



Coping with Change through Innovation: New Approaches, Tools, & Collaborations

Northwest Scientific Association 89th Annual Meeting

The Evergreen State College, Olympia, Washington

March 27-30, 2018

Program and Abstracts
Northwest Scientific Association
89th Annual Meeting

The Evergreen State College, Olympia, Washington

March 27 – 30, 2018

Held in Cooperation with

The Evergreen State College

Northwest Lichenologists

U.S. Forest Service

Washington Department of Natural Resources

Thank You to all who helped!

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

NWSA/NWL Local Planning Committee

Dylan Fischer, The Evergreen State College
Constance Harrington, USFS PNW Research Station
Joe Rocchio, WA Department of Natural Resources
Lalita Calabria, The Evergreen State College
Robin Leshner, U.S. Forest Service (retired)

Session Organizers

Sam Brenkman
Matthew Brousil
Lalita Calabria
John Calambokidis
Patrick Dehaan
Dylan Fischer
Jessica Halofsky
Mary Mahaffy
David Peterson
Janet Prevéy
Joe Rocchio
Andrea Woodward

NWSA Webmaster

Andrea Pipp

Program

Leslie Brodie

Volunteers

Pauline Allen
Jess Andrade
Claudia Arends
Ryan Balkcom
Nichole Criss
Jessica Doyle
Rae Handy
David Heydt
Irene Hinkle
Zach Holker
John Messina
Nils Nelson
Alex Pavlinovic
Anchal Ricki
Elle Rise
Heidi Steinbach
Hamish Stevenson
Heather Stewart
Jackie Van Der Hout
William Wiskes
Viva Worthington
Michael Zirpoli

Table of Contents

NWSA - Linking Scientists throughout Northwestern North America.....	2
NWSA – Board of Directors	2
Welcome Letter from NWSA President.....	3
Maps and Information	
Campus Map – The Evergreen State College.....	4
Purce Hall and Area Map <i>plus</i> Meal Options near campus	5
General Program Overview for Wednesday and Thursday	6
Wednesday Program	
Morning Schedule of Speakers and Titles	8
Biography of Dr. David L. Peterson, Keynote Speaker	9
Afternoon Schedule of Speakers and Titles	
Special Session – Adapting to the Effects of Climate Change in Aquatic and Infrastructure Management	10
Technical Session – Wildlife Biology and Management	11
Special Session – Changes in Top Predators of the Salish Sea.....	12
Pacific Northwest Lichenology and Bryology	13
Workshop – New Tools for Science in the 21st Century	14
Evening Poster Session – Presenters and Titles.....	15
Evening Banquet with Presentation by Dr. Jon Riedel.....	18
Thursday Morning Program	
Special Session - Native Food Plants of the Northwest	19
Technical Session - Ecology, Geology, Hydrology, and Riparian Habitats.....	20
Technical Session – Forest Management and Forest Health	21
Pacific Northwest Lichenology and Bryology.....	22
Thursday Afternoon Program	
Workshop - Northwest Lichenologists Lichen ID	22
Special Session - Native Food Plants of the Northwest (cont.)	23
Workshop – Applications in R programming for Ecology and Natural Resources ..	23
Ethics Panel Discussion.....	23
Special Session- Fisheries Conservation and Management in the PNW	24
Special Session – Ecoregional Land Mgmt. in Response to Changing Climate.....	25
Field Trip: Prairies of the South Sound: Conservation and Restoration.....	26
Field Trip: Using Small Unmanned Aircraft to Inform Natural Resource Mgmt.....	27
Field Trip: Bryophytes, Lichens, & Ecosystem Ecology of Acidic Peatlands	28
Field Trip: Lichens of Deschutes Falls County Park.....	29
ABSTRACTS	31

NWSA - Linking Scientists throughout Northwestern North America

Since 1923 the Northwest Scientific Association (NWSA) has existed for the purpose of promoting scientific knowledge in the northwestern United States and western Canada. Our membership includes professional and amateur scientists, resource professionals, teachers and students interested in applied, natural, physical, environmental and conservation sciences in the Northwest. Each year the NWSA publishes four issues of our peer-reviewed journal, *Northwest Science*. Our annual meetings are held throughout the Northwest and provide an opportunity for our members and the scientific community to share their current research results and foster collaborative interactions.

Would you like to get involved? Students are encouraged to join and participate in the NWSA. All members in good standing, including Student members, are eligible to serve on various committees, including the Nominations, Student Grants, Awards and Honors, and local Annual Meeting Program committees. Would you like to get involved and begin networking with the oldest and largest association of scientists in the Northwest? To learn more, talk to one of the board of directors, or visit our website at <http://www.northwestscience.org>.

A Special THANK YOU is extended to our 2017-2018 Board of Directors

President: Gregg Riegel
USDA Forest Service
Bend, OR

Northwest Science Editor: Dylan Fischer
The Evergreen State College
Olympia, WA

Past- President: Andrea Woodward
USGS Forest and Rangeland
Ecosystem Science Center

Webmaster: Andrea Pipp
Montana Natural Heritage Program

Secretary: Janelle Downs
Pacific Northwest National Laboratory

Treasurer: Robin Leshner
U.S. Forest Service (retired)

Board of Directors:

Jocelyn Aycrigg	University of Idaho
Matthew Brady	Lewis-Clark State College
Matthew Brousil	Washington State University
Lucius Caldwell	Cramer Fish Sciences
Constance Harrington	USFS Pacific Northwest Research Station
Jan Henderson	USFS (retired)
McLain Johnson	WA Department of Fish and Wildlife
Meg Krawchuk	Oregon State University
George Last	Pacific Northwest National Laboratory (retired)
Chris Lauver	University of Washington
Clayton Marlow	Montana State University
Joe Rocchio	WA Department of Natural Resources
Regina Rochefort	National Park Service
Ed Sala	WSU Press
Matt Stumbaugh	
John Villella	Siskiyou Biosurvey



WELCOME FROM THE PRESIDENT OF THE ASSOCIATION

We are excited to welcome you to the 89th Annual Meeting of the Northwest Scientific Association! A lot has happened in our beautiful part of the world since we last met at The Evergreen State College in 1998. The geography of the Northwest that defines our Association, from Alaska and Western Canada, to northern California and eastward to the Continental Divide of the Rocky Mountains, is vast—yet the landscape, biophysical and social connections continually reinforce our enthusiasm as a small yet vibrant scientific association as we celebrate our 95th year. This year's meeting builds on this connection and focuses attention to our current state of being, "*Coping with Change Through Innovation: New Approaches, Tools, and Collaborations*".

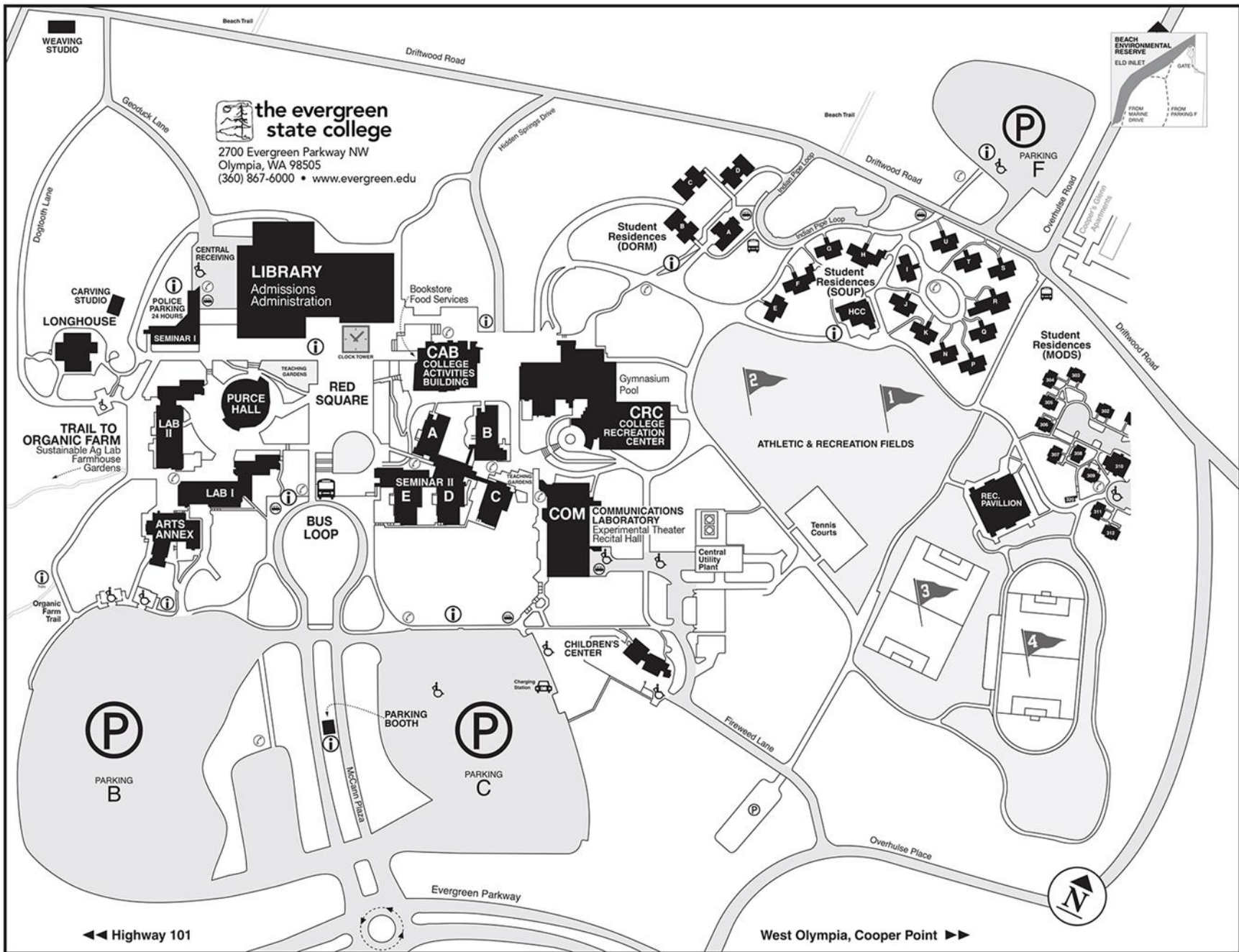
A very deserving big thank you to our meeting organizers, co-chairs Dylan Fisher and Connie Harrington, Joe Rocchio, Lalita Calabria, Andrea Pipp and Robin Leshner, who have been working for the last year to assemble the speakers, deal with logistics and countless details to make event this happen. We are grateful to our generous sponsors and cooperators: The Evergreen State College, Washington Department of Natural Resources - Washington Natural Heritage Program, Northwest Lichenologists, and the U.S. Forest Service. The generous support of TESC and Conference Services plus the large contingent of Evergreen student volunteers have all contributed to make this a successful meeting. Dr. Jennifer Drake, the Vice Provost of TESC welcomes us to the campus.

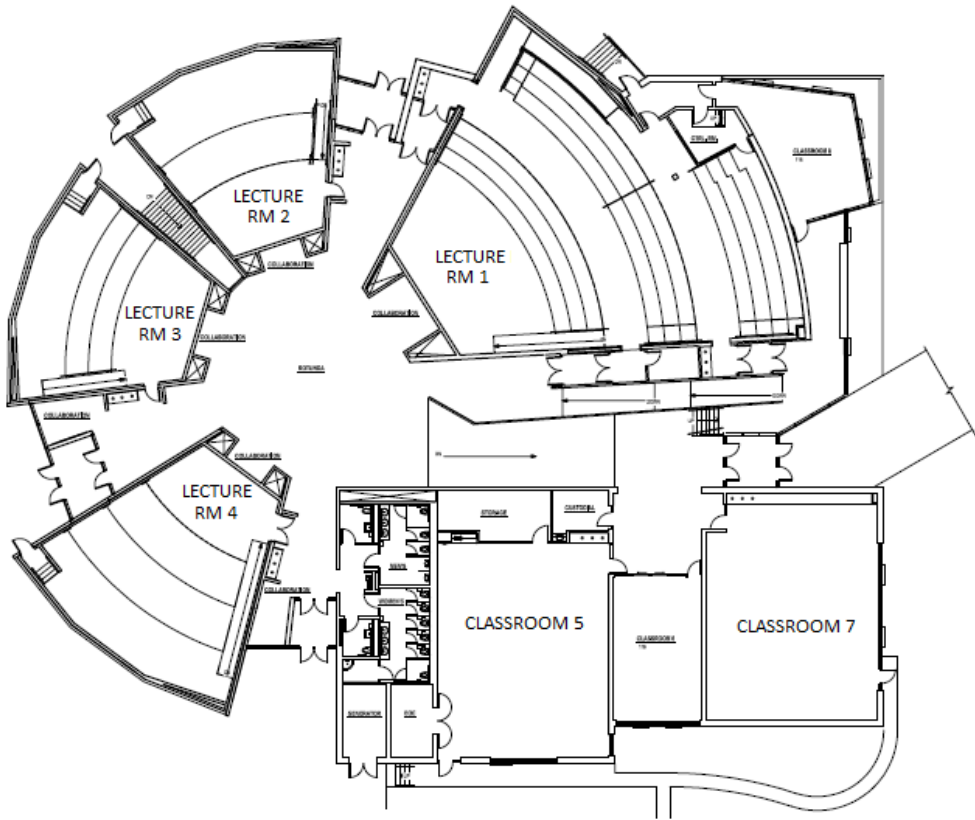
We are fortunate to have Hilary S. Franz, Washington State Commissioner of Public Lands give our Welcome address. We are honored to have Dr. David L. Peterson, (emeritus US Forest Service Research Biologist) deliver the keynote speech "*Function Over Form: Sustainability and Natural Resources in a Warmer World*". He will focus on the progress of assessment and implementation of climate-informed management. Dave is a long time and very active member of NWSA, serving as the Editor of our journal *Northwest Science* and until recently as the Book Review Editor. Dave is an NWSA Honorary Life member and Nobel Peace Prize winner. Our plenary session will explore how we are preparing to reduce the negative effects of climate on hydrologic infrastructure from recognizing the role of beavers in restoring and maintaining function, to refugia necessary for salmonid survival in a warming climate. Our Banquet speaker, Dr. Jon Riedel, geologist with North Cascades National Park, will share his 30 years of research on the sensitive response of Washington's glaciers to climate change, from the last major ice age 30,000 years ago to modern glaciers. We are pleased once again to have the Northwest Lichenologists be part of our annual meeting, like their revered epiphytic lifeform, we are very attached to each other! Northwest Lichenologists are hosting technical sessions on PNW Bryology & Lichenology, a workshop on Crust Lichens, discussion on rare lichens with the Washington Natural Heritage Program, plus two field trips to interesting local habitats of diverse cryptogamic flora.

What makes this meeting unique is nearly a full day technical session focused on Native Food Plants of the Northwest. Our meeting would not be complete without topical sessions on Aquatic and Riparian Systems, Fisheries, Predators of the Salish Sea, Geology, Forest Health and Management, Wildlife Biology, plus Adapting to Effects of Climate Change in Aquatic and Infrastructure Management, and Ecoregional Land Management in Response to Changing Climate that tie back to the meeting theme. Make sure you save brain space for workshops on Applications in R Programming and New Tools for Science in the 21st Century. The poster session will provide an opportunity to visit informally with fellow scientists while enjoying a wide array of posters covering a diversity of topics.

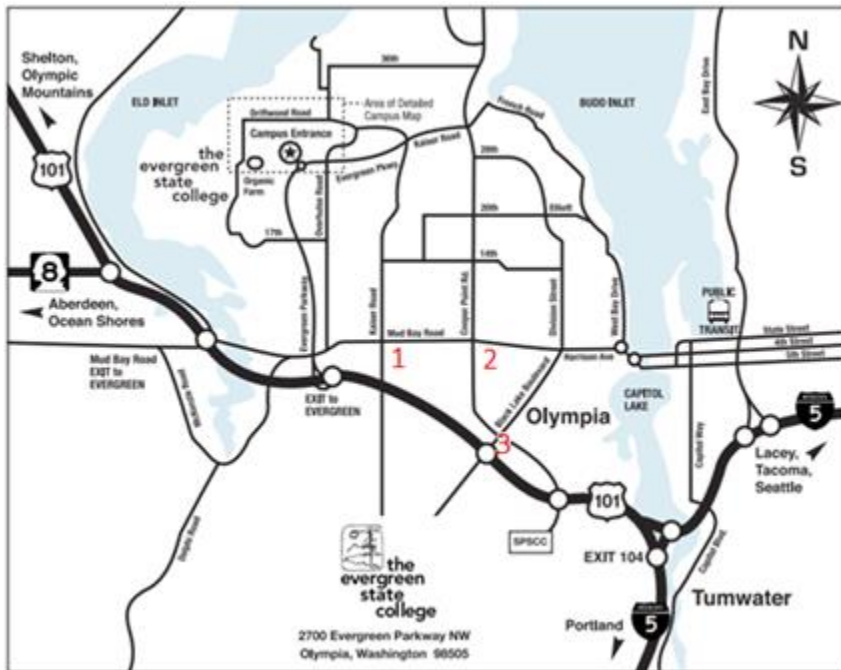
Socializing and making connections is a very big part of the NWSA Annual Meeting. Opportunities exist at every break to strike up conversations and connect at depth at our social, poster session, banquet and business lunch. Our hope is you will come away re-energized with new information, thought provoking ideas, and socially connected. What happens at Northwest Science does not stay at Northwest Science and that is good.

