity to urban center and with presence of wolves. This study will provide baseline information on the initial effects recolonizing wolves have on coyote abundance in northeastern Washington.

ORAL

PATTERNS IN NATIVE AND INTRODUCED PLANT SPECIES IN GARRY OAK MEADOWS: IMPLICATIONS FOR FUTURE TRENDS AND EFFECTIVE MANAGEMENT. Joseph R. Bennett, Peter Arcese, Centre for Applied Conservation Research, Faculty of Forestry, University of British Columbia, 2424 Main Mall, Vancouver BC V6T 1Z4; Peter Dunwiddie, School of Forest Resources University of Washington Box 354115, Seattle, WA 98195; *jrb5 'at' interchange.ubc.ca*

Invasive introduced species are a major threat to the Garry Oak Ecosystem (GOE). However, no systematic documentation of patterns of native and introduced species through a broad range of GOE meadows exists, and it is nearly impossible to predict future trends in introduced species. As part of a collaboration to help understand species distributions in GOEs, we summarized synoptic trends in native and introduced species in GOE meadows. We conducted multi-scale surveys on 86 GOE meadows on Vancouver Island and adjacent islands, including many sites not previously surveyed. We found striking differences in the representation of native and introduced species. Contrary to popular conception, native species continue to dominate GOE meadows: While some meadows near Victoria are composed largely of introduced species, most are native-dominated. Small islands are particularly well-protected—Some exhibit >90% relative cover of natives. However, on a per-species basis, introduced long dispersers are more common on both inter-, and intra-site scales than any other species. In <150 years, many have reached the most remote locations, and may continue to expand their populations. Introduced short dispersers are most often rare on both scales. However, as many of these species have become invasive elsewhere, they probably represent an important future threat, and some may attain similar levels of dominance to their native counterparts. We recommend that conservation efforts increase focus on protection and preservation of small, isolated islands, as well as monitoring and removal of species that can currently be managed but will likely become threats in the future.

CONIFER COLONIZATION OF PRIMARY SUCCESSIONAL HABITATS AT MOUNT ST. HELENS. M. Keith Birchfield, John Bishop, Science Program, Washington State University Vancouver, 14204 NE Salmon Creek Avenue, Vancouver, WA, 98686-9600; *mkeithbirch 'at' gmail.com*

In a region dominated by coniferous forests, conifer colonization is an important component to understanding revegetation and succession at Mount St. Helens. This study analyzes the density, size, and composition of conifers as well as the factors influencing their establishment and survival on primary successional habitats created by the 1980 eruption of Mount St. Helens. Surveys were conducted in 2002 and 2007 at permanent plots along transects on the Pumice Plain. For 2002 and 2007, mean conifer densities were 23.5 (SD=68.5) trees ha⁻¹ (n=606) and 23.3 (SD=33.1) trees ha⁻¹ (n=168), respectively; mean heights were 0.35 (SD=0.49) m (n=112) and 0.70 (SD=0.47) m (n=752), respectively; and mean basal diameters were 14 (SD=23) mm (n=111) and 28 (SD=22) mm (n=767), respectively. Species assemblages consisted primarily of *Abies procera* (2002=45% and 2007=52%) and *Pseudotsuga menziesii* (2002=38% and 2007=35%) with a small population of *Tsuga heterophylla* (2002=15% and 2007=11%). Multivariate analysis (non-metric multidimensional scaling) of 2007 conifer abundance with environmental variables revealed a significant positive correlation between conifer abundance and slope ($r=0.16$, $p=0.045$). Spatial analysis of mapped data using a GIS revealed clusters of relatively high conifer density; however, these clusters were not strongly associated with any particular variables in the study. The results from this study will be used in conjunction with a more in depth assessment of conifer colonization being undertaken in 2010.

ORAL

THE SURPRISING EFFECTS OF INSECT CONSUMERS ON PRIMARY SUCCESSION AT MOUNT ST. HELENS. John G. Bishop. Washington State University, Vancouver, WA 98686. *bishopj 'at' vancouver.wsu.edu*

This talk will review evidence for extraordinary impacts of insect consumers on key plant colonists (Lupin, Willow, and Huckleberry) at Mount St. Helens. Three case studies will be examined: 1) On primary successional surfaces created by the 1980 eruption, several guilds of insect herbivores greatly reduce the spread of the principal plant colonist, *Lupinus lepidus*, a keystone species that facilitates soil development, thereby altering succession. 2) Sitka Willow is the first colonist to provide three dimensional physical structure on primary successional sites at Mount St. Helens, thereby altering plant communities and forming habitat for several mammalian and avian trophic guilds. It too has had its rate of biomass increase dramatically decreased by insect consumers, in this case a non-native willow stem-boring weevil and a native clear winged moth. 3) Black huckleberry, though few in number, represents the first animal-dispersed shrub to colonize the Pumice Plain. Its demography in primary succession is much more heavily impacted by consumers and absence of pollinators than in secondary succession. We propose that these examples represent an expected phase of early succession during which the effects of mutualists and consumers on colonizing plants are greatly amplified relative to their effect in more mature systems. The effect may be attributable to the temporary absence of additional species that might buffer the interactions. I propose an alternative view of succession: a dispersal-mediated process by which the distribution of interaction strengths becomes stable.

A PETROLOGIC COMPARISON OF CRETACEOUS AND EOCENE PLUTONS NEAR OMAK, WA. Devin Black, Jeff Tepper, Geology Department, University of Puget Sound, 1500 N. Warner, Tacoma, WA, 98416, *dfblack 'at' pugetsound.edu*

Three plutons located in the Omak Quadrangle (WA) have been studied with the goals of: (1) establishing their chemical and mineralogical characteristics, (2) determining their tectonic affinities, and (3) estimating their emplacement depths using Al-in-hornblende barometry. This work is part of a larger study that seeks to identify differences between Cretaceous and Eocene magmatism in the eastern WA and ID. The three plutons are the main phase of the Conconully Granodiorite (a Cretaceous medium-to-coarse-grained, equigranular granodiorite with accessory biotite, hornblende, magnetite, apatite, sphene, and zircon), the Leader Lake Quartz Monzonite (a Cretaceous fine-to-medium-grained quartz monzonite with accessory biotite, magnetite, apatite, sphene, zircon, and primary muscovite), and the Granodiorite of Omak Lake (an Eocene coarse-grained, porphyritic biotite granodiorite with pink and grey K-feldspar megacrysts). The data will be compared to work previously done and with the work of current students in other areas of north-central Washington and northern Idaho to determine any trends in regional chemical change or local anomalies. Spidergrams indicate that all three plutons have subduction zone affinities. The two Cretaceous plutons have lower Na values than the Eocene pluton and also display higher Ba (2258–1046 ppm vs. 672 ppm), Rb (119.8–93.3 ppm vs. 45.4 ppm), Cs (2.05–1.81 ppm vs. 0.66 ppm), and lower Sr (438–515 ppm vs. 753 ppm), Sc (1.5–3.7 ppm vs. 6.0 ppm), and Zr (41–92 ppm vs. 130 ppm).

A COMPARISON OF EOCENE AND CRETACEOUS PLUTONS, BOUNDARY COUNTY, IDAHO: PETROLOGY AND TECTONIC IMPLICATIONS. Sam Blakely, Jeff Tepper, University of Puget Sound, 1500 N. Warner Tacoma, WA 98416; Andy Buddington, Spokane Community College, 1810 N. Greene St Spokane, WA 99217-5399; *sblakely 'at' ups.edu*

This study focuses on five adjacent plutons in Northern Idaho, one of Eocene age and four of Cretaceous age, with the goals of better understanding: (1) the magmatic and tectonic changes that occurred in this area between the Cretaceous and Eocene, and (2) the origins of concentric zoning in the Eocene pluton. Whole rock chemical analysis, petrography, Al-in-hornblende barometry and U-Pb dating are the main methods of analysis. The Eocene Trapper Peak pluton is situated within an assemblage of Cretaceous granites and gneisses. The pluton is about 0.5 km across, ranges from quartz monzonite to monzonite, and is comprised of two distinct zones: (1) a 20–70 m wide porphyritic chilled margin that is chemically heterogeneous (7–15 wt.% MgO; 53–56 wt.% SiO₂), and (2) a medium grained, homogenous center with chemical traits similar to the average of the porphyritic margin (~54 wt. % SiO₂). The two units of Trapper Peak have similar trace element signatures and whole rock chemistry, indicating that the units form a continuous body with the only differences being textural. The Cretaceous plutons sampled are more felsic (SiO₂ 63–67 wt. %), have higher concentrations of Na and Al, and lower concentrations of Mg, Ca, Ti and Fe. Trace elements vary greatly between the Cretaceous plutons; La/Yb ratios range from 5 to 45.

THE INFLUENCES OF SPATIAL HETEROGENEITY REGULATED BY TERMITES ON COMPETITION AMONG GRASSES. Ashleigh Boyd, University of Puget Sound, 2458 Wheelock Student Center, Tacoma, WA 98416; *aboyn 'at' ups.edu*

Habitat heterogeneity promotes species interactions and biodiversity. In the Laikipia region in Kenya, the savanna ecosystem is composed of one species of acacia tree which dominates cover, and several species of grass which dominate the understory. Spaced regularly within this monocultural system are mounds created by fungus-harvesting termites (*Odontotermes* spp.). This keystone species creates heterogeneity via a range of physical, geochemical, and biological mechanisms. On mounds, *Pennisetum stramineum* composes 80% of the ground cover, whereas off mound it diminishes to <25% cover. Conversely *Pennisetum mezianium* and *Brachiaria lachnantha* dominate the matrix (>50%) but are scarce on mounds (<20%). As water and nitrogen are limited in this ecosystem, I examined the effects of termite mounds on partitioning and recycling of leaf nitrogen in grasses via stable isotope analysis of leaf nitrogen and carbon, as well as examined mound effects on water response in the three grass species. I also examined herbivore graze preference and effects of herbivore exclusion. My results show *P. stramineum* on termite mounds was grazed more often than *P. stramineum* off mounds, whereas *B. lachnantha* was grazed more often off mound than on mound. *P. mezianium* was seldom grazed. In response to water, *P. stramineum* and *B. lachnantha* did not show a difference in timing of flush nor did distance from mound affect flush. Grasses sampled inside herbivore exclosures showed higher $\delta^{15}\text{N}$ values and %C/N in older leaves than grasses exposed to herbivores. *P. stramineum* showed consistently higher %N values regardless of location but when water is available.

KNOTWEED CONTROL IN THE CHEHALIS RIVER BASIN, WASHINGTON; 5 YEARS OF LESSONS LEARNED. April G. Boe and Sarah Hamman, The Nature Conservancy, 120 Union Ave SE, Ste. 215, Olympia, WA 98501; *aboyn 'at' tnc.org*

The Nature Conservancy began controlling *Polygonum cuspidatum*, *P. sachalinense*, and *P. bohemicum* (Japanese, giant and bohemian knotweeds) in the Chehalis River Basin (Washington) in 2004 based on evidence of its likelihood to significantly alter riparian habitats. During the 5 years as the project lead, TNC has employed an adaptive management approach to achieve success and incorporate lessons learned. Treatment methodology has changed based upon evolving science and field observations. For example, based on measures of knotweed regeneration, foliar treatments of aquatic-approved imazapyr have been adopted as the primary control method, while the less effective injection and foliar application of glyphosate has been reduced or eliminated. Observations that soil type and shading influence the efficacy of chemical treatments have informed management. For instance, on gravel bars in full sun, one year of chemical treatment will generally result in 100% control, whereas in shaded sandy-loam or forest soils, regeneration of small, sickly stems will continue for several years with annual treatments. TNC has also evolved in its outreach methodology. We have engaged partners in the educational community to highlight the threat of invasive species to riparian habitats in and out of the classroom. Partnerships are a cornerstone to the long-term success of the project. TNC's ability to adapt to the evolving landscape of invasive species management has allowed for the on-going success of knotweed control in the Chehalis River Basin.

RESPONSE OF UNDERSTORY VEGETATION TO VARIABLE-DENSITY THINNING ON THE OLYMPIC PENINSULA. Leslie Chandler Brodie, U.S. Forest Service, Pacific Northwest Research Station, 3625 93rd Ave. SW, Olympia WA, 98512; *lbrodie 'at' fs.fed.us*

The Olympic Habitat Development Study was designed to test if active management in 35- to 70-year-old conifer stands could accelerate the development of stand structures and plant communities associated with late-successional forests. Variable-density thinning (creation of gaps and retention of unthinned areas within a thinned matrix) initially increased percent cover and number of herbaceous species. Increases were moderate 3 years after thinning, larger after year 7, and were reduced in year 10. Twenty-one introduced species were recorded on thinned plots at low levels of cover (all but one were less than 3%); control plots had six introduced species, all with coverages $\leq 0.1\%$. At one site, an introduced species, *Rubus laciniatus*, was not recorded as present prior to thinning, reached 71% cover in gaps by year 7, but receded to approximately 15% cover in year 10, having been largely replaced by a native species, *Rubus spectabilis*. Subtreatments within the variable-density thinned plots (matrix thin, unthinned or gap) have increased the spatial variability in plant cover relative to the control plots. Shrubs and trees are developing more slowly after thinning than herbaceous species; response of woody species was strongly influenced by pre-treatment conditions but also responded to the variability created by the thinning. The creation of gaps initially resulted in increased plant diversity and cover, especially by species favored by disturbance (both native and non-native species). Cover of most of these species declined over time as light levels in the understory decreased following crown expansion of residual and understory trees.

EMERGENCE AND EARLY SURVIVAL OF BITTER CHERRY (*PRUNUS EMARGINATA*) UNDER VARIED CANOPY COVERAGE, SOUTHERN VANCOUVER ISLAND. Kevin Brown, KR Brown and Associates, 4043 Zinnia Road, Victoria, BC V8Z 4W2; *treenutrition 'at' gmail.com*

On southern Vancouver Island, bitter cherry (*Prunus emarginata*) may be a significant and undesired competitor in conifer plantations. Cherry may also be desirable for use in value-added wood products, but its regenerative characteristics and growth potential are largely unstudied. As part of a broader study on those topics, I examined emergence and survival from planted cherry seeds in relation to canopy coverage (open, partial, closed), substrate (mineral / organic), and protection from herbivores (cage, no cage) on a south-facing site near Jordan River on southern Vancouver Island. A total of 1152 filled seeds were planted in November 2007. Emergence, mortality, seedbed temperatures, and soil moisture contents were measured during the 2008 and 2009 growing seasons. The same seedlot was used in controlled environment studies of germination in response to stratification, photoperiod, and temperature. No seedlings emerged in 2008. In 2009, total emergence was low (2.9%). Emergence began in late March 2009 and was 97% complete by mid-May. In all, 78% of emergents were in the open; the remainder were under partial canopy. Seedlings under the partial canopy emerged later and suffered 100% mortality. Through the 2nd growing season, net emergence was greatest (16%) on caged, mineral soil seedbeds in the open cutblock. Patterns of emergence with respect to timing and to seedbed temperatures were consistent with germination responses to temperature in controlled environments. Low emergence rates are offset somewhat by a persistent bank of seed in soil.

TO BEE OR NOT TO BEE: HOW EMERGENCE TIME AND POLLEN LIMITATION AFFECT THE REPRODUCTIVE MODE OF AN EARLY-FLOWERING BUTTERCUP. Hazel Cameron-Inglis, Anita Percell, Lyn Baldwin, Thompson Rivers University, 900 McGill Road, Kamloops, BC V2C 5N3; *hazel-cameron-inglis@mytru.ca*

A shortage of pollinators and/or pollen in a flowering plant population may impose reproductive challenges for plants with flowers maturing early within the flowering season. This is especially relevant if asynchrony between flower and pollinator emergence occurs. Variation in the rate of self-, or cross-fertilization throughout the season may be one evolutionary strategy non-obligate cross-pollinating (facultative xenogamous) plants use to compensate for pollen limitation in a highly varied pollinator environment. This study examines the change of self and cross-fertilization rates of buttercups (*Ranunculus glaberrimus*) over the course of the flowering period and evaluates the potential impact of pollen limitation during different periods of the same season in Kamloops, British Columbia. The early flowering phenology of the sagebrush buttercup makes this species an excellent candidate to explore the fitness of individual reproductive modes under changing environmental conditions. Pollinator exclusion, emasculation and manual pollination treatments were used to constrain newly emerged buttercups to specific modes of reproduction. Reproductive fitness of each treatment was assessed by measuring seed count and seed mass. In 2008, significant differences in reproductive fitness, regardless of emergence time, was found between the control and the bagged (selfing), emasculated (outcrossing), and bagged + emasculated (apomixis) treatments (2-sample Wilcoxon test, $p < 0.05$). In 2009, only the control and bagged + emasculated treatments, regardless of emergence time, were significantly different. This study documents the mating system strategy employed by *R. glaberrimus* and provides insight into the link between reproductive mode and rates of self-fertilization in buttercups.

FIGHTING FOR FENDER'S BLUE BUTTERFLY IN A RECOVERING PRAIRIE. Alexa Carleton, Cheryl Schultz. School of Earth and Environmental Sciences, Washington State University Vancouver, 14204 NE Salmon Creek Ave, Vancouver, WA 98686; *alexacar 'at' wsu.edu*

Development, agriculture, and invasive species have claimed over 99.5% of the Willamette Valley's prairie landscape. One alarming consequence is the decline of the endangered Fender's blue butterfly (*Icaricia icarioides fenderi*) and its threatened host plant, Kincaid's lupine (*Lupinus sulphureus kincaidii*). This study evaluates the effectiveness of three restoration projects, initiated adjacent to existing habitat in 2001, 2005, and 2007, in assisting the recovery of a Fender's blue population in Eugene, OR. In 2009, I assessed vegetation, butterfly, and egg distribution in native and restored habitat. The oldest restoration area (2001) provided less native nectar (22.6 mg/m²) than the more recent restoration areas (37.6 for 2005 and as much as 317.2 for 2007). However, it was visited by more butterflies: 0.018 individuals/m² compared to 0.003 (2005) and 0.001 (2007). Comparable trends were seen for a variety of indices, including lupine density, egg density, and butterfly fecundity, such that older restorations had greater habitat value for Fender's blue. As restoration areas mature, they will play a key role in Fender's blue recovery. Results suggest that habitat quality improves with restoration age and that assessing a restoration's impact requires long-term monitoring, at least 6–10 years. Given the rate of decline of Lepidopteran species, there is an urgent need to pursue restoration strategies that directly impact resource availability and in turn butterfly fecundity.

PRAIRIE LANDOWNER'S MANAGEMENT GUIDE. Laurel Carver, The Nature Conservancy, 120 Union Ave, Olympia WA, 98502; Sara Noland, ESA Adolfsen, 5309 Shilshole Avenue NW Suite 200, Seattle, WA 98107; *lcarver 'at' tnc.org*

The Nature Conservancy is working with regional partners to create a guide for prairie-friendly land use practices for prairie landowners in Western Washington. We will produce an electronic document for distribution to prairie landowners through The Nature Conservancy, USFWS, conservation districts, NRCS and WDNR. The guide will be organized in three main sections, based on the type of land use and the goals of the landowner. It will provide an overview of the current best land management practices of residential lands, agricultural and working lands as well as natural areas. The primary objective of the Prairie Management Guide is to encourage the best land management practices on historic Western Washington prairies. It will emphasize the essential role of private landowners in the conservation of this rare and threatened ecosystem. It will provide landowners with an understanding of the best management practices for maintaining, restoring and protecting their remnant prairie, detailed maps to show landowners the historic location of prairies based on soils data, and provide a basic field guide to native and invasive flora and fauna of Western Washington prairies. The guide will also have a comprehensive resource section for landowners who desire more information on conservation organizations, landowner incentive programs, native plant and seed sources, prairie plant and wildlife guides, suggested reading and links to other useful information.

GEOCHEMISTRY OF THE LATE EOCENE GRAYS RIVER VOLCANICS, SOUTHWESTERN WASHINGTON AND NORTHWESTERN OREGON: EVIDENCE FOR A SLAB WINDOW IN THE CASCADIA FOREARC. Christine Chan, Jeffrey Tepper, Geology Department, University of Puget Sound, 1500 N. Warner #1048, Tacoma, WA 98416; Bruce Nelson, Department of Earth and Space Sciences, University of Washington, 4000 15th Avenue NE, Seattle, WA 98195; *cchan 'at' pugetsound.edu*

The Grays River Volcanics (GRV) is one of several Late Eocene to Early Oligocene volcanic units that erupted within the Cascadia forearc basin. Consisting of >2000 m of submarine and subaerial flows and volcanoclastics, the GRV (~42–37 Ma) extend from NW Oregon into SW Washington and show a younger-to-the-north age progression. These lavas are chemically similar to, but younger than the 44 Ma Tillamook Volcanics (TV) of the Oregon Coast Range. Previous explanations for GRV and TV magmatism include forearc rifting, hot spot activity, or passage of a slab window. The goals of our investigation are to characterize the chemical and isotopic signature of the GRV and better constrain the tectonic setting in which they formed. The GRV postdate the more voluminous 53–45 Ma Crescent Basalts (CB) and show greater enrichment in Ti, K, and P. Neither unit shows chemical evidence of subduction (e.g., HFSE depletion) but the GRV have lower $^{143}\text{Nd}/^{144}\text{Nd}$ (avg. ϵNd 5.3) compared to the CB (avg. ϵNd 6.1) indicating a different and more enriched source. The wide range of Pb isotope ratios among GRV samples ($^{206}/^{204}=19.152\text{--}19.525$; $^{207}/^{204}=15.563\text{--}15.603$; $^{208}/^{204}=38.792\text{--}39.230$) further suggest that individual magma batches ascended from the mantle without mixing. This trace element and isotopic evidence for an asthenospheric source, combined with northward age progression of volcanism, support a slab-window setting. A similar setting may also explain younger forearc basaltic centers in Oregon if left-stepping offsets in the subducting Kula-Farallon ridge caused southward jumps of the ridge-trench triple junction.

HABITAT ENHANCEMENT FOR A FEDERALLY THREATENED PLANT (*LUPINUS SULPHUREUS* SSP. *KINCAIDII*) USING MANAGED LIVESTOCK GRAZING. Marty Chaney, Area Agronomist, USDA Natural Resources Conservation Service, 1835 Black Lake Blvd. SW, Suite D., Olympia, WA 98512; marty.chaney@wa.usda.gov

Less than 2% of western Washington's original native prairies remain today. These shrinking prairie habitats are host to several federally listed threatened and endangered species, including Kincaid's lupine (*Lupinus sulphureus* var. *kincaidii*). The federal recovery strategy lists some of the primary threats to these species as invasion by non-native plant species and succession. The original listing proposal for Kincaid's Lupine proposed designation of two private properties in Lewis County as Critical Habitat. The owners of one parcel, who raise dairy livestock on the pastures, elected to use a Coordinated Resource Management process to develop a conservation plan with a team of federal and state agencies, including USDA-Natural Resources Conservation Service (NRCS), USFWS, and WA DNR. The resulting conservation plan will maintain and improve the habitat for Kincaid's lupine through managed cattle grazing. The conservation plan was deemed to be at least equivalent to the protections provided by a Critical Habitat designation and this farm was excluded from the final designation. Management concepts in the plan include: managing grazing to maintain prescribed stubble heights during the spring and early summer and minimize soil compaction; limiting machinery use and avoiding mowing and harrowing operations in lupine zones between March 15 and lupine seed maturity; minimizing supplemental fertilizer additions in field areas containing lupine and associated prairie species; and avoiding tilling or reseeding the areas containing lupine. In addition, farm management effects on the lupine zones will be periodically assessed, and management adjusted to maintain and/or enhance the lupine populations.

UNDERSTANDING THE DYNAMICS OF A VIBRIOSIS RESERVOIR IN SHAPING NORTHWEST COASTAL ECOSYSTEMS. Bashira Chowdhury, Amy Ven, Department of Biology, 24 Kincaid Hall, University of Washington, Seattle, WA 98195-1800; bashira@u.washington.edu

Coastal vibriosis has increased significantly as noted in the recent epidemics affecting crustaceans along the Pacific Northwest and humans, as gastroenteritis, along the Washington coast. Initial investigations suggest *Vibrio* bacteria increased due to rising water temperatures and decreasing salinity conditions associated with a changing coastal climate. However, *Vibrio* bacteria have no known reservoir to explain the effects of these environmental conditions—a major gap in our understanding of how this pathogenic family shapes our coasts. Reservoir hypotheses for *Vibrio* center on chitinous crustaceans as virulence genes encode chitin attachment proteins. To elucidate this *Vibrio*-chitin connection, we examined the physiological correlation between *Artemia salina*, a common crustacean found along coasts, and *Vibrio*—specifically investigating the growth of *Artemia* and *Vibrio* populations in the water column. We found there was a significant positive correlation between growth in *Artemia*, as measured by hatching efficiency of *Artemia* cysts and survival efficiency of newly-hatched nauplii, and *Vibrio* concentrations in the water column, under conditions mimicking the rising water temperatures associated with the disease outbreaks. No significant physiological correlation between *Artemia* and *Vibrio* under varying salinity conditions was observed. These results suggest warmer water temperatures may increase the chitinous crustacean and *Vibrio* populations, potentiating vibriosis outbreaks along our coasts.

TRACKING RARE NONVASCULAR PLANTS IN OREGON: 30 YEARS OF CHANGE. John A. Christy, Oregon Natural Heritage Information Center, Oregon State University, 1322 SE Morrison St., Portland, OR 97214-2423; *john.christy 'at' oregonstate.edu*.