Sincerely,
Gregg Riegel, President
Northwest Scientific Association





PURCE HALL



Quick meal choices near campus

1. - Don Juans Mexican Restaurant
- Blue Heron Bakery and Café

2. Multiple options on both sides of Cooper Pt Rd and nearby on Harrison St. Just a few:
 - IHOP, Burger king, Arby's
 - Jimmy John's, Subway
 - Dickey's BBQ, California food truck
 - Vic's Pizza, Brewery City Pizza,
 - Domino's Pizza, Pizza Hut
 - Basil Leaf, Koibito Sushi, Emperor's
 - Palace, Asian Deli
 - Olive Garden, McDonald's
 - Safeway Deli, Olympia Coffee
 - Roaster's

3. - Haggen Grocery Store Food Court
- Trader Joe's

Northwest Scientific Association 89th Annual Meeting

Wednesday March 28, 2018

Time	Purce Hall Lobby	Purce Hall 1	Purce Hall Rm 2	Purce Hall Rm 3	Purce Hall Rm 4	Purce Hall Rm 5 and 7	Lab 1 Rooms 1040-1050	Library 4300	
7:30-8:00	Registration	Welcomes WA Public Lands Commissioner Keynote Address Plenary Buying Time – Adapting to Climate Change in the Northwest				Poster set up			
8:00-8:20									
8:20-8:35									
8:35-9:35									
9:35-10:05									
10:05-10:35	BREAK								
10:35-11:35		Plenary Buying Time – Adapting to Climate Change in the Northwest Panel Discussion				Poster set up			
11:35-12:00									
12:00-1:20		LUNCH - on your own							
1:00 (NWL)									
1:20-1:40		Adapting to Effects of Climate Change in Aquatic and Infrastructure Management	New Tools for Science in the 21st Century Workshop	Wildlife Biology and Management	Changes in Top Predators of the Salish Sea	Northwest Lichenologists (NWL) Tech Session - Rm 5 Poster set up - Rm 7			
1:40-2:00									
2:00-2:20									
2:20-2:40									
2:40-3:00									
3:00-3:20									
3:20-3:40		Adapting to Effects of Climate Change in Aquatic and Infrastructure Management	New Tools for Science in the 21st Century Workshop	Wildlife Biology and Management	Changes in Top Predators of the Salish Sea	Poster set up	NWL - WNHP Rare Lichen Discussion		
3:40-4:00									
4:00-6:15						Poster Session (attended)			
6:30-9:30								Banquet with Presentation by Jon Riedel	

Northwest Scientific Association 89th Annual Meeting

Thursday March 29

Time	Purce Hall Lobby	Purce Hall Rm 1	Purce Hall Rm 2	Purce Hall Rm 3	Purce Hall Rm 4	Purce Hall Rm 5 and 7	Lab 1 Rooms 1040-1050	Lab 2 Computer Appl. Lab
8:00-8:20	Registration	Native Food Plants of the Northwest	Ecology and Geology Aquatic and Riparian Systems	Forest Management and Forest Health	Pacific Northwest Lichenology and Bryology	Posters		
8:20-8:40								
8:40-9:00								
9:00-9:20								
9:20-9:40								
9:40-10:00	BREAK							
10:00-10:20		Native Food Plants of the Northwest	Aquatic and Riparian Systems	Forest Management and Forest Health	Pacific Northwest Lichenology and Bryology	Posters		
10:20-10:40								
10:40-11:00								
11:00-11:20								
11:20-11:40								
11:40-1:00	NWSA Business Lunch Library 4300							
1:00-1:20		Native Food Plants of the Northwest	Fisheries Conservation and Management in the Pacific Northwest	Ecoregional Land Management in Response to Changing Climate		Posters	Crust Lichens on Conifer Bark Workshop	
1:20-1:40								
1:40-2:00								
2:00-2:20								
2:20-2:40								
2:40-3:00	BREAK							
3:00-3:20			Fisheries Conservation and Management in the Pacific Northwest	Ecoregional Land Management in Response to Changing Climate	Ethics Panel Discussion	Posters	Crust Lichens on Conifer Bark Workshop	Applications in R Programming for Ecology and Natural Resources Workshop
3:20-3:40								
3:40-4:00								
4:00-4:20								
4:20-4:40						Take down		
4:40-5:00								

Wednesday AM, March 28

Keynote and Plenary Session

Purce Hall Rm 1

Welcomes

- 8:00** **Gregg Riegel/Dylan Fisher** *Welcome, Opening Remarks*
- 8:10** **Jenifer Drake**, Provost and VP for Academic Affairs
Welcome to The Evergreen State College
- 8:20** **Hilary Franz** *Welcome from the WA State Commissioner
of Public Lands*
-

Keynote Address

- 8:35** **David L. Peterson** *Function over form: Sustainability and
natural resources in a warmer world*
-

Plenary Session

Buying Time – Adapting to Climate Change in the Northwest

- 9:35** **Rhonda Strauch** *Preparing our infrastructure for a new
hydrologic cycle*
- 10:05** **BREAK**
- 10:35** **Dan Isaak** *Restoration and refugia for salmonids in a
warmer world*
- 11:05** **Michael Pollock** *Keeping water in the mountains: Beavers
to the rescue*
- 11:35** **Panel discussion with audience**
- 12:00 – 1:20** **LUNCH - On your own**

Dr. David L. Peterson - Keynote Speaker



Dave Peterson is emeritus Senior Research Biologist with the U.S. Forest Service Pacific Northwest Research Station, and Professor in the University of Washington School of Environmental and Forest Sciences. His research has focused on fire ecology, subalpine forest ecology, effects of environmental stress on tree growth, and effects of climate change on forest ecosystems.

The author of 220 scientific articles, he recently published the books *Climate Change and United States Forests* and *Climate Change and Rocky Mountain Ecosystems*. As a contributing author for the Intergovernmental Panel on Climate Change, he was a co-recipient of the Nobel Peace Prize. He has been a member of the Northwest Scientific Association since 1990, and was formerly editor of *Northwest Science*. He currently works on climate change adaptation on federal lands throughout the West. Dave lives on his family's tree farm in Skagit County, Washington.

Wednesday PM, March 28

Special Session – Adapting to the Effects of Climate Change in Aquatic and Infrastructure Management

Location: Purce Hall Rm 1

Moderator: *Jessica Halofsky*

- 1:20** **Guillaume Mauger**, Haley Kennard and Julie Morse
Integrated floodplain management in Washington state: how can we make it more resilient?
- 1:40** **Kami Ellingston**
Restoration of a coastal estuarine ecosystem: a tool to increase biodiversity, species resiliency and hydrologic storage capacity in response to storm surge and sea level rise
- 2:00** **Timothy Quinn**, George Wilhere, Jane Atha and Lynn Helbrecht
Integrating climate change into the design and permitting of water crossing structures
- 2:20** **Bill Shelmerdine**
Infrastructure management and climate change on the Olympic National Forest; adaptation strategies for road management
- 2:40** **BREAK**
- 3:00** **Jen Watkins**, Rhonda Strauch and George Wooten
Integrating climate considerations in developing a sustainable road system on the Mount Baker Snoqualmie National Forest
- 3:20** **Tim Beechie**
River restoration for a changing climate
- 3:40** **Group Discussion**

Wednesday PM, March 28

Technical Session – Wildlife Biology and Management

Location: Purce Hall Rm 3

Moderator: Tom DeMeo

- 1:20** **Shelby Hunter** and Margaret O'Connell
Vocalizations influence roost-site selection in overwintering cavity-nesting birds in eastern Washington
- 1:40** **Gail Olson**
Translocation of Mazama pocket gophers: a 5-year update and recommendations for potential future translocations
- 2:00** **Jessica Stitt**, Leona Svancara, Lee Vierling and Kerri Vierling
Smartphone LiDAR can measure keystone habitat structures for wildlife studies
- 2:20** **James Swingle**, Damon B. Lesmeister, Mark A. Linnell and John D. Bailey
Red tree vole response to artificial nests: testing the lack-of-structure hypothesis
- 2:40** **BREAK**
- 3:00** **Azzurra Valerio**, Mariacristina Valerio, Luca Casadei and Robert Wielgus
Stress-mediated effects of wolves on free-ranging livestock: can prey gut microbiome predict stress response in predator-prey interactions?
- 3:20** **Tara Newman**, Yukiko Hashida, John Withey, David Lewis and Jeffrey Kline
Consequences of climate adaptation policies for potential wildlife habitat on private forestland in Washington, Oregon, and California
- 3:40** **Tom DeMeo** and Fred Hall
The Fred Hall legacy: Forty years of photo monitoring in the Pacific Northwest

Wednesday PM, March 28

Special Session – Changes in Top Predators of the Salish Sea

Location: Purce Hall Rm 4

Moderator: *John Calambokidis*

- 1:20** **Laurie Shuster**, David Anderson, Jessica L Huggins, Annie B. Douglas, Nathan Harrison, Susan Berta, and John Calambokidis
Dolphins in inland Washington State Waters: Are warmer water species expanding into our region?
- 1:40** **David Anderson**, Joseph R. Evenson, Laurie Shuster, and John Calambokidis
Harbor porpoise return to the Puget Sound: A tale of the recovery of a sentinel species
- 2:00** **Stephanie Norman**, Jessie Huggins, Jennifer Olson, Dyanna Lambourn, Amanda Warlick, Joe Gaydos, and John Calambokidis
Changes in strandings of cetaceans in Puget Sound/Salish Sea
- 2:20** **Steve Jeffries**, Pat Gearin Dyanna Lambourn, and Bob DeLong
Occurrence, abundance, and trends in pinnipeds in the Salish Sea
- 2:40** **BREAK**
- 3:00** **Kiirsten Flynn**, Gretchen Steiger, Elana Dobson, Mark Malleson, Brian Gisborne, Ted Cheeseman, Susan Berta, and John Calambokidis
Return of the Giants of the Salish Sea: Increased occurrence of humpback into the Salish Sea
- 3:20** **Alie Perez** and John Calambokidis
Gray whale discovery and adoption of feeding grounds in northern Puget Sound in spring
- 3:40** **John Calambokidis**, Dave Cade, James Fahlbusch, Jack Burdett, and Jeremy Goldbogen
Deployment of suction-cup attached multi-sensor video tags reveal feeding habits of gray whales on ghost shrimp in northern Puget Sound

Wednesday PM, March 28

Northwest Lichenologists Technical Sessions: Pacific Northwest Lichenology and Bryology

Location: Purce Hall Rm 5

Moderator: Daphne Stone

- 1:00** **Abby Glauser** and Bruce McCune
Sampling protocols in Lichenology: Epiphyte and ground layer contributions to macrolichen diversity over a climate gradient in Oregon
- 1:20** **Roger Rosentreter** and Heather Root
Biocrust community composition in grazed and ungrazed Winterfat vegetation type
- 1:40** **Katherine Glew**
Peltigera extenuata: An overlooked species in the Pacific Northwest
- 2:00** **Robin Leshner**, Nancy A. Fredricks and Jan A. Henderson
Grimmia lesherae, a pioneer species in Little Ice Age communities in the North Cascades of Washington
- 2:20** **Walter Fertig**
Prioritizing rare lichen species for conservation: Lessons from vascular plants
- 2:40** **BREAK**

Pacific Northwest Lichenology and Bryology (Cont.)

Location: Lab 1 (immediately S of Purce Hall)
Rooms 1040 and 1050

Moderator: Jeanne Ponzetti

- 3:00-4:00pm** **Walter Fertig**
Washington Natural Heritage Program Rare Lichen List Discussion
- 4:00-6:15pm** **Joint NWSA NWL Poster Session Classrooms 5 & 7**

Wednesday PM, March 28

Workshop – New Tools for Science in the 21st Century

Location: Purce Hall 2

Moderator: Dylan Fischer

- 1:20** **Ian Stupakoff and Brandon Sackmann**
Standardized and Cost-effective Benthic Habitat Mapping Tools for Marine and Hydrokinetic Site Environmental Assessments
- 2:00** **Edwin J. Reidel**
Sensors, imagers, robots, and software: Measurement in the era of plant phenotyping
- 2:40** **BREAK**
- 3:00** **Greg Crutsinger**
The drone industry from a scientific perspective; where it's been and where its headed next
- 3:40** *Panel discussion*
-
- 4:00-6:15** **Poster Session and Social with appetizers & host bar**
Location: Purce Hall 5 and 7
- 6:30–9:30** **Evening Banquet with guest speaker, Jon Riedel**
“Blue Legacy: 100 Years of Change in Washington's Glaciers”
Location: Library 4300

Wednesday Evening, March 28
Poster Session and Social 4:00- 6:15 pm

Location: Purce Hall Classrooms 5 and 7

(Presenting author shown– see Abstract section for co-authors and complete abstract)

Adrienne Akmajian	MASS MORTALITY EVENT OF PURPLE OLIVE SNAILS (<u>OLIVELLA BIPLICATA</u>) IN NEAH BAY, WASHINGTON
Adrienne Akmajian	YEAR-ROUND ALGAL TOXIN EXPOSURE IN FREE-RANGING SEA LIONS
Ryan Balcom	BASIDIOMYCETE YEASTS IN THE THALLI OF PACIFIC NORTHWEST LICHENS OF THE LOBARIACEAE.
Yianna Bekris	EFFECTS OF VARIABLE DENSITY THINNING ON NON-NATIVE PLANT SPECIES IN THE OLYMPIC HABITAT DEVELOPMENT STUDY
Miles Berkey	TWO SEASONS OF BRYOPHYTE SURVEYS
Veronica Biesianda	DEFORMATION ACROSS THE HURRICANE RIDGE FAULT IN THE SOUTHEASTERN OLYMPIC PENINSULA
W. Dillon Blankenship	EXAMINING IN VITRO MOSS GROWTH IN TACKIFIERS FOR POTENTIAL USE IN RANGELAND RESTORATION AND REHABILITATION.
Steven Borrego	LONG DISTANCE DISPERSAL OF A WOLF FROM NORTHEASTERN WASHINGTON INTO THE GREATER YELLOWSTONE ECOSYSTEM
Hope Braithwaite	ODONATA OF THE CASCADE-SISKIYOU NATIONAL MONUMENT: INVENTORY, SPATIAL DISTRIBUTION AND RELATIVE ABUNDANCE WITHIN DIVERSE HABITATS
Leslie Brodie	HOW DOES CLIMATE INFLUENCE RANGES OF BERRY- AND NUT PRODUCING NATIVE NORTHWESTERN SHRUBS?
J.D. Brooks	CAMOUFLAGE AND SEXUAL DICHROMATISM IN THE NORTHERN PACIFIC RATTLESNAKE (<u>CROTALUS OREGANUS</u>)
Emily Lindstrum Carson	USING DENDROCHRONOLOGY AND RADIOCARBON DATING TO INVESTIGATE A SUBFOSSIL FOREST IN PUGET LOWLAND AND SOUTHEAST OLYMPIC MOUNTAINS
Kara Caselas	EVALUATING STAND RELEASE EFFECTIVENESS WITHIN OREGON WHITE OAK COMMUNITIES AND IMPACTS TO FUEL LOADS
Joe Di Meglio	FOUR UNIQUE GENOTYPES WITHIN <u>STICTA FULIGINOSA</u> SPECIES COMPLEX OF THE PACIFIC NORTHWEST
Leila Duchac	CAN PASSIVE ACOUSTIC MONITORING DETECT AND IDENTIFY VOCALIZATION PATTERNS IN TWO CONGENERIC FOREST OWLS IN THE PACIFIC NORTHWEST?

Alex Foster	INFRASTRUCTURE MANAGEMENT AND CLIMATE CHANGE ON THE OLYMPIC NATIONAL FOREST; ADAPTATION STRATEGIES FOR ROAD MANAGEMENT
Sarah Francis	QUANTIFYING THE MAGNITUDE AND SPATIAL VARIABILITY OF BEDROCK EROSION BENEATH THE SISTERS GLACIER, WASHINGTON, USING COSMOGENIC ³ HE CONCENTRATIONS
Dan Gavin	AN ATLAS OF THE OLYMPIC PENINSULA: TRANSLATING SCIENCE
Jade Gjerde	GLORIA LICHEN ASSESSMENT ON THE BEARTOOTH PLATEAU IN PARK COUNTY, WYOMING
Tabitha A. Graves	DEVELOPING A VULNERABILITY ASSESSMENT FOR HUCKLEBERRIES.
Ciarra Greene	UTILIZING SCIENCE TO ENSURE SAFE ACCESS TO CULTURAL RESOURCES ON PUBLIC LANDS: THE PORTLAND NATIVE AMERICAN COMMUNITY AND TRADITIONAL GATHERING OF CAMAS
Nathan Harrison	GOOGLE EARTH SATELLITE IMAGES PROVIDE NOVEL METHOD FOR EXAMINING FEEDING AREAS OF GRAY WHALES IN PUGET SOUND, WASHINGTON
Irene Hinkle	LICHENS FOR DYE
Jessica Hudec	A STRATEGIC APPROACH TO HUCKLEBERRY MANAGEMENT ON GIFFORD PINCHOT NATIONAL FOREST.
Emma Huston	EFFECTS OF VARIABLE DENSITY THINNING ON SPATIAL PATTERNS OF OVERSTORY TREES IN MT. HOOD NATIONAL FOREST
Araya Jensen	UNIQUE INSIGHTS INTO ARBOREAL RODENT BEHAVIOR AND SPECIES INTERACTIONS USING REMOTE CAMERAS AT ARTIFICIAL NESTS
Maya Kahn-Abrams	FOREST FLOOR MOSSES HOST NITROGEN FIXING CYANOBACTERIA IN TEMPERATE RAINFORESTS OF WESTERN WASHINGTON
Maya Kahn-Abrams	CORDYCEPIN CONTENT IN COMMERCIAL MYCELIUM AND FRUITING BODY SUPPLEMENTS OF THE MEDICINAL FUNGI <u>CORDYCEPS MILITARIS</u>
Rick Kelsey	A REVIEW OF BIOACTIVE COMPOUNDS IN YELLOW-CEDAR THAT PROTECT THE TREES AND POSSIBLY HUMAN HEALTH
Stacia Krause Ledbetter	SUMMER UNDERGRADUATE RESEARCH FELLOWSHIPS: ECOPHYSIOLOGY OF CTENOPHORES
Beverly Luke	ARE SUB-FOSSIL FORESTS IN AUBURN AND FIFE, WASHINGTON VICTIMS OF THE SAME EXPLOSIVE ERUPTION AT MOUNT RAINIER? TESTING THE HYPOTHESIS WITH RADIOCARBON DATING AND TREE-RING ANALYSIS
Linsay Millward	SMALL MAMMAL MICROHABITAT USE AND SPECIES COMPOSITION OF A WILDLIFE CROSSING STRUCTURE COMPARED WITH NEARBY FOREST
Ariel Quinn Moran	RADIOCARBON DATING AND DENDROCHRONOLOGY INVESTIGATION OF A ~530CE SUBFOSSIL FOREST AT KENT, WASHINGTON

Christina Muller-Shinn	INTER-SEASONAL AND INTERANNUAL SHIFTS OF PACIFIC WREN TERRITORIES.
Suphasiri Muttamara	GEOGRAPHIC VARIATION IN VOCALIZATIONS OF AMERICAN PIKAS (<u>OCHOTONA PRINCEPS</u>) IN SOUTHWESTERN OREGON AND NORTHERN CALIFORNIA.
Erika Petzinger	IDENTIFICATION OF A DARK SEPTATE FUNGUS THAT FORMS A SYMBIOTIC ASSOCIATION WITH <u>ARTEMESIA TRIDENDATA</u>
Miranda Plumb	PACIFIC LAMPREY IN PUGET SOUND AND WASHINGTON COAST STREAMS
Anchal Rikhi	TREE SPECIES DIVERSITY EFFECTS ON PRODUCTIVITY IN A NORTHWEST FOREST
Shayna Rossiter	SEASONAL AND SPATIAL VARIATION OF SOIL RESPIRATION IN A PACIFIC NORTHWEST SECOND-GROWTH FOREST
Steve Shen	RARE EARTH ELEMENTS AS A GEOGRAPHICAL TRACER IN THE COLUMBIA RIVER BASIN VIA MULTICollector INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY.
Hamish Stevenson	DIET ANALYSIS OF RAINBOW TROUT FROM SPIRIT LAKE, MOUNT ST. HELENS: AN INDICATOR OF NEW ZEALAND MUD SNAIL INVASION IN A POST-ERUPTION ENVIRONMENT
Anthony M. Waldrop	MONITORING RESTORATION OF COASTAL TEMPERATE RAINFOREST – METHODS AND FIVE YEAR RESULTS.
Doug Westlind	VARIABLES ASSOCIATED WITH POST-FIRE ATTACK BY RED TURPENTINE AND WESTERN PINE BEETLE ON PONDEROSA PINE IN THE PACIFIC NORTHWEST
Telissa Wilson	AN INTERDISCIPLINARY APPROACH TO UNDERSTANDING EVOLUTIONARY PHYSIOLOGY IN CTENOPHORA
William Wiskes	HOME RANGE AND TERRITORY USE IN THE PACIFIC WREN (<u>TROGLODYTES PACIFICUS</u>).
Emily Wolf	VARIATION IN FOLIAR FUNGAL ENDOPHYTE COMMUNITIES OF <u>ALNUS RUBRA</u> ACROSS A METROPOLITAN AREA
Michael Zirpoli and Heidi Steinbach (co-presenters)	THE EFFECTS OF REINDEER LICHEN (<u>CLADONIA SPP.</u>) AQUEOUS EXTRACTS ON PRAIRIE PLANT SEED GERMINATION AND SEEDLING GROWTH

NWSA Banquet, Wednesday Evening 630-930
Location: Library 4300

***“Blue legacy: 100 years of
change in Washington’s
Glaciers”***

Presented by Jon Riedel,
North Cascades National Park



Jon Riedel is a geologist with the National Park Service at North Cascades National Park. He holds a M.S. degree from the University of Wisconsin (1987) and a Ph.D. from Simon Fraser University (2007). For more than 30 years his research has focused on the sensitive response of Washington’s glaciers to climate change, from the last ice age 30,000 years ago to modern glaciers. Dr. Riedel's recent research into the distant past has focused on glaciation of the valley and environmental conditions during the last ice age. Jon established glacier monitoring programs at Olympic (2013), Mount Rainier (2003) and North Cascades (1993) national parks to track changes in more than 500 glaciers. Recent publications from this data have quantified the changes in volume and runoff from glaciers in several regional watersheds. Jon also serves as president of the Skagit Climate Science Consortium, a nonprofit team of 13 researchers focused on studying the impacts of climate change in Puget Sound’s largest watershed.