Since 1983, the Oregon Natural Heritage Program has tracked a growing assortment of bryophytes, lichens, fungi, and marine algae. After nearly 30 years, 492 taxa have been variously listed or de-listed, reflecting changes at a variety of temp and spatial scales. Local and regional interest in ecosystems, biodiversity, and conservation increased dramatically during the period, creating a surge in expertise in both the public and private sectors. However, much of the state is still poorly collected and historical geographical inequities remain. The pattern and history of listings for each group of nonvascular plants reflects the depth and breadth of local expertise, as well as politics and policy at the national level. Sixteen liverworts, mosses, and lichens have been on lists since 1983, but listings of most taxa showed distinct upticks in 1991 (liverworts, mosses, lichens), 1998 (mosses, fungi), 2004 (lichens, fungi), and marine algae (2010). Listings for liverworts have not changed much over the years, indicating a conservative history, good knowledge about their conservation status, and the relatively small number of species in the group. In contrast, listings for the other groups have been more dynamic, indicating a greater degree of uncertainty about their abundance and conservation status, due in part to the larger number of species in each group. Because of the historical dearth of information about nonvascular plants in Oregon, dynamic lists and a lack of legal constraints have proved to be an acceptable format for tracking potentially rare taxa.

URBANIZING FLORA OF PORTLAND, OREGON, 1806–2008. John A. Christy, Oregon Natural Heritage Information Center, Oregon State University, 1322 SE Morrison St., Portland, OR 97214-2423; Angela Kimpo, Portland Water Bureau, 1120 SW 5th Ave, Portland, OR 97204; *john.christy 'at' oregonstate.edu*.

The vascular flora of the Portland-Vancouver area is documented by herbarium specimens and publications dating back to 1806. Urbanization has had predictable effects on the region's vegetation. Native species still outnumber exotics by 16 percent, but today there are about half as many common native species as there were in 1925, and the number of rare native species has increased twelve-fold. Since 1925 the number of common exotics has nearly tripled. The rate of introduction of exotics between 1875 and 1924 averaged between 4.1 and 9.3 species per year, coinciding with rapid growth in population, commerce, and urbanization during that period. The rate of introductions between 1925 and 1999 averaged about 47 new species every 25 years, or an average of 1.9 species per year. Problems posed by the loss of habitat and native species in our area are to some degree counterbalanced by new challenges posed by the arrival and departure of exotic species. Since 1930, the use of water for shipping ballast has reduced the importation of exotic plants, but the growth of the nursery industry has offset this loss by a growing number of exotic ornamental species that have naturalized in our area. Species similar to 128 exotic "waif" species that failed to naturalize prior to 1930 may respond favorably to climate change, giving some indication of future changes in the flora.

ORAL

TECHNIQUES TO PROMOTE GARRY OAK SEEDLING SURVIVAL IN AREAS WITH HIGH LEVELS OF HERBIVORY AND COMPETITION. David R. Clements, Seth Luginbill, Department of Biology, Trinity Western University, Langley, BC V2Y 1Y1; Randy Van Dragt, Department of Biology, Calvin College, 3201 Burton Street, S.E., Grand Rapids MI, 49546-4301; Robert Pelant, Pacific Rim Institute of Environmental Stewardship, 180 Parker Rd., Coupeville, WA 98239; *clements'at'twu.ca*

Regeneration of Garry Oak (*Quercus garryana*) seedlings within Garry oak ecosystems is important to maintain the health of this threatened habitat. However, poor regeneration of Garry oak seedlings has often been observed and little is known about techniques to promote seedling success. Suppression of invasive grasses and exclusion of herbivores have been suggested as two leading restoration techniques. Two independent studies were initiated in early 2000's to examine questions surrounding Garry oak recruitment: one at the Crow's Nest Ecological Research Area (CNERA) on Salt Spring Island, BC and another at the Pacific Rim Institute for Environmental Stewardship on Whidbey Island, WA. In both areas, Garry oak seedlings were caged and monitored for growth and relative health. Over a period of 7 years at CNERA growth was significantly greater in caged than in uncaged control plants, which was indicative of high browsing pressure and relatively high palatability of Garry oak seedlings to black-tailed deer and feral sheep. A similar pattern of growth and development was observed in the Pacific Rim site oaks. Within the first 3 years caged and weed blocked oaks exhibited higher growth and survival rates than other treatments. However, weed block proved a hindrance in following years leading to a reduction in oak health and survival. This study demonstrated that the caging of Garry oak seedlings, although labor-intensive and requiring frequent maintenance, provides valuable protection from large ungulate browsers, but vigilance is required to protect young seedlings from other threats such as voles or competing vegetation.

ORAL

CREATING A MARKET FOR PRAIRIE HABITAT IN THE WILLAMETTE BASIN. Bobby Cochran, Willamette Partnership, 2550 SW Hillsboro Hwy, Hillsboro, OR 97123; and Paul Adamus, Oregon State University and Adamus Resource Assessment; *cochran 'at cleanwaterservices.org*.

In August 2009, a group of 25 agencies, conservation organizations, and other stakeholders agreed to pilot a new system for quantifying the ecosystem services provided by wetlands, streams, and upland prairie in the Willamette Basin; and for using those measures to improve the effectiveness of compensatory mitigation and provide new conservation incentives for landowners. This paper documents the Counting on the Environment process used to construct the upland prairie calculator and how it fits into potential voluntary and regulated markets for prairie credits. The upland prairie calculator measures the habitat function lost at a development site or gained at a conservation or restoration site using the site's position in the landscape, management regime, and vegetation makeup. US Fish and Wildlife Service, Oregon Department of Fish and Wildlife, and other agencies have approved testing of the calculator and associated credit issuance process for use in Habitat Conservation Plans, consultations that require mitigation, and other programs. The prairie calculator's framework was designed to fit well with other functional assessment methodologies and to expand easily to new geographies and habitat types.

SHORELINE IMPACTS DUE TO POTENTIAL INCREASES TO FULL POOL LEVELS, BANKS LAKE, WASHINGTON. David Cordner, Anthony Gabriel, and Tommy Wachholder, Geo-Ecology Research Group, Department of Geography, Central Washington University, Ellensburg, WA 98926-7420; *wachholt 'at' cwu.edu*

We assessed the amount and type of shoreline habitat that would be inundated through proposed 0.3-0.6 m increases in full pool water levels on Banks Lake, Washington, including an assessment of the vulnerability of various shoreline types to increased erosion along the 201 km of shoreline. Using airphotos and field checks, the shoreline was classified and digitized into 11 habitat types based on morphostatigraphic geomorphic units and presence of armoring. Using GIS, the potential inundation of shoreline habitat was quantified using a bathymetric model interpolated from digitized topographic and bathymetry information. Erosion susceptibility of the Banks Lake shoreline was determined by creating an expert weighted model that combined shoreline type, nearshore slope characteristics, and output from a weighted wind fetch model that incorporated fetch for multiple wind directions. Estimates of inundation and erosion susceptibility were quantified by habitat type, and mapped on a GIS map. The inundation zones and shorelines most vulnerable to erosion were characterized based on state-wide GIS datasets related to wetland and priority habitats, including the National Wetland Inventory and priority habitat information obtained through Washington Department of Fish and Wildlife. Inundation through 0.3–0.6 m increases in full pool levels could flood between 1.32.2 million m² of shoreline habitat, while 8.1% of the shoreline has high erosion susceptibility. Inundation and erosion susceptibility varies considerably according to shoreline type, both in terms of spatial extent as well as the type of habitat and species that are impacted, including eight wetland classes and fourteen priority habitats.

ORAL

URVIVAL AND COLONIZATION OF AMPHIBIANS: LESSONS FROM THE 1980 ERUPTION OF MOUNT ST. HELENS. Charlie Crisafulli, Forest Service, Pacific Northwest Research Station, Olympia Forestry Sciences Laboratory, Olympia, WA 98512; Charles P. Hawkins, Watershed Sciences, Utah State University, Logan, UT 843322; *ccrisafulli 'at' fs.fed.us*

Amphibians are thought to be sensitive to environmental change and incur both direct and indirect mortality as well as population declines when exposed to stressors, such as habitat alteration. The 1980 eruption of Mount St. Helens altered a vast area (~600 km²) of forest, stream, seep, and lake habitats used by a diverse assemblage of amphibian species; creating an outstanding opportunity for study. From 1980 through 2009, the responses of amphibians to the eruption were monitored in areas influenced by lateral blast, debris avalanche, and pyroclastic flows. All amphibians were presumably killed by the debris avalanche and pyroclastic flows, but ~130 new ponds were created during the eruption, and several of these were colonized by amphibians within three years; within nine years six species established. In the blast zone 11 species survived. Most pond-breeding species successfully reproduced one year after the eruption, and populations of some species (e.g., *Bufo boreas*) expanded dramatically during the first two post-eruption decades. Surveys for pond-breeding species from 1995 to 1997 yielded the full assemblage of seven possible species, with some species present at all 33 sites sampled. Stream-breeding species experienced high mortality throughout most basins, but five years after the eruption, the tailed frog (*Ascaphus truei*) was breeding in all blast zone streams sampled (n=10) and was breeding in 26 of 28 streams sampled from 1995–1997. Three terrestrial salamander species have not been observed in the entire study area from 1980–2009. Overall, most amphibian species demonstrated remarkable resistance and/or resiliency to the 1980 eruption.

BROWSING AND RIPARIAN SHRUBS: HISTORIC EVIDENCE AND RESTORATION, MIDDLE FORK JOHN DAY RIVER, OREGON. Christine Davis, Steven M. Wondzell, Agnieszka Przeszlowska, Aquatic-Land Interactions, USDA Forest Service, Olympia Forestry Sciences Lab, 3625 93rd Ave, SW Olympia, WA 98512; *cdavis02 'at' fs.fed.us*

Riparian vegetation is often the target of stream restoration efforts because it is linked to the quality of habitat available for salmon, steelhead, and bulltrout. Restoration of near-stream riparian areas on the Forrest and Oxbow Conservation Areas have been fenced to exclude domestic livestock. Additionally, long strips were planted with native riparian species to jump start re-establishment of woody riparian vegetation. However, after 3 growing seasons, most of the planted seedlings remain small. These observations suggested that browsing was preventing restoration treatments from having their desired effect. In late spring 2009, the Confederated Tribes of the Warm Springs Indian Reservation of Oregon constructed fenced exclosures to experimentally test the effect of elk and deer browsing on the growth of the riparian plantings. In conjunction with the tribe, we began a project to monitor the effect of browsing exclusion through time. We measured the height and diameter of browsed plants inside and outside of the exclosures for one growing season (June–October 2009). Preferred species showed a dramatic treatment effect: they grew substantially inside the exclosures, but very little outside the exclosures. There was no treatment effect for non-preferred species, especially alder and Ponderosa pine. Knowing the relative browse preferences and survivorship of native species may be valuable for restoration planting.

RESTORING HIGHLY DEGRADED HABITATS FOR RARE SPECIES IN PUGET LOWLAND PRAIRIES. Eric Delvin, University of Washington and The Nature Conservancy, 120 Union Ave SE, Olympia, WA, 98501; Jonathan D. Bakker, Peter Dunwiddie, School of Forest Resources, University of Washington, Box 354115, Seattle, WA 98195-4115; *edelvin 'at' tnc.org*

The prairies of Puget Lowland are one of the most endangered ecosystems in the United States, and include populations of several rare plants and animals. Most protected prairie habitats have some native elements; their management focuses on enhancement by controlling invasive species and increasing native diversity. However, effective conservation requires increasing the total acreage of prairie by restoring prairie habitat on abandoned agricultural lands. Our multi-year research project is developing treatments for restoring native communities in abandoned agricultural fields. We are using a novel experimental approach that is both adaptive and iterative. Restoration strategies consist of combinations of site preparation techniques and seeding mixtures. Strategies are replicated temporally and spatially to understand when and where they are most effective, and the most successful strategies are retested in increasingly larger areas in subsequent years. The cumulative result is restoration of significant areas of prairie habitat that could support future translocations of endangered butterflies such as Taylor's Checkerspot, Mardon skipper, Puget Blue, and Valley Silverspot. In addition, we are establishing a new population of Golden Paintbrush, a federally threatened species. Results from 2009 indicate large differences among sites in seeding success and suggest that solarization is a promising site preparation treatment. By restoring compositional, structural, and functional components of these prairie systems, the project will also benefit many other species, common and rare, within the prairie ecosystem.

INVASIVE PLANTS OF SOUTH PUGET LOWLAND PRAIRIES: SUCCESS STORIES, CONTROL EFFORTS AND FUTURE CHALLENGES. Casey Dennehy, The Nature Conservancy, 120 Union Ave SE #215, Olympia WA 98501; *cdennehy 'at' tnc.org*

The south Puget Lowland prairie ecosystem is one of the most unique habitats in Washington State and is considered one of the most endangered ecosystems in North America. The primary biological threat to south Puget Lowland grasslands is the establishment of non-native noxious weeds, which can modify the composition, structure, and ecology of the landscape by degrading the prairie and displacing native vegetation. The Nature Conservancy began restoring degraded prairie habitat in the 1990s by removing Scot's broom via mechanical and chemical control methods and has since initiated a prescribed fire program that has resulted in drastic broom reduction. However, as one challenge is met, another is discovered, and a new generation of invasive plants has emerged as threats to the ecosystem. Tall oatgrass is an invasive bunchgrass that is invading native prairie habitat and is proving very difficult to control. Land managers for The Nature Conservancy, Fort Lewis Fish and Wildlife, Washington Fish and Wildlife, and Washington State DNR have partnered to improve strategies for tall oatgrass and have initiated several experimental trials to maximize control efforts. The trials have revealed that the herbicide Fusilade DX offers better control compared to Poast, and that Nufilm IR performs better than other non-ionic surfactants; other trials are ongoing. Additional invasive plants such as mouse-ear hawkweed and sulfur cinquefoil also pose significant threats; experimental trials and current management strategies will be summarized for these plants as well.

PLANTING OREGON WHITE OAK IN THE PACIFIC NORTHWEST. Warren D. Devine, Constance A. Harrington, USDA Forest Service Pacific Northwest Research Station, 3625 93rd Ave. SW, Olympia, WA 98512; *charrington 'at' fs.fed.us*

Oregon white oak seedlings are often planted during restoration of Pacific Northwest oak woodlands and savannas on sites where some or all of the original oak trees have been removed. In a series of trials established beginning in 2001, we tested (1) treatments to achieve seedling root morphologies known to increase planting success in related species, and (2) cultural treatments to increase seedling post-planting survival and growth. For seedlings grown in containers, air-pruning at the container base led to greater lateral root growth and eliminated circling of roots, while mycorrhizal inoculation increased seedling growth response to fertilization. Nursery practices such as root management and culling small seedlings increased the percentage of seedlings with good growth potential. Post-planting cultural treatments tested included control of competing vegetation, tree shelters, fertilization, and irrigation. Keys to successful establishment were: planting quality seedlings of sufficient size to compete with other vegetation, controlling competing vegetation during establishment to improve soil water availability, and protecting seedlings from damage by rodents, deer, and elk. Plastic mulch was effective in controlling vegetative competition and significantly increased soil water content compared to non-mulched seedlings. While all tree shelter types significantly reduced animal damage, solid-walled tree shelters also increased seedling height growth rate during the first few years after planting. Controlled-release fertilizer applied at planting did not significantly increase seedling growth. Weekly irrigation increased first-year seedling growth when combined with vegetation control. Although early growth rates of planted oak seedlings were quite variable, this variation decreased after the seedlings became established.

ORAL

SOUTH PUGET LOWLAND PRAIRIES NATIVE PLANT PRODUCTION; LESSONS LEARNED AND FUTURE CHALLENGES. Grace Diehl and Anita Goodrich, The Nature Conservancy of Washington, 120 Union Ave SE, Suite 214, Olympia, WA, 98501; *gdiehl 'at' tnc.org*

Over the past twelve years, plant production has become one of the most important components of restoration of western Washington's south Puget Lowland prairies, constantly evolving in scope and sophistication to meet the increasing demands of an entire region. A broad array of collaborative partners has and continues to support expanding production loads and research needs. Today The Nature Conservancy (TNC) works closely with these partners at a number of production facilities including TNC's Shotwell's Landing Native Plant Nursery, Department of Natural Resources' Webster Nursery, Stafford Creek Correctional Center, and other contracted sites. Along the way important lessons and strategies have been creatively explored regarding native plant seed collection, production, processing, storage, propagation, and planting as well as native plant plug production, care, and planting. Exploring each of these topics has solved many challenges while simultaneously raising important questions for the future, including seed sourcing and tracking, harvesting techniques, and increased connectivity within and beyond our region. In the future, south Puget Lowland prairie plant production will remain accessible and restoration-focused and will continue to tackle these challenges.

ORAL

A COMPARISON OF STAND STRUCTURE AND DEVELOPMENT OF DOUGLAS-FIR OLD-GROWTH, PLANTATIONS, AND YOUNG NATURAL FORESTS IN WESTERN OREGON. Chris Dowling, Olympic National Forest, USDA Forest Service, Olympia, WA. 98512; *cdowling 'at' fs.fed.us*

Tree ages, size, species composition, diameter growth, and density were studied in Douglas-fir old-growth, plantation, and young natural stands in three locations in western Oregon to determine whether plantations and young natural stands would likely develop old-growth structures and characteristics. The Douglas-fir age ranges found in plantations were much narrower than those found in the young natural stands and in the old-growth stands indicating that old-growth developed with low initial stand densities. This was further supported by high diameter growth rates and tree and stand structural characteristics. These low initial stand densities were probably the result of prolonged stand establishment and likely enabled sustained height and crown size advantages among old and younger trees. The mean diameters of the dominant trees in the old-growth and young natural stands were very similar by age 40 and 100 and appeared to be growing at nearly the same rate for first 100 years. In contrast, the mean dominant diameters in the plantations and old-growth by age 40 and 100 were significantly different, indicating the plantations are growing at a slower rate than young natural and old-growth forests. Both the young natural stands and the plantations, when simulated to age 250, maintained higher densities of smaller diameter trees than the old-growth stands. This simulation outcome indicates the possible inability of these stands to self-thin to the densities found in old-growth stands without some sort of density-reducing disturbance.

ORAL

RIPARIAN PLANT COMMUNITIES ON SMALL MOUNTAIN STREAMS IN MANAGED FORESTS. Lana D'Souza, Laura Six, Bob Bilby, Western Timberlands Research, Weyerhaeuser, Federal Way, WA 98001; Jonathan D. Bakker, School of Forest Resources, University of Washington, Seattle, WA 98195; *lana.dsouza 'at' weyerhaeuser.com*

Riparian vegetation is an integral part of riparian zone function. Small montane streams comprise a large proportion of stream channel length and have unique physical and ecological conditions that may impact the surrounding vegetation. We quantified spatial (distance from stream) and temp (time since last disturbance) variation in the plant community around small streams in managed forests of western Washington. Spatially, three distinct plant communities were identified for the herb and shrub layers: riparian (0-10 m from stream), transitional (10-30 m), and upslope areas (30-80 m). Species richness was greatest in the riparian areas for both layers, and 12 indicator species associated with these communities were identified. Temporally, the oldest age-class (>100 years) contained a distinct shrub community, the highest species richness of shrubs, and the most indicator species. The youngest age-class (31-51 years) contained the highest species richness of herbs, though all three age-classes differed in composition for the herb layer. Our results illustrate that, although riparian areas on small streams are much narrower than those found on larger fluvial systems, they contain a distinct understory plant community that is reflective of time since last disturbance.

ORAL

CONSERVATION OF SOUTH PUGET LOWLAND PRAIRIES—STATUS AND PROGRESS: 1995 TO 2010. Patrick Dunn, The Nature Conservancy, 120 Union Ave SE, Olympia, WA 98501; *pdunn 'at' tnc.org*

Prairies in the south Puget Lowland, bounded by Tacoma and Oakville, WA, have been a focus of conservation efforts for decades. The region contains the largest expanses and highest quality native grassland west of the Cascade Mountains, notably Joint Base Lewis-McChord (20,352 acres proposed for enrollment in Candidate Conservation Agreement) and sites owned by state and local agencies and private non-profits (8 sites, 3,500 acres). When assessed over the last fifteen years, conservation efforts in the region have made considerable positive gains. Three new prairie sites (1,570 acres) have been protected and Mima Mounds Natural Area has enlarged (167 acres). Positive gains have occurred in the condition of protected prairies—ecological processes, such as fire has been introduced to all protected areas (40 burns with 1,861 acres in 2009), while the control of Scotch broom has improved vegetation structure (exemplified by >90% of Mima Mounds with less than 5% cover of broom). Recovery efforts for rare species show significant gains, with translocations to establish populations now occurring for plant, butterfly and bird species. The conservation community supporting prairies has grown. Numbers of practitioners (working group membership up ten-fold), funding and the technical infrastructure have all increased. Cooperative conservation facilitated this trend, ensuring shared goals and priorities throughout the conservation community. However, challenges remain for conservation in how to adequately manage a fragmented landscape, especially in the face of continuing land conversion, new pests, and potential impacts from climate change.

WET PRAIRIE SWALES OF THE SOUTH PUGET LOWLAND, WASHINGTON. Richard Easterly, Debra Salstrom, SEE Botanical Consulting, 1225 Verona St. Bellingham, WA 98229; Chris Chappell, Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA 98501; *seebotanical 'at' comcast.net*

In the south Puget Lowland, wet prairies are typically limited to swales and low-gradient riparian areas in open topography with few or no firebreaks that isolate them from historically frequent fires. After pre-Euro-American settlement fires ceased, rates of woody vegetation encroachment likely varied dramatically between sites. Moist sites within smaller prairies and savannahs and along narrow riparian corridors would have been more rapidly converted than sites within large, droughty plains where widespread fire would be more easily carried and encroachment from peripheral wooded or wetland sites would take longer. So in marginal sites, species able to persist under some woody cover were more likely to have been components of wet prairie swales; alternatively, sites that were more easily maintained as prairie by fire may have included species less tolerant of shade. Thus topography and importance of the site to Native Peoples played roles in the composition and dynamics between upland prairies and wet prairie swales. In the study area, native prairie vegetation in wet prairie swale habitat has been nearly extirpated, and the original vegetation composition is unknown. Information about prairie landscapes in the mid-18th century is provided by early Europeans and General Land Office surveys. Using historic information together with topography, hydrology, and current vegetation assessments, we constructed a map indicating areas with potential historic wet prairies. Wet prairie swales probably contributed significant resources relative to adjacent dry upland sites and likely enhance wildlife resource availability. Their management is likely important to the long-term conservation of some prairie species.

GERMINATION STUDIES TO EXAMINE THE SEED ECOLOGY OF *LUPINUS LEPIDUS* VAR. *LEPIDUS*, *LUPINUS POLYPHYLLUS* AND *LUPINUS ALBICAULIS* (FABACEAE). Carl Elliott and Dylan Fischer, The Evergreen State College, 2700 Evergreen Pkwy NW, Olympia, WA 98502; *ellcar26 'at' evergreen.edu*

Restoration plans for south Puget Sound prairies, Washington, USA highlight the need to test the germination requirements of native taxa through methods that simulate environmental conditions. This effort will create baseline data for the re-introduction of native plants. Our study set out to examine the importance seasonal weather conditions and anthropogenic fire events as germination cues for three native *Lupinus* species of prairie and oak savannah plant communities. A full-factorial design was used to measure germination rate response: first, to diurnal temperature fluctuations during summer seed dormancy period; secondly, to seasonal temperature fluctuations leading to germination in fall or spring and the interactions among the factors. Fresh seed of each species exhibited physical dormancy. For *Lupinus polyphyllus* and *Lupinus albicaulis*, data confirm the findings of previous experiments with temperate climate legumes. Those suggest that the sequence of chilling below 5° C for six weeks followed by cool diurnally alternating temperatures is an important environmental cue to promote germination of physically dormant seeds during favorable early spring conditions. However; data also suggest interspecific variation in germination response within *Lupinus*. *L. lepidus* exhibited significant germination rates only when the seed was exposed to temperatures simulating fire events. The seed of *Lupinus* species may be influenced a number of naturally variable environmental conditions both in the developmental phase of physical dormancy and in promoting germination

during favorable conditions. Restoration approaches recognizing this variation may more effectively harvest, store, and germinate these species that are important for the restoration of Pacific Northwest prairies.

ORAL

CLIMATE DOES NOT ALWAYS DETERMINE ELEVATIONAL RANGE LIMITS IN CONIFERS AT MOUNT RAINIER NATIONAL PARK. Ailene Kane Ettinger, Kevin Ford, and Janneke HilleRisLambers, Biology Department, Box 351800, University of Washington, Seattle, WA 98195-1800; *ailene 'at' u.washington.edu*.

The role of climate in determining species' range limits has fascinated ecologists for centuries, and is particularly relevant in the face of global climate change. In this paper, we seek to understand how important climate is in determining elevational range limits of conifers in the Pacific Northwestern United States. We analyzed correlations between climatic variables (over the past 100 years) and annual tree growth across the altitudinal ranges of six common conifer species on Mount Rainier. Climate variables, including temperature and precipitation, do appear to play an important role in driving elevational range limits in trees on Mount Rainier. However, we found that growth-climate relationships differ between species, and that tree growth was most highly correlated with climate variables at high elevations. Growth in low-elevation species was poorly correlated with temperature and precipitation. In addition, while growth was synchronous at high elevations, it was asynchronous at low elevations. This suggests that range limit dynamics are not always governed by climate; competitive environment or other local conditions may play an important role, particularly in low elevation, closed- canopy forests.

POSTER

COMPARISON OF HAND-POLLINATED AND NATURALLY-POLLINATED PUGET BALSAMROOT (*BALSAMORHIZA DELTOIDEA* NUTT.) TO DETERMINE POTENTIAL POLLINATOR LIMITATIONS ON PUGET LOWLAND PRAIRIES. Lisa Fazzino and H. Elizabeth Kirkpatrick, Department of Biology, University of Puget Sound, Tacoma, WA, 98416; Cheryl Fimbel, The Nature Conservancy, 120 E. Union, #215, Olympia, WA 98501; *lfazzino 'at' pugetsound.edu*

Decreases in pollinators, particularly honeybees, threaten seed-limited plants, such as Puget balsamroot (*Balsamorhiza deltoidea*), requiring adequate pollination for proper seed production in the degraded south Puget Lowland prairies. To determine pollinator-limitation of Puget balsamroot, we compared seed set in inflorescences that were either hand-pollinated (maximum pollination) or naturally-pollinated throughout bloom on three prairies in the south Puget Lowland area (Johnson, upper Weir, 7S). Seeds were categorized as plump (viable) or shriveled (inviable). Categories were confirmed with germination trials, and seed percentages were weighted according to germination rates. In addition, baseline pollinator population data were collected by recording insect visitation on Puget balsamroot for 10 to 30 minute intervals on all prairies. All prairies had similar production of germinants/inflorescence, or expected number of offspring for the first year. However, within 7S prairie, hand-pollinated inflorescences had a greater number of potential germinants/inflorescence than naturally-pollinated inflorescences. The higher viable seed production in the hand-pollinated treatment suggests that Puget balsamroot may be pollen-limited on 7S prairie, and soil resources are not likely limiting seed production under natural pollination conditions. 7S prairie also had the highest ratio of fl resources to bees measured at the time of the study, suggesting that competition for bees may be a factor limiting pollen transfer among Puget balsamroot on this relatively intact prairie. However, Puget balsamroot seed set could be influenced not only by pollinator limitation, but also by localized soil resource limitation, as is possible in Johnson and upper Weir prairies.

ORAL

BUTTERFLY HABITAT ENHANCEMENT IN PUGET LOWLAND PRAIRIES OF WESTERN WASHINGTON. Cheryl Fimbel, Hannah Anderson, Grace Diehl, Sarah Hamman, The Nature Conservancy of Washington, 120 E. Union #215, Olympia, Washington 98501; Birdie Davenport, Washington Department of Natural Resources, PO Box 280, Castle Rock, Washington 98611; Rod Gilbert, Jeff Foster, Fort Lewis, Public Works ATTN: AFZH-PWT / MS-17, Box 339500 / Bldg 1210, Fort Lewis, Washington 98433; Dave Hays, Ann Potter, The Washington Department of Fish and Wildlife, 600 Capitol Way N. Olympia, Washington 98501; Mary Linders, The Washington Department of Fish and Wildlife, 600 Capitol Way N. Olympia, Washington 98501 and Fort Lewis Fish and Wildlife, Public Works ATTN: AFZH-PWT / MS-17, Box 339500 / Bldg 1210, Fort Lewis, Washington 98433; David Wilderman, Washington Department of Natural Resources, PO Box 47014, Olympia, Washington 98504; *cfimbel 'at' tnc.org*

Two Puget Lowland prairie butterfly species, the Taylor's Checkerspot (*Euphydryas editha taylori*) and Mardon Skipper (*Polites mardon*), are candidates for listing under the federal Endangered Species Act. Reintroduction of these two species is a primary goal of Puget Prairie conservation partners. Suitable habitat is the primary limiting factor to reintroduction due to prairie habitat loss and degradation. Conservation partners have been working to restore native prairie habitat, emphasizing enhancement of butterfly resource patches at current and formerly occupied sites. In 2007, The Fort Lewis Army Compatible Use Buffer (ACUB) initiative supported the convening of a cooperative, interdisciplinary and interagency butterfly habitat enhancement team to strategically develop and implement habitat improvements for these rare butterflies. Progress to date includes: a cooperative approach to identification and evaluation of 14 management units across 10 prairie sites; development of restoration targets and multi-year work plans; nectar plant surveys to guide location of enhancement efforts; weed control treatments underway (prescribed fire, herbicide spraying, conifer removal, and mowing); propagation and planting of 196,000 native forb and 29,000 grass seedlings of butterfly nectar and larval resources; and standardized vegetation monitoring protocols to evaluate treatment success across multiple prairies. This collaborative approach benefits from the expertise of numerous partners and serves as a model for integrating research and monitoring into habitat restoration and adaptive management to support butterfly reintroduction efforts across multiple prairie sites.

ORAL

POLLINATORS ON NATIVE AND DEGRADED PUGET LOWLAND PRAIRIES IN WESTERN WASHINGTON. Cheryl Fimbel, The Nature Conservancy of Washington, 120 E. Union #215, Olympia, Washington 98501; Laurence Packer, Rm. 209A Lumbers Building, York University, 4700 Keele St. Toronto, Ontario, M3J 1P3; *cfimbel 'at' tnc.org*

Conservation partners in Puget Lowland prairies seek ways to enhance pollination as an ecosystem service to complement ongoing prairie restoration efforts. We systematically surveyed bees and other flower-visiting insects in nine prairie sites representing a range of prairie conditions (native vs. non-native plant resources) in 2009 on Fort Lewis in western Washington. Total capture rates of bees in bowl traps (3.64 bees/bowl/day) were higher in Puget Lowland prairies than rates reported for most other studies in the western and eastern U.S. Preliminary results suggest that restoration actions that promote a combination of abundant and diverse forbs, especially native forbs, and bare ground characteristics, may contribute to an abundant bee community on Fort Lewis prairies. *Solidago canadensis* and *S. missouriensis* appear to serve important roles as the latest blooming native forbs providing fl resources used by a variety of

pollinators, and are recommended for restoration plantings. Anecdotal observations reveal that long-blooming flowers of native and invasive shrubs; and forbs growing in mesic microsites such as mound tops, swale bottoms, and tree edges, are used by native bees and are likely important for sustaining pollinator communities where forb resources are lacking or have senesced on these well-drained, glacial outwash prairies.

ORAL

EVIDENCE FOR HISTORICAL ANADROMY IN THE DAM-OBSTRUCTED LAKE CHELAN (WA) WATERSHED. J. Ford, Dept. Fisheries and Wildlife, Oregon State University, 104 Nash Hall, Corvallis, OR, 97331-3803; B. Finney, Dept. Biological Sciences, Idaho State University, 921 South 8th Avenue, Stop 8007, Pocatello, ID 83209-8007; H. Kling, Algal Taxonomy and Ecology, Inc., 31 Laval Dr., Winnipeg, Manitoba, Canada R3T 2X8; G. Clarke, Environmental Change Research Centre, University College, London, UK; R. Heinith, Columbia River Intertribal Fish Commission, 729 NE Oregon Suite 200, Portland, OR 97232; *jesse.ford 'at' oregonstate.edu*

Lake Chelan, the largest and deepest lake in Washington, drains to the Columbia River via a short outlet with a small natural falls. European settlement began in the surrounding Wenatchee Valley in the late 1800s, and the lake was first dammed in 1892 for irrigation. A hydropower dam began delivering electricity in 1903. We used a multi-proxy paleoecological approach to investigate whether the Lake Chelan system may have supported natural runs of anadromous salmonids prior to dam construction, despite the falls at the outlet. The immense size and rapid flushing time of Lake Chelan makes it unlikely that sedimentary signals of historic salmon runs would be found; we therefore selected a linked upstream lake for investigation. Wapato Lake itself was dammed in the early 1900s as part of local irrigation development. Two surface sediment cores, one penetrating a thick Mount St. Helens tephra (1482-1500 AD), display almost continuous pre-dam stable nitrogen signals consistent with the presence of anadromous salmonids in the basin (mean $\delta^{15}\text{N} = 5.21 \pm 1.58\text{‰}$ and $6.30 \pm 1.58\text{‰}$). Post-dam sediments have lower values generally consistent with salmon-free conditions ($2.55 \pm 0.6\text{‰}$ and $3.73 \pm 1.11\text{‰}$). A slow decline in $\delta^{15}\text{N}$ around the early 1800s culminated in a state change around the time of the earliest Lake Chelan dam. Following damming, Wapato Lake changed from a turbid, productive lake dominated by blue green algae and *Stephanodiscus parvus* toward one dominated by green algae with significant representation of *Fragilaria crotonensis*.

ORAL

OAK WOODLAND MONITORING AT JOINT BASE LEWIS-MCCHORD, WASHINGTON. Jeffrey R. Foster, US Army, Forestry Branch, Public Works, Box 339500 MS17, Joint Base Lewis-McChord, WA 98433; *jeffrey.r.foster 'at' us.army.mil*

Forty-nine belt transects (length 46 to 320 m) were established in Oregon white oak occurrences on Joint Base Lewis-McChord. Twenty-seven transects were in grassland-conifer forest ecotones, seven in grassland-riparian ecotones, and 15 in non-ecotonal oak stands. The transects were divided into 15.2-m-long plots, distributed among five alliances: 11% in oak savanna, 31% in oak-dominant, 16% in oak-conifer, 30% in conifer-oak, and 10% in conifer. Plot measurements showed that oak overstory basal area increased in the order conifer < oak savanna = oak-conifer = conifer-oak < oak-dominant. Oak pre-commercial stem density was highest in the oak dominant and oak-conifer alliances, but sapling density did not differ among alliances. Oak stem diameter distributions showed a deficiency of saplings in the oak savanna and oak-dominant alliances. The largest oaks (> 80 cm dbh) grew in the oak savanna alliance; maximum diameter was 152 cm. Modal oak height was 12–18 m in all alliances; maximum was 30 m. Multi-stemmed oaks occurred

in 30% of plots, averaging 47 genets/ha. Oaks with open-grown crown shape occurred primarily in the oak-dominant and oak savanna alliances; suppressed oaks were found only in the oak-conifer and conifer-oak alliances. Overstory cover increased in the order oak savanna < oak dominant = oak-conifer = conifer-oak < conifer. Shrub cover was lowest and ground cover highest in the oak savanna alliance. Relative cover and frequency of understory, shrub, and ground species differed among alliances. Statistical power analysis predicted minimum detectable effect sizes for future re-sampling to detect change over time.

ORAL

MONITORING NATIVE GRASSLAND HABITAT QUALITY IN THE SOUTHERN PUGET LOWLAND.

Jeffrey R. Foster, US Army, Forestry Branch, Public Works, Box 339500 MS17, Joint Base Lewis-McChord, WA 98433; Gail S. Olson, Wildlife Program, Science Division, Washington Department of Fish and Wildlife, 600 Capital Way N, Olympia WA 98501; jeffrey.r.foster@us.army.mil

Native grasslands in the southern Puget Lowland are a vanishing ecosystem that provides habitat for four candidate species for listing under the Endangered Species Act. We implemented a uniform vegetation monitoring protocol across eight grasslands as a baseline survey of native vegetation and candidate species habitat requirements. Comprehensive (wall-to-wall) grassland measurement of vegetation attributes on 25 m x 25 m (625 m²) quadrats was coupled with systematic 1 m x 1 m (1 m²) quadrat surveys of species richness. Spatially explicit, vegetation attribute maps were created for each grassland from the 625 m² data to assist site managers' habitat restoration efforts. There were distinct differences between sites in the frequency distributions of native grasses, non-native invasive species, butterfly nectaring/ovipositing species, and native species richness. The total number of native, grassland-obligate species was 9–15, depending on site. A priori statistical power analysis is being carried out on both 625 m² and 1 m² data to determine minimum sample sizes for assessing change in vegetation over time.

ORAL

PONDEROSA PINE IN WESTERN WASHINGTON. Jeffrey R. Foster, US Army, Forestry Branch, Public Works, Box 339500 MS17, Joint Base Lewis-McChord, WA 98433; jeffrey.r.foster@us.army.mil

Native ponderosa pine is found at several locations in western Washington, the largest occurrence being at Joint Base Lewis-McChord (JBLM). This pine population, present at the time of Euro-American settlement (maximum tree age $\approx$ 400 yr), is genetically distinct from pine east of the Cascades. At JBLM, pine occurs across 2,790 ha and is dominant or co-dominant across 346 ha. There are two distinct pine types: (a) woodlands and savannas, and (b) closed Douglas-fir forests with scattered pines. Much of the former has received ecological restoration treatments (Douglas-fir removal, pine thinning, prescribed fire, Scot's broom mowing), and some of the savanna has native grassland understory. Overstory pine density and basal area are similar, but precommercial pine density is much lower and pine regeneration absent, in closed forest vs. woodland/savanna. Modal pine diameter is 50% greater in woodland/savanna than in closed forest. Woodland/savanna overstory pines are, on average, 33 yr younger and 14 m shorter, and have double the crown ratio, triple the radial growth rate, and half the height:diameter ratio, compared to closed-forest pines. Overstory Douglas-firs adjacent to pines in closed forests are typically decades younger than the pines. Existing evidence suggests that (a) the pre-European pine stands were woodlands and savannas; (b) these stands, and stands established 80-160 yr ago, have converted to closed Douglas-fir forest in the absence of fire and the remaining pines are suppressed; and (c) most current woodlands/savannas established on former grasslands in the past 80 yr.

SPATIOTEMP PATTERN AND PROCESS IN ISOTOPIC RECORDS COLLECTED FROM ALASKAN REY WOLVES 50,000 YEARS AGO TO PRESENT. Kena Fox-Dobbs, University of Puget Sound, Department of Geology, Tacoma, WA 98416; Justin Yeakel, University of California Santa Cruz, Program in Ecology and Evolutionary Biology, Santa Cruz, CA 95064; *kena 'at' pugetsound.edu*

Isotopic records collected from bone collagen of fossil, historic and modern grey wolves from non-coastal Alaska provide insight into the diets and habitat preferences of wolves over the past 50,000 years. For most of the Pleistocene from 50,000 to 10,000 years ago the Alaskan large carnivore guild was diverse and included grey wolf, American lion, scimitar-tooth sabercat, brown bear, and short-faced bear. Of these five, only gray wolves were present continuously through the entire late Pleistocene in Alaska. Morphologic and tooth wear analyses suggest that ancient Alaskan wolves were either generalist large animal predators or scavengers. If ancient Alaskan wolves were scavengers, it might explain why they persisted for thousands of years while populations of other carnivores waxed and waned. Dietary reconstructions from bone collagen $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values are consistent with the interpretation that fossil wolves consumed a range of prey (i.e., they were not specialized predators). The contemporary Alaskan large carnivore guild is less diverse than the Pleistocene guild, and historic and modern non-coastal Alaskan wolves are primarily ungulate (caribou and moose) predators. Variation in the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of historic and modern (1950 to 1990) Alaskan wolves can be related to spatial and temporal differences in habitat and diet, and wildlife management practices. Specifically, changes in ungulate prey selection partially reflect predator control and fluctuations in ungulate population sizes.

AQUATIC GILLED MUSHROOMS IN THE ROGUE RIVER IN OREGON: A NEW SPECIES OF *PSATHYRELLA*. Jonathan L. Frank, Robert A. Coffan, Darlene Southworth, Departments of Biology and Environmental Studies, Southern Oregon University, Ashland, Oregon 97520; *southworth 'at' sou.edu*

Mushrooms with true gills have been observed fruiting underwater in the clear, cold, flowing waters of the Rogue River in Oregon. Fruiting bodies develop and mature in the main channel, constantly submerged, near aquatic vegetation, fruiting over a period of 11 weeks. Morphological characters place these specimens in *Psathyrella* (Basidiomycota), a large genus of little brown mushrooms with 414 species in North America. DNA sequences of the ITS region and a portion of the 28S ribosomal DNA gene place this fungus in *Psathyrella sensu stricto* near *P. fontinalis*, *P. atomata*, *P. ramicola*, *P. brooksii* and *P. gracilis*. Morphological characters are consistent with DNA evidence. *Psathyrella aquatica* forms long stipes and small diameter caps. Immature stages have a thin veil that is soon lost; cystidia are ventricose with subacute apices; gills lack pink gill edges. We propose that the underwater mushrooms are a new species, *P. aquatica*. These are truly underwater mushrooms and not mushrooms fruiting on wood recently washed into the river. Substrates include water-logged wood, gravel, and the silty river bed. Water constrains spore dispersal. Underwater gills and ballistospores indicate a recent adaptation to the stream environment. This particular river habitat combines spring-fed flows, clear, cold, aerated water with woody debris in shallow depths on a fine volcanic substrate. Nitrogen-fixing cyanobacteria near fruiting body attachment sites suggest a source of nitrogen in an otherwise clear stream. This observation adds to the biodiversity of stream fungi that degrade woody substrates.

OAKS BELOWGROUND: INTERACTIONS AMONG MYCORRHIZAS, TRUFFLES, AND SMALL MAMMALS. Jonathan L. Frank, David S. Taylor, Darlene Southworth, Department of Biology, Southern Oregon University, Ashland, OR 97520-5071; southworth@sou.edu

Hidden underground, oak roots form mycorrhizas consisting of root tips and fungal hyphae. Mycorrhizas are mutualistic, benefitting both partners, and obligate, necessary for each. Expansion of oaks expand into new habitats depends on dispersal of acorns and their fungal partners. Little is known of this dual dispersal. Here we assess availability of ectomycorrhizal inoculum as a function of distance from mature oaks. Along transects into grasslands and shrublands, away from mature trees of *Quercus garryana*, we examined soil cores for ectomycorrhizal roots and rodent fecal pellets for fungal spores, and planted acorns as bioprobes. We identified spores by microscopy and mycorrhizas by DNA. Mycorrhizas were present in soil cores 5 m from parent trees, but not beyond, in grassland or shrubland. Spores of truffles (hypogeous fungi) were found in rodent fecal pellets at distances up to 35 m from mature trees. The number of small mammals trapped in grasslands was 10% of that in shrublands. Truffle species formed mycorrhizas with first-year seedlings within the root zone of mature trees in shrublands and grasslands, and with second-year seedlings beyond the root zone in shrublands only. These data indicate that seedlings near mature trees obtained fungal inoculum as the hyphae of mycorrhizas associated with mature trees. Seedlings beyond that obtained fungal inoculum as spores dispersed by rodents. We conclude that rodent dispersal of fungal spores promotes seedling establishment away from mycorrhizal networks in *Q. garryana*.

POSTER

BAT BOX PREFERENCE STUDY ON FORT LEWIS, WASHINGTON. Sanders Freed, The Nature Conservancy of Washington, Olympia, WA 98501; Greg Falxa, Cascadia Research Collective, Olympia, WA 98501; sfreed@tnc.org

Ten bat species are found in the Puget Trough of western Washington, five of which have federal or state conservation status. Recent research on Fort Lewis has documented all ten species present, providing impetus for conservation action. The loss of historical roosting habitat (old growth snags), has forced numerous bat species to adapt to human structures and artificial roosts as primary roosting habitat. Over the past two years, we tested three bat box designs to determine which was most preferred by resident bats. Ten boxes of each design were built and placed in arrays at ten sites across Fort Lewis. In 2008, the Uncle George (UG) design had the most use (50%) as assessed by guano traps and bat observations, followed by the dual chambered rocket box (DCR) (40%), and lastly the mammoth box (10%). In 2009, the UG received the most use (80%), followed by the DCR (50%), and lastly the mammoth (10%). Although the UG had the most use, the DCR received more extensive use at several sites (large amounts of guano), indicating numerous bats residing in the structure. Cost breakdown is as follows, DCR- 63\$; UG-50\$; Mammoth- 25\$, not including mounting hardware and post. The most labor intensive box was the DCR, followed by the UG and the Mammoth. This research suggests the UG may receive the most use by area bats and is reasonable in cost and construction time, although the DCR showed promise for use by aggregations of bats and may provide maternity roosting habitat.

ORAL

LONG-TERM MONITORING OF FISH, STREAM TEMPERATURE, AND CHANNEL CHARACTERISTICS FOLLOWING THE 1980 ERUPTION OF MOUNT ST. HELENS. Brian Fransen, Jason Walter, Weyerhaeuser Timberlands Technology, Federal Way, WA, 98063; *brian.fransen 'at' weyerhaeuser.com*

Monitoring was initiated on three streams following the eruption of Mount St Helens. Fish populations, water temperature, and channel characteristics were assessed annually. Each stream was impacted differently by the eruption. Schultz Creek lies closest to the mountain, and nearly all vegetation was obliterated by the force and heat of the eruption. Hoffstadt Creek lies near the margin of the blast zone where vegetation was both singed by heat of the lateral blast and then impacted by its torrent of debris.. Herrington Creek lies outside of the blast zone, flowing across a large mudflow deposit within the South Fork Toutle River. Cutthroat trout survived the eruption in all 3 drainages. Due to a variety of juvenile-stocking and adult-transport practices, fish populations in each stream have varied over the past 30 years, making interpretation of trends difficult. However, juvenile fish showed a surprising resiliency in severely impacted habitats in spite of warm stream temperatures, minimal woody debris, and low pool availability. Steelhead and coho introduced above natural barriers in two streams suppressed native resident cutthroat trout populations, which persist in relatively low numbers where juvenile steelhead and coho are abundant. Re-establishment of riparian vegetation varied, likely influenced by factors such as the proximity of a seed source and/or the persistence of live willow roots along channel margins. Stream temperatures decreased as canopy cover was re-established. Changes in channel character though time varied with substrate composition and disturbance severity. Long-term monitoring projects provide unique opportunities to understand recovery processes following catastrophic disturbance.

ORAL

INVASIVE SQUIRREL CONTROL; A TRIAL ON FORT LEWIS, WASHINGTON. Sanders Freed, Cheryl Fimbel, The Nature Conservancy of Washington, Olympia, WA, 98501; *sfreed 'at' tnc.org*

Fort Lewis Military Reservation and its conservation partners seek to enhance a small population of western gray squirrels (*Sciurus griseus griseus* Ord) inhabiting oak-conifer woodlands on the reservation. A strategy of reducing non-native eastern gray squirrel (*Sciurus carolinensis* Gmelin) numbers in a western gray squirrel priority conservation zone is being considered. To evaluate this approach, we conducted a trial eastern gray squirrel removal program in the spring of 2006, and removed 31 eastern gray squirrels from the conservation zone. We monitored the populations of both species, using hair snag tubes for 12 months post-removal to assess removal efficacy. Our trial revealed that it was practical to humanely trap and euthanize squirrels in a field situation, but intensive efforts are not likely to capture all eastern gray squirrels in a relatively large natural area. Finally, hair-snag squirrel monitoring devices proved useful in directing our trapping efforts both before and during the trapping operation.

POSTER

MANAGEMENT OF COASTAL PROCESSES AND STRESSES IN WASHINGTON STATE PARKS. Anthony Gabriel, Geo-Ecology Research Group, Department of Geography, Central Washington University, 400 E. University Way, Ellensburg, WA 98926-7420; *Gabriela 'at' cwu.edu*

The policies and practices of 18 Washington State parks representing different coastal landforms and processes were qualitatively evaluated to determine the extent to which they are consistent with scientific understanding of geomorphic and ecological processes. Coastal types included

bedrock cliffs, coastal bluffs, gravel beaches, tidal flats and marshes, dunes, deltas, cusped forelands, and barrier spits. The evaluation used principles initially developed to assess the sustainable management of sandy barrier coastal systems, based on a synthesis of stress concepts gleaned from ecology and geomorphology that are pertinent to modelling environmental stress-response, including those related to stress-dependency, frequency-recovery relationships, environmental heterogeneity, spatial hierarchies and linkages, structural-functional response, and temp change. These form the framework for evaluative principles which may be applied to assess how policies and management practices reflect key biophysical processes and human stresses within various coastal systems. Using evidence gathered from shoreline inventories, policy, planning and management documents for each park, key informant interviews with park staff, and field observations during site visits, management policy and practice were assessed by giving evidence of: 1) conscious acknowledgement of elements of the evaluative principles; 2) implementation of policy consistent with the evaluative principles; 3) existence of policies and practices contrary to the evaluative principles; and 4) total disregard of evaluative principles. Findings include a discussion of factors influencing the extent to which the principles of sustainable management are reflected in the policies and practices of the selected parks, as well as management recommendations which have implications for similar coastal park environments.

ORAL

30 YEARS OF VOLCANOLOGICAL RESEARCH AT MOUNT ST. HELENS—THE WORLDWIDE LEGACY OF THE 18 MAY 1980 ERUPTION. Cynthia A. Gardner, U.S. Geological Survey, 1300 SE Cardinal Court, Vancouver, WA 98683; *cgardner 'at' usgs.gov*

The 18 May 1980 eruption of Mount St. Helens is perhaps the most important historical eruption since Pliny the Younger described the Mount Vesuvius eruption in 79 A.D. Its impact is due to the convergence of many factors: accessibility, excellent monitoring, the computer and technology revolution, and the eruption's occurrence in a country with the resources to respond scientifically and politically. And the events themselves—from the remarkable ground deformation and large earthquakes to the enormous landslide and lateral blast—were both colossal and poorly understood, yet fortunately extraordinarily well observed. The eruption galvanized scientific interest in explosive volcanism and gave credibility to the notion that with monitoring, research, and planning, explosive eruptions could be forecasted and their effects mitigated. Because of its accessibility, Mount St. Helens became a renowned natural laboratory for studying flowage processes and lava-dome growth, to test hypotheses about time scales of geochemical and geophysical phenomena and to develop new monitoring techniques. The eruption spurred interest in understanding how granular flows transform to more water-rich ones and taught us that hazards owing to sedimentation can persist long after an eruption is over. The volcano's reawakening in 2004 highlighted the delicate balance of forces between eruption and no eruption and revealed a unique situation of dome growth through a glacier. The legacy of Mount St. Helens, however, is not just its scientific richness, but also important lessons learned about crisis response and community resiliency. It is a legacy that continues to underpin volcano-crisis responses worldwide.

POSTER

ASSESSMENT OF POTENTIAL ENVIRONMENTAL CONTROLS OF INVASIVE AQUATIC PLANTS IN WASHINGTON STATE LAKES. Anthony Gabriel and Jeff Gray, Geo-Ecology Research Group, Department of Geography, Central Washington University, 400 E. University Way, Ellensburg, WA 98926-7420; *grayje 'at' cwu.edu*

This study examined the distribution of freshwater weed species in Washington State lakes. Lakes with invasive species were identified using a GIS database compiled through the Washington Department of Ecology's (DOE) Freshwater Aquatic Weed Program, which has selectively monitored the distribution of 29 aquatic invasive non-native plants since 1991. The 494 lakes in the DOE database were compared with a GIS database of Washington State lakes classified by lake type. Using a series of scoping questions outlined in a Decision Support System for Lake Shoreline Assessment developed for the DOE by the Geo-Ecology Research Group, over 1200 lakes, mostly over 20 acres, were classified into several principal types: coastal, coulee, glacial drift plain, kettle, glacial scour, cirque, crater, oxbow, gravel pits, and impoundment lakes. A Microsoft Excel database was created for various physical lake and human use variables for the 452 lakes found in both databases, and potential relationships and differences were statistically analyzed using chi-square and Mann-Whitney U nonparametric tests ($p < 0.05$). The distribution of 24 species were analyzed with regards to a variety of environmental characteristics and potential controlling factors, including lake characteristics such as type, hydrologic linkages, morphology (e.g. size, perimeter, perimeter-area ratios, depth), water quality parameters (when available through the DOE Lake Water Quality Monitoring Program), and elevation, as well as anthropogenic characteristics such as presence of boat launches, proximity to cities, and other estimates of human use such as proportions of developed land along shorelines, county densities and number of licensed boats in each lake's county.