Thursday AM, March 29
**Special Session - Native Food Plants of the Northwest: Ecology,
Culture and Management in a Changing World**

Location: Purce Hall Rm 1

Moderator: *Janet S. Prevéy*

- 8:00** **Janet Prevéy** and Constance Harrington
Changing phenology of northwestern shrubs
- 8:20** **Tabitha Graves**, Carolyn Shores, and Nate Mickle
*Mapping the keystone plant species, huckleberry (Vaccinium membranaceum),
using remote sensing imagery*
- 8:40** **Constance Harrington**, Lauren Parker, Janet Prevéy and Leslie Brodie
Current and future bioclimatic niche of Vaccinium membranaceum
- 9:00** **C. Greene** and Tabitha Graves
Phenology monitoring of cultural resources through citizen science
- 9:20** **Michael Case**, John Kim and Becky Kerns
*A climate change assessment of first foods and medicinal plants in the Pacific
Northwest*
- 9:40** **Bryan Endress**, Eric Quaempts and Shawn Steinmetz
*Using first foods to guide the management of upland ecosystems of the
Confederated Tribes of the Umatilla Indian Reservation*
- 10:00** **BREAK**
- 10:20** **William Deacy**
*Shifting red elderberry phenology disrupts Kodiak brown bear and salmon food
webs*
- 11:00** **Todd Murray** and Dalilia Rendon
*Spotted wing drosophila, a new pest of high elevation Vaccinium species in the
Pacific Northwest*
- 11:20** **Robin Leshner**, Jan Henderson, Christopher Ringo and David Peter
*Ecology and distribution of salal on the Olympic National Forest: using a
potential habitat model and map to address sustainability issues*
- 11:40–1:00** **LUNCH**

Thursday AM, March 29
Technical Session: Ecology, Geology, Hydrology, and Riparian Habitats

Location: Purce Hall Rm 2

Moderators: Sam Brenkman and Patrick DeHaan

8:20 **Donald Zobel** and Joseph Antos
How and why to calculate resilience: responses to burial by understory plants

8:40 **Ann Potter**
Collecting information on imperiled insects in Washington state: two projects to survey for butterflies and bumble bees with citizen naturalists

9:00 **Jack Koch**, E. Alan Verde
Carbonic anhydrase activity in the symbiotic sea anemone Anthopleura elegantissima in different symbiotic states and different sizes

9:20 **Robert Carson**, Hannah Buckland *Distribution of late Quaternary tephra east of the Cascade range*

Riparian and Aquatic Habitats and Hydrology

9:40 **Laura Six**, Maryanne Reiter, Peter James, and Robert E. Bilby
Effects of current forest practices on organic matter dynamics in headwater streams at the Trask River watershed, Oregon

10:00 **BREAK**

10:20 **Scott Kugel**
Abandoned mine land impacts on tributaries in the upper Yakima River watershed, eastern Cascade, Washington

10:40 **David Conklin**
WW2100 Streamflow model skill assessment

11:00 **Steven Acker**, Gordon Reeves, Ian-Huei Yau, Hohan Hogervorst, and Brett Blundon
Classification of riparian ecosystems in northwest Oregon for restoration planning.

11:20 **Warren Devine**, Teodora Minkova, Ashley Steel, Alex D. Foster and Kyle Martens
Winter thermal regimes of small fish-bearing streams on the Olympic Peninsula

11:40–1:00 **LUNCH**

Thursday AM, March 29
Technical Session – Forest Management and Forest Health
Location: Purce Hall Rm 3

Moderator: *William Carlson*

- 8:00** **Joanne Ho**
Humans as keystone species: a perspective on forest management and climate change
- 8:20** **Daniel Donato**, Joshua S. Halofsky and Matthew J. Reilly
Corralling a black swan: establishing natural range of variability under a regime of rare, large fires in Washington's west Cascades
- 8:40** **Caitlin Littlefield**
Spatial and temporal patterns of juvenile abundance and annual growth 10-years post-fire
- 9:00** **Regina Rochefort**, Shay Howlin, Lacey Jeroue, John Boetsch and Lise P. Grace
Trends in the health of whitebark pine populations in North Cascades National Park Service Complex and Mount Rainier National Park
- 9:20** **Laura DeWald**, Richard Snieszko, Marianne Elliott, Gary Chastagner and John Russell
Genetic variation in Pacific madrone: management implications for future climate conditions
- 9:40** **Viktoria Wagner**, Pedro M. Antunes, Michael Irvine, Christine McManamen and Cara R. Nelson
Herbicides in invasive non-native plant management
- 10:00** **BREAK**
- 10:20** **Jacob Betzen**, Amy Ramsey, Dan Omdal, Patrick Tobin and Greg Ettl
Bigleaf maple decline in western Washington
- 10:40** **Amy Ramsey**, Dan Omdal, Richard Snieszko and Doug Savin
Western white pine disease resistance in western Washington: operational planting and the latest in resistant stock types
- 11:00** **Amy Ramsey** and Dan Omdal
Root disease caused tree mortality in western Washington forests: highlighting the impacts of a significant disturbance
- 11:20** **Jan Henderson**, Robin Lesher, David Peter, Christopher Ringo
A 20+ year record of soil and air temperature measurements from remote sites on the Mt. Baker-Snoqualmie National Forest
- 11:40–1:00** **LUNCH**

Thursday, March 29
Pacific Northwest Lichenology and Bryology

Location: Purce Hall Rm 4

Moderator: *John Villella*

- 8:00** **Hanne Larsen**, Eric Steen Hansen and Hanne N. Rasmussen
The distribution of corticolous lichens on Danish angiosperm trees
- 8:20** **Elise DiMeglio**, Bruce McCune, Alyssa Shiel and Peter Neitlich
Heavy metal deposition and impacts to vegetation and lichen communities along the Red Dog Mine Haul Road at the Cape Krusenstern National Monument, Alaska
- 8:40** **Heather Stewart-Ahn** and Lalita M. Calabria
Identification of ascomycete and basidiomycete symbionts in Cladonia macilenta using integrative taxonomy
- 9:00** **Bruce McCune**
Sterility as a way of life in the lichen gGenus Cladonia
- 9:20** **Veera Tuovinen**, Stefan Ekman, Göran Thor, Toby Spribille and Hanna Johannesson
Yeasts in the cortex of Letharia lichens
- 9:40** **Carrie Woods**, McKinley Nevins and Emma Didier
The non-random distribution of epiphytes in temperate rainforest trees

10:00 **BREAK**

Moderator: Katherine Glew

- 10:20** **Toby Spribille**
Lichen or not: recognizing the limits of fungal DNA and restoring the lichen as the object of study by lichenologists
- 11:00** **Amanda Hardman**
Calicioid lichens and fungi from Northeast Washington
- 11:20** **Koa Tom**
Value of lichens: An artist's perspective

11:45-1:15 **LUNCH**

Moderator: Bruce McCune **LOCATION: Lab 1 (S of Purce Hall) Rms 1040 and Rm 1050**

- 1:20-4:40** *Northwest Lichenologists Lichen ID Workshop: Pacific Northwest Crust Lichens on Conifer Bark*

Thursday PM, March 29
**Special Session - Native Food Plants of the Northwest: Ecology,
Culture and Management in a Changing World (cont.)**

Location: Purce Hall Rm 1

Moderator: *Janet S. Prevéy*

1:00 **Erin Smith**, Selena Ahmed, Carmen Byker Shanks, Margaret Eggers and Virgil Dupuis

Wild food consumption, valuation, and observations of environmental change among Montana hunters, anglers, and harvesters of wild edible plants

1:20 **Bryan Endress**, Joshua Averett, Eric Quaempts and Shawn Steinmetz

Distribution and abundance of culturally-important first foods in Pacific Northwest bunchgrass communities

1:40 **Sarah Hamman** and Joyce Lecompte-Mastenbrook

Building reciprocal benefits and transdisciplinary partnerships by incorporating indigenous knowledge into the management and restoration of camas prairie cultural ecosystems

**Workshop – Applications in R programming for Ecology and
Natural Resources (pre-registration required)**

Location: Computer Applications Lab, Lab 2 (SW of Purce Hall)

Moderator: Matt Brousil

2:00 **Jacob Strunk**

R packages and GIT version control

3:00 **Janet Prevey**

Making beautiful graphics in R

4:00 **Robert Clark**

Ecological data and GLMM'S: Troubleshooting linear models in R with LEM4

Ethics Panel Discussion (see Hardcastle abstract, p.57)

4:00 – 5:00 Location: Purce Hall 4

Thursday PM, March 29

Special Session- Fisheries Conservation and Management in the Pacific Northwest, Location: Purce Hall Rm 2

Moderators: Sam Brenkman and Patrick DeHaan

- 1:00** **Lauren Kuehne** and Julian Olden
Olympic mudminnow: laying a foundation for collaborative conservation
- 1:20** **Celeste Mazzacano** and Travis Williams
Assessing a freshwater mussel population in a backchannel of the Willamette River
- 1:40** **Julian Olden** and Mathis Messenger
Brace yourselves, rusties are coming: rapid invasion of rusty crayfish, Orconectes rusticus, in the Columbia River basin
- 2:00** **Keith Denton**, Mike McHenry, Raymond Moses, Wilson Wells, George Pess, Oleksandr Stefankiv and Eric Ward
Using multi-beam imaging sonar to monitor adult Chinook and steelhead populations in the Elwha River and beyond
- 2:20** **Kathryn Sutton** and Sam Brenkman
Life history observations of landlocked Chinook salmon prior to anadromous salmonid reintroductions in Lake Cushman, WA
- 2:40** **BREAK**
- 3:00** **Gabe Madel**, Andrew Claiborne, Hannah Faulkner, Riley Freeman and James Losee
Life history strategies, movement patterns, and growth rates of anadromous coastal cutthroat trout in South Puget Sound
- 3:20** **Justin Bohling**, Jennifer Von Bargen and Peter Bahls
Gene flow, differentiation, and hatchery influence among Hood Canal coho salmon populations
- 3:40** **Karl Polivka**, Joe Mihaljevic and Shannon Claeson
Chinook habitat restoration projects
- 4:00** **Zachary Moore** and Roger Tabor
Chinook salmon restoration projects
- 4:20** **McLain Johnson** and Andrew Murdoch
Examining mechanisms that explain recent trends in abundance of spring Chinook and summer Chinook salmon in the upper Columbia River
- 4:40** **Roger Tabor**, Alex Bell, Zachary Moore, Scott Stolnack, Daniel Lantz, David Beauchamp, Lyle Britt, John Green and Tim Robinson
Effect of artificial nighttime lighting on the phototaxic behavior of subyearling salmonids in lentic nearshore areas

Thursday PM, March 29

Special Session – Ecoregional Land Management in Response to Changing Climate, Location: Purce Hall Rm 3

Moderator: Andrea Woodwood

- 1:00** **Mary Mahaffy** and John Mankowski
Landscape conservation cooperatives – past and future collaborations
- 1:20** **Preston Hardison**
Guidelines for considering traditional knowledges (tks) in climate change initiatives
- 1:40** **Larry Campbell**, Jamie Donatuto, Sarah Grossman and Swinomish Indian Tribal Community
Evaluating impacts of sea level rise and storm surge on nearshore natural resources habitats and Swinomish community health
- 2:00** **Tom Miewald**, M. Mahaffy, J. Mankowski and M. Kearney
Pacific Northwest coastal conservation blueprint
- 2:20** **Jen Watkins**
Collaborating across borders to adapt to change in Cascadia
- 2:40** **BREAK**
- 3:00** **David Peterson** and Jessica Halofsky
Implementing climate change adaptation in forest ecosystems of Southwest Oregon
- 3:20** **Lynn Helbrecht** and Jessi Kershner
Using climate vulnerability assessments to inform species management and recovery
- 3:40** **Dan Isaak**
The crowd-sourced NorWeST temperature database and massive microclimate scenarios for streams and rivers of the Pacific Northwest
- 4:00** **Se-Yeun Lee**, Aimee Fullerton, Joshua J. Lawler and Christian E. Torgersen
Incorporating spatial heterogeneity in temperature into climate vulnerability assessments for coastal Pacific streams
- 4:20** **Rachel Gregg**, Whitney Reynier, Lisa Gaines and Jeff Behan
Evaluating the supporting science behind climate adaptation actions to address sea level rise and coastal change
- 4:40** **Panel Discussion**

Friday, March 30 – NWSA Field Trip

Northwest Scientific Association presents

PRAIRIES OF THE SOUTH SOUND: CONSERVATION AND RESTORATION

Meeting Time: 9:00 am – 4:30 pm Friday, March 30, 2018

Meeting Location: Parking Lot B

Transportation: Free transportation using vans provided WA-DNR

Leaders: **David Wilderman**
Ecologist, Natural Areas Program, WA Department of Natural Resources
Sarah Hamman
Restoration Ecologist, Center for Natural Lands Management

Maximum Group Size: 30 people

The prairies and oak woodlands of western Washington host a wide range of native plants and animals, many of which are rare due to declining habitat availability. Additionally, traditional cultural practices, such as fire and native plant harvesting, have largely been lost. Over the last 15 years the scale and complexity of restoration efforts have grown across this landscape to restore historical disturbances and diversity while considering desired future conditions. On this field trip we will visit a regional native seed farm and two native prairies to learn about seed sourcing and seed production in a restoration context, fire ecology and rare species, and adaptive management in a system with shifting restoration priorities.

Violet Prairie Seed Farm: tour from about 9:45 to 11:30am

- Adapting agricultural practices into a restoration context.
- Seed sourcing considerations, including climate change.

Scatter Creek Wildlife Area: tour & enjoy a picnic lunch from about 11:45am to 1:30pm

- Fire ecology and butterflies.
- Recovery of rare species, including Taylor's checkerspot and Mazama pocket gopher.

Mima Mounds Prairie: tour Mima Mounds

- Shifting restoration targets: How to adapt management to shifting priorities.
- Sharing different available restoration tools.

3:30-4:30pm: Travel back to The Evergreen State College

Friday, March 30 – NWSA Field Trip

Northwest Scientific Association presents

USING SMALL UNMANNED AIRCRAFT TO INFORM NATURAL RESOURCE MANAGEMENT: APPLICATIONS BY THE WASHINGTON DEPARTMENT OF NATURAL RESOURCES

Meeting Time: **8:00 am – 12:00 noon, Friday March 30, 2018**

Meeting Location: Lab II, Rooms 1223A and 1223B (building immediately west of Purce Hall)

Leader: **Miles Micheletti**

Forest Technician, Washington Department of Natural Resources

Maximum Field Trip Size: 30 people

The Washington State Department of Natural Resources manages more than 5.6 million acres of trust lands for revenue production and conservation. Accurate and timely survey data is critical to many trust management objectives. Small unmanned aircraft (sUAS) can rapidly collect high-resolution two- and three-dimensional geographic data to inform silvicultural treatments, habitat goals, and to monitor change over time. sUAS have the potential to automate surveys that previously required dangerous and tedious field work, while collecting full-coverage data that reduces the effects of sampling. sUAS data also acts as a permanent visual record of site conditions for future reference, and is easy for non-specialists to share, understand, and appreciate. Using both classroom and field exercises we will demonstrate how sUAS are used to collect data as well as describe how the resulting two- and three-dimensional data products help DNR address numerous natural resource management issues such as old growth delineation, precommercial thinning, landslide volume and scope estimation, and more. If time allows we will utilize sUAS to estimate the size, density, and structural variability of a forest area on the Evergreen State College campus.

Friday, March 30 – NWSA Field Trip

Northwest Scientific Association and Northwest Lichenologists presents

BRYOPHYTES, LICHENS, & ECOSYSTEM ECOLOGY OF ACIDIC PEATLANDS

Meeting Time: 8:30 am – 1:30 pm, Friday March 30, 2018

Meeting Location: Parking Lot B

Leaders: **Joe Rocchio** – Ecologist for Washington DNR

Lalita Calabria – Professor, Bryologist, & Lichenologist for The
Evergreen State College

Transportation: Van & car-pooling options

Maximum Field Trip Size: 35 people

Northwest Lichenologists (NWL) will co-lead a field trip on the last day of the conference with DNR senior vegetation ecologist and PNW peatland expert, Joe Rocchio, focusing on bryophytes, lichens, & ecology of acidic peatlands located southeast of Matlock, Washington. Because of their low pH and poor nutrient content, acidic peatlands, also known as bogs and poor fens, have distinct biotic composition and structure. We will explore the diversity and patterns of vascular plants, bryophytes, and lichens across various ecological gradients that characterize these peatlands.

Come prepared with rubber boots, rain gear, and a hand-lens. Waterproof hiking boots *may* keep your feet dry but rubber boots are a better bet. We will have a few extra hand-lenses to share.

Friday, March 30 – NWSA Field Trip

Northwest Lichenologists presents

LICHENS OF DESCHUTES FALLS COUNTY PARK

Meeting Time: **8:30 am – 1:30 pm, Friday March 30, 2018**

Meeting Location: Parking Lot B

Leader: Jeanne Ponzetti, Lichenologist

Transportation: Van & car-pooling options

Sign-up is at the Registration Table

This recently re-opened park is about 45 minutes from Olympia, and features a river with waterfalls surrounded by oaks and conifers. There are interesting lichen communities to checkout.

Find out more about the park at: <http://www.co.thurston.wa.us/parks/parks-deschutes-falls.htm>

Come prepared with appropriate foot gear, rain gear, a hand-lens, lunch, and water.

ABSTRACTS

NWSA ORAL AND POSTER PRESENTATIONS

(Arranged alphabetically by last name of presenting author)

CLASSIFICATION OF RIPARIAN ECOSYSTEMS IN NORTHWEST OREGON FOR RESTORATION PLANNING.

Steven A. Acker, Mt. Hood National Forest, 16400 Champion Way, Sandy, OR 97055; Gordon H. Reeves, U.S. Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; Ian-Huei Yau, U.S. Forest Service, Region 6, 3106 Pierce Parkway Suite D, Springfield, OR 97477; Johan Hogervorst; Brett Blundon, Willamette National Forest, 3106 Pierce Parkway Suite D, Springfield, OR 97477; stevenaacker@fs.fed.us

In the mountainous Pacific Northwest, variability of the structure and composition of riparian vegetation in time and space is an integral part of the sustained diversity and productivity of aquatic ecosystems, including anadromous fish. Disturbance processes such as flooding, sediment deposition, debris flows, and wildfire help maintain diversity of riparian vegetation. Spatial patterns of disturbance regimes and vegetation development correspond to climate and geology at the broad scale, and factors such as landform at the finer scale. We propose to use understanding of the spatial distribution of climate, geology, disturbance regimes, and landforms to divide riparian networks into segments with similar potential disturbance and vegetation development characteristics. The classified riparian network forms a template for evaluating historical variability of ecosystems in the absence of overt human management, providing a useful context for planning and management. We identified three ecoregions in northwest Oregon with important differences in geology and climate (Coast Range—dissected landscape dominated by sandstone, rain-dominated hydrology; Western Cascades—dissected landscape dominated by volcanic rocks, rain- and snow-dominated hydrology; High Cascades—gentle landscape dominated by volcanic rocks, snow-dominated hydrology). Within the High Cascades, we identified 12 stream-reach types, varying in channel width, predominant disturbance process (fluvial, mixed-severity fire, stand-replacement fire), and potential presence of hardwood trees. For the Western Cascades, the greater diversity of relevant geomorphic processes (debris flows, earthflows), resulted in 17 stream-reach types. The Coast Range is likely to be intermediate in diversity of stream-reach types, since debris flows are the predominant relevant geomorphic process.

MASS MORTALITY EVENT OF PURPLE OLIVE SNAILS (*OLIVELLA BIPLICATA*) IN NEAH BAY, WASHINGTON.

Adrienne Akmajian, Ericka Hundrup, and Michael Murner, Nic Pfeffertaggart, Jonathan Scordino, PO Box 115, Makah Indian Tribe, Neah Bay, WA 98357; marine.ecologist@makah.com

The purple olive snail (*Olivella biplicata*) has a long history of cultural and economic importance to tribes along the US West Coast, including the Makah Indian Tribe of Washington State. The Makah Tribe traditionally harvests olive snails (called ke·ʔi·c by the Makah Tribe) at Hobuck Beach on the Makah Indian Reservation in Neah Bay, WA to use in cultural regalia and artisanal crafts for commercial sales. In response to concern raised by a tribal elder about olive snail abundance, the Makah Fisheries Management Summer Youth Program surveyed the northernmost extent of Hobuck Beach for olive snails in 2009 and 2010. A mass mortality event of olive snails (estimates of 187,740 to 250,320 deceased snails) in June of 2014 prompted the continuation of trend counts from 2014 through 2017. We observed a 98% decline in snail density from 2.44 ± 1.8 (standard error) snails per m² (spm) in 2010 to 0.024 ± 0.001 spm in 2014. Subsequent surveys (2015 to 2017) indicated apparent recovery of the population at the trend site, likely from snails residing at greater depth outside of the surveyed area. The cause of this mass mortality event remains unknown. In this study we use geospatial interpolation to examine density estimates for Hobuck Beach during and after the mortality event and discuss several hypotheses for the cause of the die-off. This study is the first to present population trend and density analyses for the purple olive snail in the Pacific Northwest.

POSTER

YEAR-ROUND ALGAL TOXIN EXPOSURE IN FREE-RANGING SEA LIONS. Adrienne M.

Akmajian, Jonathan J. Scordino, PO Box 115, Makah Fisheries Management, Neah Bay, WA 98357; Alejandro Acevedo-Gutiérrez, 516 High Street, Department of Biology, Western Washington University, Bellingham, WA 98225; marine.ecologist@makah.com

Harmful algal bloom (HAB) toxins cause illness and mortality in marine mammals worldwide, yet the potential for year-round exposure to these toxins has not previously been studied. We measured concentrations of domoic acid and saxitoxin in scats from Steller sea lions (*Eumetopias jubatus*; n = 383 scats) and California sea lions (*Zalophus californianus*; n = 125 scats) over a two-year period. Toxin concentrations in the scat were compared to the prey remains in the scat and to concentrations in nearshore bivalves. Saxitoxin was detected in 45 % and domoic acid was detected in 17 % of all scats tested, and both toxins were detected in all seasons and months of the year. A variety of benthic and pelagic fish were significantly associated with toxins in sea lion scat including prey with low occurrence in the sea lions' diet. Toxins detected in winter scats confirm that West Coast marine mammals are exposed to domoic acid and saxitoxin through their prey outside of the expected algal bloom seasons.

ORAL

HARBOR PORPOISE RETURN TO PUGET SOUND: A TALE OF RECOVERY OF A

SENTINEL SPECIES. David Anderson, Laurie Shuster, John Calambokidis, Cascadia Research Collective, 218½ W 4th Ave., Olympia WA 98501; Joseph Evenson, Washington Department of Fish and Wildlife, Olympia WA 98501; DAnderson@CascadiaResearch.org

Harbor porpoise were the most common cetacean throughout Washington State's inland marine waters in the 1940s. By the 1970s, they were rarely if ever sighted in the Puget Sound, with greatly reduced numbers in the Strait of Juan de Fuca as well. Annual winter aerial marine bird surveys conducted by WDFW documented their recovery in the northern inland waters throughout the 1990s, with animals regularly sighted south of Admiralty Inlet starting in 2000, reaching the southern end of Puget Sound by 2005. Harbor porpoise are once again the most common cetacean in our inland waters, with several thousand animals found within the Puget Sound year round. Small boat surveys in the South Puget Sound have revealed a harbor porpoise hotspot off Steilacoom, with large feeding aggregations regularly seen in Carr Inlet, and seasonally in Case Inlet. The absence of the larger Dall's porpoise from the waters of the Salish Sea was noted in several early papers, though by the 1970s sightings of Dall's porpoise were common, especially around the San Juan Islands. As the harbor porpoise population recovered, sightings of Dall's porpoise declined to the point where they are, once again, rarely seen in the inland waters. The return of large numbers of harbor porpoise, a high trophic level predator, is certain to have an impact on the Puget Sound ecosystem, however, it is difficult to speculate about potential changes at this time.

POSTER

BASIDIOMYCETE YEASTS IN THE THALLI OF PACIFIC NORTHWEST LICHENS OF THE LOBARIACEAE. Ryan Balkcom and Lalita M. Calabria, The Evergreen State College, 2700 Evergreen Parkway NW, Lab 1, Olympia, WA 98505; balrya07@evergreen.edu

The discovery of basidiomycete yeasts in the thalli of over 190 lichen species (Spribille et al. 2016) may help clarify long-standing questions about unique chemistry and morphology within lichens. The primary goal of this project was to identify potential basidiomycete yeasts in the thalli of 3 species within the Lobariaceae using molecular methods developed by Spribille and co-workers (2016). Epiphytic Lobariaceae lichens are recognized for their significant contribution to biomass in Pacific Northwest forests, some supplying significant amounts of nitrogen via cyanobacterial symbionts. We collected fresh lichen thalli of *Lobaria pulmonaria* (n=2), *Lobaria scrobiculata* (n=1), and *Sticta fuliginosa* (n=2) from The Evergreen State College campus and identified each specimen to species using dichotomous keys. We extracted DNA according to the DNAeasy kit and performed PCR using ascomycete (ITS-1F & ITS4) and basidiomycete (ITS_syrho_1 & LRO_syrho_R) primers from Spribille et al 2016. We sent amplified DNA to an outside lab (MC Lab) for sequencing, used MEGA7 software to align our sequences and performed BLAST searches with resulting DNA alignments. One of the *L. pulmonaria* specimens indicated a 100% match with basidiomycete yeast *Rhodospordiobolus ruineniae*. The second specimen, and the *S. fuliginosa* specimens, matched with *Septobasidium* species. The *L. scrobiculata* specimens matched with yeasts from the *Rhodotorula* and *Bannozyma* genera. To our knowledge, these are the first findings of basidiomycete yeasts in the Lobariaceae family, all from the *Pucciniomycotina* subdivision. Future research should include repeating this analysis to compare intraspecific variation with species collected from various locations across the Pacific Northwest.

ORAL

RIVER RESTORATION FOR A CHANGING CLIMATE. Tim Beechie, Northwest Fisheries Science Center, NOAA Fisheries, 2725 Montlake Blvd. E., Seattle, WA 98112; tim.beechie@noaa.gov

Future climate scenarios suggest that riverine habitats will be significantly altered in the next few decades, forcing managers to ask “How vulnerable are habitats and species to climate change?” and “How should river restoration activities be altered to adapt to climate change?” Recent vulnerability assessments indicate that vulnerabilities to climate change vary among species and among locations, and that some areas and species may be more resilient. Adapting restoration plans and activities to climate change depends in part on which restoration actions can either ameliorate a climate change effect or increase habitat diversity and resilience, which we assessed by literature review. In general, actions that restore connectivity or restore watershed and ecosystem processes are most likely to be robust to climate change effects because they allow species and riverine ecosystems to evolve in response to shifting stream flow and temperature regimes. We offer a decision support process to illustrate how to evaluate whether a restoration plan or project design should be altered to accommodate climate change effects.

EFFECTS OF VARIABLE DENSITY THINNING ON NON-NATIVE PLANT SPECIES IN THE OLYMPIC HABITAT DEVELOPMENT STUDY.

Yianna Bekris, Janet Prev y, Leslie Brodie, Constance Harrington, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue SW, Olympia, WA, 98512-1101; yiannabekris@fs.fed.us

Management practices have left the Pacific Northwest with many second-growth stands lacking the heterogeneity, diversity, and species richness of late-successional forests, which serve as critical habitat for a number of sensitive species. The Olympic Habitat Development Study was designed to address interest in forest management practices that hasten the development of specific late-successional features in second-growth stands using variable-density thinning. One concern with such methods, however, is the potential for the introduction of non-native plants. Disturbance from logging can create conditions that introduce and favor non-native species, several of which have been shown to have negative effects both ecologically and economically. We test the hypothesis that initial disturbance from logging increases the number and cover of non-native plant species, but because many are shade intolerant, they will decrease over time as native shrubs and young trees re-establish. We found that the number of non-native species, as well as the cover of non-native species, initially increased after logging. Seven non-native species were found pretreatment, 15 were present 3 years after treatment and non-native cover was highest 7 years after treatment. By year 17 post-treatment, only 4 species (*Digitalis purpurea*, *Ilex aquifolium*, *Mycelis muralis*, and *Rubus laciniatus*) remained and cover had become negligible likely due to the natural decrease in light levels as overstory crowns expanded, seedlings regenerated, and native shrub cover increased. Because of the ecological and economic cost of non-native species, understanding how they change over time in response to management and disturbance is of utmost importance.

TWO SEASONS OF BRYOPHYTE SURVEYS FROM THE NORTH CASCADES.

Miles E. Berkey, North Cascades National Park Complex, 810 State Route 20, Sedro- Woolley, WA 98284; mberkey45@gmail.com

Bryophyte collection trips in the North Cascade Range during the 2016 and 2017 field seasons prioritized sites likely to support rare species as well as sites able to develop the bryophyte inventory of the North Cascades National Park Complex (NOCA). Within the Okanogan-Wenatchee National Forest, focus was given towards surveying for the globally imperiled mosses – *Brachydontium trichodes* (F. Weber) Milde, *Brachydontium olympicum* (E. Britton) T.T. McIntosh & J.R. Spence, and *Bryoxiphium norvegicum* subsp. *norvegicum* (Brid.)  . L ve and D. L ve – among the subalpine and alpine zones of Rainy Pass, yet all bryophyte species encountered were collected. Montane riparian sites and acidic wetlands received the greatest collection efforts within NOCA. Combined, 124 liverwort and moss species were documented throughout the collection sites. Rare liverwort species collected from NOCA and Rainy Pass were: *Radula obtusiloba* (A. Evans) S. Hatt., *Asterella lindenbergiana* (Corda ex Nees) Lindb. ex Arnell, *Anastrophyllum sphenoloboides* R.M. Schust., *Marsupella sparsifolia* (Lindb.) Dumort., *Nardia breidleri* (Linnpr.) Lindb. and *Ptilidium ciliare* (L.) Hampe. Two of the mosses collected were shown to have a conservation status of concern: *Andreaea rothii* F. Weber & D. Mohr, and *Tetraplodon mnioides*. Eight *Sphagnum* species and three other wetland obligate species were newly documented for the Park. Such developments for NOCA’s bryophyte inventory indicate its acidic wetlands to have been poorly surveyed for bryophytes thus far, and likely support more undocumented taxa. The bulk of the species collected were common to the North Cascades.

ORAL

BIGLEAF MAPLE DECLINE IN WESTERN WASHINGTON. Jacob Betzen, University of Washington, School of Environmental and Forest Sciences, Box 352100, Seattle, WA 98195-2100; Amy Ramsey, Dan Omdal, Washington State Department of Natural Resources, 1111 Washington St SE, Olympia, WA 98501-2283; Greg Ertle, Patrick Tobin, University of Washington, School of Environmental and Forest Sciences, Box 352100, Seattle, WA 98195-2100; betzen@uw.edu

We investigated the extent and severity of a recently reported decline in bigleaf maple (*Acer macrophyllum*). In 2010 reports from the general public began to reach the WA DNR. This prompted an exploratory survey throughout the range of bigleaf maple in Washington State, which revealed widespread decline. Symptoms of this decline include yellow flagging of large branches, small leaf size, partial or entire crown dieback, and mortality. No pathogens commonly responsible for bigleaf mortality have been found present in sufficient numbers of affected trees to indicate a main causative agent. We surveyed tenth-acre plots at a subset of the original DNR survey sites, and randomized plots throughout Western Washington. In these plots, we recorded basic forest measurements, and collected soil samples and leaf samples from healthy and declining bigleaf maple, and tree cores from a subset of bigleaf maple and Douglas-fir. We also collected weather, soil, and land-use information from online databases. Our initial results indicate a correlation between the severity of decline in a bigleaf maple to the proximate to a road, as well as a link to recent weather patterns. Future research will involve an elemental analysis on the leaf and soil samples, and dendrochronological analysis on the tree cores. We will attempt to statistically determine whether any of the possible biotic or abiotic factors are correlated with presence and severity of bigleaf maple decline, and determine the temporal and spatial record of the decline's spread and establishment, to indicate the presence or absence of a pathological agent.

POSTER

DEFORMATION ACROSS THE HURRICANE RIDGE FAULT IN THE SOUTHEASTERN OLYMPIC PENINSULA, WA, USA. Veronica C. Biesiada, Nancy A. Price, Department of Geology, Portland State University, 1721 SW Broadway, Portland, OR, 97201. Vcb@pdx.edu.

The Olympic Mountains of NW Washington, USA, have undergone a complex deformational history that is heavily influenced by E-W accretion from the Cascadian Subduction Zone (Tabor & Cady, 1978) and N-S shortening from regional rotation (McCaffrey et al., 2007). The interpretation of deformation structures provides insight into the role of these tectonic models in the uplift of the Olympic Mountains. This study investigates structures along a transect where the Hamma Hamma River crosses the Hurricane Ridge Fault, which juxtaposes the meta-sedimentary core (west) and the basaltic Crescent Formation (east). In the study area, the meta-sedimentary unit is characterized by outcrop-scale folding with calculated fold axis of 69→342. Two distinct fabrics are present: a foliation (130, 65) which is best developed in the slate layers and fractures (180, 75) that cross-cut bedding and other structures. Veins are also present, have a similar orientation to the foliation, and are cross-cut by fractures. The Crescent Fm. has near vertical, N-S striking beds which are cut by five fracture populations and four vein populations. Two of the fracture populations dominate at (303, 40) and (211, 39), and one vein orientation dominates at (315, 40). The foliation, bedding, and veins in the meta-sediments are overprinted by the N-S oriented fracture fabric, which may be related to the exhumation and fracturing of the Crescent Fm. Considering the regional setting, these structures can be related to the both models of deformation.

EXAMINING IN VITRO MOSS GROWTH IN TACKIFIERS FOR POTENTIAL USE IN RANGELAND RESTORATION AND REHABILITATION. W. Dillon Blankenship, Oregon State University, Dept. of Botany & Plant Pathology, Cordley Hall, Corvallis, OR 97331; Lea Condon, and David A. Pyke, U.S. Geological Survey, Forest & Rangeland Ecosystem Science Center, 3200 SW Jefferson Way, Corvallis, OR 97331; blankewy@oregonstate.edu

Desert mosses are integral parts of biological soil crusts in the Great Basin, but restoration of these mosses has met limited success. We applied tackifiers to fragments of *Syntrichia ruralis* as a potential restoration delivery method and observed their growth over five weeks in a growth chamber. Tackifiers are compounds used in restoration and rehabilitation activities for temporarily stabilizing soils and adhering seed and mulch to soil following disturbance, such as road cuts and fire. We tested the three most common tackifiers, guar, psyllium, and polyacrylamide, at three concentrations (0.5x, 1x, and 2x) relative to the recommended application rate against a water control. We collected specimens of *S. ruralis* near Bend, Oregon, separated them into single 6-7mm green fragments, and grew them on sand substrate in sets of ten in petri dishes. We used four replicated blocks to account for light/humidity variation in the growth chamber with dish as the sampling unit. We randomly assigned dishes to one of ten possible tackifier combinations (three tackifier types x three concentrations and a water only control). We measured lateral shoot development and rhizoid extent weekly during the experiment to track moss growth. Preliminary results indicate that more new shoots/fragment were produced in all treatments. A mean of 21 new shoots/dish (2.1 shoots/fragment) were grown in tackifiers and 19 new shoots/dish when grown in distilled water (1.9 shoots/fragment). These results suggest that tackifiers could be an effective means of field application of this desert moss.

GENE FLOW, DIFFERENTIATION, AND HATCHERY INFLUENCE AMONG HOOD CANAL COHO SALMON POPULATIONS. Justin Bohling, Jennifer Von Bargen, US Fish and Wildlife Service, 1440 Abernathy Creek Rd, Longview, WA 98632; Peter Bahls, Northwest Watershed Institute, 3407 Eddy St, Port Townsend, WA 98368; justin_bohling@fws.gov

Freshwater tributaries are essential for the life cycle for anadromous salmon and research and management of salmon often focus on the tributary-level to understand population dynamics and enhance spawning conditions. However, these spawning populations do not exist in a vacuum: dispersal between populations can unite them demographically and genetically. Artificial propagation can also impact spawning population through competition and introgression between hatchery-origin and wild salmon. Understanding these interactions is vital to characterizing salmon biology and implementing effective management. Our goal in this study was to examine the genetic relationship among wild coho salmon (*Oncorhynchus kisutch*) spawning populations in the Hood Canal of Washington. Included in our study were samples collected from seven tributaries along with samples from broodstock raised at Quilcene National Fish Hatchery. We generated genetic using high-throughput sequencing of restriction-site associated DNA sequence (RADseq) data. This approach allowed us to generate data from over 30,000 genetic markers distributed across the coho genome. We found that there was little genetic differentiation between tributaries; in fact, for some populations the temporal differences in allele frequencies were more significant. The hatchery broodstock from Quilcene NFH was genetically differentiated from wild populations and there was evidence of intermixing in both directions: hatchery-origin fish were captured on spawning grounds and wild-origin fish were used as broodstock. These results suggest coho salmon populations in this area function as a metapopulation in which dispersal facilitates genetic exchange. Along with enhancing our knowledge of coho salmon biology, it has implications for management and restoration activities.

POSTER

LONG DISTANCE DISPERSAL OF A WOLF FROM NORTHEASTERN WASHINGTON INTO THE GREATER YELLOWSTONE ECOSYSTEM. C. Steven Borrego and Azzurra Valerio, Washington State University, School of the Environment, Pullman, WA 99164; steve_borrego@yahoo.com

Gray Wolf (*Canis lupus*) populations in Idaho, Montana and Wyoming have grown rapidly since the 1995-1996 Northern Rocky Mountains (NRM) restoration effort. Subsequently, dispersing wolves from the NRM population and Canada have facilitated recolonization of vacant habitat in neighboring states, including Washington (WA). We documented the long-distance dispersal of a wolf from northeastern WA into the Greater Yellowstone Ecosystem. As part of a separate research effort in June 2016, we fit a GPS collar (24-hour fix rate) on a yearling male wolf, and used ArcGIS 10.5 to analyze the movement path as Euclidean point-to-point segments. In December 2016 the wolf dispersed from his natal territory, near Colville, WA and continuously traveled a minimum distance of 2501 km across 237 days until localizing near Island Park, ID in July 2017. We calculated 16 missing fixes (days) during the event, therefore distance is underestimated. During the dispersal phase, the daily mean movement was 11 km (range = 0-55 km). The wolf traversed all 3 NRM states and to the furthest extent to the Wind River Range, WY (Euclidean distance = 845 km from natal territory). The dispersal trajectory followed river and highway corridors, and included agricultural and developed, human populated areas such as Post Falls ID, Missoula MT, McCall ID, Boise ID, and remote areas such as Craters of the Moon NMP, Grand Teton NP and Yellowstone NP. This case highlights the connectivity of wolf populations at a landscape level and their natural expansion into not only vacant but occupied habitat.

POSTER

ODONATA OF THE CASCADE-SISKIYOU NATIONAL MONUMENT: INVENTORY, SPATIAL DISTRIBUTION AND RELATIVE ABUNDANCE WITHIN DIVERSE HABITATS. Hope Braithwaite, Michael Parker, Department of Biology, Southern Oregon University, 1250 Siskiyou Blvd., Ashland, OR 97520; braithwah@sou.edu

The Cascade-Siskiyou National Monument (CSNM), Oregon, USA was established to protect biological diversity. Biodiversity of aquatic organisms is high and although dragonflies and damselflies (Order Odonata) are conspicuous and readily observable and identifiable, this is the first inventory of Odonata in the CSNM, including spatial distribution and relative abundance within and among diverse aquatic habitats. Seven sites, including both lentic and lotic habitats, were visited monthly June through September 2017. Surveys included catch-and-release and photograph records and reliable sight identifications with the aid of close-focusing binoculars for adults and collected specimens for nymphs. To date, 46 taxa (30 dragonflies, 16 damselflies) are documented in the CSNM. Dragonflies (suborder Anisoptera) were represented by the families Aeshnidae, Cordulegastridae, Corduliidae, Gomphidae and Libellulidae. Damselflies (suborder Zygoptera) were represented by the families Calopterygidae, Coenagrionidae and Lestidae. Both number of species and number of individual odonates was highest in July in all but two sites. A notable species, *Aeshna tuberculifera* was recorded at Parsnip Lakes, the southernmost location known for this species in the western USA. This study creates a benchmark of odonate species diversity for the CSNM that can be further updated and utilized to potentially monitor changes in environmental conditions including aquatic habitat quality, water quality and community responses to climate change.