ORAL

CLIMATE AND FIRE CONTROLS OF BROAD-SCALE VEGETATION PATTERNS IN NORTHWESTERN NORTH AMERICA: PROJECTIONS OF THE CLIMATIC WATER BALANCE AND NO-ANALOG CLIMATES. Daniel G. Gavin, Department of Geography, University of Oregon, Eugene OR 97403-1251; *dgavin 'at' uoregon.edu*

The climatic water balance is regarded as the most functionally significant control of the distribution of biomes and plant species, and is a fundamental process driving dynamic global vegetation models. However, the water balance has rarely been implemented in a wide array of statistical approaches of projecting climate change on species distribution. Likewise, the role of recurrent fire is a secondary process that affects the position of vegetation ecotones. We analyzed 34 vegetation classes in northwest North America at a resolution of 400 meters with respect to the climatic water balance and estimates of presettlement fire intervals from > 40 paleoecological studies. Simple statistical models summarized climate within each vegetation class and these models were applied to future climate scenarios from output of eight GCMs (2080-2099 AD). A set of three variables (actual evapotranspiration, deficit, winter temperature) distinguished among vegetation classes similarly or better than other common predictor variable sets. Similarly, these variables resulted in few areas of "no-analog" future climates (i.e., combinations of climate variables unlike any that exist today). In contrast, other commonly used variables resulted in a greater extent of no-analog climates, indicating the importance of using ecophysiologically meaningful variables when assessing analog conditions. In summary, a simple climatic water balance is a stronger predictor of major patterns of vegetation than previously shown, that historical fire explains forest boundaries in several regions, and that the forecast of no-analog climatic conditions is sensitive to the set of variables employed.

ORAL

CONSTRUCTING A NUTRIENT MASS BALANCE MODEL FOR POST-ERUPTION SPIRIT LAKE, MOUNT ST. HELENS NATIONAL VOLCANIC MONUMENT, WASHINGTON. James E. Gawel, Nicole Butcher, Ashley Datema, Heather Jennings, Cameron Marshall, Bridget Mason, Mindy Roberts, Tiffany Wax, University of Washington Tacoma, 1900 Commerce St., Campus Box 358436, Tacoma, WA 98402; Meghan Blanchet and AJ Joseph, Bellarmine High School, 2300 S. Washington St., Tacoma, WA 98405; and Charlie Crisafulli, US Forest Service Olympia Forestry Sciences Laboratory, Mount St. Helens National Volcanic Monument, 42218 NE Yale Bridge Rd., Amboy, WA 98601; *jimgawel 'at' uw.edu*.

The 1980 eruption of Mount St. Helens and the resulting landslide resulted in dramatic changes in the bathymetry of Spirit Lake and the biogeochemistry of the surrounding watershed. One striking change following the eruption was a significant decrease in the average depth and an increase in surface area of the lake. Although Spirit Lake as a whole is still classified as oligotrophic, as it was before the eruption, the productivity of the lake has increased significantly in the newly created shallow system along the southern shore. Our study aims to compare basic limnological parameters through time and to construct a combined hydrology and nutrient mass balance model of the post-eruption Spirit Lake as a means of understanding the bioenergetics of this now productive ecosystem. To estimate the various sources and sinks of nitrogen and phosphorus for Spirit Lake we collected data during the summer and fall of 2008 and 2009, including basic physical and chemical lake parameters, stream flow rates, insect emergence and deposition fluxes, amphibian and fish biomass, aquatic plant biomass and volume, plankton biomass, and water samples from streams, groundwater, and the lake water column. Our initial mass-balance model shows the relative weight of each of these reservoirs and the fluxes across the lake boundary. A greater understanding of the processes governing the productivity of Spirit Lake will be useful for making informed management decisions for this lake in transition.

ORAL

OREGON WHITE OAK WOODLAND STAND STRUCTURES IN SOUTHWESTERN OREGON: INSIGHTS INTO RECRUITMENT TRENDS AND IMPLICATIONS FOR RESTORATION AND MANAGEMENT. Laurie A. Gilligan, Patricia S. Muir, Department of Botany and Plant Pathology, Cordley 2082, Oregon State University, Corvallis, OR 97331-2902; *gilligal 'at' science.oregonstate.edu*

Oak woodlands on public lands in southwestern Oregon are often thinned according to fuel treatment prescriptions to reduce fire hazard and accomplish ecosystem restoration, under the assumption that current fuel loads are unnaturally high. Little is known, however, about historical or current Oregon white oak stand structures, and managers lack information on which to base restoration-focused prescriptions. We inventoried 40 Oregon white oak-dominated woodlands across 2 study areas in southwestern Oregon to describe their tree size and age structures and relationships to the environment. Diameter distributions of living Oregon white oak trees often formed reverse J-shaped curves, which, taken alone, might suggest continuous recruitment over time. Evaluation of stand structures using sapling data together with age and diameter distributions, however, painted another picture; in many stands, most recruitment apparently occurred in large pulses. Peak recruitment of living Oregon white oak trees often occurred following European settlement, and most recruitment in dense stands typically occurred pre-fire suppression. Ages of sapling-sized oaks ranged from 5 to 164 yr. Oak seedlings were present in all sites, but 64% of stands had low sapling to tree ratios. No strong relationships between sapling to tree ratios and the environment were identified using multivariate analyses. High variability of stand structures and relationships to site factors and history suggests that site-specific

management prescriptions with follow-up monitoring of resulting oak recruitment may enhance restoration efforts and further understanding of oak regeneration dynamics.

POSTER

TRACKING THE LATE-GLACIAL OUTBURST FLOOD FROM GLACIAL LAKE CARBON, WASHINGTON STATE, USA. B.S. Goldstein, Geology Dept., Univ. of Puget Sound, CMB 1048, Tacoma, WA 98416; Patrick Pringle, Centralia College, Science Dept., 600 Centralia College Blvd. Centralia WA 98531; B. Parker, Z.O. Futornick, Geology Dept., Univ. of Puget Sound; *goldstein 'at' pugetsound.edu*

Glacial Lake Carbon drained during early retreat of the Puget Ice Lobe, creating a catastrophic flood that subsequently transformed into a debris flow as exposures of the andesite-rich Lily Creek Formation (1 Ma) and Wingate Hill Drift (~500 ka?) were undercut and remobilized. A discontinuous boulder train of andesite, distinct from the intrusive and metamorphic-rich lithologies characteristic of Puget Lobe till, is the basis for mapping the pathway of the debris flow. The flow passed between the ice margin and the Cascade mountain front south and westward to the Nisqually River along a path that extended from La Grande on the east to a location just west of the confluence of Tanwax Creek with the Nisqually River. West of there, the ice margin prevented the flow from passing farther down the Nisqually Valley, and the flow was diverted southward into the Deschutes River valley. Farther west, andesite fragments exist in the matrix of Mima mounds at Rock, Violet, and Mound Prairies west of Tenino, as well as at Rocky Prairie near Offutt Lake. In this region, prairies containing Mima mounds appear to occur only on the outwash terrace corresponding to the first recessional position of the Puget Lobe (Walsh and Logan, 2005). We suggest that mound topography may be used for delineating the debris flow pathway. This relationship also appears to hold true to the west within the Black River Valley where andesite is a component within the Mima Prairie mounds—also located on the first recessional terrace level.

ORAL

EFFECTS OF COMPETITION ON SEASONAL PATTERNS OF DIAMETER GROWTH IN OREGON WHITE OAK. Peter Gould, Constance Harrington, and Warren Devine. PNW Research Station, 3925 93rd Ave SW, Olympia, WA 98512; *pgould 'at' fs.fed.us*

Competition for light and soil water are known to negatively impact the growth and survival of Oregon white oak (*Quercus garryana*) in former savannas and woodlands that have been invaded by conifers or have otherwise become more dense. Intensive measurements of tree diameters and soil water were undertaken over a 22-month period starting in spring 2008 to better understand how resource availability affects growth. Band dendrometers that can detect diameter changes at a resolution of 0.1 mm were installed on 41 oaks at the Black River-Mima Prairie Glacial Heritage Preserve near Littlerock, WA. Oaks were selected so that approximately equal numbers were in each of four competitive conditions: open-grown, moderate hardwood competition, moderate conifer competition, or high conifer competition (i.e., overtopped by conifers). Soil moisture sensors installed near each study tree were used to track seasonal changes in water availability. Periods of both expansion and contraction of tree diameters were recorded with the dendrometers. Most diameter expansion occurred either during the early summer, as a result of cambial growth, or during late fall and winter, presumably as a result of stem rehydration. Competition had a profound impact on diameter growth with open-grown trees exhibiting about twice the rate of summer expansion compared to those in the other competitive conditions. Periods of contraction were most pronounced during late summer in oaks with high levels of competition. Our results show that competition, particularly from overtopping conifers, can reduce diameter growth to an extremely slow rate.

ORAL

ASSESSING CLIMATE CHANGE VULNERABILITIES ON THE OLYMPIC PENINSULA. Jessica E. Halofsky, David L. Peterson, U.S. Forest Service, Pacific Northwest Research Station, 400 N. 34th St., Suite 201, Seattle, WA 98103; *jhalo 'at' uw.edu*

To address the effects of climate change, natural resource managers need more information on ecosystem vulnerabilities to climate change that can, in turn, help them to implement effective adaption strategies. We initiated a case study at Olympic National Forest and Olympic National Park to assess potential climate change vulnerabilities on the Olympic Peninsula and facilitate development of adaptation options. The first step in the vulnerability assessment process involved a review of available climate model projections to determine likely levels of exposure to climate change on the Peninsula (degree of deviation in temperature and precipitation). In the next step, we reviewed relevant literature and available impact model projections to identify likely climate change sensitivities in each of four focus areas on the Olympic Peninsula, including hydrology, vegetation, fish, and wildlife. Whenever necessary, we worked with regional scientists and specialists from the Forest and Park to interpret available information and apply it more directly to Olympic Peninsula ecosystems. Finally, we reviewed current management activities at the Forest and Park and identified management constraints to evaluate some aspects of adaptive capacity, or the capacity to implement adaptive actions. This process successfully set the stage for development of adaptation options at the Forest and Park (see related presentation by D. Peterson) and illustrated the utility of place-based vulnerability assessments in preparing natural resource agencies for climate change.

ORAL

DRY FOREST RESTORATION, CARBON POOLS, AND BIOMASS IN EASTERN WASHINGTON: TRENDS AND OPPORTUNITIES UNDER CURRENT MANAGEMENT. Joshua S. Halofsky, Forest Resources and Conservation, Washington State Department of Natural Resources, 1111 Washington Street SE, PO Box 47016, Olympia, WA 98504; Miles Hemstrom, Portland Forestry Sciences Lab, P.O. Box 3890 Portland, OR 97208; Eric Watrud, Washington State Department of Natural Resources–Southeast, 713 Bowers Road, Ellensburg, WA 98926; M. Reese Lolley, The Nature Conservancy, 32 North Third Street, Suite 310, Yakima, WA 98901; *joshua.halofsky 'at' dnr.wa.gov*

Working with a multi-stakeholder collaborative, we modeled the likelihood of restoring dry, Central Cascades Washington forests under current management and no management (other than fire suppression) scenarios over the next two centuries. We found the likelihood of retaining large diameter (>20 in. DBH) forests with greater than 40% canopy cover to be low under both scenarios given existing natural disturbance regimes. We also projected declines in potential timber volume, available aboveground tree biomass, and total aboveground tree carbon under both scenarios. Our analyses indicate the type, frequency, and extent of current treatments across the landscape designed to restore drier forest types do not appear to mitigate the effects of likely future natural disturbances. A loss in potential ecological, economic, and related ecosystem service opportunities in these eastside forests seems probable if there is no change in current management.

ORAL

FIRE IN PACIFIC NORTHWEST PRAIRIES AND OAK WOODLANDS: A REVIEW. Sarah Hamman, The Nature Conservancy, 120 Union Ave. SE #215, Olympia, WA 98501; Peter Dunwiddie, University of Washington, 5548 38th Ave. NE, Seattle, WA 98105; *shaman 'at' tnc.org*

In the Pacific Northwest (PNW), cessation of anthropogenic burning since the mid-1800s in the prairies and oak woodlands of the Willamette Valley-Puget Trough-Georgia Basin ecoregion has resulted in large-scale degradation and loss of habitat due to tree and shrub encroachment. Widespread invasive species, deep thatch accumulations, and extensive moss cover now limit the ability of native plants to germinate and thrive. These changes in habitat structure and function have contributed to the decline of several plant and animal species. The fire-dependence of these species highlights the value of reintroducing this vital ecosystem process. Over the past decade, prescribed fire has been increasingly applied throughout the ecoregion and used in conjunction with other restoration techniques (herbicide, seeding native species) with variable results on ecosystem structure and functioning. This variability likely is a result of differential fire intensity, dictated by fuels, weather, application technique and initial vegetation composition and structure. While fire surrogates such as mowing and herbicide application may be valuable tools for restoring some sites, prescribed fire most closely replicates key natural processes that historically maintained prairie and oak woodland communities. When carefully applied as a long-term strategy, landscape-scale use of fire may help sustain many fire-dependent species and processes that presently are poorly understood. Future research on species-specific responses to fire, how fire intensity can be manipulated to achieve ecological goals, and effects of repeated fires on community composition, structure, and function will help to refine this tool for maximum effectiveness in prairie and oak woodland restoration.

ORAL

THE 1930s SURVEY OF FOREST RESOURCES IN WASHINGTON AND OREGON. Constance A. Harrington, US Forest Service, Pacific Northwest Research Station, 3625 93rd Ave SW, Olympia, WA 98512; *charrington 'at' fs.fed.us*

Forest resources in Washington and Oregon were surveyed in the early 1930s by employees of the Pacific Northwest Forest Experiment Station. This was the first of several periodic forest surveys which collected the same information (forest cover, species, size class) for all forested lands in Washington and Oregon in a short period of time using the same methods. Earlier surveys exist but were done for other purposes (e.g., suitability for agriculture or basis for taxation), were not comprehensive (i.e., did not cover all forest lands), and most of them have not been summarized or made available in modern formats. The 1930s surveys can be useful in documenting past forest conditions and provide an overview of stand conditions 80 years ago. For example, examination of areas harvested by 1930 (most via railroad logging) provides a snapshot of logging activity at that point in time. In addition, these surveys served as a basis for planning future logging activities. The 1930s surveys were the basis of several U.S. Forest Service publications and maps, but over time people have forgotten the existence of these early surveys. Furthermore, some products from the 1930s surveys (such as maps) have become separated from their documentation. The author will provide an overview of the planning, conduct, and early results from the 1930s survey and also will cover some other early surveys which can serve as resource material for modern researchers. Early results from the 1930s survey are available in electronic as well as paper formats.

EGG DROP SOUP: OVIPOSITION SELECTION OF THE MARDON SKIPPER (*POLITES MARDON*) IN PUGET LOWLAND PRAIRIES. Erica Henry, Cheryl Schultz. School of Earth and Environmental Sciences, Washington State University Vancouver, 14204 NE Salmon Creek Ave, Vancouver, WA 98686; [erica_henry 'at' wsu.edu](mailto:erica_henry@wsu.edu)

Lack of basic biological information about at-risk species is a key limiting factor in butterfly conservation. The habitat requirements of the Washington state endangered mardon skipper (*Polites mardon*) have only been studied in the southern Washington Cascades. To examine oviposition selection in the Puget Lowland prairies, we observed eighty-eight oviposition events during the 2009 flight season. We sampled vegetation at oviposition (n=88) and random locations (n=88), measuring 22 habitat variables with respect to the oviposition plant, vegetation structure, and the plant community. Eighty-six of the eighty-eight eggs were laid on *Festuca roemerii*, a native, perennial bunchgrass. Discriminant function analysis revealed selection of egg-laying sites based on habitat structure. Females laid eggs in small *F. roemerii* bunches in sparsely vegetated (low vertical vegetation structure, high moss cover) areas of the prairie. These results are contrary to those in the Cascades where mardon are generalists and females oviposit in densely vegetated areas suggesting that the species has geographically specific habitat requirements. In the south Puget Sound, mardon habitat is severely degraded and understanding the factors influencing oviposition selection is crucial to develop effective restoration strategies. Our results emphasize the importance of managing for appropriate habitat structure in addition to hostplant and nectar resources to maintain viable mardon populations.

POSTER

SPATIAL DISTRIBUTION AND HABITAT CHARACTERISTICS OF A NOVEL POPULATION OF THE ENDANGERED TAYLOR'S CHECKERSPOT BUTTERFLY. Jennifer Heron, BC Ministry of Environment, UBC Campus, Vancouver, BC; Nicole Kroeker, Parks Canada, Victoria, BC; Patrick Lilley, Nick Page, Raincoast Applied Ecology, Vancouver, BC; [nick 'at' raincoastappliedecology.ca](mailto:nick@raincoastappliedecology.ca)

We report on recent studies by Parks Canada and BC Ministry of Environment on the spatial distribution and habitat characteristics of a large Taylor's Checkerspot population in recently logged areas of Denman Island, BC. This population is thriving in moist, disturbed habitats where checkerspot larvae use several species of *Veronica* as host plants. This is a previously unrecorded group of host plants for Taylor's Checkerspot in the Pacific Northwest; most historic populations used non-native *Plantago* species in dry coastal meadows. Both *Plantago* and *Veronica* have similar chemical constituents that are essential for the development of checkerspot larvae. We discuss the implications for recovery planning posed by a resource specialist butterfly dependent on host plants in an early successional plant community.

POSTER

GEOSPATIAL ASSESSMENT OF NON-POINT SOURCE POLLUTION IN SMALL COASTAL WATERSHEDS AND EFFECTS ON SHELLFISH HABITATS IN THE PUGET SOUND. Christopher Hilferty, Department of Geography & Land Studies, Resource Management Program, Central Washington University, 400 E. University Way, Ellensburg, WA 98926-7420; [hilfertyc 'at' cwu.edu](mailto:hilfertyc@cwu.edu)

This project looked at the effectiveness of three different Geographic Information System (GIS) approaches in creating patio-temporal models of non-point source pollution effects in small coastal

watersheds in the Puget Sound. I determined the effectiveness of the Nonpoint Source Pollutant and Erosion Comparison Tool, ArcHydro, and the use of spatial overlays for creating models of the causes and effects of non-point source pollution on coastal landscapes, including shellfish habitats in the Southern Puget Sound. The study site, Woodland Creek, is located in the Southern Puget Sound near Lacey, Washington. Woodland Creek has faced significant development stresses over the past few decades, leading to repeated 303(d) listings and the closures of major shellfish harvesting areas near its confluence with Henderson Inlet. The spatial outputs of the N-SPECT and ArcHydro models and the results of the multivariate-criteria decision analysis for the spatial overlay model were statistically compared with water quality data gathered by federal, state, and county agencies in order to assess the utility of the different modeling approaches in linking spatial changes with water quality trends. The literature on geospatial modeling of pollutants generally focuses on large watersheds, which makes the projects focus on small watersheds in the Puget Sound significant. Comparison of the ease of use and accuracy of the three GIS approaches allows land-managers, policy makers, and the public to both see the environmental effects of land-use change and development on Woodland Creek, and to determine the effectiveness of these models for future projects.

ORAL

PROPAGATING SENSITIVE HERBACEOUS NATIVE SPECIES FOR REINTRODUCTION IN URBAN NATURAL. Marsha Holt-Kingsley, Metro Native Plant Center, Metro Regional Government, 600 NE Grand Ave., Portland, OR 97232; marsha.holt-kingsley@oregonmetro.gov

Metro's Native Plant Center (NPC) was established in 2005 for the purpose of preserving the genetic integrity of targeted herbaceous native species and to enhance the diversity of Metro's restoration projects. The propagation of sensitive species at the NPC focuses on specific habitat types including oak woodlands and upland wet prairies. For the past three years, Marsha Holt-Kingsley has researched and utilized low-tech and innovative protocols to collect and amplify seed plus produce plant materials to support reintroduction efforts on Metro sites. Seed scouting and collection, the compilation of phenological data (aka the "Bloomtime Project"), monitoring, and seed grow-out are achieved by trained citizen volunteers. At present the NPC propagates 75 herbaceous species including: *Delephinium leucophaeum* (DELLEU), *Calochortus tolmei*, (CALTOL) and *Sidalcea nelsonii* (SIDNEL). One long-term project posing interesting challenges and results is the production of *Delephinium leucophaeum* tubers. The DELLEU project is comprised of seed collection from three urban natural areas, propagation of tubers, and the introduction and monitoring methodology in collaboration with Dr. Keith Karoly, Professor of Biology at Reed College. Initial results show that the smallest population collected from the Camassia Nature Preserve has the highest production success rate for tuber production and mass while the largest population located at Cooper Mountain had the lowest success rate and tuber mass. Long term monitoring and observation of greenhouse and field methods will define our protocols and effort to produce locally sensitive plant materials to further enhance natural areas throughout the Portland Metro region.

ORAL

CONVERGENCE AND DIVERGENCE OF NUTRIENT STOICHIOMETRY IN DECOMPOSING FOREST DETRITUS. Peter Homann, Huxley College of the Environment, Western Washington University, Bellingham, WA 98225-9181; Peter.Homann@wwu.edu

General theory of forest floor dynamics indicates a convergence of properties during detrital decomposition. However, the property of multi-nutrient stoichiometry, i.e. the relative amounts of many nutrients in the detritus, has not been rigorously evaluated. In this study, the stoichiometry

of ten nutrients (N, P, K, Mg, K, S, Mn, Fe, Zn, Cu) was compared between different leaf litters by quantifying the angle between vectors that represent multi-nutrient concentrations in multi-dimensional space. For Douglas-fir and red alder litters produced and decomposed in adjacent forest stands, during the first three years of decomposition the stoichiometries became more similar yet remained substantially different; during the subsequent three years, the stoichiometries diverged. Analysis of the few other studies that report multi-nutrient concentrations indicate convergence of stoichiometries for different litters decomposing in the same system, and divergence of stoichiometry for the same litter decomposing in different systems. Manganese was an important contributor to the stoichiometric differences, dominating the difference between Douglas-fir and red alder and in 35% of the other comparisons. In contrast, nitrogen was a minor contributor to stoichiometric differences. In conclusion, decomposing litter is an open system exposed to physical, chemical, and microbiological processes, and its stoichiometry is influenced by its initial properties and the environment in which it decomposes. Because detritus is an important and dynamic pool of nutrients, its nutrient stoichiometry may produce feedbacks to nutrient availability in the forest ecosystem.

ORAL

PLANT PROPAGATION FOR GARRY OAK ECOSYSTEMS RESTORATION IN BRITISH COLUMBIA.

Fred Hook, City of Victoria, Parks Division, #1 Centennial Square, Victoria, BC V8W 1P6; *fhook 'at' victoria.ca*

Availability of Garry oak ecosystems native plants suitable for restoration in British Columbia is limited by market size and public resistance. Commercial growers do not generally provide most of the range of needed plants. Many projects must grow their own stock or use contract growers. The Restoration Implementation Group of the Garry Oak Ecosystems Team and its Native Plant Propagation Steering Committee are addressing this issue through outreach to growers, garden centres, and gardeners.

POSTER

RECOVERY OF A SIMPLIFIED LICHEN COMMUNITY NEAR THE PALMERTON ZINC SMELTER.

Natalie M. Howe, 338 Spear St. #7D, San Francisco, CA 94105; James C. Lendemer; Cryptogamic Herbarium, Institute of Systematic Botany, The New York Botanical Garden, Bronx, NY 10458-5126; *nataliemhowe 'at' gmail.com*

We present data to show an increase in lichen diversity and cover after remediation efforts at a polluted site. In a landmark study in 1972 Thomas H. Nash III surveyed the lichen communities in the vicinity of the Lehigh Gap, Pennsylvania immediately downwind of an operating zinc smelter in Palmerton, Pennsylvania and compared them to those in the Delaware Water Gap, a relatively unpolluted site approximately 30 miles away. He found that the lichen cover and diversity were considerably lower in the contaminated sites of the Lehigh Gap, and concluded that lichen diversity had been severely negatively impacted by the air pollution from the zinc smelter there. In 2006, we repeated Nash's study of lichens in the Lehigh Gap using the same methodology in order to see what changes had occurred with cessation of zinc smelting in 1980. We found increased lichen cover and species diversity in comparing the data from 1972 and 2006. We conclude that the lichen community is recovering on the basis of a three-fold increase in lichen diversity and marked increase in lichen cover. Some of the most abundant lichens were 'pioneer' species typical in disturbed sites in eastern North America; foliose and fruticose species were also returning to the area. Part of the survey area is now the site of the Lehigh Gap Wildlife Refuge, and as the land

managers' goals now include protection and enhancement of the site's natural resources, it will be interesting to see how the lichen community continues to evolve.