POSTER

HOW DOES CLIMATE INFLUENCE RANGES OF BERRY- AND NUT PRODUCING NATIVE NORTHWESTERN SHRUBS? Leslie Brodie, Janet Prev y, and Constance Harrington, U.S. Forest Service, Pacific Northwest Research Station, 3625 93rd Ave. SW, Olympia WA, 98512; lbrodie@fs.fed.us

Berry- and nut-producing shrubs of the Pacific Northwest are an important food source for foraging wildlife and pollinators, are culturally important as components of traditional tribal diets and are also harvested for recreational and commercial use. In this project, we are developing information on how climate change will impact the ranges of ecologically and culturally important northwestern shrubs including huckleberry, salal, and hazelnut. Accurate mapping of current ranges of shrubs is one way to understand the relationship between climate variables and shrub distributions. Current range maps of many species, however, is only available at the county or state scale. More accurate maps of current ranges will act as the starting point to help managers understand how climate change is likely to affect the location (range) and timing of berry and nut production of widely distributed shrub species. The first step in this process is the collation of currently available data sources including herbarium specimens and various vegetation assessments. Using presence/absence data from all these data sources in conjunction with climate information will allow us to develop more detailed plant range maps than those currently available and can be used to develop future range maps based on projected changes in climate. This information could then be used to help managers determine priorities for competing projects, evaluate vulnerabilities, consider if other fruit-producing shrub species might be planted in areas of traditional harvesting, or identify if new areas might need to be developed for traditional or commercial use.

POSTER

CAMOUFLAGE AND SEXUAL DICHROMATISM IN THE NORTHERN PACIFIC RATTLESNAKE (*CROTALUS OREGANUS*). Jefferson D. Brooks Graduate Student; Daniel D. Beck, Professor, Department of Biological Sciences, Central Washington University, 400 E University Way, Ellensburg, WA 98926-7537 USA. Corresponding Author Email: Brooksjd@cwu.edu

As ambush predators, Northern Pacific Rattlesnakes (*Crotalus oreganus*) are highly reliant upon crypsis to hunt, as well as to avoid predators. Presumably, rattlesnakes have evolved coloration and patterns that match the local substrates of their habitats. However, the extent to which this occurs in *C. oreganus* is unknown. To determine how snakes might interact with the color background of their environment, we used standardized digital photography to record snake coloration and substrate coloration around their overwintering hibernacula (dens), where they spend considerable time on the surface basking in the spring. Satellite imagery was used to classify habitat type at the landscape level. Preliminary results suggest that snake coloration matches local habitat type, and this correlation is stronger for females than for males. Females also had color ratios that were more similar to the substrates immediately surrounding the den than males. Males showed greater contrast in tail banding, potentially indicating increased selection for warning coloration. These results indicate that *C. oreganus* in Washington is sexually dimorphic in color, which may be due to the differing natural histories of the sexes: males frequently travel far from their dens during the active season, whereas females do not, especially when they are gravid. These differences may lead to the sexes encountering different varieties of substrates and, consequently, for selection on males to show stronger warning coloration and for females to show greater crypsis.

ORAL

DEPLOYMENT OF SUCTION-CUP ATTACHED MULTI-SENSOR VIDEO TAGS REVEAL FEEDING HABITS OF GRAY WHALES ON GHOST SHRIMP IN NORTHERN PUGET SOUND.

John Calambokidis, James Fahlbusch, Jack Burdett, Cascadia Research Collective, 218½ W 4th Ave., Olympia WA 98501; Dave Cade and Jeremy Goldbogen, Stanford University, 120 Oceanview Boulevard, Pacific Grove CA 93950; JCalambokidis@CascadiaResearch.org

As part of a project conducted with the Washington Department of Natural Resources, we examined the feeding behavior of a group of a dozen gray whales that return annually (some for over 25 years) to northern Puget Sound for 2-3 months each spring. This location is >200 km off the migration route for gray whales. We examined gray whale feeding and social behavior from 11 deployments of suction-cup attached multi-sensor video tags in spring of 2015-16. The tags gathered 132 hours of data (including one >67h attachment). Video and kinematic data revealed gray whales fed almost exclusively on intertidal ghost shrimp during high tide periods. Dive depths during feeding were 2.5-3 m (barely enough waters to swim) and some areas were over 2 km from deeper water. Feeding periods ranged from <1h to >6h skewed towards the incoming period around the high tide. Gray whales spent extensive periods milling in several other areas during other portions of the tide cycle but the tags revealed they were not engaged in feeding and showed a high degree of social interaction among whales including frequent body contact with other whales. Prey density data indicates that despite the limited time these areas are accessible, the prey density and feeding rate would make this a very advantageous strategy despite the riskiness. This small number of whales may be removing 100 metric tons or more of ghost shrimp each spring in an area where a human harvest for ghost shrimp also occurs.

ORAL

EVALUATING IMPACTS OF SEA LEVEL RISE AND STORM SURGE ON NEARSHORE NATURAL RESOURCES HABITATS AND SWINOMISH COMMUNITY HEALTH.

Larry Campbell, Jamie Donatuto, Sarah Grossman, Swinomish Indian Tribal Community, 17337 Reservation Rd, La Conner, WA 98257; Eric Grossman, US Geological Survey, Pacific Coastal and Marine Science Center, Western Fisheries Research Center, Seattle, 6505 NE 65th St, Seattle, WA 98115; jdonatuto@swinomish.nsn.us

Recent publicity has illuminated that Indigenous people are some of the most impacted by climate change. What is less broadcasted is that many Indigenous communities are also at the forefront of assessing impacts and developing adaptation plans. The Swinomish Indian Tribal Community, a Coast Salish people (Washington State), signed a proclamation to address climate change in 2007, then published an impact assessment in 2009 and an action plan in 2010. As part of on-going efforts, Swinomish staff worked with community members to pilot a method of evaluating community health impacts based on projected sea level rise and storm surge effects on shellfish habitat. The project used a set of Swinomish-specific Indigenous Health Indicators, which focus on non-physical aspects of health that are priorities to Swinomish people (community connection, natural resource security, education, self-determination, cultural use, and resilience). Findings demonstrate that: when shellfish habitat is impacted, so is Indigenous community health; not all community health indicators are equally impacted; and, the community health indicators of highest concern (natural resources security) are not necessarily the same indicators most likely to be impacted (cultural use). Based on the findings and feedback from community participants, the exploratory trials were successful, and Swinomish has since launched a more detailed project to assess community health impacts. Indigenous-specific health indicators may be useful to Indigenous communities who are assessing climate change sensitivities and creating adaptation plans.

POSTER

USING DENDROCHRONOLOGY AND RADIOCARBON DATING TO INVESTIGATE A SUBFOSSIL FOREST IN PUGET LOWLAND AND SOUTHEAST OLYMPIC MOUNTAINS.

Emily Lindstrum Carson, Centralia High School, 813 Eshom Road, Centralia, WA 98531; Patrick T. Pringle, Centralia College Science Dept., 600 Centralia College Blvd. Centralia WA 98531; Trevor Contreras, Department of Natural Resources, 1111 Washington St SE, Olympia, WA 98502; ecarson@centralia.wednet.edu

Exploration of the channel of Johns Creek, a tributary to the Hamma Hamma River on the west side of the Hood Canal, Washington revealed a forest of semi-buried subfossil trees, one of which had previously been dated to ~1100 yr ago (Contreras and others, 2012). Using saws and increment borers, we sampled seven of the subfossil trees, five that lie subhorizontal and two growth-position stumps. Because the death date on the tree dated in 2012 was similar in age to the circa 900 CE Seattle Fault, we used a combination of radiocarbon dating and tree-ring analysis in order to determine if these partially buried subfossil trees were victims of the Seattle fault rupture that were later exposed during channel migration of Johns Creek. We submitted two wood samples from tree Ham01 for radiocarbon analysis. The calibrated radiocarbon lab results on the two samples yielded ages of 877–950 CE and 932–985 CE (95% probability), consistent with the age of the Seattle Fault. Previous dating of a coseismic subsidence event in the Hamma Hamma River delta (E. Lindstrum, et al., 2002) resulted at ~947 CE and at up river at Lena Lake at 767–997 CE (95% probability; Logan, et al., 1998). Provisional results of tree-ring analysis shows the buried trees died the same year as a tree exhumed a Seattle Fault tsunami deposit by Atwater (1999).

ORAL

DISTRIBUTION OF LATE QUATERNARY TEPHRA EAST OF THE CASCADE RANGE.

Robert J. Carson, Department of Geology, Whitman College, Walla Walla, WA 99362; Hannah Buckland, School of Earth Sciences, University of Bristol, Clifton, Bristol, UK. carsonrj@whitman.edu

The tephra blown easterly from Cascade volcanoes was deposited as an ever-thinning blanket. Most Mazama ash (from the 8 ka eruption at Crater Lake) and Glacier Peak ash (13 ka) was then eroded from the mountains and hills to become secondary deposits in a variety of geomorphic settings: gullies (e.g. Pole Bridge, Lostine River, Wallowas), alluvial fans (e.g. Wallula Gap), taluses (e.g. Sentinel Gap), floodplains (e.g. Touchet River at Dayton), and even glaciers (e.g. Greenland ice sheet). Primary Mount St. Helens tephra from 16 ka is within the Touchet beds of the Missoula floods, and from 1980 is in Potholes sand dunes. Primary Mazama ash on the horizontal uplands of the Blue Mountains is as much as 1 m thick; considering the distance from Crater Lake, the unusually thick deposit suggests a front and/or precipitation to wash ash from the skies. Primary tephra eroded from the drainage basin of the northern Elkhorn Mountains was deposited on the Grande Ronde River floodplain west of La Grande; above a basalt colonnade is 1 m of secondary Glacier Peak ash overlain by 2 m of overbank sediments topped by 1 m of secondary Mazama ash.

ORAL

A CLIMATE CHANGE ASSESSMENT OF FIRST FOODS AND MEDICINAL PLANTS IN THE PACIFIC NORTHWEST. Michael J. Case, Case Research/University of Washington, John Kim, USFS Pacific Northwest Research Station, Becky Kerns, USFS Pacific Northwest Research Station; mcase@uw.edu

Climate change has already led to significant changes in species composition, phenology, biotic interactions, and disturbance regimes in western North America. Native Americans may be highly vulnerable to these changes because they rely heavily on natural resources, including traditional foods and medicinal plants. We applied an integrated assessment and identified changes to first foods and medicinal plants across the Pacific Northwest. Specifically, we applied a dynamic general vegetation model (DGVM) across Washington and Oregon and assessed projected changes in vegetation types. We then identified tribally-important first foods and medicinal plants that exist within these habitats and modeled the impacts of climate change. Our results show substantial changes in suitable habitat for some first foods and medicinal plants (such as huckleberries and sagebrush). We demonstrate how this information can be used in partnership with tribal organizations to help inform resource management and adaptation planning.

POSTER

EVALUATING STAND RELEASE EFFECTIVENESS WITHIN OREGON WHITE OAK COMMUNITIES AND IMPACTS TO FUEL LOADS. Kara Caselas, Jeffrey Gerwing, Department of Environmental Science and Management, Portland State University, 1719 SW 10th Avenue, Portland, Oregon 97201; kcaselas@pdx.edu

Oregon white oak (*Quercus garryanna*) and associated plant communities provide key habitat to a number of plant and animal species, including state listed threatened populations of Western grey squirrel. Over the past 150 years, human actions such as fire suppression have allowed encroaching conifers to reduce the extent and quality of historic Oregon white oak habitat. Oregon white oak and associated habitats are common in Klickitat County, which has one of the largest remaining acreages of Oregon white oak habitat in the state of Washington. While most oak habitats in the Pacific Northwest are found on private lands, Klickitat County contains a significant percentage of oak resources under public ownership, which provides unparalleled opportunities for landscape level management of these habitats. A common management strategy to restore oak woodlands and savannas is oak release, in which stands are thinned to enhance stand conditions, improve wildlife features, and reduce the risk of habitat destroying fire. I examined the response of Oregon white oak trees fifteen years post-treatment, evaluating tree growth, seedling and cut stump responses, and fuel load accumulation, and compared these findings to untreated areas. Within treated areas, released trees had larger stem diameter on average compared to untreated areas. However, treatments may have led to unintentional increases in surface fuels, as treated areas had higher levels of fuel classes measured (1, 10, 100 and 1000hr). These results indicate that unless surface fuels created by treatment methods are addressed, the occurrence of wildfire may result in loss of habitat acreage.

ORAL

ECOLOGICAL DATA AND GLMM'S: TROUBLESHOOTING LINEAR MODELS IN R WITH LEM4. Robert Emerson Clark, Washington State University Department of Entomology, 100 Dairy Road, Pullman, WA 99164-1120; robert.e.clark@wsu.edu

GLMMs (Generalized Linear Mixed Models) have their own sets of assumptions, pitfalls, and quirks that can create headaches if not accounted for—this workshop will take an applied approach to resolve common error messages and misuses of GLMM that can plague researchers attempting to get statistical results. Using examples from ecological data, the presenter will go over common problems such as pseudoreplicated co-variables, random effects assumptions, failed model convergence, how to accurately report parameter estimates, “nonsensical” post-hoc tests, and a brief introduction to resolving model overfitting with AIC. Specifically, we will go over example R code step-by-step in a pre-formatted dataset, and this will be followed by a short question and answer session.

ORAL

WW2100 STREAMFLOW MODEL SKILL ASSESSMENT. David R. Conklin, Oregon Freshwater Simulations Inc., 1915 NE 55th Ave., Portland, OR 97213; david.conklin@freshwatersim.com

The WW2100 project modeled daily flows in 9,300 stream reaches in the Willamette River basin under recent historical climate and projected future climates. After the WW2100 project ended in 2016, we used the model to hindcast seven years of daily flows (2010-16), and compared simulated flows aggregated by month to all available USGS gage data from the Willamette River basin of similar record length. We characterized the model's skill using statistics recommended by Moriasi and colleagues. Using Moriasi's criteria, the WW2100 model produced “good” to “very good” matches to observations in most of the gage locations. Statistics for the WW2100 model of Willamette River basin flows are comparable to statistics for the CA-BCM model for basins in California, as reported by Flint and colleagues five years ago.

ORAL

SHIFTING RED ELDERBERRY PHENOLOGY DISRUPTS KODIAK BROWN BEAR AND SALMON FOOD WEBS. William Deacy, Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331; will.deacy@gmail.com

Mangers and researchers generally assume that abundance of interacting species drives their trophic interactions. However, recent work has shown that attributes besides abundance, such as phenology, can strongly mediate species interactions. I will present data showing how Kodiak brown bears are influenced by, and respond to, the phenology of their foods. First, I will present evidence of individual brown bears exploiting variation in sockeye salmon spawning phenology by tracking salmon runs at two scales: along a single spawning stream and across a 2,800 km² region of Kodiak Island. At the local scale, data from time lapse cameras show bears tracking salmon spawning from the upper to lower sections of a tributary. At the regional scale, data from 40 GPS collared brown bears show bears visited multiple spawning sites to consume salmon for much longer than is possible at a single site. Second, I will explore how bears responded to asymmetric phenological shifts between primary foods: sockeye salmon and red elderberries. In years with anomalously high spring air temperatures, elderberry fruited several weeks earlier and became available during the period when salmon spawned in tributary streams. Bears departed salmon spawning streams, where they typically kill 25-75% of the salmon, to forage on berries on adjacent hillsides. This prey switching behavior attenuated an iconic predator-prey interaction and likely altered the many ecological functions that result from bears foraging on salmon. These results show how climate-induced shifts in resource phenology can alter food webs through a mechanism other than trophic mismatch.

ORAL

THE FRED HALL LEGACY: FORTY YEARS OF PHOTO MONITORING IN THE PACIFIC NORTHWEST. **Thomas E. DeMeo**, Fred C. Hall (retired), USDA Forest Service, Pacific Northwest Region, Portland, OR 97204; tdemeo@fs.fed.us

Former Blue Mountains and Regional Ecologist Fred Hall has left us with a remarkable legacy of photo monitoring conducted from 1970 until 2010. Topics investigated included vegetation response following wildfire, range monitoring, and tracking a network of relevés (comprehensive plots) used to develop plant association classifications Region-wide. Accomplishments include 30 years of range monitoring at Emigrant Creek; post fire monitoring of the Rocky Fire. Long-term monitoring of this sort is rare, and can uncover patterns not seen with three- to five-year projects. For example, monitoring at Emigrant Creek over time revealed beavers and their effects on trees on site changed the local hydrology more than livestock grazing. Work continues to capture and post this legacy on line, for all to benefit.

ORAL

USING MULTI-BEAM IMAGING SONAR TO MONITOR ADULT CHINOOK AND STEELHEAD POPULATIONS IN THE ELWHA RIVER AND BEYOND. **Keith Denton**, K. Denton and Associates, LLC, 672 Hooker Rd, Sequim WA 98382; Mike McHenry, Raymond Moses, Wilson Wells, Lower Elwha Klallam Tribe, 670 Stratton Rd, Port Angeles, WA 98362; George Pess, Oleksandr Stefankiv, Eric Ward, NOAA Northwest Fisheries Science Center, 2725 Montlake Blvd. East Seattle, WA 98112; keith8denton@gmail.com

The Elwha River, located on the Olympic Peninsula in Washington State, is the site of the largest dam removal project to date in the United States and was completed in the fall of 2014. We have been using multi-beam imaging SONAR to monitor adult Chinook populations in the Elwha River since 2008 and steelhead since 2010. SONAR has proven an effective tool to provide accurate estimates of both abundance and run timing before, during, and after dam removal where traditional methods now have reduced efficacy. Namely, SONAR can “see” through the turbidity that has limited traditional visual surveys and can continue to provide a basin wide estimate in the face of newly opened, difficult to access spawning grounds. The project also conducts weekly net sampling in the vicinity of the sites to capture migrating salmon and thus apportion raw fish passage derived from the SONAR to species specific passage. The net sampling can also be used to inform hatchery contributions to the total return. Our escapement estimates for Chinook for the last four years (2013, 2014, 2015, 2016) have been 4,250; 4,360; 4,112; and 2,628 fish, respectively. The decline in the 2016 Chinook population is likely due to effects of dam removal when those fish were juveniles in the river, but the population remains above 20-year averages. Steelhead passage for the 2013-2017 has been 385; 1,200; 1,450, 890, and 1,130 fish, respectively. Beyond the Elwha, the use of SONAR to improve estimates of salmon escapement is expanding both geographically and in species of interest.

WINTER THERMAL REGIMES OF SMALL FISH-BEARING STREAMS ON THE OLYMPIC PENINSULA. Warren D. Devine, Teodora Minkova, Washington State Department of Natural Resources, 1111 Washington St. SE, Olympia, WA 98504; E. Ashley Steel, USDA Forest Service Pacific Northwest Research Station, 400 North 34th Street, Suite 201, Seattle, WA 98103; Alex D. Foster, USDA Forest Service Pacific Northwest Research Station, 3625 93rd Ave. SW, Olympia, WA, 98512; Kyle D. Martens, Washington State Department of Natural Resources, 1111 Washington St. SE, Olympia, WA 98504; warren.devine@dnr.wa.gov

Winter temperatures in coastal Pacific Northwest streams have a strong influence on aquatic biota, including salmonids during egg development and juvenile life stages. Relatively little research has been conducted on these winter stream thermal regimes, despite evidence that recent climate trends are affecting stream water temperature (T_w) in winter more than in summer. For 5 years, we measured T_w hourly in 54 fish-bearing headwater streams (elevation=27 391 m) on the western Olympic Peninsula, WA. Our objective was to identify characteristics at the landscape, watershed, and reach scales that influence facets of the winter thermal regime such as seasonal and extreme T_w , diel and annual T_w range, and degree-day accumulation. Winters were generally long and mild (mean $T_w=5.7$ °C), with short-term, region-wide T_w fluctuations of up to 5 °C in response to weather patterns. Stream bankfull width ranged from 2-10 m, and larger streams were associated with colder winter T_w and greater annual T_w ranges. T_w generally decreased with increasing elevation, although elevation did not influence T_w on the coldest days. Watersheds with greater prevalence of glacial materials overlying the sedimentary bedrock were associated with colder T_w compared to watersheds with only sedimentary bedrock, suggesting possible groundwater influence. In 2015, a warm winter potentially representative of future conditions, the warm T_w anomaly increased with elevation. Future monitoring and management of riparian and aquatic resources can be improved through better understanding of how winter temperatures are distributed and controlled and through estimates of how these patterns and processes may change in the future.

GENETIC VARIATION IN PACIFIC MADRONE: MANAGEMENT IMPLICATIONS FOR FUTURE CLIMATE CONDITIONS.

Laura E. DeWald, Western Carolina University, Cullowhee, NC, 28723; Richard Snieszko, Dorena Genetic Resource Center, USDA Forest Service, Cottage Grove, OR, 97424; Marianne Elliott, Gary A Chastagner, Washington State University, Puyallup Research and Extension Center, Puyallup WA 98371; John H. Russell, Cowichan Lake Research Station, British Columbia Ministry of Forests, Lands, Natural Resources and Rural Development, Mesachie Lake, BC V0R 2N0; ldewald@wcu.edu

Pacific madrone (*Arbutus menziesii*) occurs from British Columbia to Southern California. The species has high cultural and specialty wood values, and is also ecologically important for wildlife habitat; colonizing following wildfire; and creating mid-story canopy biodiversity. Pacific madrone is experiencing unsustainable mortality, but reasons for the decline are unknown. Five common garden tests of 105 half-sib families representing 42 seed sources and 7 ecoregions from much of the range were established in 2011 in WA, OR and CA, and two tests were established in 2013 in BC to quantify phenotypic and genotypic variation in survival, leaf blight, height and form. Survival, dieback occurrence, blight, and form varied among test sites and seed sources, but generally not among families within seed sources. Variation in height, growth increment, and growth rate varied among test sites, sources and among families within seed sources. Test sites and years with moderate moisture and temperature conditions had greater survival (>90%), less dieback, and greater height growth for all seed sources. Variation patterns were significantly but not strongly (R^2 generally <55%) related to latitude of origin, suggesting presence of both local adaptation as well as superiority of some non-local families and seed sources. When plantations were stressed by drought or cold, non-local seed sources generally performed relatively poorly, but there were exceptions both among and within seed sources. Therefore, management of madrone for future climates should prioritize local sources but also consider movement of superior genetic material to supplement local populations.

FOUR UNIQUE GENOTYPES WITHIN *STICTA FULIGINOSA* SPECIES COMPLEX OF THE PACIFIC NORTHWEST.

Joseph R. Di Meglio, Department of Botany and Plant Pathology, Oregon State University, 2082 Cordley Hall, Corvallis, OR 97331; dimeglij@oregonstate.edu

The lichen genus *Sticta* occupies a broad array of ecological habitats and exhibits very high diversity in tropical ecosystems. Recently, molecular research in the genus has revealed several unique genotypes within the western European “*fuliginosa*” complex of *Sticta fuliginosa*; which have been described as separate species. Moreover, the western North American species of “*fuliginosa*” appear to be genetically distinct from those of western Europe. To clarify taxonomic concepts within this group, fresh specimens were collected from British Columbia, Washington, Oregon and California. Molecular data was collected by DNA extraction using the MPBio FastPrep extraction kit. ThermoScientific DreamTaq for PCR chemistry, and primers for ITS, LSU, RPB1 and mrSSU encoding regions. Sequences generated by Eurofins were aligned and assembled in Geneious R10 software. Phylogenetic trees were generated with PhyML bootstrap analysis using the GTR model in Geneious R10. We present a provisional phylogenetic dataset based on the ITS, LSU, RPB1 and mrSSU loci. We identified four unique genotypes and four monophyletic clades with high bootstrap support ($\geq 99\%$) based on the ITS and LSU loci in the *Sticta fuliginosa* complex of western North America. During initial screening, we discovered a unique genotype outside of the *Sticta fuliginosa* species complex and may be a putative new species of *Sticta* currently known only from the Pacific northwest. The findings provide the groundwork for further investigations in species delimitations and ecological differentiation within a common group of nitrogen fixing macrolichens.

HEAVY METAL DEPOSITION AND IMPACTS TO VEGETATION AND LICHEN COMMUNITIES ALONG THE RED DOG MINE HAUL ROAD AT THE CAPE KRUSENSTERN NATIONAL MONUMENT, ALASKA.

Elisa B. Di Meglio, Bruce McCune, Department of Botany and Plant Pathology, Oregon State University, 2082 Cordley Hall, Corvallis OR 97331; Alyssa Shiel, College of Earth, Ocean and Atmospheric Science, 104 CEOAS Administration Building, Corvallis OR 97331; Peter Neitlich, National Park Service Alaska Regional Office, 240 W 5th Ave, Anchorage AK 99501; elisa.dimeglio@oregonstate.edu

Cape Krusenstern National Monument is located in Northwestern Alaska and is crossed by the DeLong Mountain Transportation System haul road. The haul road is the only route for transportation of concentrated zinc (Zn) and lead (Pb) ore from the Red Dog Mine to the port site. The mine is ~50 km northeast of the monument and is one of the largest Zn mines in the world. In 2001, high metal levels in the moss *Hylocomium splendens* were attributed to fugitive ore dust released during transport. Since then, the mine has implemented measures to reduce fugitive dust. In 2006, vegetation and lichen community data were collected and a decrease in heavy metal levels in mosses were documented. In 2017, we remeasured the 2006 sites with the goals of (1) analyzing spatial patterns and change in metal levels of Zn, Pb and cadmium (Cd) from 2006 to 2017, and (2) analyzing change in vegetation and lichen communities from 2006 to 2017. Here, we present preliminary results of goal (2) where a negative relationship between species richness ($r = 0.91$) and Pb ($r = -0.69$) to axis 1 in nonmetric multidimensional scaling was observed. Blocked PerMANOVA and blocked Indicator Species Analysis demonstrated extensive shifts in community composition from 2006 to 2017, but these may be more related to climate change than to metal deposition.

CORRALLING A BLACK SWAN: ESTABLISHING NATURAL RANGE OF VARIABILITY UNDER A REGIME OF RARE, LARGE FIRES IN WASHINGTON'S WEST CASCADES.

Daniel C. Donato, Washington Department of Natural Resources (DNR), 1111 Washington Street SE, PO Box 47014, Olympia WA 98504-7016, and University of Washington, School of Environmental and Forest Sciences, Seattle WA 98195; Joshua S. Halofsky, Washington Department of Natural Resources (DNR), 1111 Washington Street SE, PO Box 47014, Olympia WA 98504-7016; Matthew J. Reilly, Humboldt State University, 1 Harpst Street, Arcata CA 95521; daniel.donato@dnr.wa.gov

One of the mysteries of the Western Washington Cascades is how much old-growth and how much early-seral conditions would be on the landscape under the natural regime of rare but very large, severe wildfires. Estimates of the natural range of variation (NRV) for these habitats are needed as benchmarks for ecosystem management, restoration efforts, and supporting threatened species. However, establishing the NRV is challenged by inherently scarce data for the most important disturbance events driving these systems (large fires on century to multi-century scales). Here, we estimate the NRV of late-seral and early-seral conditions in forests with stand-replacing fire regimes in the Cascade Range of Western Washington. Using a modeling approach, we assess the degree to which NRV estimates are robust to widely varying assumptions derived from existing literature, regarding: a) overall rates of burning (fire rotations), and b) how fire acreage is distributed through time (as highly infrequent, synchronous events or relatively frequent, disparate events). Results suggest that, under any plausible assumptions regarding fire rotations and synchronies, wildfire events (or episodes) would typically burn hundreds of thousands to >1 million hectares at a time. Similarly, under most scenarios, wildfire dynamics result in late-seral forests composing ~45 to 90% (median 70%) of the region typically, and structurally complex early-seral conditions composing ~1 to 30% (median 6%). Current conditions strongly differ from these ranges, with most of the landscape (68%) instead covered by dense, young to mid-seral forests, a situation which would rarely, if ever, occur under the natural disturbance regime.

CAN PASSIVE ACOUSTIC MONITORING DETECT AND IDENTIFY VOCALIZATION PATTERNS IN TWO CONGENERIC FOREST OWLS IN THE PACIFIC NORTHWEST? Leila Duchac, Damon B. Lesmeister, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; Katie M. Dugger, Nash Hall, Oregon State University, 2820 SW Campus Way, Corvallis, OR 97331; Zack J. Ruff, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; leila.duchac@oregonstate.edu

Passive acoustic monitoring using autonomous recording units (ARUs) is a fast-growing area of wildlife research, especially for rare, cryptic species that vocalize. Recent advances in ARU technology allow for long-duration recordings and more efficient sound processing, including machine-learning approaches using convolutional neural networks, which provide an efficient means to identify and classify sounds of interest. While ARU monitoring does not allow for tracking demographic rates in the same way as mark-recapture methods, it increases spatial and temporal coverage, does not disturb animals, improves crew safety, records all vocalizing species within the listening radius, and provides a permanent record of vocalizations. Northern spotted owl (*Strix occidentalis caurina*, hereafter NSO) populations have been monitored since the mid-1980s using mark-recapture survey methods. We investigated the use of ARUs to detect calls of NSO as well as barred owls (*Strix varia*), a recently arrived congener that has expanded its range to now encompass the entire NSO range, threatening NSO persistence through competition. We deployed 150 ARUs in three NSO demographic study areas in Oregon and Washington from March-July 2017 and recorded continuously every night. Preliminary results suggest that ARUs are an effective monitoring tool for determining at least presence/absence of NSO and other owl species through the breeding season. Limited results also show that NSO and barred owls may temporally partition calling activity, with NSO concentrating vocalizations around crepuscular periods and barred owls vocalizing throughout the night.

RESTORATION OF A COASTAL ESTUARINE ECOSYSTEM: A TOOL TO INCREASE BIODIVERSITY, SPECIES RESILIENCY AND HYDROLOGIC STORAGE CAPACITY IN RESPONSE TO STORM SURGE AND SEA LEVEL RISE. Kami S. Ellingson, Siuslaw National Forest, 3200 SW Jefferson Way, Corvallis, OR 97331 kellingson@fs.fed.us

Salmon River watershed on the north-central Oregon Coast, USA is 195 km² in size, with an 800 hectare estuary that extends to river kilometer 6.5. The basin has a diverse ownership and management: United Nations Biosphere Reserve, US Forest Service Cascade Head Scenic Research Area, The Nature Conservancy-headlands, Oregon Department of Fish and Wildlife Cascade Head Marine Reserve, private industrial forest-uplands, Oregon State Parks and rural residential along the lower reaches of main-stem Salmon River. Nearly all of the lower estuary was diked and gated in the mid 1950-60's and has been studied and restored in 10 year increments since 1978. All but one low marsh system was altered to prevent tidal inflow and control freshwater outflow. Modified drainage and flooding of estuarine area, in high demand for development and agriculture, restricted fish access and tidal inundation. Nearly the entire estuary is now restored to a natural, historic tidal regime, resulting in significant regeneration of native biodiversity. Salmonids response to tidal channel and marsh restoration was studied throughout the estuary recovery. Chinook and Coho Life History's responded to habitat removal (diking) and habitat gain (restoration). Restored estuarine Life History's contribute to adult returns—up to 75% of Chinook and ~30% of Coho spawners are tied to the restored Salmon River marshes. Monitoring of restoration efforts across the estuary indicate that the re-established tidal channels and associated marsh area provide increased flood capacity during peak tides coupled with storm surge, resulting in less up stream flooding impacts on rural residential properties.

ORAL

USING FIRST FOODS TO GUIDE THE MANGEMENT OF UPLAND ECOSYSTEMS OF THE CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION. Bryan A. Endress, Eastern Oregon Agriculture and Natural Resource Program, Oregon State University, La Grande, OR, 97850; Eric Quaempts, Shawn Steinmetz, Confederated Tribes of the Umatilla Indian Reservation, 46411 Timíne Way, Pendleton, OR, 97801; bryan.endress@oregonstate.edu

First Foods have sustained tribal people since time immemorial and the relationship between First Foods and the Tribes is essential to the ongoing culture of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). The First Foods serve a fundamental role in the health, well-being, and cultural identity of the Tribes and are considered to constitute the minimum ecological products necessary to sustain CTUIR subsistence and cultural needs. Recently, the Department of Natural Resources of the CTUIR adopted a mission based on First Foods: “To protect, restore, and enhance the First Foods - water, salmon, deer, cous, and huckleberry - for the perpetual cultural, economic, and sovereign benefit of the CTUIR...” In order to assist in applying this mission to natural resource management decisions, the CTUIR created a vision statement: *Our vision for upland landscapes is to ensure healthy, resilient and dynamic upland ecosystems capable of providing First Foods that sustain the continuity of the Tribe’s culture.* The primary goals of this vision are to: 1) articulate CTUIR’s vision for upland resource management, 2) serve as the foundation for planning and managing upland ecosystems and resources, and 3) serve as a resource for non-Tribal land managers, policy makers, and other stakeholders to better understand the importance of First Foods and provide a framework to consider and incorporate First Foods concepts into their management activities within CTUIR’s ceded territory. We will present this vision, highlighting desired ecological characteristics of upland ecosystems and provide a framework for planning, management and restoration efforts.

ORAL

DISTRIBUTION AND ABUNDANCE OF CULTURALLY-IMPORTANT FIRST FOODS IN PACIFIC NORTHWEST BUNCHGRASS COMMUNITIES. Bryan A. Endress, Joshua P. Averett, Eastern Oregon Agriculture and Natural Resource Program, Oregon State University, La Grande, OR, 97850; Eric Quaempts, Shawn Steinmetz, Confederated Tribes of the Umatilla Indian Reservation, 46411 Timíne Way, Pendleton, OR, 97801; bryan.endress@oregonstate.edu

Pacific Northwest bunchgrass communities support a diverse assemblage of spring ephemeral forb species, many of which are important First Foods for the Confederated Tribes of the Umatilla Indian Reservation. However basic information regarding the abundance and distribution of these ecologically and culturally important species as well as their relationships to environmental or biological factors, is largely lacking, making it difficult to assess their status or health. Many of these species are only active above-ground for a short period of time further complicating assessments. In order to inform monitoring and management of these First Foods, we conducted research in northeastern Oregon to: (1) document the richness, distribution and abundance of culturally-important First Foods at our study site, (2) measure the distribution and density of *Lomatium cous* and *Camassia quamash* and evaluate how abundances vary with microhabitat factors, and (3) assess variation in abundance estimates in relation to the date (month) of sampling. Data were collected in 30 plots, and we identified all vascular plant species and estimated their canopy cover. We also recorded plant density for *L. cous* and *C. quamash*. Plots were resampled in mid-April, mid-May, and mid-July. Results indicated that these grassland communities are a source of numerous First Foods. Distribution and abundance of these species, however, varied greatly across plots and responded differently to measured environmental gradients. Moreover, estimates were greatly influenced by the date of sampling, highlighting the challenges in surveying, monitoring and managing these important First Foods.

ORAL

PRIORITIZING RARE LICHEN SPECIES FOR CONSERVATION: LESSONS FROM

VASCULAR PLANTS. Walter Fertig, Washington Natural Heritage Program, Department of Natural Resources, PO Box 47015, Olympia, WA 98504; walter.fertig@dnr.wa.gov

Resources for conservation are always limited, so it is important to prioritize which species need the most attention. I developed a simple, qualitative system to rank the conservation priority of the entire native vascular plant flora of Wyoming. Each taxon was assessed using seven qualitative factors: Wyoming's contribution to global distribution, number of populations in the state, number of individuals, habitat specificity, intrinsic rarity, magnitude of threats, and population trend. Each factor was scored on a binary scale (0 for unthreatened, 1 for at risk) by a team of experts. If data were insufficient, the factor was scored "unknown". Minimum scores for each species were calculated by summing the values of each factor and treating unknowns as 0, while maximum scores were derived with unknowns equaling 1. Both summary scores were averaged to determine the conservation priority. Those taxa at risk for the largest number of factors had a higher conservation priority than those at risk for relatively few. Species with 3 or more unknown scores were identified as "data deficient" and a priority for more study. This protocol identified about 22% of the state's flora as being rare, but just 2% in imminent danger of extirpation and thus in greatest need of immediate conservation attention. This system has since been adopted by the Utah and Arizona native plant societies to develop and prioritize rare plant lists. The same methods could be applied to northwestern lichens to identify important data gaps and identify species most in need of conservation.

ORAL

RETURN OF THE GIANTS TO THE SALISH SEA: INCREASED OCCURRENCE OF HUMPBACK INTO THE SALISH SEA. Kiirsten Flynn, Gretchen Steiger, Elana Dobson, John Calambokidis, Cascadia Research Collective, 218½ W 4th Ave., Olympia WA 98501; Mark Malleson, Center for Whale Research

P.O. Box 1577, Friday Harbor WA 98250; Brian Gisborne, Juan de Fuca Express, Victoria, BC V8V 2G5; Ted Cheeseman, Happywhale, 904 Columbia St, Santa Cruz CA95060; Susan Berta, Orca Network, 485 Labella Vista Way, Freeland WA 98249; KFlynn@CascadiaResearch.org

Humpback whales were once common in the Salish Sea and were reported to over winter in these waters. A whaling station based in southern Vancouver Island from 1907 to 1910 hunted these whales through the winter months killing several hundred and largely eliminating them from these waters. Cascadia Research has conducted long-term studies of humpback whales along the US West Coast since the 1980s and documented their steady recovery from whaling; population increased at about 7-8% per year through about 2010 and then stabilize suggesting they may have finally recovered to pre-whaling numbers. In the late 2000s, we documented increased sighting reports of humpback whales in inside waters and extending into Puget Sound. Some of these whales were also documented staying through the winter months. These whales have now become common in the Salish Sea and become a focus of some whale watch operations on both the Washington and British Columbia side of the border (especially when killer whales are absent). We used photographic identification to investigate humpback whale movements and matches of identification photographs to other areas reveals that these whales travel to a mix of breeding areas primarily Hawaii and Mexico in winter months. Matches also show many of these whales using inside waters represent whales that had been using outside offshore waters, suggesting a shift over time into inside waters. We speculate that humpback whales, which show site fidelity to specific regions, only returned to these former feeding areas when their recovering population size forced their expansion into inside waters.

POSTER

ECOSYSTEM RECOVERY ON TWO DEBRIS FLOWS IN WESTERN WASHINGTON. Alex D. Foster, Peter A. Bisson, USFS Pacific Northwest Research Station, 3625 93rd Avenue SW, Olympia, WA 98512; Shannon Claeson, USFS Pacific Northwest Research Station, 1133 N. Western Avenue, Wenatchee, WA 98801; John Heimburg, Terry Jackson, Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; Jamie Glasgow, Wild Fish Conservancy Northwest, PO Box 402, 15629 Main Street NE., Duvall, WA 98019. alexfooster@fs.fed.us

In steep, headwater streams of the Pacific Northwest, storms and flooding often trigger landslides and subsequent debris flows. These primary agents of change dramatically affect aquatic and riparian habitats and associated biological communities. An exceptionally powerful storm struck southwestern Washington in December 2007 causing two large debris flows near Olympia, WA. The two impacted streams had several years of prestorm data, providing a rare opportunity to examine the recovery of aquatic species, vegetation and stream temperature. Cutthroat trout were found along the debris flows just months after the events making up >95% of the aquatic community. Initially, most trout were young-of-the-year fish, but after 4 years, trout age class resembled pre-impact and reference. After the debris flow, trout occupied habitats further upstream than previously, surmounting perceived barriers such as a 16m bedrock chute with slope of 33%. Tailed frogs rebounded to pre-impact levels in 2 years. Sculpin were found progressively further upstream to re-occupy habitats in about 3 years. Crayfish were slow to recover, and western brook lamprey found before the debris flows were not detected even 5 years afterwards. Temperatures showed large increases in daily, diel and average 7 day maximum compared to pre-impact years and the adjacent reference stream. Initially, vegetation richness increased substantially, then leveled off in year 3, however vegetation cover increased in all 5 post survey years. Red alder was the predominate recolonizing tree, its cover and growth were slow for 2 years until seedlings bolted in the 3rd year.