ORAL

OLD-GROWTH LEGACIES: COARSE WOODY DEBRIS IN 21 HEADWATER CATCHMENTS IN THE WILLAPA HILLS, WA. Jack E. Janisch, William J. Ehinger, Environmental Assessment Program, Washington Department of Ecology, P.O. Box 47710, Lacey, WA 98502-7710; *jack.janisch 'at' ecy.wa.gov*

Railroad logging and clearcutting of old growth in the Willapa Hills of Western Washington left substantial forest legacies. As part of a larger study in this region, we quantified legacy CWD of the channel zone in 21 small headwater catchments (area ~1–8 ha), which had been clearcut then burned ~60–70 years earlier. In a sub-set of these catchments, we also mapped distributions of old-growth stumps within 33 m of the channels. Total CWD volume intersecting the channel zone ranged from 3.6–141.4 m³, the latter reflecting bucked old-growth logs abandoned in study channels. Fraction of total CWD volume estimated to be of old-growth origin ranged from 31.7–92.7 %, or equivalent carbon (C) storage of ~0.3–20.1 Mg C per channel, currently. Estimated volume of mapped old-growth stumps (n~1200) ranged from ~ 28–141 m³ per catchment, or ~ 16.6–67.1 m³ ha⁻¹. Assuming fifty years since clearcutting and a decomposition constant of $k = 0.02$, old-growth stumps are currently storing ~1.5–5.8 Mg C ha⁻¹ and releasing ~0.03–0.12 Mg C ha⁻¹ yr⁻¹. Broad gaps in stump distribution observed in some catchments may suggest former occupation by rapidly-decomposing species. Other cases are associated with old slides, still evident in the channels. These data were collected as part of the Riparian Ecosystem Management project, a long-term study led by the Washington Department of Natural Resources to better understand headwater catchments and inform adaptive management.

POSTER

NEW STRATIGRAPHIC AND RADIOCARBON EVIDENCE FOR THE AGES OF LANDSLIDE-DAMMED UPPER AND LOWER GREENWATER LAKES, PIERCE COUNTY, WASHINGTON. Joe Kasperski, Karl Wegmann, North Carolina State University; Department of Marine, Earth, and Atmospheric Sciences 2800 Faucette Drive, Rm. 2121 Jordan Hall, Raleigh, North Carolina 27695-8208; Patrick Pringle, Centralia College, 600 Centralia College Blvd., Centralia WA 98531. *Wegmann 'at' ncsu.edu*

An increasing body of evidence shows that the Pacific Northwest has a history of large-magnitude earthquakes. These earthquakes are known to cause landslides that can dam rivers and form lakes that may last thousands of years. The upper and lower Greenwater Lakes in Pierce County, Washington (47.088°N, 121.452°W) likely formed from such processes. Preliminary identification of tephra atop landslides damming the lakes helps limit the timing of their formation. Mount St. Helens set Wn tephra (AD 1479) exists on both the upper and lower landslides and thus sets a limiting minimum age. A pre-Wn and possibly unknown Mount Rainier tephra is present only on the lower landslide, suggesting diachronous slide movement. Accelerator mass spectrometry radiocarbon analysis of wood collected from drowned trees rooted in the bottom of the lakes suggests that their formation occurred between 1,605 to 1,515 yr BP (340–430 cal AD for upper Greenwater Lake and 405–460 cal AD for lower Greenwater Lake, including offsets). The probable age of landslide formation will be compared to a regional paleoseismic catalog under development. The ~1,600 yr BP age is correlative with a major seismic event for the Cascadia subduction zone. The identification of large, landslide-producing earthquakes in the Pacific Northwest will help seismic-hazard preparedness efforts in this populous region.

WILLAMETTE VALLEY OREGON WHITE OAK AND PONDEROSA PINE RESTORATION INVENTORY;
Tom O'Neill, Malcolm Anderson, Northwest Habitat Institute, P.O. Box 855, Corvallis, OR 97339;
Ann Kreager, *habitat 'at' nwhi.org*

In recent times, there have been a number of attempts to use remote sensing to inventory Oregon White Oak (*Quercus garryana*) and other focal habitats in the Willamette Valley. None had field validation associated with them, resulting in data of unknown reliability and therefore not ideal for resource agency planning, acquisition, and restoration purposes. In 2000, the Northwest Habitat Institute began to inventory Oregon White Oak and Ponderosa Pine (*Pinus ponderosa*) and has since driven some 60,000 miles throughout the valley. The inventory was conducted by visually recording the vegetation class, tree size, canopy closure, and structural condition of each forest stand within sight distance of accessible roads. To date, almost 6,000 oak stands (~175,000 acres) have been identified with a minimum mapping unit size of 1 acre. Riparian areas are currently being inventoried at the same minimum mapping unit scale. The southern portion of the valley is completed and has an accuracy assessment of 85% between the 27 vegetation classes. The northern portion riparian inventory is scheduled to be completed in 2010. Support for this effort came from National Fish and Wildlife Foundation, Bureau of Land Management, Forest Service, Oregon Department of Fish and Wildlife, Bonneville Power Administration, and The Nature Conservancy.

SUCROSE ADDITION IN PUGET PRAIRIE RESTORATION: THREE YEARS OF SOIL AND COVER RESPONSES. H. Elizabeth Kirkpatrick, Kaitlin Lubetkin, Alexander Titus, Biology Department, University of Puget Sound, Tacoma, WA 98416-1088; kirkpatrick 'at' pugetsound.edu

Scot's (Scotch) broom (*Cytisus scoparius*) invasion increased soil nitrate levels in the naturally dry, nutrient-poor soils of the south Puget Lowland prairies (Washington State, USA). Although broom has been successfully controlled, the higher soil nitrate level allowed many other non-native species to invade and competitively exclude the natives. We tested the responses of native and non-native plant species to sucrose addition to reduce soil nitrate in two intact, but invaded, remnant prairies. In March and April, 2006, in a stratified random design, we sprinkled on the soil surface a total of 2.4 kg/m² of sucrose (1 kg/m² carbon) on 72 1-m² plots paired with 72 control plots. Cover of every species was assessed in June 2006, June 2007, and June 2009. Only three months after addition, sucrose had reduced the total cover of non-native species significantly and markedly (up to 50%) whereas the total cover of native species showed only non-significant reductions in cover (up to 16%). One year later, the sucrose treated soils contained significantly lower nitrate levels than control soils, and suppression of non-native species persisted. However, three years after sucrose treatments, both the soil and native/non-native species cover effects have dissipated, becoming indistinguishable from controls. Moreover, soil microbial functional communities have become similar to those in the control plots. The soils and cover trends are similar on mounds and in swales. These results suggest that the sucrose additions created a short-lived window of opportunity from which the relatively slow-growing native plants were unable to benefit sustainably.

POSTER

AN ASSESMENT OF THE VEGETATIVE RESPONSE TO ACTIVELY AND PASSIVELY MODIFIED FLOODPLAINS ON THE UPPER YAKIMA RIVER, WASHINGTON. Kolten Kusters, Department of Geography, Resource Management, Dean Hall, Central Washington University, Ellensburg, WA 98926, kustersk@cwu.edu

A dynamic relationship exists between fluvial processes of a river system and the vegetation found within its riparian corridor. Riverine disturbance regimes created by variation in flow influence colonization and succession of adjacent vegetation communities. As it flows through Kittitas County in central Washington State, the Yakima River represents one of the most highly modified and regulated river systems in the United States. Over a century of anthropogenic modifications including upland timber harvest, dams, irrigation diversions, floodplain confinement, and floodplain gravel mining have dramatically altered the natural disturbance regime and the interactions between the river and its floodplain. The research explored how floodplain vegetation communities have reacted to the actively and passively modified river through time. The results of this study provide a standardized set of baseline conditions by which management practices can be developed and assessed.

POSTER

PALEOMAGNETIC EVIDENCE FOR CLOCKWISE TECTONIC ROTATION OF GRAY RIVER VOLCANICS, SOUTHWESTERN WASHINGTON. Lucy Kruesel, Mike Valentine, Department of Geology, University of Puget Sound, 1500 N. Warner St., CMB 4032, Tacoma, WA 98416-4032; lkruesel@ups.edu

Southwestern Washington and Northwestern Oregon are home to the Middle Eocene Gray River Volcanics (GRV), a widespread rock unit containing mafic volcanic flows and minor pyroclastic rocks interlayered with clastic sediments. This study uses paleomagnetism to examine the structural/tectonic history of these lava flows. Nine sites, each consisting of at least 10 samples from a single lava flow from the GRV, were sampled in three areas. Six sites along Germany Creek north of Stella, WA, and two sites east of Clatskanie, OR were sampled in July 2009. One site from a quarry on Fossil Creek Road, about 2 miles east of Grays River, WA, was sampled in October, 2008. Alternating field and thermal demagnetization studies were performed on samples from all sites. Germany Creek samples yield inconsistent magnetic directions within flows and from flow to flow. Germany Creek flows are structurally deformed, with moderately steep dips. Samples from gently-dipping flows near Clatskanie and Fossil Creek exhibit well-behaved demagnetizations and demonstrate consistent directions. Preliminary directions from these three sites indicate significant clockwise rotation of the GRV of about 20 degrees since the Middle Eocene. Analysis of samples from other GRV flows near Clatskanie and Bebe Mountain is underway to confirm or refute this result. In addition, polished sections of samples from all locations will be examined to determine if the magnetic minerals present are primary or secondary. This may help explain the scatter in directions from Germany Creek samples.

OAK WOODLAND CONSERVATION ON PRIVATE LANDS IN WASHINGTON STATE: LOCAL CHALLENGES AND OPPORTUNITIES. Ted Labbe, Washington Department of Fish and Wildlife, Priority Habitats and Species Program, 2108 Grand Blvd., Vancouver, WA 98661; *ted.labbe 'at' dfw.wa.gov*

In Washington State, Oregon white oak woodlands conservation on private lands focuses on a mix of local government regulatory and incentive programs, as well as land preservation and restoration by conservation entities. Efforts vary considerably by locale, and include regulation under local critical areas ordinances, rural and natural resource lands zoning, innovative development options, financial incentives, fee-simple land/easement acquisition, active restoration, landowner outreach, and other voluntary tools. A review of local land use regulatory and incentive programs reveals varying levels of habitat protection across the range of Oregon white oak, enabling cross-jurisdiction comparisons and highlighting conservation opportunities. Local critical areas ordinances frequently highlight oak woodlands for protection and reference WDFW's oak woodland habitat management recommendations. However, general measures to safeguard rural lands, offer financial incentives for conservation, and better support innovative 'conservation-oriented' development designs vary by county.

THE VALUE OF ECOLOGICAL RESTORATION VOLUNTEER PROGRAMS: A CASE STUDY IN WESTERN WASHINGTON STATE. Catherine Langenfeld-Dillon, Master of Environmental Studies, The Evergreen State College, 2700 Evergreen Parkway NW, Olympia, WA 98505; Grace Diehl, Lauren Poulos, The Nature Conservancy, Washington Field Office, 120 Union Ave SE, Suite 214, Olympia, WA 98501. *mythos83 'at' hotmail.com*

Localized, grassroots participation in ecological restoration has powerful social and environmental implications. Successful volunteer programs enable participants to connect with their local natural environments. Such connections create feelings of ownership, dedication, and motivation to restore and protect the land. Localized citizen advocacy is significant for professional environmental organizations and government agencies because participants' efforts aid in an organization's ability to achieve its conservation goals. Ecological restoration is an environmental initiative requiring long-term dedication and commitment by numerous individuals. Investment in volunteer programs is an effective method that land managers can use to foster long-term community stewardship, while accomplishing their restoration goals. My research focused on restoration efforts of local advocates who conduct prairie restoration work on public lands under the management of The Nature Conservancy. This case study shows how volunteers have advanced local ecological restoration efforts on the Glacial Heritage Preserve and other western Washington prairies. Research was conducted as an elaborated case study. Qualitative data was gathered through interviews and participant observation. Interviews were transcribed, reviewed, and systematically coded for overriding themes that repeatedly emerged. Three themes were identified: Volunteer Experiences, Shared Values, and Volunteer Motivations. This research illustrates the vast amount of work that dedicated citizen stewards accomplish for restoration-

focused environmental initiatives. Complete research results can be found at:
<http://www.southsoundprairies.org/documents.htm>

POSTER

PETROLOGY OF THE JORDAN LAKES PLUTON; AN INVESTIGATION OF SEPARATE SOURCE VERSUS STRUCTURAL TILT HYPOTHESES; NORTH CASCADES, WASHINGTON. Micah Gregory-Lederer, Jeff Tepper, University of Puget Sound, 1500 N. Warner Tacoma, WA, 98416; *mgregorylederer@pugetsound.edu*

The Jordan Lakes pluton is a Cretaceous biotite hornblende tonalite that sharply intrudes the metamorphic Napeequa schist, outcropping near the projected trace of two major N/S and NW/SE trending strike-slip faults. As mapped by the USGS, the pluton appears nearly circular, with an average diameter of roughly 9 km; of special interest to this study is an eastern trending limb of the pluton which extends an additional 5.5 km east of the main body. Variations in petrology and fabric between these regions within the pluton have led to suggestions that 1) the eastern lobe of the pluton differs in source from the main body or 2) it is a deeper region of the same pluton exposed by steep NW tilting following emplacement. Our study addresses these conflicting interpretations, examining spatial variations within the pluton with the goal of determining whether the limb and body lack a commonly-derived source magma, or conversely, represent zones within a tilted pluton. Sampling was conducted in the eastern lobe and southwest regions of the pluton; ICP-AES major element analysis of twelve samples revealed significant compositional variations within the eastern lobe, in contrast to a more homogeneous southwestern interior. Notably, eastern lobe rocks appear on average to have elevated Mg (2.2 % versus 1.56 %) and correspondingly lowered K (2.13 % versus 3.49 %). Preliminary ICP-MS trace element analysis indicates a common source magma, while positive Eu anomalies (Eu/Eu* from .71 to .84) preclude extensive fractional crystallization as a source for compositional variations.

POSTER

CLOSED-BASIN WETLAND POND FLUCTUATIONS AND THEIR CAUSES OVER TIME, WATERVILLE PLATEAU, WASHINGTON. Karl Lillquist, Anthony Gabriel, Ben Sainsbury, Thomas Winter, Geography Department, Central Washington University, 400 East University Way, Ellensburg, WA 98926. *lillquis@cwu.edu*

Wetland ponds commonly occupy hydrologically-closed basins in hummocky glacial terrain. Water level variations in Northern Great Plains "Prairie Potholes" wetland ponds have been well studied; however, little is known about the timing and causes of closed-basin pond area fluctuations on Washington State's Waterville Plateau. This semiarid area is unique in that ponds occupy glacial deposits and Missoula Flood-scoured scablands. We used Landsat Thematic Mapper imagery to identify 52 wetland ponds and their watersheds, 16 of which are located on end moraine, 15 on ground moraine, and 21 on scablands, on the eastern Waterville Plateau between 1986–2007. Waterville Plateau wetland pond areas fluctuated markedly on an annual scale, generally reaching their maxima at the end of the wet season in March and April. Minima were more dispersed throughout the year. Pond areas generally increased in wetter years and decreased in dry years. Statistical relationships between precipitation and pond area fluctuations are strongest on the thinly till-mantled scablands, suggesting geomorphic surfaces and associated substrate affect the rapidity of hydrologic response to climatic events. Agricultural land uses are not visually or statistically linked to pond areas on any geomorphic surfaces types. These results suggest that other variables, including groundwater input, basin size, and soil infiltration rates, may also impact pond area fluctuations on the Waterville Plateau. This study's significance lies in its development of baseline knowledge about Central Washington wetland ponds, especially given

predicted climate and land-use change, and potential impacts of resulting water-level fluctuations on waterfowl.

ORAL

MEASURING SUCCESS OF A BUTTERFLY REINTRODUCTION: A CASE STUDY OF *EUPHYDRYAS EDITHA TAYLORI*. Mary Linders and Gail Olson, Washington Department of Fish and Wildlife, 600 Capitol Way N. Olympia, WA 98501; *lindemjl 'at' dfw.wa.gov*

The science of butterfly reintroduction is still in its infancy. Hundreds of reintroductions have been attempted; most have failed, while also suffering from inadequate monitoring and documentation (Oates and Warren 1990). Biologists reintroducing invertebrates must overcome unique challenges: multiple life stages with different habitat needs, short life spans, and long periods when animals are difficult to locate. Butterflies are sensitive to environmental change (e.g., McLaughlin et. al. 2002), and populations fluctuate daily, making it difficult to identify whether one or many factors affect success. Taylor's checkerspot butterfly (*Euphydryas editha taylori*), once a harbinger of spring on Puget Lowland prairies, has declined to near extinction. Through release and monitoring methods development we explore how reintroductions might appear to succeed or fail. Near-, and longer-term monitoring strategies are being employed to measure success. Short-term strategies include habitat recognition, site fidelity, and short-term survival, while mid-term measures include survival, mating, and oviposition; long-term strategies will require population persistence once releases are complete. Release of postdiapause larvae first led to adult emergence in 2007. In 2009, a record number (2,247) of postdiapause larvae were released across three sites (SC1, SC2, and FL2). Behavioral response indicated acceptance of the habitat by larvae and adults. Distance sampling of adults in 2009 showed that despite a small sample size (n = 43 butterfly clusters), density estimates at one site (SC1) ranged from 0.0 to 7.3 adults per ha, with abundance estimates ranging from 5.1 to 23.7 for the 3.25-ha survey area.

ORAL

GOLDEN PAINTBRUSH (*CASTILLEJA LEVISECTA*) RECOVERY EFFORTS AT THE NAAS NATURAL AREA PRESERVE ON WHIDBEY ISLAND, WASHINGTON. Cheryl B. Lowe; Mark Sheehan, Whidbey Camano Land Trust, 765 Wonn Rd., Suite C-201, Greenbank, WA 98253. *Cheryl 'at' wclt.org*

The federally threatened golden paintbrush (*Castilleja levisecta*) once grew in prairies from Oregon's Willamette Valley to Vancouver Island, B.C. Now, only twelve populations remain. Six of these populations are found on Whidbey Island, including one at the Naas Natural Area Preserve. The primary restoration goals for this site are to increase the extant golden paintbrush population and re-establish up to five more acres of native northern Puget Lowland prairie. Common prairie species associated with golden paintbrush at this moist site include *Carex tumulicola*, *Festuca rubra*, *Sanicula crassicaulis* and others. *Sanicula* may be one of the preferred "host" plants here. Over the last 4 years, mowing, thatching, exclusion fencing, tree and shrub removal, prescribed burning, and augmentation have been used at this site. Success rate for augmentation plantings is over 55%. Wild *Castilleja levisecta* plants have also increased significantly. A comparison of restoration efforts will be made between this site and a nearby *Castilleja* site, where early studies of pollinators and seed dispersal patterns are being conducted.

POSTER

NEW RADIOCARBON AGES ON SUBMERGED FORESTS IN ELD AND HENDERSON INLETS NEAR OLYMPIA, WASHINGTON. Jo Martens, Centralia High School, 813 Eshom Road, Centralia, WA 98531, *jmartens@centralia.wednet.edu*, Patrick T. Pringle, Science Dept, Centralia College, 600 W.

Locust, Centralia, WA 98531, and Michael Polenz, Division of Geology and Earth Resources, Washington Department of Natural Resources, P. O. Box 47007, Olympia, WA 98504-7007; *martens 'at' centralia.wednet.edu*

Previous studies of submerged forests in Puget Sound show evidence of subsidence, possibly caused by movement along shallow crustal faults that intersect the south Puget Lowland (Gower et al, 1985; Sherrod, 2001). The discovery of a submerged Squaxin Island tribal village site called Qwu?gwe in Mud Bay provided evidence of submergence at Mud Bay (Croes and others, 2005). Garrison-Laney (2003) turned up additional evidence of subsidence there. Our calibrated calendric radiocarbon ages for three submerged (> 2m), bark-bearing Douglas fir snags in Eld Inlet were in the range of A.D. 1450 to modern. We could not definitively tie their submergence to that of the submerged village because of the broad error range and uncertain stratigraphic context. A calendric radiocarbon age of A.D. 790 to 1040 on an intertidally exposed bark-bearing rooted stump at the mouth of Woodland Creek at Henderson Inlet appears correlative with stumps dated by Sherrod (2001) that were likely killed by coseismic subsidence. The Woodland Creek stump is rooted at about present sea level and thus is >1m below the Mean High Water Level. All dating used standard radiocarbon techniques, and results are expressed here at 95.4 percent probability confidence level and calibrated using program Oxcal (k=1.6). The project has been greatly assisted by a Partners-in-Science grant from the M.J. Murdock Charitable Trust. Thus this research not only assists in interpretation of the paleoseismic and environmental history of Eld and Henderson Inlets, but also provides an important link for local high school students to recent geologic history.

ORAL

CLARIFICATION OF THE LICHEN *UMBILICARIA ANGULATA* AND ITS RELATIVES. Bruce McCune, Dept. Botany and Plant Pathology, 2082 Cordley Hall, Oregon State University, Corvallis OR 97331-2902; *Bruce.McCune 'at' science.oregonstate.edu*

Umbilicaria angulata Tuck. (lichenized ascomycetes; Umbilicariaceae) is an occasionally collected species in the Pacific Northwest. While quite distinct in its typical form, the species has been confused with others, especially *U. semitensis* Tuck., which was synonymized with *U. angulata* by G. Llano. Unusual morphs of other species, even such usually distinct species as *U. torrefacta* and *U. phaea*, can also be confused with *U. angulata*. Points of distinction between these species and *U. angulata* are given. Spores are surprisingly useful for identifications in this group of *Umbilicaria* species, considering that spore characters are virtually ignored in most keys within this genus. *Umbilicaria angulata* has faintly textured simple spores that are considerably larger than in other typically fertile *Umbilicaria* species in our region. One form of *U. angulata* produces schizidia from the upper cortex, an unusual characteristic in *Umbilicaria*. In Oregon and Washington the species mainly occurs west of the Cascade crest. Reports east of the Cascades need to be re-examined.

ORAL

DEVELOPMENT AND CURRENT STATUS OF THE SOUTH PUGET SOUND COOPERATIVE
ECOLOGICAL BURN PROGRAM. Mason McKinley, The Nature Conservancy, 120 East Union
Avenue, Olympia, WA 98540; mmckinley@tnc.org

The prairie, oak and ponderosa pine habitats of Puget Sound are fire-dependent ecosystems, most of which have been degraded or lost after 150 years without fire. Early Conservation Action Planning (CAP) pointed out the need to develop a burn program capable of burning at appropriate scale, but efforts to do so were hampered by regulation, poor availability of trained crew and equipment, and a wider culture that did not perceive the value of controlled burning. A five-year Collins fire study established the value of fire as a restoration tool when used in conjunction with other techniques. In 2007, the South Sound prairie partners began a concerted effort to overcome obstacles and implement a burn program that would serve ecological fire needs in South and North Puget Sound. That initiated a multi-faceted approach to build local capacity through training and equipment purchases, address local regulatory policy constraints, establish landowner agreements, expand our pool of firefighters through volunteer recruitment and by offering training experiences to regional fire agencies, improve fire planning and monitoring procedures and more effectively network with national and local fire practitioners. Since 2007, we have gone from 1-2 burns per season, to 40 completed burn projects totaling almost 2000 acres in 2009. Burn planning is coordinated with rare species and invasive weed management and overlapping restoration techniques such as native seeding. In addition, we have established a region-wide burn monitoring program, and initiated conversations with other state-wide prescribed fire practitioners to assess interest in forming a prescribed fire council.

ORAL

EPIPHYTIC CRYPTOGRAM ECOLOGICAL CHARACTERISTICS IN EUROPEAN HEMIBOREAL FORESTS,
LATVIA. Anna Mežaka, Guntis Brūmelis, Alfons Piterāns, Department of Botany and Ecology,
Faculty of Biology, University of Latvia, Kronvalda bulv 4, Riga, LV-1010, Latvia; amezaka@at.lu.lv

Epiphytic bryophytes and lichens are important components of global biodiversity. The aim of the present study is to provide an overview of the epiphytic bryophyte and lichen species distribution and the main ecological characters in Latvian deciduous forests. The study on epiphyte diversity was conducted in 34 territories in Latvia including five European Union protected habitats. In total 148 epiphytic (73 bryophyte and 75 lichens) species were found in the present study. Overall 14 species were red-listed in Latvia and 21 were Woodland Key Habitat (WKH) indicator species. Epiphytic bryophyte and lichen species distribution was analyzed in relation to forest type, stand age, area and connectivity in forest stand level and tree species, height, diameter at breast height, inclination, bark crevice depth, bark pH and tree age in tree level. Tree level as well as forest stand level variables influenced significantly epiphytic bryophyte and lichen species distribution, but differences were found among epiphytic species groups.

POSTER

AFFECTS OF URBAN DEVELOPMENT ON GARRY OAK (QUERCUS GARRYANA) ACORN DISPERSAL
PROCESSES. Julia Michalak, Interdisciplinary Urban Planning and Design, 224 Gould Hall, Seattle,
WA 98195; michalak@at.u.washington.edu

Numerous studies show that increased residential and commercial development reduces native species richness and increases non-native species dominance and abundance. However, few studies demonstrate how these changes alter ecosystem processes, particularly animal-mediated seed dispersal. Animal dispersal is critical for oak trees which have large, heavy, seeds and because burying acorns significantly increases survival probability. My research asks: *How does landscape context influence seed predation, dispersal and germination of Garry Oak (Quercus garryana)?* I selected two oak woodland fragments on the Ft Lewis Military Base, one in a developed landscape and the other in a forested landscape. Within each fragment, acorns were arrayed in plots located under three different canopy types: oak, non-oak forest, and open. Each plot consisted of 10 acorns planted beneath the soil surface and 10 marked with flags and left on the soil surface. There were six plots per canopy type per site, with 720 acorns used in total. Flags facilitate acorn relocation without significantly influencing dispersal behavior or germination. Both landscape type and canopy cover influenced seed predation and germination. Seed predation was highest under non-oak forest canopy and higher at the urban site. Germination was higher under oak canopy and at the forested site. Differences in germination appear to be driven by seed predation. Garry Oak woodlands are a priority habitat in Washington. Policies to protect oaks often result in “islands” of oak fragments within a matrix of developed land. These policies may be protecting adult oaks but failing to adequately protect regeneration processes.