POSTER

QUANTIFYING THE MAGNITUDE AND SPATIAL VARIABILITY OF BEDROCK EROSION BENEATH THE SISTERS GLACIER, WASHINGTON, USING COSMOGENIC ³HE CONCENTRATIONS. Sarah Francis, Doug Clark, Colin Amos, Department of Geology, Western Washington University, 516 High Street, Bellingham, WA 98225; Ken Farley, Division of Geological and Planetary Sciences, California Institute of Technology, 1200 East California Blvd, Pasadena, CA 91125; Paul Bierman, Department of Geology, University of Vermont, 81 Carrigan Drive, Burlington, VT 05405; francis3@wwu.edu

³He cosmogenic nuclide analyses provide a powerful tool to infer cirque-glacial erosion depths at a relatively high spatial resolution. We measured cosmogenic ³He concentrations in bedrock along glacial flow-line transects to estimate cirque-glacial erosion depths beneath the Sisters Glacier, North Cascades, WA within the Holocene glacier limits. ³He accumulates in bedrock exposed at the surface as a result of cosmic ray bombardment; the concentration of cosmogenic ³He increases with exposure time as well as proximity to the surface. We used field mapping, lidar data and aerial imagery to identify bedrock fractures, glacial fluting, and terminal moraines, to establish the Holocene maximum extent of the Sisters Glacier. Detailed Holocene glacial chronologies from nearby Mount Baker indicate that the Holocene forefield of the Sisters Glacier was likely exposed for ca. 10 kyr after Pleistocene deglaciation, then covered by Neoglacial ice for ca. 2 kyr until the last century. Results of our analyses show increased subglacial erosion with proximity to the modern glacier, as well as some stochastic erosional patterns that likely indicate glacial ice plucking. Complicating our interpretation, it was difficult to isolate the cosmogenic ³He component from some of our samples because ³He from the mantle is not removed through the typical sample processing techniques. We have modified our processing technique to minimize this uncertainty. In early March, we plan to analyze ~15 more samples to strengthen our results.

POSTER

AN ATLAS OF THE OLYMPIC PENINSULA: TRANSLATING SCIENCE. Daniel Gavin, Alethea Steingisser, Josie Imrie, Katherine Perry, James E. Meacham; Department of Geography, University of Oregon, Eugene, OR 97403-1251; dgavin@uoregon.edu

A thematic atlas that successfully synthesizes scientific data and visualizes the complex spatial and temporal patterns of a region can be one of the most effective mediums for conveying science and inspiring the reader's imagination. Integrating compelling cartographic and data-rich graphics with interpretive text invites the reader to a deeper understanding and appreciation for a place. We are embarking on creating an Atlas of the Olympic Peninsula with an emphasis on the physical geography (climate, landforms, biota), and the human imprint created by land ownership juxtaposed against the largest protected temperate forest in the world. We have the dual goals of general education of physical geography and landscape change as well as developing materials to aid in conservation planning. Here we present four topical "page pairs". The dramatic spatial variation of the peninsula's precipitation was mapped monthly and presented alongside snow and cloud climatology. Logging history (since 1972) was compiled from published sources and overlaid with old-growth forest, urban areas, and agriculture, revealing the magnitude of disturbance outside the park. Time-series maps show how logging has shifted among landownership. Tree height was mapped from satellite data for the entire peninsula and from Lidar data for a study area on the Hoh River. A topographic transect of canopy height from point cloud data reveals the multiple factors contributing to patterns in tree height. The project aims to tell the geographic story of the peninsula's outstanding diversity in landscape, and its environmental importance and challenges.

POSTER

GLORIA LICHEN ASSESSMENT ON THE BEARTOOTH PLATEAU IN PARK COUNTY, WYOMING. Jade M. Gjerde, Megan M. Poulette, Department of Environmental Science, Rocky Mountain College, Billings, MT 59102; Jade.Gjerde@rocky.edu

This research project established a baseline inventory of lichen species on four summits on the Beartooth Plateau in Park County, Wyoming during the summer of 2017. Four summits currently undergoing monitoring through the Global Observation Research Initiative in Alpine Environments (GLORIA) network were used to measure frequency and abundance of lichen species on permanent survey plots. This data was used to determine the extent of lichen contribution to species richness and biomass to this area. Analysis on frequency, abundance, ecotone, aspect, and microhabitat were performed to better understand the current population of lichen in this high alpine area. Ratio comparisons were used to determine that highest species diversity occurred in the subnival ecotone, alpine turf microhabitat, and on north and west aspects. Highest occurrence of lichens was found in the subnival ecotone, bedrock and scree microhabitat, and on south facing aspects. Crustose lichens were found to be the dominant thalli type present on all summits. In total, 30 species were found within the study area. In summary, this research provides a baseline data set which can be used to generate evidence-based predictions related to climate change and foster a better understanding of ecosystem function through future surveys.

ORAL

SAMPLING PROTOCOLS IN LICHENOLOGY: EPIPHYTE AND GROUND LAYER CONTRIBUTIONS TO MACROLICHEN DIVERSITY OVER A CLIMATE GRADIENT IN OREGON.

Abby L. Glauser, Bruce McCune, Department of Botany and Plant Pathology, Oregon State University, 2701 SW Campus Way, 2082 Cordley Hall, Corvallis, OR, 97331; abby.glauser@oregonstate.edu

Many lichen community studies focus on epiphytic lichens. For example, the US Forest Service Forest Inventory and Analysis (FIA) program uses a protocol for lichen inventory that only samples lichens on boles and branches above 0.5 meters in height. This protocol does not account for terrestrial lichens growing on soil, stumps, logs, small shrubs, and tree bases. Due to differences in substrate and resource availability, the lichen communities in this ground layer may have a much different composition than their epiphytic counterparts. In this study we examine how each of these layers contributes to total plot diversity, whether the ground layer adds meaningful data to overall plot diversity in certain climates, and how well epiphyte macrolichen diversity can be used to estimate total macrolichen diversity in Oregon. We obtained both epiphyte and ground layer community data for 38 plots spanning a climate gradient including the Pacific coast, Coast Range, Willamette Valley, Cascade Range, and central Oregon. Results indicate that on average, 76% of total plot diversity is captured by sampling epiphytes, and 39% by sampling the ground layer. Plots contain on average 18 species unique to the epiphyte layer and 7 unique to the ground layer. All climate zones showed similar results when examined individually, except central Oregon, where a greater proportion of total plot diversity was captured in the ground layer. Total macrolichen diversity can be estimated fairly well from epiphytic lichen diversity, but a different relationship holds in central Oregon than in western Oregon.

ORAL

PELTIGERA EXTENUATA: AN OVERLOOKED SPECIES IN THE PACIFIC NORTHWEST.

Katherine Glew, Associate Curator, Lichen Collections, WTU Herbarium, Burke Museum of Natural History, University of Washington, Seattle, WA 98195; kglew@uw.edu

Peltigera extenuata is found in North America, Europe and China. From the upper surface, it resembles *Peltigera didactyla*. In Washington State it was recently found for the first time on the Olympic Peninsula. Previously it was found in the Washington Cascades and the Colville area and surrounding states and Canadian provinces. *Peltigera extenuata* was resurrected to the species level in 2003 by Goffinet, Miądlikowska & Goward. The undersurface of *P. extenuata* is distinctive from *P. didactyla* in that the rhizines have multiple branches and are described as flocculent. Its distribution is not well documented in the Pacific Northwest, assuming individuals identifying the *Peltigera* in the field did not view the underside of the lichen that would have separated it from *P. didactyla*. Unlike *P. didactyla*, which may be fertile with apothecia, *P. extenuata* has rarely been observed to have these structures. Chemistry may also be used to distinguish the two species. A map will be provided to show the local distribution of *Peltigera extenuata*. A complete description of *Peltigera extenuata* will be provided to facilitate its identification in the field.

POSTER

DEVELOPING A VULNERABILITY ASSESSMENT FOR HUCKLEBERRIES. Tab A. Graves¹, Bob Rose², ¹US Geological Survey, Northern Rocky Mountain Science Center, 38 Mather Drive, PO Box 169, West Glacier, Montana 59936. ²Yakama Nation, Fisheries Resource Management Program, P.O.Box 151, Toppenish, WA. 98948. tgraves@usgs.gov

A group of interested scientists and managers recently developed a draft vulnerability assessment for *Vaccinium membranaceum*, a huckleberry species important throughout the northwest to local economies, cultural practices, and wildlife sustenance. We identified a range of potential sensitivities, under the broad categories of potential changes in habitat suitability, climate, seasonal weather, and species interactions. In this version (1.0), we drafted two infographics illustrating hypothesized needs and exposures for berry formation and for shrub presence over time. We will share the list of potential sensitivities and draft infographics. We invite all to provide feedback and share knowledge.

ORAL

MAPPING THE KEYSTONE PLANT SPECIES, HUCKLEBERRY (*VACCINIUM MEMBRANECEUM*), USING REMOTE SENSING IMAGERY. Tab A. Graves¹ Carolyn Shores², Nate Mikle¹; ¹US Geological Survey, Northern Rocky Mountain Science Center, 38 Mather Drive, PO Box 169 West Glacier, Montana 59936; ²School of Environmental and Forest Sciences, University of Washington, Seattle, WA 98040; tgraves@usgs.gov

Black huckleberry (*Vaccinium membranaceum*) is a keystone plant species that provides food and shelter for wildlife species and is a culturally and economically important resource for humans, particularly indigenous communities in both the United States and Canada. As such, understanding where huckleberries are on the landscape and how their distribution is changing in response to disturbance such as fire, will inform decisions ranging from forest, fire, and recreation management. We used two approaches to map huckleberry shrubs in Glacier National Park, Montana. Using methods easily accessible to wildlife and forest managers, we predicted huckleberry presence based on 1) a single-date classification of NAIP imagery using the shrub's color change in autumn and 2) a generalized linear model using Landsat spectral bands. We achieved overall classification accuracy of $\geq 74\%$. Classification accuracy was higher for lower levels of tree canopy cover. We also describe differences in predictions and uses of maps from the two approaches.

UTILIZING SCIENCE TO ENSURE SAFE ACCESS TO CULTURAL RESOURCES ON PUBLIC LANDS: THE PORTLAND NATIVE AMERICAN COMMUNITY AND TRADITIONAL GATHERING OF CAMAS.

Ciarra S. Greene, Center for Science Education, Portland State University, Portland, OR 97201; on behalf of the Portland Native American Community; greene.ciarra@gmail.com

Native Americans have been conducting and contributing to science for millenia. We have observed nature and passed on evidence-based Traditional Ecological Knowledge (TEK) from generation to generation. Prior to colonization, this knowledge enabled our people to live with ample nutritional resources. Our long-standing relationship to nature continues today in tribal, rural, and urban communities, yet access to cultural resources proves challenging due to modern land management practices. The Native American community and public land managers in Portland, Oregon are addressing this challenge through the restoration of cultural resources across the landscape. One focus in these efforts is the camas plant (*Camssia quamash*), which grows in wetland and prairie ecosystems. Access to local natural areas has been granted for Native American community members to gather camas, yet pesticide and herbicide application as land management practices have created uncertainty regarding the safety of ingesting the camas bulbs. The Native American community gathered camas bulbs in November 2015 for analysis, which resulted in glyphosate (pesticide) and triclopyr (herbicide). There are various factors which may influence the uptake of pesticide and herbicide residuals in camas which need further investigation, including pesticide/herbicide application details (date, location), preferential uptake of pesticide/herbicides in camas among the present plant community, the impact of pit roasting bulbs on residuals, and traditional land management practices like prescribed burning. Utilizing TEK and science to ensure safe access to cultural resources is paramount in preserving our cultures and enhancing the value of indigenous perspectives on land management practices and policies.

PHENOLOGY MONITORING OF CULTURAL RESOURCES THROUGH CITIZEN SCIENCE.

Ciarra S. Greene, NSF Graduate Research Fellow, Portland State University, Portland, OR 97207; Tabitha Graves, Ph.D., US Geological Survey, Northern Rocky Mountain Science Center, Glacier National Park, West Glacier, MT 59936; cgreene@pdx.edu

Indigenous populations have been observing the seasonal changes in plants and animals for millenia, basing their livelihood off the land. The modern study of the seasonal changes is called phenology and is useful in understanding how a changing climate might impact ecosystems. In Glacier National Park, grizzly bears roam the landscape and are dependent on the widespread huckleberries (~15% of their diet). By gathering data on huckleberry phenology and productivity in relation to varying climate patterns, predictions on broader impacts (grizzly bears, pollinators) can begin to inform land management efforts. The USGS has developed a mobile app, ScienceCache, which provides park visitors the opportunity to submit observations on huckleberry phenology. The mobile app has components of geocaching with guided phenological identification and data collection of specific huckleberry shrubs found throughout the Park. Future versions may include audio, photos, and text to include perspectives from local tribes. Huckleberries have environmental, economic, and cultural importance throughout the Northwest, with gatherers continually monitoring the shrub through their development, awaiting the ripe berries. Tribal traditional gatherers continue to gather a variety of other culturally significant species for food, medicine, ceremony, and crafting utilitarian objects. The NSF Greater Research Internship focuses on: Exploring the methods of phenology monitoring occurring through citizen science (with particular interest in cultural resources and tribal communities), diversifying phenology knowledge by including traditional ecological knowledge, and developing a curriculum template on traditional seasonal rounds and phenology, phenology and climate data analysis, and further predictions and inquiry.

ORAL

EVALUATING THE SUPPORTING SCIENCE BEHIND CLIMATE ADAPTATION ACTIONS TO ADDRESS SEA LEVEL RISE AND COASTAL CHANGE. Rachel M. Gregg, Whitney Reynier, EcoAdapt, PO Box 11195, Bainbridge Island, WA; Lisa Gaines, Jeffrey Behan, Institute for Natural Resources, Oregon State University, 234 Strand Agriculture Hall, 170 SW Waldo Place, Corvallis, OR 97331; Rachel@EcoAdapt.org

Climate change is one of the most pressing issues facing natural resources management, and decision makers at all levels are faced with choices on how to avoid, minimize, adapt to, and/or mitigate climate change impacts. Practitioners often struggle with how to identify and prioritize specific climate adaptation actions. Management actions may have a higher probability of being successful if they are informed by available scientific knowledge and findings. By evaluating actions on scientific knowledge and findings, we may be able to increase resource management effectiveness and efficiency. Here we provide an overview of the ASAP as well as a case study evaluating sea level rise adaptation actions along the Oregon and Washington coasts. Sea level rise is having and will continue to have a wide range of effects on coastal habitats, species, and communities, ranging from saltwater intrusion of freshwater ecosystems and aquifers to habitat conversion and infrastructure loss. Some of these effects are already causing forced relocation of coastal communities in Alaska (e.g., Shishmaref, Kivalina, Newtok) and Washington State (e.g., Hoh). Our methodology includes literature reviews and interviews, an expert elicitation process, and extensive engagement with natural resource managers and scientists from federal, state, tribal, and private entities working to address sea level rise, particularly using natural and nature-based approaches. This project is a partnership between EcoAdapt, Oregon State University's Institute for Natural Resources, the Northwest Climate Science Center, and the North Pacific Landscape Conservation Cooperative.

ORAL

BUILDING RECIPROCAL BENEFITS AND TRANSDISCIPLINARY PARTNERSHIPS BY INCORPORATING INDIGENOUS KNOWLEDGE INTO THE MANAGEMENT AND RESTORATION OF CAMAS PRAIRIE CULTURAL ECOSYSTEMS. Sarah T. Hamman, 120 Union Ave. #215, Olympia, WA 98502; Joyce Lecompte-Mastenbrook, 6841 40th Avenue NE, Seattle WA 98115; shamman@cnlm.org

Restoration of degraded cultural ecosystems worldwide has typically lacked input and insight from Indigenous groups that have created and maintained these areas for millennia. The camas prairies of the Pacific Northwest have a long history of Native American cultivation of native plants for food and fiber. Native American harvest and management was severely disrupted in most open prairies of the region over 200 years ago, as Euro-American diseases and colonization dramatically altered the land practices of Indigenous communities across the landscape. The newly formed Camas Prairie Cultural Conservation Education and Research Program (CCERP), initially funded through the University of Washington's Center for Creative Conservation, has gathered over 20 partners to work across real and perceived boundaries to share and honor Indigenous knowledge and practices for the greater goal of ecological and cultural conservation of camas prairies. Through transdisciplinary partnerships between Tribes, federal agencies, universities and non-profits, the CCERP is developing a tribally-driven teaching and research program focused on the South Puget Sound prairies of Washington State. We hope to encourage increased access to camas harvesting using traditional harvesting methods, and evaluate effects of this practice on the prairie ecological community using western scientific monitoring design. Additionally, we're developing a K-12 curriculum that raises awareness of, and appreciation for, Indigenous histories of camas prairie cultural ecosystems, and the importance of camas harvesting to tribal communities today.

ENGAGING THE PUBLIC AND POLITICIANS IN CLIMATE SCIENCE DISCUSSIONS: UNDERSTANDING OUR ROLES AS CITIZENS, SCIENTISTS AND EMPLOYEES. ORAL (PANEL DISCUSSION) - Alan Hardacastle, moderator (panelists **Steve Ghan**, Pacific Northwest National Laboratory; **David L. Peterson**, PNW Research Station, retired and **Dan Seimann**, WA Department of Natural Resources).

How can scientists advocate for appropriate policy while navigating their professional roles, citizen's rights, scientific ethics, and employer guidelines within a politically charged environment? As many groups work to mitigate the effects of climate change, scientists are called on to help to inform and influence policy. Their role might seem relatively uncontroversial, but there are potential pitfalls to avoid.

- Communicating scientific findings in a politically charged arena requires sound judgement and a deliberate approach to educating and engaging others.
- Exercising one's social responsibility and citizen's rights to engage in advocacy are vitally important. How can scientists avoid clashing with employer's rules of engagement?
- Scientists new to public information dissemination and debate may not consider the perception of bias by others, and the conflicting political values in environmental debate.
- Newcomers to scientific debate may need to understand their own values and biases, and how to use the relevant scientific/technical communities to help overcome their own dogmatism.

How have professionals in the climate change arena met these challenge? An invited panel of climate scientists and advocates will hold a panel discussion guided by a moderator. Panelists will answer several prepared questions exploring their roles as climate science producers, consumers, educators, and political advocates.

GUIDELINES FOR CONSIDERING TRADITIONAL KNOWLEDGES (TKS) IN CLIMATE CHANGE INITIATIVES. Preston Hardison, Tulalip Tribes of Washington, Natural Resources Treaty Rights Office, 6406 Marine Dr., Tulalip, WA 98271; phardison@tulaliptribes-nsn.gov

Traditional knowledges have been recognized by many United Nations agencies and instruments, national governments around the world, and an increasing number of institutions, scientists, and organizations as necessary for meeting climate change adaptation and mitigation goals. Indigenous Peoples have contributed observations related to climate change, place-based information for downscaling models, and traditional technologies and practices for decreasing emissions and adapting to impacts. However, there are significant challenges in access and using traditional knowledges (TKs). TKs, while providing useful information to society at large, are generally not conceived of by indigenous peoples as secular information that operates in the same way as knowledge in an open science framework. It is inextricably connected to their culture, spirituality, the land, and identity as peoples. In the United States, access and use of TKs outside of tribal communities also involve issues of tribal sovereignty and jurisdiction, treaty rights, and tribal trust obligations. This talk will present the principles developed by The Climate and Traditional Knowledges Workgroup in 2014 to inform the Department of Interior's Advisory Committee on Climate Change and Natural Resource Science (ACCCNRS) and the North Pacific Landscape Conservation Cooperative. These include, among others, the principles of free, prior and informed consent for accessing and using TKs, doing no harm, understanding and communicating both risks and opportunities, establishing common understandings, creating stable institutional interfaces, building long-term relationships, respecting cultural sensitivities, and recognizing the equal standing of multiple knowledge systems. The presentation will provide an update on the adoption and use of these principles.