ORAL

LICHEN ECOLOGY AND DIVERSITY OF A SAGEBRUSH STEPPE IN OREGON: 1977 TO THE PRESENT. Jesse Miller, 1036 Adams St, Eugene, Oregon, 97402; Jeanne Ponzetti, 2914 Central SE, Olympia, Washington, 98501; Roger Rosentreter, US Department of the Interior, Bureau of Land Management, 1387 Vinnell Way, Boise, Idaho, 83709; *kawriver 'at' gmail.com*

We present a lichen checklist of 139 species from the Lawrence Memorial Grasslands Preserve and nearby lands in Wasco County, Oregon, based on collections made in the 1970s and 1990s. Collections include epiphytic, lignicolous, saxicolous, muscicolous, and terricolous species. One of these collections has been used as the type specimen for a newly-described species, *Placopyrenium conforme*. To evaluate differences between collections made in the 1970s and 1990s, taxa are placed in six morphological groups: fruticose, foliose, crustose, squamulose, stratified nitrogen-fixers, and gelatinous nitrogen-fixers. We found that more recent visits to the preserve added a greater proportion of terricolous squamulose, fruticose, gelatinous, and crustose species to the list than species from other substrates and morphological groups, reflecting developments in the taxonomy and understanding of biological soil crusts over recent decades. The trade-off between smaller-scale study plots that capture accurate species abundance information and larger plots that capture more complete species richness information is amplified in the sagebrush-steppe because of the small size and cryptic nature of many lichens. We discuss the benefits of both approaches to lichen monitoring in these ecosystems. This project was possible because voucher specimens were saved from the original 1977 survey, which allowed us to address changes in species concepts.

ORAL

IS THE PAST PRESENT? HISTORICAL SPLASH DAM STREAM DISTURBANCE DETECTION IN THE OREGON COAST RANGE. Rebecca R. Miller. Department of Fisheries and Wildlife, 104 Nash Hall, Oregon State University, Corvallis, OR 97331; Kelly M. Burnett Pacific Northwest Research Station, USDA Forest Service, Corvallis, Oregon 97331; *Rebecca.Miller 'at' oregonstate.edu*

Splash damming was a common method of log transport in the Oregon Coast Range from the 1880s through 1950s. Splash dams created an upstream reservoir in which water and logs were stored before being released in large freshets to downstream lumber mills. Much historical anecdotal evidence and recent literature suggest that these practices heavily scoured streams and left behind little in-channel complexity. However, such “rural legends” have not been quantitatively confirmed nor have the locations of splash dams been comprehensively mapped. In this study, all known splash dam sites were included in a geo-database and mapped in GIS. Splash dam sites were located through intense literature, museum and field searches. Interviews were conducted with current and retired fisheries biologists, local historians and one splash dam operator. The GIS map was overlaid with available continuous and probabilistic stream surveys to compare habitat characteristics upstream and downstream of splashed dams and between splashed and non-splashed basins. Areas below splash dams had more bedrock but less cobble or large wood than areas above splashed dams. Likewise, streams in splashed basins contained more bedrock but less key wood than streams in non-splashed basins. Basin area and channel slope were similar between streams in splashed and non-splashed basins. Results from this study show that activities taking place 50–130 years ago may still affect stream characteristics. Knowledge of environmental legacies can enhance basic mechanistic understanding of streams and may shed light on unexplained relationships between current land use and in-channel conditions.

ORAL

OVERVIEW OF RESTORATION ACTIVITIES UNDERWAY AT ROCKY POINT, BC. James Miskelly, Tracy Cornforth, Formation Safety and Environment, CFB Esquimalt, Bldg 199 Dockyard, P.O. Box 17000, Station Forces, Victoria, BC V9A 7N2; *james.miskelly 'at' forces.gc.ca tracy.cornforth 'at' forces.gc.ca*

Rocky Point is the largest property associated with Canadian Forces Base Esquimalt near Victoria, BC. The property supports a number of military activities and includes approximately 600 ha of Garry oak and associated ecosystems. Much of the property was farmed prior to its acquisition by the Department of National Defense (DND), and the level of disturbance to natural systems varies greatly across the site. Major habitat types include California oat-grass prairies, oak woodlands, maritime meadows, and vernal pools. The property includes populations of ten federally listed species at risk and at least 25 provincially listed species. To date, protection actions have targeted small areas presently occupied by rare species and have focused mainly on the prevention of damage from training activities and on targeted invasive shrub removal. DND is now working to broaden recovery actions at Rocky Point to an ecosystem level. Several major challenges are pervasive across the property, including conifer encroachment, gorse infestation, and invasive grasses. In 2010, DND will conduct trials to assess management options and will be seeking advice from other land managers and restoration practitioners.

ORAL

CARBON AMENDMENT AS A RESTORATION TOOL. Rachel M. Mitchell, Jonathan D. Bakker, School of Forest Resources, University of Washington, Box 354115 Seattle, WA 98195-4115; *rachelmm 'at' u.washington.edu*

In 2008, we began to investigate whether soil carbon amendments could alter plant abundance and composition. We tested the effects of two types of carbon (C), sugar and activated carbon (AC), suggested as prairie restoration tools. Sugar stimulates the microbial community, changes the soil osmotic potential, and can temporarily reduce plant available nitrogen (N). AC adsorbs plant available N and organic compounds. Our study site is a grassland dominated by non-native species in central Whidbey Island. We used experimental plots that received three different

pretreatments (mowed, tilled, or planted with *Festuca roemerii*) to assess the generality of the results. Sugar (42% C; 1000 g/m²) and AC (420 g/m²) were applied in early Spring 2008; control plots were untreated. Plots were monitored for two years with respect to community composition, biomass, and species richness. Activated carbon (AC) did not affect any of these variables. Sugar affected community composition and biomass in 2008, and reduced richness in 2009. Forb biomass was negatively affected by the sugar application, while that of grasses and legumes was not. These results suggest that sugar may be a useful tool for temporarily reducing the prevalence of non-native forbs during restoration treatments.

ORAL

GLOBAL WARMING. Mohammad Sharraf Moghaddasi, Islamic Azad University, Saveh branch/Iran; *memo1340 'at' yahoo.com*

Global warming is the observed increase in the average temperature of Earth's atmosphere and oceans in recent decades and its projected continuation into the future. Global average near-surface atmospheric temperature raised $0.6 \pm 0.2^{\circ}\text{C}$ in the 20th century. Prevailing scientific opinion on climate change is that "most of the warming observed over the last 50 years is attributable to human activities."^[4] The main cause of human-induced component of warming is the increased atmospheric concentration of greenhouse gases which leads to warming of the surface and lower atmosphere. Models referenced by the Intergovernmental Panel on Climate Change (IPCC) predict that global temperatures may increase by 1.4–5.8 °C between 1990 and 2100. The uncertainty in this range results from both the difficulty of predicting the volume of future greenhouse gas emissions, and uncertainty about climate sensitivity. An increase in global temperatures can, in turn, cause other changes, including rising sea level and changes in the amount and pattern of precipitation. These changes may increase the frequency and intensity of extreme weather events, such as floods, droughts, heat waves, hurricanes, and tornados. Other consequences include higher or lower agricultural yields, glacier retreat, reduced summer stream flows, species extinctions, and increases in the ranges of disease vectors. Warming is may affect the number and magnitude of these events; however, it is difficult to connect particular events to global warming. Although most studies focus on the period up to 2100, warming likely will continue past then, since CO₂ has a long average atmospheric lifetime.

POSTER

ANCIENT ALASKA YELLOW-CEDAR GROVES IN THE OLYMPIC MOUNTAINS, WASHINGTON. Marshall D. Murray, 3689 Cooks Hill Road, Centralia, WA 98531-9011; *skoookum 'at' localaccess.com*

Eight ancient Alaska yellow-cedar (*Callitropsis nootkatensis*) (AYC) groves have been found in the Olympic Mountains. The AYC occur at elevations of 800–1000 m where precipitation is high and fire frequency is low. These groves have not burned for >1000 years and contain the oldest trees in Washington. Size of AYC range from 150–365 cm diameter. The 365-cm diameter tree is the largest AYC in the United States and is estimated to be >2000 years old. Growth of large, old AYC is slow. A tree 180 cm diameter had 922 annual growth rings on the outer 30 cm of its radius. Photographs show the physical characteristics of the trees. The groves are not well known but are accessible by road or trail and have important scientific and recreational values.

ORAL

A NEW SPECIES OF PARMELINA (PARMELIACEAE) FROM THE NORTHERN HEMISPHERE. Peter Nelson and Ryan Kepler, Oregon State University, Department of Botany and Plant Pathology, Cordley Hall 2082, Corvallis, Oregon 97331; James Walton, National Park Service, Central Alaska Network, 4175 Geist Road, Fairbanks, Alaska 99709. *nelsopet 'at' science.oregonstate.edu*

A species of a lichenized ascomycete in the genus *Parmelina* is proposed as new to science based on material from Alaska and Russia. It is segregated from *P. coleae* by its spore dimensions, geographic range and molecular data from three gene loci. We show this new species as a distinct clade in the context of the recent phylogeny of the *Parmelina quercina* group. It is the second species in its genus recognized from western North America.

ORAL

COMPARISON OF BURNING AND MOWING TREATMENTS IN A WILLAMETTE VALLEY WET PRAIRIE, OREGON, 2001–2007. Jason Nuckols, Ed Alverson The Nature Conservancy, 87200 Rathbone Rd, Eugene, OR 97402; Nathan Rudd, The Nature Conservancy, 821 S.E. 14th Ave. Portland, OR 97214; *jnuckols 'at' tnc.org*

Wet prairies, typically dominated by *Deschampsia cespitosa*, occurred extensively in the Willamette Valley at the time of Euro-American settlement. Historical evidence and recent habitat changes suggest that fires set by Native Americans were an important ecological process for maintenance of wet prairies. Late summer fires may have been important for both suppressing woody vegetation and for promoting important life history features such as vegetative growth, seed production and seedling recruitment. Implementation of prescribed fire for prairie management is challenging, and dry season mowing has been utilized as an alternative management in wet prairies. We initiated an eight-year experiment to test the effects of late-summer/fall mowing and burning on native and non-native vascular plants in a remnant Willamette Valley wet prairie. We analyzed change in percent frequency from pre-, to the first two post-treatment years with ANOVA for a randomized complete block design. Thirty-three of fifty-four species showed treatment effects from burning or mowing. With burning, 19 species showed positive treatment effects (the increase of a native or decrease of non-native species) and 8 showed negative treatment effects. With mowing, 11 species showed positive, and 10 showed negative treatment effects. While both fire and mowing appear to provide short term benefits to native wet prairie species, more introduced species benefitted from mowing, so prescribed fire may be a preferred management treatment where and when it can be implemented. However, decisions about management treatments may differ depending upon the suite of introduced species that occur at a given site.

POSTER

PRAIRIE MOSAIC HABITAT MATRIX OF SOUTH PUGET LOWLAND PRAIRIES: IDENTIFYING SPATIAL RELATIONSHIPS AND CONNECTIVITY TO THE PACIFIC LUTHERAN UNIVERSITY CAMPUS. Reed Ojala-Barbour, 140th Street Ct. E, Tacoma, WA 98446; *ojalabra 'at' plu.edu*

Geographic Information System (GIS) was used to identify the spatial relationship of prairie mosaic habitat in Fort Lewis-McChord military reservation and adjacent Pierce County to the Pacific Lutheran University Campus (PLU). Analysis of the habitat matrix shows extreme fragmentation and degradation due to urbanization and conifer invasion. However, the PLU Campus has oak woodland that is well connected by open space to greater prairie mosaic habitat and small urban patches of remnant prairie. Some of these habitats located within a one-mile buffer of campus

have been identified by Pierce County as an Upland Biodiversity Management Area. Through the removal of invasive species and restoration of native plant associations, PLU campus oak woodlands may provide viable habitat in the greater matrix of southern Puget Lowland prairies.

ORAL

INFLUENCE OF *BROMUS TECTORUM* LITTER ON THE PHOTOSYNTHETIC CAPACITY OF A MOSS DOMINATED BIOLOGICAL SOIL CRUST. Tyler Osgood, Marcelo Serpe, Department of Biological Sciences, Boise State University, Boise, ID 83725-1515; Roger Rosentreter, USDI Bureau of Land Management, Boise, ID 83709; *mserpe 'at' boisestate.edu*

Various factors including changes in vegetation composition are contributing to the loss of biological soil crust cover. In the Intermountain West, invasion by *Bromus tectorum* has led to changes in vegetation composition and accumulation of litter in sagebrush habitats. In this study, we have investigated the effect of *B. tectorum* litter on the composition and physiological characteristics of a biological soil crust dominated by the moss *Bryum argenteum*. For this purpose, we prepared trays with moss crust; half of these trays were used as controls, and the rest had litter to cover two-thirds of the moss crust surface. The trays were exposed outdoors to natural conditions between the summers of 2008 and 2009. Four times during this period November 2008, and February, May, and July of 2009, we estimated the crust photosynthetic capacity using chlorophyll fluorescence. No differences in crust cover were detected between treatments. In contrast, the presence of litter decreased the photosynthetic capacity of the crust. At saturating light intensities, the electron transport rates were $38 \pm 23\%$ higher in control than in litter-covered samples. Furthermore, prolonged exposure to litter decreased the Fv/Fm ratio, which represents the optimum quantum yield of photosystem II. The largest difference was observed for the February collection, when the Fv/Fm ratios were 0.76 ± 0.08 and 0.35 ± 0.08 for the control and litter treatments, respectively. The low Fv/Fm values in the litter treatment indicate that the presence of litter significantly damaged the photosynthetic apparatus.

POSTER

FIELD OBSERVATIONS OF OVIPOSITION AND EARLY DEVELOPMENT OF THE COASTAL TAILED FROG (*ASCAPHUS TRUEI*). Amber Palmeri-Miles, Central Washington University, Ellensburg, WA 98926; Keith Douville, Julie Tyson, Kristen Ramsdell, Marc Hayes, Washington Department of Fish and Wildlife, Olympia, WA 98501; *palmeria 'at' cwu.edu*

Knowledge of tailed frog oviposition sites, always concealed in streambeds, is limited. What is known is based on opportunistic discoveries during the examination of instream substrates. These haphazard discoveries have resulted in encountering various stages of clutch development, but have never involved field observation of oviposition. Hence, here we report the first field observation of oviposition by tailed frogs and provide selected data on early development. Our observations were made on Miller Creek on the eastern Olympic Peninsula. During rubble-rouse sampling for stream-associated amphibians on 29 July 2008, we rolled a large boulder beneath which 4 adult female *A. truei* and 183 *A. truei* eggs were found. One female was actively laying eggs. To help gauge development, we revisited this site 9 times through embryonic and post-hatching development, and placed 7 eggs in an instream enclosure simulating streambed conditions. High resolution examination of a photograph indicated that oviposition was communal; we estimated that 3 egg masses with 70, 68, and 47 eggs were laid on the same rock with a fourth mass of 24 eggs located <1 m downstream. Our data on embryonic and early larval development agree closely with the laboratory data of Brown (1975. Comp. Biochem. Physiol. 50A:397-405). We recorded a similar decline in growth rate during early larval development that may reflect the transition from the lipid-and-protein-rich yolk diet of hatchlings to the less nutritious diet of diatoms and detritus

of actively feeding young larvae. We provide a perspective for reconsidering the concept of communal oviposition.

ORAL

ASSESSING THE EFFICACY OF BUFFER STRIPS IN SUSTAINING BRYOPHYTE DIVERSITY IN BC INTERIOR FORESTS. Christine Petersen, Dr. Lyn Baldwin, Dr. John Karakatsoulis, Departments of Biological Science & Natural Resource Science, 900 McGill Road, PO Box 3010, Thompson Rivers University, Kamloops BC V2C 5N3; Scott Black, Dr. Gary E. Bradfield, Botany Department, 3529-6270 University Boulevard, University of British Columbia, Vancouver, BC V6T 1Z4; *cpetersen@tru.ca*

Small mountain streams make up a large portion of the watershed in interior British Columbia and are ecologically important. Yet these small streams are neglected under the current BC forestry practice codes. Debate exists over the riparian buffer widths necessary to protect the environment and maintain floristic diversity. The purpose of our research was to examine the effectiveness of different riparian buffer types (continuous, one sided, two-sided, and clear-cut) and width in maintaining riparian bryophytes and promoting community reassembly post harvest in the adjacent uplands. We examined 30 riparian sites and their uplands in the B.C. Interior Montane Spruce forests. Bryophyte, vascular plant and shrub diversity were determined using a nested sampling design. Analysis found riparian old-growth associated bryophyte species richness and frequency was maintained with buffers (one sided and two-sided). Multivariate ordination also found buffer width and remaining canopy cover within 50-m radius strongly affected the bryophytes in the riparian sites with buffers, whereas disturbance appeared to affect species composition in clear-cut riparian sites. Linear regression supported the importance of intact riparian forest with other habitat quality variables (soft CWD and concavity). In the uplands, the presence of a buffer regardless of width or type had no effect on community reassembly. Our results have important management implications as they indicate that even small buffers can mitigate forestry impacts on riparian areas adjacent to small, high-elevation streams.

ORAL

ADAPTING NATURAL RESOURCE MANAGEMENT TO CLIMATE CHANGE ON THE OLYMPIC PENINSULA. David L. Peterson, Jessica E. Halofsky, U.S. Forest Service, Pacific Northwest Research Station, 400 N. 34th St., Suite 201, Seattle, WA 98103; *peterson@fs.fed.us*

Climate change presents a major challenge to natural resource managers both because of the magnitude of potential effects of climate change on ecosystem structure, process, and function, and because of the uncertainty associated with those potential ecological effects. Concrete ways to adapt to climate change are needed to help natural resource managers take the first steps to incorporate climate change into management and take advantage of opportunities to balance the negative effects of climate change. We established a science-management partnership with Olympic National Forest and Olympic National Park to determine how federal land managers on the Olympic Peninsula can adapt to a warmer climate. Following a vulnerability assessment for water, vegetation, wildlife, and fisheries resources (see related presentation by J. Halofsky), adaptation options were elicited from resource managers through facilitated dialogues at focused workshops. This process produced both strategic and tactical adaptation options for the Olympic Peninsula, and illustrated the utility of a place-based partnership for adapting to climate change. This approach and the adaptation options that were developed can be used by other National Forests, National Parks, and natural resource agencies in adapting to climate change.

ECOLOGY, BIOLOGY AND CONTROL OF SOME EXOTIC-INVASIVE WEEDS ON FEDERAL LANDS IN BRITISH COLUMBIA, CANADA. Raj Prasad, Pacific Forestry Centre, 506 West Burnside Road, Victoria, B.C. V8Z 1M5; *RPrasad 'at' pfc.cfs.nrcan.gc.ca*

Scotch broom (*Cytisus scoparius*), Gorse (*Ulex europaeus*), Daphne (*Daphne laureola*), and English ivy (*Hedera helix*), are prominent, invasive plants posing a serious threat to Garry oak and associated ecosystems on federal lands in Victoria, British Columbia. These plants colonize disturbed areas quickly, form dense mono-specific stands, remain persistent, and defy easy eradication programs. They suppress and inhibit the growth of native plants and ultimately arrest forest succession. Several federal departments and Parks Canada have expressed great concerns regarding their rapid incursion, adverse impacts, and the resulting degradation of native habitats. We examined the population dynamics, phenology, and control methods of these invasive plants on federal lands near Victoria, B.C. Of the several methods of control tested, including manual cutting, application of a registered herbicide (triclopyr), a fungal bioherbicide (*Chondrostereum purpureum*), and a commercial plastic mulch, we found that some treatments (mulch and herbicide) provided 100% efficacy on control of sprouting of all four invasive species. While one bioherbicide (*Fusarium tumidum*) was very effective on Scotch broom in the greenhouse, it was not applied under field conditions. The other bioherbicide (*Chondrostereum purpureum*) produced a variable response when applied under the field conditions. Manual cutting was the least effective. Also a novel prospective bioagent (*Phomopsis sp. denovo*) was isolated from dying and dead samples of Daphne that holds a great promise for control of Daphne. A new technology using superheated water (Aquacide) to kill vegetative shoots of gorse did not offer long term control, nor was it found to be cost effective.

SOME RECENT DISCOVERIES PERTAINING TO SUBFOSSIL FORESTS IN THE PACIFIC NORTHWEST—EXAMPLES FROM LAKE CRESCENT AND LOWER DRY BED LAKES, OLYMPIC MOUNTAINS, WASHINGTON. Patrick Pringle, Centralia College, 600 Centralia College Blvd., Centralia WA 98531, Karl Wegmann, North Carolina State University; Department of Marine, Earth, and Atmospheric Sciences 2800 Faucette Drive, Rm. 2121 Jordan Hall, Raleigh, North Carolina 27695-8208; Dan Pontbriand, National Park Service, Isle Royale National Park, 800 East Lakeshore Drive, Houghton, Michigan 49931-1895, William Westlake Walker, 1039 SW 151st Street, Burien, Washington, 98166; *ppringle 'at' Centralia.edu*

Landslides that dam streams can create lakes containing subfossil forests that may record the timing of ancient earthquakes. Ages of such lakes are of interest to biologists studying the genetics of fish trapped in them. We report new AMS radiocarbon ages on subfossil trees from Lake Crescent and lower Dry Bed Lakes. The Lake Crescent trees yielded ages of 3,990 yr BP (offset ~130 yr, or 2,440–2,340 BC calibrated) and 325 yr BP (offset 60), and the lower Dry Bed Lakes tree yielded ages of 1,310 and 1,210 yr BP (offsets of 239 and 136 respectively, or 900–1,000 AD calibrated and combined). The older age from Lake Crescent represents a new estimate for timing of possible seismic activity and damming of the lake, whereas the younger age is similar to previous radiocarbon results. Video footage taken during sampling (by Pontbriand) may help determine if the trees are rooted or if they slid into the lake. We will compare these ages to results from recent trenching studies on nearby faults as well as compare tree-ring patterns at the sites. The new data from lower Dry Bed Lake further constrain the results there previously obtained by

Schuster and others (1992); however, additional radiocarbon analyses will be needed to allow 'wiggle matching' and dendrochronological refinement of the dates. These systematic investigations will be necessary to further resolve many similar radiocarbon ages (1,250–1,000 yr BP) obtained for faults, landslides, and submergence in the south Puget Sound region and southeast Olympic Mountains.

ORAL

STRONG SEED LIMITATION IN PRAIRIE GRASSLANDS OF THE GARRY OAK ECOSYSTEM. Karen Reagan, University of Washington Biology, Box 351800, Seattle, WA 98195-1800; Peter Dunwiddie, School of Forest Resources, University of Washington, Box 354115, Seattle, WA 98195; Tom Kaye, Amanda Stanley, Institute for Applied Ecology, PO Box 2855, Corvallis, OR 97339-2855. *sphitz 'at' u.washington.edu*

How best to allocate limited resources is a critical issue in many conservation and land management decisions. In Pacific Northwest prairies, land managers must often decide whether it is necessary to sow costly native seed to enhance the diversity of native grasslands. Alternatively, will native species recover and repopulate sites once competitors are removed? To address these questions, we conducted a five-year study across nine field sites in two states to explore better ways to control invasives and enhance native diversity. At each site we established arrays of 20 plots—five treatments with four replicates. We tested four combinations of multi-year treatments directed at controlling invasives, including burning, herbiciding, and mowing. The fifth set of plots was left untreated, and serving as a reference. Using a split-plot design, we used four levels of seed addition (none, seeding in 2006, seeding in 2007 and seeding in both years) to examine the significance of seed limitation, the treatment effect, and the interaction between the two. Pooling data across all sites, the number of native seedlings was significantly greater when seed was added suggesting that seed limitation strongly constrains the abundance and diversity of native plants in these prairies. Pre-seeding site preparation was also significant, but to a lesser degree. Treatment effects varied among the added species, although treatments that included burning tended to increase the number of seedlings of all species.

ORAL

NEW BASAL CAMBRIAN LICHENS FROM MONTANA. Gregory J. Retallack, Department of Geological Sciences, University of Oregon, Eugene, OR 97403-1271; *gregr 'at' uoregon.edu*

Three problematic fossils newly discovered in red siltstones of the basal Flathead Sandstone at Fishtrap Lake, central western Montana, provide evidence of life on land during the earliest Cambrian (ca. 542 million years old). This age determination is based on known stratigraphic ranges of associated trace fossils: *Bergaueria hemispherica*, *Didymaulichnus lyelli*, *Torrowangea* sp. nov., and *Manykodes pedum*. Unlike rare trace fossils in grey shales, the problematic new fossils form low-diversity, high-density assemblages in the surface horizons of two kinds of red paleosols formed on supratidal flats and terraces of a cliffed coast. One of these fossils is a marginate discoid comparable with Vendobiont fossils such as *Hallidaya*. Another new fossil is a quilted irregular thallus comparable with Vendobiont fossils such as *Kempia*. Also found were remains of *Arumberia banksi* Glaessner and Walter, but preserved in three dimensions with internal carbonaceous seams suggesting constructional similarity with *Ernietta*, *Pteridinium* and *Yangtziiramulus*. The newly described fossils from Fishtrap Lake are preserved in life position and in three dimensions with a filamentous microstructure that is densely woven and coherent on top but dispersed below in remains comparable with *Kempia*, woven into an ellipsoidal shape in remains comparable with *Hallidaya*, and organized into a double layered system of chambers in *Arumberia*. These microstructures are unlike metazoan or algal histology, and most similar to the histology of foliose lichens.

ORAL

THE WORLD'S GREATEST MIDLIFE CRISIS IN ANTARCTICA-THE PERMIAN-TRIASSIC EXTINCTIONS. Gregory J. Retallack, Department of Geological Sciences, University of Oregon, Eugene, OR 97403-1271; *gregr 'at' uoregon.edu*

The Permian-Triassic mass extinction is the largest known discontinuity in the history of life. New studies of superbly exposed sequences in Antarctica now demonstrate two separate but geologically abrupt mass extinctions on land. One mass extinction during the Middle Permian (260 Ma) extinguished as many species as the one that destroyed the dinosaurs at 65 Ma, and was followed by an even a bigger mass extinction during the Late Permian (253 Ma). Both Middle and Late Permian extinctions have long been apparent among marine invertebrates, and were also times of warm-wet greenhouse climatic transients, marked soil erosion, switch from high to low sinuosity and braided streams, soil stagnation in wetlands, and profound negative carbon isotope anomalies. Both mass extinctions may have resulted from catastrophic methane outbursts to the atmosphere from coal intruded by feeder dikes to flood basalts, such as the Middle Permian Emeishan Basalt and Late Permian Siberian Traps. These fatal greenhouse crises of the past are worst-case scenarios for greenhouse crises of the future.

ORAL

THE EFFECTS OF FIRE, HERBICIDE, AND INVASIVE SPECIES LEGACY IN A PACIFIC NORTHWEST PRAIRIE. E. Rook, R. Seyferth, J. Kirsch, C. LeRoy, D.G. Fischer, Field Ecology Lab, Lab II 3265, The Evergreen State College, 2700 evergreen parkway NW, Olympia, WA, 98505; *fischerd 'at' evergreen.edu*

In this study we evaluate prairie plant community responses to restoration and a key invasive species (*Cytisus scoparius*) within an active restoration matrix in the south Puget Lowland, WA. Plant community diversity and abundance were measured across five data sets spanning three years in multiple spring and fall field seasons. We compared native and non-native plant community diversity among different aged burn treatments, pre- and post-burn treatments, graminoid-specific herbicide applications, and plots with differing historical proximity to the N-fixing invasive *C. scoparius*. We report three major findings from our work: 1) Plant-species richness was highest in most recently-burned sites and in post-burn plots ($P < 0.05$). Data suggest an increase in plant species richness in burn treatments may be driven by an increase in diversity and abundance of non-native plants ($P < 0.05$); 2) Graminoid-specific herbicide significantly reduced non-native grass cover over four consecutive years of application ($P < 0.05$); and 3) Using a combination of GIS modeling and ordination, we found relationships which suggest historical proximity to *C. scoparius* may be significantly related to promotion of non-native species abundance ($P < 0.05$). This work suggests that while plant communities may respond to fire and herbicide as restoration tools, fire may also promote non-native species dominance over native species. Further, key soil-modifying invasives can have a 'legacy' effect, which may exacerbate the effects of high-intensity restoration activities. Restoration strategies that integrate landscape history and consider the impact of invasive species legacy could increase restoration successes.

ORAL

LICHEN HABITAT MAY BE ENHANCED BY THINNING TREATMENTS IN YOUNG *TSUGA HETEROPHYLLA*-*PSEUDOTSUGA MENZIESII* FORESTS. Heather T. Root; Bruce McCune, Department of Botany & Plant Pathology Cordley 2082 Oregon State University Corvallis, OR 97331-2909

U.S.A.; Peter Neitlich, Western Arctic National Parklands, National Park Service, 41A Wandling Rd, Winthrop, WA 98862; *rooth 'at' science.oregonstate.edu*.

Forest structural characteristics manipulated by alternative thinning treatments were associated with increases in cyanolichen and alectorioid species richness and changes in lichen community compositions. At two sites in moist conifer forests of western Oregon, lichen community monitoring plots were established before thinning treatments; the most diverse plots in each treatment were retained as diversity islands whereas the less diverse plots were treated in the thinning prescription. We resampled these plots approximately 10 years after thinning. At one site we found that lichen communities in diversity plots were quite similar to those in the surrounding treated forest and that the proportion of *Tsuga heterophylla* in the stand was negatively associated with alectorioid and cyanolichen richness. At both sites, hardwood gaps and open-grown trees were positively associated with cyanolichen species richness. At the other site, surrounding plots were more like diversity leave-islands after thinning than before. Furthermore, thinned plots had more hardwood gaps following the thinning. These thinned plots hosted more *Bryoria*, *Candelaria concolor*, *Leptogium polycarpum*, *Peltigera collina*, *Nephroma laevigatum* and *Physcia tenella* than had been observed prior to thinning. We concluded that thinning treatments retaining remnants, open-grown trees and hardwood gaps have potential to favor lichen communities rich in cyanolichen and alectorioid species.

ORAL

DORMANCY AND GERMINATION IN PACIFIC NORTHWEST PRAIRIE PLANTS. Michael Russell, Department of Horticulture, ALS 4017, Oregon State University, Corvallis, OR 97331-7304; *russelmi 'at' hort.oregonstate.edu*

Germination is the first stage of most plants life cycle. If a seed germinates during a season that is too cold or too dry, the seedling will not establish. Plants have developed a number of mechanisms that increase the likelihood that their seeds will germinate in the appropriate season. One is dormancy, which results in a seed not germinating, even when conditions are otherwise favorable. Plants can be characterized based on what type of dormancy their seeds exhibit. dormancy types include physical, morphological, physiological, morphophysiological, and combinational dormancy. A series of experiments was conducted to test for these types of dormancy among a group of Pacific Northwest native prairie plants. Temperatures fluctuate seasonally, so a seed may be able to ensure germination at the appropriate time through its temperature tolerances. An additional experiment was conducted on a temperature gradient table to test the temperature tolerances of some of these species. Evidence of Physical dormancy was found in three of seven tested species. Physiological dormancy was found in 10 of 29 tested species. There were 20 species tested on the temperature gradient table, 15 of which had enough germination to draw conclusions. Five of those species germinated best at cool temperatures. One species germinated best at warm temperatures. Six species had good germination across a wide range of temperatures. Three species had narrow tolerance ranges at intermediate temperatures. This information can be useful in plant propagation, habitat restoration projects, and for understanding the general ecology of these species.

POSTER

PLANT-SOIL FEEDBACK AS A FACTOR IN PRIMARY SUCCESSION. Rudy Salakory; John Bishop; School of Biological Sciences Washington State University Vancouver, 14204 NE Salmon Creek

Avenue, Vancouver, WA 98686-9600; Rick Gill School of Biological Sciences Washington State University Pullman, WA 99164; *rudimentary 'at' wsu.edu*

We conducted a greenhouse experiment to determine the effect of two plant species, dwarf mountain lupin (*Lupinus lepidus* var. *lobbii*) and dune bentgrass (*Agrostis pallens*), on each other's growth through their effect on communities of soil organisms. We used a factorial set of sterilizations and inoculations as follows: We collected native soils from early primary successional habitat of Mount St. Helens and sterilized half; the other half remained untreated. We established three paired treatment blocks of Lupin, Agrostis and None within each sterilized and non-sterilized half and grew first-generation plants. Soils of replicates within six blocks were then homogenized and half of each block subsequently sterilized a second time to disable the first-generation microbial community; the other half remained untreated. We grew a second generation of Lupin and Agrostis in these eighteen blocks, whose biomass we analyzed as a function of the treatments. For Agrostis we found the following: Soils with microbial community controls (soil sterilization) had positive effects on second generation Agrostis biomass. Agrostis biomass was largest in soils with a Lupin predecessor, next largest with no predecessor and had the smallest biomass in soils with an Agrostis predecessor. A second sterilization between generations produced the same pattern, but had a higher biomass across all treatments. Our results may indicate soil microbial communities in the root zone of these colonizing species are self-inhibiting, or that colonizing plants must compete with soil microbial communities for limited resources in early-successional habitats.

POSTER

WOLF CONSERVATION AND NATIVE PRAIRIE RESTORATION AT WOLF HAVEN INTERNATIONAL, TENINO, WASHINGTON, USA. Linda Saunders, Tami Williams, Conservation Program, Wolf Haven International, Tenino, WA 98589; *lsaunders 'at' wolfhaven.org*

For over 27 years, Wolf Haven International has been a non-profit wolf sanctuary and education facility. We are recognized as one of the largest wolf centers in the U.S. We have more than 18,000 visitors annually, including over 3,000 school-age children. We house 48 wolves, including 8 endangered Mexican wolves and 3 endangered red wolves. For the past decade we have been part of the U.S. Fish and Wildlife Service's Species Survival Plan breeding program for the Mexican wolf and red wolf. We are one of three facilities in the U.S. raising Mexican wolves for release back into the wild. In 1998, Mexican wolves from Wolf Haven were part of the first pack released back into the wild into the southwest U.S., 38 years after being extirpated. In 2009, six female Mexican wolves from our multi-generational pack traveled to Saltillo, Mexico, to be part of a breeding program to release Mexican wolves back into the wild into Mexico for the first time. We partner with the U.S. Fish and Wildlife Service, the Natural Resources Conservation Service, Washington Department of Fish and Wildlife, The Nature Conservancy, and the Department of Army to restore our native prairie. We have been actively restoring our prairie since 2001 and have been the recipient of experimental translocations of endangered and rare species such as the Mazama pocket gopher and golden paintbrush. We are restoring butterfly habitat for future rare butterfly releases. Wolf Haven's prairie serves as an important habitat stepping stone to neighboring restored prairies.

ORAL

INTERDECADAL PATTERNS OF TOTAL SEDIMENT YIELD FROM A MONTANE CATCHMENT, SOUTHERN COAST MOUNTAINS, BRITISH COLUMBIA, CANADA. Erik Schiefer, Department of Geography, Planning & Recreation, Northern Arizona University, Box 15016, Flagstaff, AZ 86011-

5016; Brian Menounos, Natural Resources and Environmental Studies Institute and Geography Program, University of Northern British Columbia, 3333 University Way, Prince George, BC V2N4Z9; Channa Pelpola, Stantec Consulting Ltd., 4370 Dominion Street, Burnaby, BC V5G4L7; Marwan Hassan, Olav Slaymaker, Department of Geography, University of British Columbia, 1984 West Mall, Vancouver, BC V6T1Z2; *Erik.Schiefer 'at' nau.edu*

We reconstruct sediment yield for a mountain watershed of western Canada since the mid-twentieth century from studies of annually laminated lake sediments, delta progradation, and solute transfer. Total yield averaged $320 \pm 40 \text{ Mg km}^{-2} \text{ a}^{-1}$ and comprised $\sim 35\%$ suspended load, 50% bedload, and 15% dissolved load. Ratios between the individual yield components varied approximately threefold at inter-annual timescales because of significant variability in the suspended and bedload fractions. Asynchronous flux in suspended and bedload fractions through time arise from differences in sediment availability and transitory sediment storage in the channel. Periods of elevated yield are associated with rapid glacier recession, an extreme rainstorm, and a landslide. Our results indicate that in montane environments, extrapolation from even decade-long monitoring programs may lead to biased projections of long term yield and delivery mode proportions if variations in sediment supply and catchment response to hydroclimatic and geomorphic controls are not considered.

ORAL

CONSERVATION OF PRAIRIE-OAK BUTTERFLIES IN OREGON, WASHINGTON AND BRITISH COLUMBIA. Cheryl Schultz, Alexa Carleton, Erica Henry, Tyler Hicks and Rhiannon Thomas Washington State University Vancouver, 14204 NE Salmon Creek Ave, Vancouver, WA 98686; *schultzc'at'vancouver.wsu.edu*

The prairie-oak ecosystem in Oregon, Washington and British Columbia is highly at-risk due to habitat conversion, fragmentation, invasive species, lack of appropriate disturbance, and new threats such as coming changes in climate. These threats severely impact numerous butterfly species, including Fender's blue (*Icaricia icarioides fenderi*–Federally Endangered), Oregon silverspot (*Speyeria zerene hippolyta* - Federally threatened), mardon skipper (*Polites mardon*-Federal candidate), Taylor's checkerspot (*Euphydryas editha taylori*– Federal candidate) and Island Marble (*Euchloe ausonides insulanus*- Federal species of concern). In the absence of active management, habitat for these butterflies would likely disappear. Management for these butterflies includes a mix of fire, mowing, herbicides, manual approaches, nectar and hostplant enhancements, and *de novo* restoration. We discuss a range of current challenges and emerges issues for butterfly conservation across the region, highlighting major efforts and success stories.

ORAL

REINTRODUCTION OF WESTERN BLUEBIRD TO THE SAN JUAN ISLANDS. Gary Slater, Ecostudies Institute, PO Box 703, Mount Vernon, WA 98273; Bob Altman, American Bird Conservancy, 311 NE Mistletoe, Corvallis, OR 97330; *glslater 'at' ecoinst.org*

Species reintroductions are an important conservation tool. The Western Bluebird, a secondary cavity-nester, was considered common in oak-prairie habitats of the San Juan Island Archipelago during the early 1900s, but disappeared due to habitat loss and fragmentation and competition for nest sites. Traditional conservation strategies of land protection, habitat management, and outreach have been implemented, yet the bluebird's northernmost population remains 100 miles to the south. With natural recolonization unlikely, a 5-year reintroduction program was initiated to establish a viable population on the San Juan Islands. Demographic monitoring was conducted

to evaluate the success of the project. From 2007 to 2009, 25 pairs of bluebirds and 4 pairs with dependent young were translocated to San Juan Island. Pairs were placed in outdoor aviaries in suitable habitat and held for one to three weeks. Approximately, 47% of released pairs established a territory and bred. During the 2009 breeding season, the population size on San Juan Island was ≥ 18 adults, and 42 young were fledged. Return rates of adults and offspring were generally low in 2009 (adults: 40%; juveniles: 20%), but return rates may have been affected by severe winter weather and a cold spring. Overall, several criteria indicate short-term reintroduction success: population size has increased annually and both translocated individuals and their offspring have successfully reproduced. Ultimately, we aim to estimate population growth rates to evaluate long-term success. Community involvement on the islands has been high and has been critical to the success of this project.

ORAL

GARRY OAK STAND HISTORY IN SOUTHERN COASTAL BRITISH COLUMBIA. Shyanne J Smith, Quercus Consulting, 1354 Coppermine Road, Sooke, BC V9Z 1B2; *shyanne.smith 'at' gmail.com*

Many North American oak savannahs are experiencing conifer and shrub encroachment, resulting in closed canopy woodlands and forests. In order to maintain oak savannahs, managers need to understand the processes that historically maintained these systems and the processes and conditions that are currently affecting stand structure and regeneration. Despite the high level of interest in the Garry oak ecosystems of southern coastal British Columbia and their restoration, there has been little research on historical stand structure and change in these savannah systems. One effective tool that can increase our understanding of stand dynamics and succession is the study of tree-ring chronologies. Tree-ring chronologies from eight island sites with mixed Garry oak and conifer canopies in and adjacent to the Gulf Islands National Park Reserve were collected and analyzed. Results indicate a dramatic increase in stand recruitment at the time of European settlement. Rates of forest encroachment were found to vary considerably between sites, with sites on smaller islands experiencing less conifer encroachment than sites on larger islands. Understanding these historical patterns and the stand dynamics of these ecosystems can help in the design of appropriate site restoration and management.

POSTER

THE GARRY OAK ECOSYSTEMS RECOVERY TEAM: A CASE STUDY OF COOPERATIVE CONSERVATION FOR SPECIES AT RISK RECOVERY. Shyanne Smith, Chris Junck, Carolyn Masson, Kersti Vaino, Garry Oak Ecosystems Recovery Team, 209-606 Courtney Street, Victoria, BC V8W 1B6; Brian Reader, Parks Canada Agency, 603 Fort Rodd Hill Road, Victoria, BC V9C 2W8; *shyanne.smith 'at' goert.ca*

The Garry Oak Ecosystems Recovery Team is an ecosystem and partnership based approach to species at risk recovery. Formed in 1999, the recovery team is a partnership of federal, provincial and local governments, specialists, conservation organizations and volunteers. Our team is responsible for recovery planning and implementation for 116 rare species in Garry oak (Oregon white oak) and associated ecosystems, including 48 species currently listed as "at risk" under the Canadian Species at Risk Act. Our umbrella ecosystem strategy identifies six complementary approaches to species and ecosystem recovery: Inventory and Mapping, Conservation and Planning, Species at Risk, Restoration and Management, Research and Communications. Using these approaches, partners and stakeholders are involved in ecosystem-level and species-level recovery planning and implementation. Approximately 30 species have recovery strategies in progress or complete and recovery actions are underway at many species at risk sites, with the voluntary cooperation of landholders. In addition to species-level planning and action, our program raises awareness and appreciation of Garry oak ecosystems and associated species at risk through development and distribution of planning, restoration and protection tools and resources,

as well as educational events, training workshops, seminars, meetings and a landholder contact program. Over the last 10 years, our program has proven to be an effective method of engaging partners and stakeholders in species and ecosystem recovery.

ORAL

FIRE HISTORY OF A DOUGLAS-FIR—OREGON WHITE OAK WOODLAND, WALDRON ISLAND, WASHINGTON. Carson B. Sprenger, Rain Shadow Consulting, Box 107, Shaw Island, WA 98286; Peter W. Dunwiddie, School of Forest Resources, University of Washington, Box 354115, Seattle, WA 98195; *carson 'at' rainshadowconsulting.com*

A fire scar chronology was constructed from a *Pseudotsuga menziesii*—*Quercus garryana* community within a 155 ha study site on southeast Waldron Island in the San Juan Islands, Washington. Sixty-two scars were identified on 15 cross-dated *Pseudotsuga* samples that documented fire events between 1530 and 1908. A master tree-ring chronology was created for the period 1685 to 2004. Composite fire intervals, individual-tree fire intervals, and natural fire rotation (NFR) were used to characterize the fire history. Season of past fires was determined by analyzing fire scar position within annual ring structure. For the historic period 1700–1879, the composite mean fire return interval (FRI) was 7.4 yrs. The historic period mean individual-tree FRI was 18.4 yrs. In contrast, only three fires were recorded during the settlement/modern period (1880–2004), resulting in a mean individual-tree FRI of 103.8 yrs. NFR, or the number of years required to burn an area equal in size to the study site, calculated to 49 yrs for all years analyzed (1700–2004), 32 yrs for the historic period, and 210 yrs for the settlement/modern period. Seasonality of past fires indicates that most fires occurred during late summer and fall. No evidence of spring or early summer burning was detected. We interpret the marked reduction in fire frequency between the historic and settlement/modern period as reflecting declines in Native American population size and activity, and eventually a cessation of deliberate ignitions by Native Americans.

ORAL

MANAGEMENT RECOMMENDATIONS FOR RESTORING PACIFIC NORTHWEST PRAIRIES FROM A LARGE-SCALE, LONG-TERM COLLABORATIVE RESEARCH PROJECT . Amanda Stanley, Institute for Applied Ecology, PO Box 2855, Corvallis, OR 97339-2855; Peter Dunwiddie, School of Forest Resources, University of Washington, Box 354115, Seattle, WA 98195; Tom Kaye, Institute for Applied Ecology, PO Box 2855, Corvallis, OR 97339-2855; *Amanda 'at' appliedeco.org*

In cooperation with numerous partners, the Institute for Applied Ecology and The Nature Conservancy conducted a 5-year study at 10 sites throughout the ecoregion (from British Columbia to the Willamette Valley) aimed at improving methods for restoring degraded prairies and oak savannas. Our manager-recommended treatment combinations included the following components: summer and fall mowing, grass-specific and broad-spectrum herbicide, and fall burning. All treatment combinations were crossed with native seed addition. As expected, we found there was no 'silver bullet'; while some treatment combinations led to large improvements in weed control and native diversity and abundance, the degree of success varied across sites. Where invasive grasses are the most pressing problem, we recommend the use of grass-specific herbicides as highly effective with minimal non-target effects on native forbs and some native grasses. Fire is a useful tool for preparing a site for seeding, but may need to be followed closely with a broad spectrum herbicide to control rapidly resprouting weeds. Careful timing of post-fire herbicide avoids later-sprouting natives. At all sites, we recommend seed addition to enhance native diversity and abundance, as our data show even relatively high quality sites show strong

seed limitation. While mowing reduces thatch and increases light penetration, mowing is ineffective at reducing weed abundance and moss cover, and thus seedling recruitment is poor. If fire is not an option, we recommend testing mowing with other methods of weed control and increasing bare soil to improve seedling success.

ORAL

ECOLOGY AND MANAGEMENT OF PRAIRIE-OAK COMMUNITY ON AMERICA'S NORTHWEST TRIBAL LANDS. Melody A. Steele, Bureau of Indian Affairs, Division of Forest and Wildland Fire Management, Portland, OR 97232-4182; *melody.steele 'at' bia.gov*

The natural and cultural Prairie-Oak community on America's Northwest Tribal Lands occurs on drier lands. The prairie-oak ecosystems are naturally fire dependent. The natural ecology is adapted to frequent lightening strikes that tend to burn rapidly across dry grass. The flora and fauna have evolved legs to out run fires and wings to fly away on the eastside of the Cascades. Historically the prairie-oak community is also culturally adapted to Native Americans intentionally setting fires. The purpose of prairie fires was to flush prey while hunting or keeping cultural plants flourishing or for maintaining a travel route, among numerous other reasons. Tribal missions and goals embrace traditional ways. To restore these prairie-oak ecosystems, management is considering recommending burning every 6 to 12 years in small areas much as was done in the past. Today management is challenged by invasive species spreading on disturbed lands. Fire effects science is needed to blend in with management experience to carry out this challenge to restore the prairie-oak ecosystems.

ORAL

PEOPLE, PLANTS AND PRAIRIES: RECONSTRUCTING THE LONG-TERM HISTORY OF UPPER CHEHALIS BASIN PRAIRIE LANDSCAPES. Linda E. Storm, Ph.D. Candidate in Ethnobotany/Ethnoecology, Environmental Anthropology, Department of Anthropology, University of Washington, P.O. Box 353100, Seattle, WA 98195; *lstorm61 'at' aol.com*, *lstorm 'at' u.washington.edu*.

I provide an overview of past people-plant interactions in the Upper Chehalis basin and illustrate how Indigenous peoples' management practices influenced the spatial extent and plant composition of prairies in the past. Paleoeological and archaeological data were evaluated to develop a conceptual model of when Indigenous peoples began prairie ecosystem management with fire and how wild plant food cultivation evolved in southwestern Washington. Historic, ethnographic, and ethnobotanical data were analyzed to understand the historic spatial extent of prairies at the time of Euro-American settlement. The cultural context(s) and potential motivations of Indigenous peoples' prairie management practices were explored by reviewing history and traditions recorded by ethnographers in the early 1900s. Finally, an exploratory field experiment was performed to test the effects of fire on ethnobotanically important plant species, specifically focusing on the cultural key-stone staple 'root food', camas (*Camassia quamash* ssp. *azurea*). The hypotheses that camas productivity increases with frequent fires and that earth mound features (Mima Mounds) would increase the availability of camas and/or other ethnobotanical plants through a seasonal round (growing season) were tested. The results of this research support these hypotheses; providing a detailed understanding of past people-plant interactions in the Upper Chehalis basin. These results provide important implications and applications for contemporary ecological restoration and cultural resource management today.

ORAL

GEOLOGY, ECOLOGY, AND HUMAN DIMENSIONS OF MOUNT ST. HELENS: 30 YEARS OF LEARNING. Frederick J. Swanson, Pacific Northwest Research Station, US Forest Service, 3200 Jefferson Way, Corvallis, OR 97331; *fswanson 'at' fs.fed.us*

The eruption of Mount St. Helens on May 18, 1980, was a globally-transformative event for volcanology, ecosystem science, and human engagement with volcanoes. Public interest in the volcano, its ever-changing landscape, and the broader societal context tell us that, even after 30 years, this is a vibrant place for learning and teaching. The 1980 and subsequent geophysical events have taught us a great deal about many poorly-known processes and deposits—the keys to understanding a volcano's past eruptions and behavior. This set the stage for a new phase of growth in basic volcanology and its application at sites of volcanic unrest throughout the world, most notable through the US Geological Survey's Volcano Disaster Assistance Program. Technological advances made it possible obtain a near-real-time record of earthquakes, ground deformation, and gas emissions before, during, and after eruptions. Ecological responses to the physical processes have been stunning in their diversity, richness, and vigor across a range of meadow, forest, lake, and river environments. In the human dimension, Mount St. Helens displaced, impoverished, and killed many people; but she has also inspired many—from grade school children to seasoned mountain scientists, poets, and philosophers. Continuing geological, ecological, and humanities inquiry at Mount St. Helens constantly adds to the rich legacy of knowledge from this place. Those of us who have had the good fortune to work at Mount St. Helens wish to encourage new work and new workers in this volcanic landscape; we have so much more to learn from this compelling teacher.

ORAL

LOGGING RAILROADS TO TRUCK ROADS: THE CHANGING FACE OF TIMBER HARVEST ON WEYERHAEUSER'S VAIL-MCDONALD TREE FARMS 1928–2000. Frank W. Telewski and Scott Barrett, Department of Plant Biology and W.J. Beal Botanical Garden and Campus Arboretum, Michigan State University, East Lansing, MI 48824; *telewski 'at' cpa.msu.edu*

The Pacific Northwest was opened up to large-scale timber harvest shortly after the turn the 20th Century, with the extensive use of logging railroads. In the mid 1920s, the Weyerhaeuser Timber Company began to look to their timber holdings in southwest Washington (Lewis, Clark, and Thurston Counties) to supply timber for their Everett mill complex. In 1928 the Company opened a 31-mile mainline from the woods south of Rainier near the company town of Vail, north to South Bay on Puget Sound. From there logs were rafted north to Everett. South into the woods, miles of logging spurs were constructed. A second operation was open west of Chehalis from a point named Camp McDonald. During the Great Depression and World War II, the face of railroad logging began change. CCC workers converted old railroad ROWs to fire roads, and the demand for labor and changes in technology during the war altered practices. Trucks replaced railroad spurs. Altered property taxation led to modern reforestation practices replacing 'cut and run'. Railroad runs were reduced to the mainline and remained viable until the mid 1990s. In this presentation we will review the historic changes in technology and their impact on land utilization.

ORAL

A PRAIRIE RESERVE DESIGN MODEL FOR PUGET TROUGH LOWLAND PRAIRIES; PRELIMINARY RESULTS TO PRIORITIZE PRAIRIE PATCHES. Theodore Thomas and Jodi Bush, U. S. Fish and Wildlife Service, Lacey, WA 98503; *ted_thomas 'at' fws.gov*

The U.S. Fish and Wildlife Service in coordination with several local agencies, non-governmental organizations and with input from an expert panel have developed a preliminary model to assist with prioritizing prairie patches for conservation. One objective was to develop a tool to help identify and prioritize the importance of existing protected and unprotected prairie patches in the Puget Trough Lowlands, Washington. In the face of ongoing development of prairies, it was essential to establish criteria that would allow protection and guide management of these prairies as habitat for Federal candidate species. The taxa of concern include Taylor's checkerspot butterfly (*Euphydryas editha taylori*), 2 subspecies of Mazama pocket gopher (*Thomomys mazama yelmensis*, *T. m. couchi*), and the streaked horned lark (*Eremophila alpestris strigata*). Protection and conservation of prairies for these species would also provide ancillary benefit to several other species at risk. For our model we used existing data for local prairies, and we enlisted an expert panel to parameterize factors that would predict species persistence for 50 years for all taxa. A secondary objective will account for the amount of restoration effort, expressed as management, colonization, and translocation that would be required to sustain the prairie network as suitable, occupied habitat for the candidate species. Results from the model could assist with prairie conservation planning and management in Thurston County and will help in the decision making for future acquisition of prairie patches.

POSTER

TORRENT SALAMANDER MOVEMENT ECOLOGY: AN UPDATED PERSPECTIVE ON A "SEDENTARY" SPECIES. Julie Tyson, Marc Hayes, Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, Washington 98501; *Julie.Tyson 'at' dfw.wa.gov*

Torrent salamanders (genus *Rhyacotriton*) are potentially characterizable as the most sedentary amphibians in the Pacific Northwest. Maximum reported movement distance for any life stage, a move recorded for 2 larvae, is only 22 m. In the course of a manipulative study examining amphibian response to different levels of shade, we opportunistically obtained 91 recaptures of larval Olympic torrent salamanders (*R. olympicus*) that had escaped from stream enclosures. Within the same year (season), 65 unique individuals moved distances ranging up to 122 m over intervals spanning 2 to 119 days. Ten of these animals had moved 2 to 100 m further than the maximum reported for any *Rhyacotriton* life stage. We also recaptured 20 individuals at intervals of 247–1048 days over 2–4 calendar years that had moved up to 123 m. Nine of these animals had moved 2 to 101 m further than previous reports. Though our data consist of escapees from stream enclosures, they illustrate that larval torrent salamanders are capable of moving distances substantially greater than previous reports. Moreover, design of all previous studies that have had some ability to describe movements in *Rhyacotriton* have not attempted recaptures outside a limited footprint, which makes underestimation of movement scale unavoidable. These findings strongly suggest that movement scale in *Rhyacotriton* merits thorough investigation.

ORAL

DOME EXTRUSION THROUGH THE CRATER GLACIER AT MOUNT ST. HELENS FROM 2004 TO 2008. James W. Vallance, U.S. Geological Survey, 1300 SE Cardinal Court, B10, S100, Vancouver, WA 98683; *jvallance@usgs.gov*

The eruption of Mount St. Helens between 2004 and 2008 provided a first opportunity to observe lava-dome emplacement through a glacier. Glacier ice had minimal influence on the extrusion, recumbent growth, and repeated breakup of solidified lava spines. Chief near-surface controls on spine extrusion were vent location, topographic surfaces concealed by glacier ice, and spine remnants emplaced previously. Ice as thick as 150 m inhibited formation of marginal repose-angle talus fans but did not provide sufficient resistance to stop or appreciably slow spine growth. Although the glacier had small influence on growing spines, spine growth and associated nearby deformation affected the glacier dramatically, initially dividing it into two arms, bulldozing it hundreds of meters first east then west, and then heaping it more than 100 m higher than its original altitude. Curiously, this mistreatment failed to cause appreciable glacier melt despite the proximity of hot rock. New gradients much steeper than those prior to the eruption accelerated glacier motion down slope to the north so that, unlike termini of other glaciers in the Pacific Northwest, Crater Glacier's terminal margins have advanced rather than retreated. Also unlike other temperate glaciers, Crater Glacier shows no evidence of either speed-up at the beginning of the ablation season or diurnal speed fluctuations during the ablation season. Evidently, there is no pressurized drainage system at the glacier bed. Instead meltwater penetrating the glacier must enter a thick layer of coarse rubble at its bed and then infiltrate into the volcano's groundwater system.

ORAL

RIPARIAN FOREST STRUCTURE AND SUCCESSION IN SECOND-GROWTH STANDS OF WASHINGTON. Lauren A. Villarin (was Mollot), College of Forest Resources, University of Washington, Seattle, WA 98105; *lauren.villarin@weyerhaeuser.com*

We examined the relationship between landform and riparian forest structure and succession in second-growth stands that had been historically railroad logged at the Cedar River Watershed. We sampled trees, saplings, seedlings, and shrubs across four geomorphic surfaces including the low floodplain, high floodplain, terrace and hillslope. Landform classification was based on topographic characteristics, proximity to the stream channel and flood frequency. Statistical analyses using generalized estimating equations (GEE) showed that landform exerted a strong influence over the distribution and abundance of overstory trees. Valley floor landforms were characterized by initial disturbance from timber harvest, and ongoing fluvial disturbance, favoring the establishment of deciduous communities dominated by red alder (*Alnus rubra*) and maintenance of early successional riparian stands. In contrast, the upslope landforms were subject to timber harvest as the stand initiating agent and were unaffected by fluvial disturbance. We found that forest composition and structure differed between the terrace and hillslope, as a result of differences in soil moisture levels, with the frequency of younger conifers being significantly higher on hillslopes. Deciduous tree reproduction was very low on terraces and hillslopes. Our research also suggests that conifer recruitment may be more successful on soil substrates than on coarse woody debris. We propose that the interplay between the disturbance regime and soil moisture conditions were the primary of vegetation differences among landforms influencing the course of succession, present stand structure, and future successional trajectories in these second-growth riparian areas.

ORAL

A MULTIVARIATE ANALYSIS EXAMINING THE EFFECT OF LANDFORM ON THE DISTRIBUTION OF RIPARIAN PLANT COMMUNITIES IN THE CASCADE MOUNTAINS OF WESTERN WASHINGTON, USA. Lauren A. Villarin (was Molloy), College of Forest Resources, University of Washington, Seattle, WA 98105; Robert E. Bilby, Weyerhaeuser Co. Environmental Forestry Research, P.O. Box 9777, Federal Way, WA 98063; David E. Chapin, Seattle Public Utilities, 19901 Cedar Falls Road S.E., North Bend, WA 98045; *lauren.villarin 'at' weyerhaeuser.com*

A considerable amount of research has been conducted on the influence of landform features on the distribution of vegetation major river floodplains. Substantially less work has examined this relationship along smaller streams in mountainous terrain. We utilized multivariate statistical techniques to examine the relationship between landform types and riparian plant floristics along small channels in Washington. Landforms were assigned to four different classes (low floodplain, high floodplain, terrace and hillslope) based on topographic characteristics and position relative to the stream channel. Landform exerted a strong influence on the distribution of tree, shrub and understory plant species. Certain taxa were found only on one or two of the landforms. Other species displayed a gradient in abundance across landforms. No single species occupied all landforms at the same level of abundance. The distribution patterns of species among the landforms suggested that primary drivers in the organization of the plant communities were moisture and susceptibility to disturbance. Plants preferring high moisture levels and resistant to the effects of fluvial disturbance typically were found on the floodplain landforms. Communities with hardwood-dominated overstories and dense shrub understories were prevalent on these sites. Slopes and terraces supported species able to cope with drier conditions and those unable to persist with frequent disturbance. Conifers were prevalent only on these drier, infrequently-disturbed landforms. These results indicate that restoration measures to increase the presence of conifer trees in riparian areas, a common activity in the Pacific Northwest, should be applied only on landforms that would naturally support these species

ORAL

DID NATIVE AMERICANS BURN THE WILLAMETTE VALLEY? INSIGHT FROM THE PALEOECOLOGICAL RECORD INTO CLIMATIC AND ANTHROPOGENIC INFLUENCES ON FIRE ACTIVITY OVER THE PAST 1200 YEARS. Megan K. Walsh, Department of Geography, 107 Condon Hall, University of Oregon, Eugene, OR, 97403-1251; Cathy Whitlock, Department of Earth Sciences, 200 Traphagen Hall, Montana State University, Bozeman, MT, 59717; Patrick J. Bartlein, Department of Geography, 107 Condon Hall, University of Oregon, Eugene, OR, 97403-1251; *mw Walsh2@uoregon.edu*

The extent to which Native Americans managed the low-elevation ecosystems of the Pacific Northwest's interior valleys prior to Euro-American settlement (ca. AD 1830) is highly debated. Many contend that the oak savanna and prairie ecosystems widespread at the time of settlement were the result of thousands of years of Native American burning. Others suggest natural climate variability controlled fire activity and determined long-term vegetation patterns. To address this debate, we reconstructed the paleoecological history of five low-elevation sites in the Willamette Valley, OR, for last 1200 years. High-resolution macroscopic charcoal and pollen analyses were used to reconstruct fire and vegetation history, and those records were compared with independent indicators of climate variability and human activity. Overall, our results strongly suggest a combination of natural and human influences on fire regimes, but they vary greatly both spatially and temporally. At some sites, including Battle Ground Lake, WA, shifts in fire activity compared closely with centennial-scale variations in climate. At other sites, such as Beaver Lake, OR, and Lake Oswego, OR, fire-regime shifts and subsequent vegetation shifts were more closely associated with inferred changes in human land-use. Perhaps most interesting is that contrary to popular belief, the records show that fires were generally infrequent in the 200-300 years prior to

Euro-American settlement of the valley. This research contributes to our understanding of long-term vegetation dynamics and the role of fire, both natural- and human-ignited, in shaping ecosystems, and provides an historical context for evaluating recent shifts in plant communities.

ORAL

ENHANCING TAYLOR'S CHECKERSPOT HABITAT IN A GRASSLAND BALD SYSTEM OF WASHINGTON'S SOUTHERN PUGET TROUGH. David Wilderman, Deborah Nemens, Washington Department of Natural Resources, 1111 Washington Street Southeast, Olympia, Washington 98504; Roberta Davenport, Washington Department of Natural Resources, 601 Bond Road, Castle Rock, Washington 98611; *david.wilderman 'at' dnr.wa.gov*

Bald Hill Natural Area Preserve (NAP), located in the southern Puget Trough of Washington, encompasses a patchwork of grassland balds that supported Taylor's checkerspot (*Euphydryas editha taylori*) as recently as 2006. Shrub and tree encroachment in balds, lack of connectivity between balds, and low larval host and nectar plant abundance led to initiation of restoration activities in 2007. Coniferous trees and shrubs are being removed or controlled within balds and in areas that historically connected balds. Native grassland species are being used to restore degraded areas and to augment larval host and nectar resources for Taylor's checkerspot. Introduced species, including orchard grass (*Dactylis glomerata*), scotch broom (*Cytisus scoparius*), and velvetgrass (*Holcus lanatus*) are also being treated through herbicide application and hand-pulling. To date, we have removed small conifers and controlled shrubs on more than four acres, treated introduced species on one and one-half acres, and planted over 2000 plugs of native species. Seed from native grassland species have been collected from the site and are being used for propagation of transplants as well as to establish seed increase beds. Planting and seeding has included a number of species, focusing on larval host and nectar species such as harsh paintbrush (*Castilleja hispida*), rosy plectritis (*Plectritis congesta*), small-flowered blue-eyed Mary (*Collinsia parviflora*), and spring gold (*Lomatium utriculatum*). Pending treatments include removal of larger coniferous trees via helicopter, continued planting and seeding of native plant species, and experimental prescribed burning.

ORAL

CONSILIENCE AND CONCINNITY. Gerould Wilhelm, Conservation Design Forum, 375 West First Street Elmhurst, IL 60126

Consilience means "jumping together" and is typified when all the elements of an ecosystem are working in harmony. The health of an ecosystem is directly related to consilience. If one acknowledges that plants and animals grow in habitats to which they are adapted, then one must accept the corollary: Change the habitat and the inhabitants change. All elements in an ecosystem must be in consilience if the system is to remain stable enough to endure changes at the rates at which mountains rise and fall. As an ecosystem's elements dropout, the ability for all other elements to jump together is accordingly and progressively diminished. Consilience includes, crucially, the Holocene-aged relationship that the system has had with any sustainable human cultures that depended on the system for critical, life-sustaining resources. Most of the World's ecosystems have had such a relationship with human cultures. The implications for ecosystem collapse when this is abrogated are evident everywhere around us. The challenge for contemporary restoration ecologists is to discover the aboriginal relationships and help our people re-engage appropriately. Concinnity is the beautiful harmony between people and place as humans understand their role in "jumping together."

ORAL

INTRODUCTION TO THE FLORISTIC QUALITY ASSESSMENT: CONCEPT, ORIGIN, AND UTILITY.
Gerould Wilhelm, Conservation Design Forum, 375 West First Street Elmhurst, IL 60126

The Floristic Quality Assessment (FQA) was developed in the 1970's as a systematic approach for assessing the quality of natural remnants in the Chicago Region. Since then, the FQA approach to assessing ecological condition has gained widespread acceptance as monitoring and assessment tool, especially for prairie and wetland ecosystems. In this presentation, I will provide a background of the FQA, discuss the concept of plant conservatism, and provide recommendations on approaches for assigning conservatism values.

ORAL

APPLICATIONS OF THE FLORISTIC QUALITY ASSESSMENT METHOD: LEARNING FROM
EXAMPLES FROM THE MIDWEST AND ROCKY MOUNTAIN STATES. Gerould Wilhelm,
Conservation Design Forum, 375 West First Street Elmhurst, IL 60126; Denny Albert, Oregon State
University, 4073 ALS Building, Corvallis, Oregon, 97331; Joe Rocchio, Washington Natural Heritage
Program, 1111 Washington Street SE, Olympia, WA 98503.

The Floristic Quality Assessment (FQA) has been used for such objectives as identifying remnant natural areas, prioritizing conservation sites, monitoring the success of restoration activities, and identifying performance standards for wetland mitigation. In this presentation, we provide examples of how the FQA has been used in other parts of North America as context for how it might be useful for monitoring and assessment of Pacific Northwest ecosystems. Specifically, we provide examples of the FQA being used for monitoring and assessing the prairie landscape of the Chicago region, coastal wetlands in Michigan, and montane/subalpine wetlands and riparian areas in the Southern Rocky Mountains of Colorado. Our intention is to generate ideas for subsequent Group Discussion (following this presentation) as to how the FQA could provide a useful and unique indicator for monitoring and assessment objectives in the Pacific Northwest.

POSTER

HISTORIC SEDIMENT SOURCE INDEX AS AN APPROACH TO IDENTIFYING AND PRIORITIZING
BEACH NOURISHMENT PROJECTS IN PUGET SOUND. Stephanie Williams, Jim Johannessen, Coastal
Geologic Services, 1711 Ellis St, suite 103, Bellingham, WA 98225; *Stephanie 'at' coastalgeo.com*

Historic Sediment Source Index (HSSI) is a process-based approach to identifying and prioritizing restoration opportunities along the shoreline. HSSI involves scoring shoreline segments based on pre-modified geomorphic character and is based on coastal processes and sediment supply to the net shore-drift system or long-term litt drift system. Sediment sources (feeder bluffs) are the primary source of beach sediment and natural erosion of feeder bluffs is essential to maintaining beaches and associated ecosystems. A feeder bluff that has been cut off, due to human-induced modifications such as bulkheads, can result in a sediment-starved beach down drift. Starved beaches become more coarse grained, and the quality of habitat becomes degraded. One impacted area along West March's Point in Skagit County was identified as a high priority for beach nourishment in the study *March's Point Geomorphic Assessment & Restoration Prioritization*, where HSSI scoring was utilized. West March's Point is now a beach nourishment project designed by Coastal Geologic Services with the overall goal of enhancing natural processes and nearshore functions that support viable forage-fish spawning and juvenile salmon rearing. The project enhances the upper beach to improve the habitat value of the beach through sediment nourishment. HSSI is a useful tool for project planning and implementation and has been applied by many groups working in the nearshore. Historic conditions mapping has been completed for

355 miles of Puget Sound shoreline. Completion of the dataset Sound-wide would allow for true process-based analysis, future beach nourishment opportunities, and overall restoration planning.

ORAL

LATE PLEISTOCENE MEGAFUNA AND THE HISTORY OF EARLY POSTGLACIAL VEGETATION ON THE SAN JUAN ISLANDS, WASHINGTON, AND VANCOUVER ISLAND, BRITISH COLUMBIA. Michael C. Wilson, Department of Earth and Environmental Sciences, Douglas College, P.O. Box 2503, New Westminster, BC V3L 5B2, Canada; *wilsonmi 'at' douglas.bc.ca*

Establishment and succession of early postglacial vegetation communities in the Pacific Northwest have typically been interpreted in terms of climatic factors, but biotic drivers must also be considered. First arrivals of particular plant species depended upon appropriate vectors, which included not only wind and water but also specific birds and mammals. Significant among the latter were megafauna such as ungulates and carnivores, each species of which had its own arrival time on Vancouver Island (VI) via filter bridges, one of which was via the San Juan Islands (SJ). Mountain goats (*Oreamnos americanus*) arrived on VI before 12,500 ¹⁴C yr BP. Giant bison (*Bison antiquus*) were present on SJ and southeastern VI from ca. 12,000 to 10,500 ¹⁴C yr BP (~14,000 to 12,500 cal yr BP) and ground sloths (*Megalonyx jeffersonii*) were present on the San Juans. Each was likely influential in importing plant propagules (zoochory), setting in motion an historical cascade of community responses; as well as in “ecological engineering” of succession through grazing, browsing, trampling of substrates, and other activities. Top predators such as bears, wolves, and humans would have influenced vegetation via a trophic cascade involving megaherbivore populations. Early succession of vegetation from tundra-like communities through open lodgepole pine (*Pinus contorta*) parklands to mixed coniferous forests tracked the arrival, presence, and extirpation of the SJ-VI megafauna as well as increasing fire frequency associated with human activity. Although the bison and ground sloths are now absent, distributional anachronisms may remain from their former presence.

ORAL

MASS WASTING IN THE YAKIMA RIVER CANYON, WASHINGTON. Tom Winter, Karl Lillquist, Department of Geography and Land Studies, Central Washington University, 400 E. University Way, Ellensburg WA, 98926; *winterth 'at' cwu.edu*

Landscape evolution in the Yakima Fold Belt of Central Washington is thought to be heavily dependent on mass wasting events such as landslides, debris flows, and rockfall. This analysis identified, classified, and mapped past mass wasting -events, as well as areas prone to future mass wasting in Central Washington's Yakima River Canyon. From this work, we identified the spatial causes and distribution of these events. Using aerial photo interpretation, historical records, and field observation, we identified 35 landslides, 28 debris flow fans, and 112 rockfall areas. These were classified by morphology as inactive-old, inactive-mature, inactive-young, and active. Inactive-old was the most common morphology for landslides. Debris flows and rockfall have higher frequencies of inactive-young and active morphologies. Mass wasting events encompass ~16 % of the study area, with deep seated landslides at ~7%, rockfall ~9%, and debris flows <1%. I used historical records to identify an additional 15 smaller mass- wasting events that could not be mapped or classified due to uncertainties in descriptions. Hazardous areas were identified based on geology, distance to faults, land use, and slope. The Yakima River Canyon is a major transportation corridor for recreationalists and residents, and is experiencing increased development. The creation of a mass wasting inventory and hazard map will help mitigate potential damages to infrastructure and transportation.

ORAL

APPLYING ECOLOGICAL PRINCIPLES TO ACHIEVE A SELF-SUSTAINING WET PRAIRIE RESTORATION. Eric Wold, Trevor Taylor, Parks and Open Space Division, City of Eugene, 1820 Roosevelt Blvd, Eugene, OR, 97403-4159; Jean Jancaitis, The Nature Conservancy, 87200 Rathbone Road, Eugene, OR 97402-9137; *eric.n.wold 'at' ci.eugene.or.us*

A goal of many wetland prairie restoration projects is to achieve diverse native plant communities that are self-sustaining in the long-term—In practice this is rarely achieved. Using ecological principles such as assembly rules and succession, the West Eugene Wetlands Program has implemented an innovative approach to wet prairie restoration. Focusing on site preparation and a strategic seeding regime, this approach produces the desired result of high native-species diversity and abundance, low non-native cover, and resistance to invasion by non-native species. This presentation will describe the Dragonfly Bend project, which utilized a no-till site preparation regime consisting of multiple herbicide applications combined with broadcast and no-till drill seeding over a two-year period. This multi-year seeding regime incorporates the unique life histories, establishment rates, and functional roles of native plant species. Techniques were evaluated based on two vegetative measures, percent cover and species richness; data were collected during the second growing season (51 species observed, 95–98 percent relative native cover) and fifth growing season (99 species observed, 99 percent relative cover). We have found that using ecological principles to inform site preparation and seeding strategies is a key element of successful wet-prairie restoration.

POSTER

THE ROLE OF THE NORTHERN POCKET GOPHER IN PRIMARY SUCCESSIONAL LANDSCAPES AT MOUNT ST. HELENS. Raymond P. Yurkewycz, Washington State University- Vancouver, Environmental Science Program, 14204 NE Salmon Creek Avenue, Vancouver, WA 98686; *raymond.yurkewycz 'at' email.wsu.edu*

The Northern Pocket Gopher (*Thomomys talpoides*) has been shown to strongly influence ecosystem dynamics in western North America through mound building and herbivory, resulting in altered plant communities and biogeochemical processes. Pocket gophers colonized the Pumice Plain of Mount St. Helens in 1992, 12 years after the 1980 eruption, and have expanded their population since that time. The objectives of the research are to determine the effects of pocket gophers on plant community diversity as well as on soil nutrient fluxes and pools in a primary successional system. I compared plant species percent cover and abundance on mounds, near mounds and in undisturbed areas. I also created artificial gopher mounds and compared rates of soil CO₂, NO₃-N, NH₄-N, and PO₄-P flux, and soil %N and %C composition between artificial mounds and undisturbed areas. Gopher mounds exhibited decreased species density and richness compared to near-mound, and undisturbed areas. Older artificial gopher mounds (one year old) exhibited decreased rates of soil CO₂ flux compared to undisturbed areas, while recently-created mounds (2 weeks old) showed no difference in soil CO₂ flux rates. Additionally, there was no difference in NO₃-N, NH₄-N, and PO₄-P flux rates or %C and %N between artificial mounds and undisturbed areas. These results indicate that gopher disturbances create conditions that are suitable for a subset of plants found in the surrounding community. They also suggest that the relationship between gopher disturbance and soil nutrient fluxes are likely mediated by interactions with plant communities and soil microbe assemblages.

ORAL

UNDERSTORY PLANT MORTALITY AND RECOVERY: LEARNING FROM THE TEPHRA. Donald B. Zobel, Botany and Plant Pathology, Oregon State University, Cordley 2082, Corvallis OR 97331-

2902; Joseph A. Antos, Biology, University of Victoria, Victoria, BC Canada V8W 3N5; *zobeld 'at' science.oregonstate.edu*

We studied the effects of the 1980 tephra (aerially-transported volcanic debris) deposit from Mount St. Helens on subalpine forest understory plants. Tephra produced major damage to forest understory plants, with changes lasting decades. Tephra 15 cm deep reduced cover of bryophytes, herbs, and (where it fell on snow) shrubs by >99%. Tephra 4.5 cm deep destroyed most bryophytes, 0-41% of herb cover, and (where it fell on snow) 66% of shrub cover. After 20 years, cover remained substantially below pre-eruption levels for bryophytes at both tephra depths, for herbs in deep tephra, and for shrubs where deep tephra fell on snowpack. After 25 years, herb recovery in deep tephra depended less on surviving plants, occurred later, and involved more turnover than in shallow tephra, but included a greater increase in plant size and the establishment of early seral herb species. Plants with different habitat breadth differed in their mechanism of recovery: those that also grow in early seral habitats had fewer residuals, later establishment, more turnover, and less flowering than species restricted to forest or that grow in forests and meadows. Plants that occur in meadow and forest had more residuals and flowered less frequently than those restricted to forest. Species with more consistent flowering showed greater shoot turnover. The 20-year increase in plant density of a species was correlated with the number of seedlings produced per flowering shoot.

start	end	Thursday, March 25, 2010			
8:00	8:20	Welcome and Introduction - Corbet Theatre, Washington Hall			
8:20	9:10	Plenary Speaker: Fred Swanson - "Geology, ecology, and human dimensions of Mount St. Helens: 30 years of learning"			
9:10	10:00	Plenary Speaker: Gerould Wilhelm - "Consilience and Concinnity"			
10:00	10:20	Break - Refreshments Science Center Lobby			
10:00	10:20	SCI 121	SCI 111	SCI 107	WAH 103
10:20	12:20	Symposium: Prairie Restoration Research - Combining Tools for Success	Climate Change	Management of Pacific Northwest Forests	Symposium: 30 Years of Research at Mount St. Helens - Lessons Learned, and their Applications around the World
12:00	1:30	Lunch - on your own			
1:30	4:10	Symposium: Floristic Quality Assesment - Potential for Application in the Pacific Northwest	Garry Oak Ecology and Restoration	Lichenology	Symposium: 30 Years of Research at Mount St. Helens - Lessons Learned, and their Applications around the World
4:10	5:40	Poster Session - Wine and Cheese Social (complimentary beverages and appetizers) - Science Center 3rd Floor			
5:40	6:30	Break - on your own			
6:30	9:30	Banquet at The Aerie Ballroom - Speaker: Greg Retallack - "The world's greatest midlife crisis in Antarctica—The Permian-Triassic extinctions"			

start	end	Friday, March 26, 2010			
10:00	10:20	SCI 121	SCI 111	SCI 107	SCI 307
8:00	10:20	Prairies and Oak Woodlands: Protection and Restoration	Prairies and Oak Woodlands: History and Inventory	Geology / Paleontology	<i>Usnea</i> Workshop
10:20	10:40	Break - Refreshments Science Center Lobby			
10:40	12:20	Prairies and Oak Woodlands: Native Plant Materials Production	Prairies and Oak Woodlands: Vertebrate Wildlife	Pacific Northwest Ecology	<i>Usnea</i> Workshop
12:20	1:30	CPOP & NWSA Business Lunches - Cafeteria, Student Center (complimentary lunch)			
1:30	3:50	Prairie Restoration: Invasive Control and Prescribed Fire	Prairie and Oak Woodlands: Invertebrate Wildlife	Symposium (1:30-4:30): Biological, Landscape, and Disturbance Legacies of Railroad Logging	

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