ORAL

CALICIOD LICHENS AND FUNGI FROM NORTHEAST WASHINGTON. Amanda Hardman, Biodiversity Research Collective 30567 Le Bleu Rd, Eugene, Oregon 97405, biodiversityresearchcollective@gmail.com

Very little information exists on epiphytic calicioid lichens and fungi from northeastern Washington State. Mostly conifer but some hardwood trees were sampled from 61, one-hectare plots located in the Okanogan-Wenatchee and Colville National Forests in northeastern Washington. A total of 668 live trees were inspected, 400 of which were cored and therefore have age data. Additionally, 56 snags, 86 shrubs, and around 20 rocks were sampled. Most live trees sampled were over 50 years old but there was a range of trees from 19 to 431 years old. The relationship between tree age and species diversity was explored. There was a strong trend for older trees to have higher species richness than younger trees. No calicioid species were found on cored trees less than 50 years old. Forty-five species were identified from the study. The number of calicioid species found in each plot varied from zero to 21. The most species found on any one tree was nine. More species of calicioids were found on *Thuja plicata* than any other substrate. Some of the most common species encountered were *Calicium viride*, *Chaenothecopsis nana*, *Chaenotheca trichialis*, and *Cyphelium inquinans*. Some species were collected just one time including *Calicium corynellum* from rock, *Chaenothecopsis consociata* growing on *Chaenotheca chrysocephala* on *Larix occidentalis*, *Chaenothecopsis epithallina* from *Pseudotsuga menziesii*, *Microcalicium ahlneri* from *Thuja plicata*, and *Phaeocalicium populneum* from *Populus trichocarpa*.

ORAL

CURRENT AND FUTURE BIOCLIMATIC NICHE OF VACCINIUM MEMBRANACEUM.

Constance Harrington, USDA Forest Service Pacific Northwest Research Station, 3625-93rd Ave SW, Olympia WA 98512; Lauren Parker, Applied Climate Science Lab, Department of Geography, University of Idaho, Moscow, ID 83844, Janet Prev y and Leslie Brodie USDA Forest Service Pacific Northwest Research Station, 3625-93rd Ave SW, Olympia WA 98512; charrington@fs.fed.us

Black huckleberry (*Vaccinium membranaceum*) is a widely distributed shrub in western North America and its berries are an important food source for people (used as a traditional food by many tribes as well as for recreational and commercial picking) and many wildlife species. However, limited knowledge is available on the current bioclimatic niche and range of this important species, or how climate change may impact its distribution in the future. We obtained data for 14,111 observed locations of huckleberry across Washington, Oregon, Idaho, and western Montana and compared those locations to climate variables from 1971-2000 to develop a current bioclimatic niche (range) for the species using Maximum Entropy Modeling. We then used multi-model future climate projections for 2 time periods (2040-2069 and 2070-2099) and 2 emissions scenarios: RCP 4.5, which assumes emissions will be reduced, and RCP 8.5, which assumes emissions will continue on the current pathway. The range for the current time period is a good match for our observed observations with the model predicting a high probability of occurrence where the data indicated the species has been observed. Both emissions scenarios result in models predicting substantially reduced ranges at both future dates with the greatest loss in range in the RCP8.5 emissions scenario for 2070-2099. Losses in predicted probability of occurrence were most common on low elevation sites throughout the current range of the species (including coastal areas in WA and northern OR with currently moist climates) and well as in the dryland portions of the interior.

GOOGLE EARTH SATELLITE IMAGES PROVIDE NOVEL METHOD FOR EXAMINING FEEDING AREAS OF GRAY WHALES IN PUGET SOUND, WASHINGTON. Nathan R.

Harrison, John Calambokidis, Cascadia Research, 218 ½ W 4th Ave, Olympia WA 98501;

nharrison@cascadiaresearch.org

Satellite images provide a valuable research tool though their use in whale research has been more limited due to challenges in resolution and catching whales at the surface. We explore a novel use of Google Earth to identify gray whale feeding pits exposed at low tide. During their migration from Mexico, a small group of gray whales (typically 8-12) forage on ghost shrimp in the waters around Whidbey Island, WA for 2-3 months each spring. Many of these whales return annually to this area (some for 25 or more years) to feed on dense intertidal ghost shrimp beds that are exposed at low tide. We searched images available on Google Earth as of March 2017, for northern Puget Sound spanning from 47.8 N to 48.4 N and 122.2 W and 122.7 W and found 10 different dates with suitable low tide images from 23 May 2005 to 17 July 2015. From these we documented 19,447 identifiable feeding pits. The highest number were seen on the Snohomish River Delta which accounted for 14,289 (73%) and were seen in 9 images spanning 5 different years from 2005 to 2015. The locations identified were consistent with observed locations gray whales were seen feeding at high tide and higher resolution images obtained from aerial flights. Studying freely available satellite images provides a non-invasive method to investigate the feeding behaviors of benthic feeding gray whales. A larger set of high-resolution images would improve this approach potentially expanding the ability to detect whales and their activities.

CONSEQUENCES OF CLIMATE ADAPTATION POLICIES FOR POTENTIAL WILDLIFE HABITAT ON PRIVATE FORESTLAND IN WASHINGTON, OREGON, AND CALIFORNIA.

Yukiko Hashida, School of Forestry and Environmental Studies, Yale University, 195 Prospect Street, New Haven, CT 06511; **John Withey**, Graduate Program on the Environment, Evergreen State College, 2700 Evergreen Parkway NW, Olympia, WA 98505; **David Lewis**, Department of Applied Economics, Oregon State University, 2591 SW Campus Way, Corvallis, OR 97331; **Tara Newman**, Graduate Program on the Environment, Evergreen State College, 2700 Evergreen Parkway NW, Olympia, WA 98505; **Jeffrey Kline**, U.S. Department of Agriculture, Forest Service Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; tara.newman@outlook.com

Private forest landowners can adapt to climate change in part by altering the timing and intensity of their harvests and the tree species they replant. Forest management decisions can lead to substantive changes in the forest stock, and therefore can cause changes to a variety of forest ecosystem services. Climate change mitigation policies that reward carbon sequestration in forests, such as carbon pricing, can also induce adaptation behavior by providing incentives to delay harvests, and/or replant tree species that sequester carbon at faster rates. We examine private forest landowners' adaptation to climate change and carbon pricing, with a focus on the consequences for potential forested wildlife habitat in the Pacific coast states of the U.S. Our empirical analysis combines a spatially explicit econometric model of private forest management with dynamic landscape simulation and habitat association data for species of concern that utilize specific forest types. We show that both climate change and carbon pricing encourage adaptation away from currently dominant forest types, leading to losses of potential habitat for a variety of wildlife species. Our study highlights potential conflicts between climate change mitigation and wildlife conservation, and the importance of incorporating landowner adaptation into policy design.

ORAL

USING CLIMATE VULNERABILITY ASSESSMENTS TO INFORM SPECIES

MANAGEMENT AND RECOVERY. Lynn Helbrecht, WDFW, PO Box 43200, Olympia, WA, 98504-3200; Jessi Kershner, Senior Scientist, EcoAdapt, P.O. Box 11195, Bainbridge Island, WA 98110; lynn.helbrecht@dfw.wa.gov

In 2015, the Washington Department of Fish and Wildlife (WDFW) and scientists from EcoAdapt conducted a climate change vulnerability assessment (CCVA) for 286 species of greatest conservation need and 80 priority ecological systems. The purpose was to determine the relative climate sensitivity of animals already at conservation risk, and specifically, how climate might amplify existing stressors and to what degree. Our goal was to collect and assemble relevant information in a format that would be easily accessible to staff, and useful in the context of species recovery and restoration activities.

The CCVA itself consists of a spreadsheet which contains information on both inherent sensitivity (based on physiology, phenology and ecological relationships) and the climatic factors determined to be most critical for each species and system, for example soil moisture, flooding, or stream temperature. We then assessed the degree of change expected for each factor, and assigned an overall vulnerability rank to each species and system. Finally, an assessment of our relative confidence was included for each ranking, generally based on the extent and quality of available reference materials. Since 2015, WDFW has been working with staff and other partners to enhance the useability of the CCVA and creating outreach products to highlight themes about climate vulnerability across similar habitat types, and between species. This talk will review the methodology used to prepare the initial CCVA, lessons learned in applying the assessment to our work, and enhancements underway.

ORAL

A 20+ YEAR RECORD OF SOIL AND AIR TEMPERATURE MEASUREMENTS FROM REMOTE SITES ON THE MT. BAKER-SNOQUALMIE NATIONAL FOREST.

Jan A. Henderson, U.S. Forest Service (retired), 21817 77th Place W., Edmonds, WA 98026; Robin D. Leshner, U.S. Forest Service (retired), 4602 226th St SW, Mountlake Terrace, WA 98043; David H. Peter, U.S. Forest Service PNW Research Station, 3625 93rd Ave. SW, Olympia, WA 98512; Christopher D. Ringo, Dept. of Crop and Soil Science, 3017 Agricultural and Life Sciences Bldg., Oregon State University, Corvallis, OR, 97331; janhenderson@msn.com

Beginning in 1989 we installed remote weather stations to record soil temperatures at seven sites in the Cascades of Western Washington, representing a range of Plant Associations and Potential Vegetation Zones. The original purpose was to determine the soil temperature regime for these sites and vegetation units. Later, air temperature sensors were installed at five of these sites. After soil temperature regimes were determined, and one site was discontinued, further measurements were used to describe temperature patterns and trends over depth, hourly, and seasonally. The last measurements were collected in either 2016 or 2017, but measurements are on-going. In the soil, the coldest months were in the spring or early summer depending on elevation, and just before snow-melt, while at higher elevations the warmest months were July, August and September. Using JJA data for warmest months and DJF for coldest months misrepresented the soil temperature regimes for these mountainous sites. No soil depths under a snowpack recorded freezing temperatures. The daily and monthly variations were more moderated at greater depths. The mean temperature at 50 cm depth varied by as little as 8.2 °C (13.1 °F) from winter low to summer high, while the annual range for AIR (at 5 feet height (1.5 m)) was 40.82 °C (73.47 °F). The mean long-term difference between AIR and soil at 50 cm was only 0.62 °C (1.1 °F). Graphs of soil and air temperature patterns by depth, season, and over 20 years of record are shown and interpreted.

POSTER

LICHENS FOR DYE. Irene L. Hinkle, Woodard Creek Homestead, 3021 26th Ave. NE, Olympia, WA 98506; irenehinkle@woodardcreekhomestead.com

This poster presentation will display samples of dye colors on silk, angora, alpaca and wool that have been obtained from lichen using both an ammonia fermentation method and a boiling water method. Additionally, different pre- and post-dye treatments to change PH of the dye bath and receptivity of the fiber will be displayed that give a wide range of color, both with and without mordants. The lichen from which the dye was obtained will be displayed along with the colors obtained from it, and information about the methodology and results. This information may spark enthusiasm for learning to identify lichens in the lay population, which may in turn, give rise to a larger base of citizen scientists to help monitor and steward our mycota and the ecosystems that support them. Ethical harvest techniques will be stressed. Summary of results: Lichen contain acids that make dyes wildly different in color than the appearance of the thallus would indicate. These acids attach directly to the proteins in animal fibers and are therefore classified as “substantive dyes” that need no mordants as chemical mediators. Therefore, the results of these experiments with lichens as a dye source demonstrate the efficacy of using them as a natural and non-toxic alternative to commercial dyes wherever they are abundant and can be sustainably harvested.

ORAL

HUMANS AS KEYSTONE SPECIES: A PERSPECTIVE ON FOREST MANAGEMENT AND CLIMATE CHANGE. Joanne Ho, School of Environmental and Forest Sciences, University of Washington, 400 N. 34th St. #201 Seattle, WA 98103. jjho@uw.edu

Humans are an endogenous organism in forest ecosystems. Whether operating as recreational visitors, consumers of ecosystem services, or resource managers, humans play a definitive role. Considering humans as part of the forest allows for climate change adaptation management to acknowledge the effects of decision making—driven by individual and societal needs and capacity— as a component of the future outcome. This presentation explores the role and impact of humans on the natural landscape using analyses of *in situ* outdoor recreation and *ex situ* water use, timber production, and non-timber forest product gathering on U.S. Forest Service lands, covering nine states (Washington, Oregon, Idaho, Montana, North Dakota, northern part of South Dakota, Utah, Nevada, southwestern part of Wyoming). Land management may benefit from a more thorough integration of recreation as its economic impact continues to grow. Furthermore, scientists and managers may both benefit from considering human behavior similar to the way biology treats wildlife, and explore integrated approaches across disciplines to better manage landscapes for multiple uses and values.

A STRATEGIC APPROACH TO HUCKLEBERRY MANAGEMENT ON GIFFORD PINCHOT NATIONAL FOREST. Jessica Hudec, U.S. Department of Agriculture, Forest Service, Gifford Pinchot National Forest, Mt. Adams Ranger District, 2455 Hwy 141, Trout Lake, WA 98650; Amy Boyd, Cowlitz Indian Tribe, Natural Resources Department, PO Box 2547, Longview, WA 98632; Cheryl Friesen, U.S. Department of Agriculture, Forest Service, Willamette National Forest, 3106 Pierce Parkway Suite D Springfield, OR 97477; Doug Glavich, U.S. Department of Agriculture, Forest Service, Siuslaw National Forest, 3200 SW Jefferson Way, Corvallis, OR 9733; Shiloh Halsey, Cascade Forest Conservancy; Amanda Keasberry, Cascade Forest Conservancy, 4506 SE Belmont Street, Suite 230A, Portland, OR 97215; Rick McClure, Headwaters Historic Services, PO Box 147, Trout Lake, WA 98650; Nathan Reynolds, Cowlitz Indian Tribe, Culture Department, PO Box 2547 Longview, WA 98632; Jamie Tolfree, Pinchot Partners Collaborative, 31 Jewell Rd, Stevenson, WA 98648; jhudec@fs.fed.us

In 2016, Pinchot Partners Collaborative Group, Cowlitz Indian Tribe, and the U.S. Forest Service began drafting a huckleberry management strategy for the Gifford Pinchot National Forest. The ultimate goal at the outset of this project was “to develop a multi-year, self-sustaining huckleberry habitat restoration program on the Gifford Pinchot National Forest that will lead to increased huckleberry production and improvement to local forest community economies.” In working toward that goal, we composed a strategy document that summarizes huckleberry ecology and traditional cultural uses, suggests priority locations for huckleberry management based on ecological, practical, and sociocultural suitability, describes potential techniques to expand and improve the quality of huckleberry habitat based on literature and past huckleberry enhancement efforts, and uses a case study to examine economic feasibility of huckleberry management. Several appendices accompany the strategy document, including a huckleberry and management literature review and comprehensive reference list (Friesen 2016); process notes for the GIS-based huckleberry treatment suitability assessment (Hudec 2016); a field validation report for the huckleberry treatment suitability assessment (Boyd and Reynolds 2017); a summary report on the initial phases of tribal notification, contacts, and consultation (McClure 2016); a database that catalogs past huckleberry enhancement treatments in northwest Oregon and western Washington (Glavich 2016); and a report on initial huckleberry enhancement treatment monitoring findings (Halsey and Keasberry 2016).

ORAL

CHANGES IN STRANDINGS OF CETACEANS IN PUGET SOUND/SALISH SEA. **Jessie Huggins**, Stephanie Norman, John Calambokidis, Cascadia Research Collective, 218½ W 4th Ave., Olympia WA 98501; Jennifer Olson, The Whale Museum, PO Box 945 Friday Harbor, WA 98250; Dyanna Lambourn, Washington Department of Fish and Wildlife, 7801 Phillips County Rd. SW, Tacoma WA 98498; Amanda Warlick, Northwest Fisheries Science Center, 2725 Montlake Blvd. E, Seattle, WA 98112; Joe Gaydos SeaDoc Society, 942 Deer Harbor Rd. Eastsound WA 98245; JHuggins@CascadiaResearch.org

Cetacean strandings in the inland waters (Puget Sound/Salish Sea) of Washington State have been systematically recorded in since the early 1980s, providing an invaluable dataset with which to track spatiotemporal trends and changes in stranding patterns. Harbor porpoise and seasonally occurring gray whales are the two most commonly stranded species in inland waters. Strandings of other large rorquals such as blue, fin, and sei whales have been historically documented in the region, though were brought into inland waters wrapped on the bows of ships. Ship strike mortality in large whales has increased dramatically in recent years. Beginning in 2001, the percentage of cetacean strandings (particularly fin whales) showing evidence of ship strikes has risen from 4% (1991-2000) to over 20%. Extra-limital strandings of warm water cetacean species, such as bryde's whales and bottlenose and common (*Delphinus* spp.) dolphins have been observed, with sightings and strandings of the latter increasing since 2006. Drastic changes in stranding occurrence, characterized by unusual mortality events, or UMEs, have been documented in gray whales (UME in 1999-2000) and harbor porpoises (UME in 2006-2007) and continued high levels of post-UME strandings for both species have been noted. These changes likely reflect increased population sizes of these two species, and in the case of harbor porpoises, a return to areas within the Puget Sound where they had previously disappeared. Likewise, the return of humpback whales to Washington inside waters, which has been captured by sighting records, has also been confirmed by an increase in stranding events, with the first stranding ever recorded inside the Puget Sound in late 2015, and three additional strandings in the following years.

ORAL

VOCALIZATIONS INFLUENCE ROOST-SITE SELECTION IN OVERWINTERING CAVITY-NESTING BIRDS IN EASTERN WASHINGTON. **Shelby Hunter**, Margaret O'Connell, Department of Biology, Eastern Washington University, 526 5th St, Cheney, WA 99004; shunter@eagles.ewu.edu

Primary cavity-nesting birds (CNB) are keystone species because the annual tree cavities they excavate become critical habitat for other species. In eastern Washington, most CNB are year-round residents. They can increase overwinter survival by night roosting in cavities and forming flocks. Birds in flocks use alarm calls to warn of threats and contact calls to promote group cohesion. Our study asks if vocalizations influence the frequency and flock size of CNB inspecting roosting sites and if flock size varies with temperature. The study has been conducted during the winters of 2016-17 and 2017-18 on Turnbull National Wildlife Refuge. Roost boxes are located at 36 stations divided between 3 forest units. At each station, we conduct an 8-minute point count prior to sunset. Following the initial point count, we conduct a second point count with 1 of 3 broadcast treatments: 1) no call 2) alarm call and 3) contact call. We compared frequency of species' presence and number of birds between treatments with a Fisher's exact test and a two-way ANOVA, respectively. We examined the effect of temperature on flock size using Poisson regression. During the 2016-17, we recorded 516 observations of 8 species and to date this winter, 381 observations of 9 species. The number and presence of Pygmy Nuthatches increased following contact call treatment for both winters. The presence of chickadees increased following alarm and contact call treatments in 2016-17 and alarm call treatment in 2017-18. Flock size increased with decreasing temperature. Vocalizations influence roost selection for some CNB.

EFFECTS OF VARIABLE DENSITY THINNING ON SPATIAL PATTERNS OF OVERSTORY TREES IN MT. HOOD NATIONAL FOREST. Emma Huston, Jeffrey Gerwing, Department of Environmental Science and Management, Portland State University, 1719 SW 10th Avenue, Portland, OR 97201; ehuston@pdx.edu

Variable density thinning (VDT) is a method of restoration thinning that attempts to increase ecosystem resilience and spatial heterogeneity in forest stands to more closely resemble mosaic-like patterns characteristic of late-successional forests, which consist of clusters of multiple trees, individual trees, and gaps. This study examines the spatial patterning of overstory trees resulting from variable density thinning of conifer forests in Mt. Hood National Forest in the western Cascade Mountains and compares these patterns with reference conditions. Stem maps were created from field surveys of study plots within one mature stand and six thinned stands designated as Late-Successional Reserve (LSR) with varying minimum inter-tree spacing distances and implementation methods (designation by design and designation by prescription). Cluster analysis revealed a higher degree of clustering in reference stands compared to thinned stands. The results indicate that while variable density thinning is able to induce within-stand horizontal spatial heterogeneity in relatively young conifer forests, currently-used prescriptions result in stands that are still more uniform than late-successional reference stands. Increasing the emphasis on openings and multiple tree clusters in restoration thinning prescriptions would better approximate overstory tree spatial patterns of late-successional forests.

IDENTIFYING SALMONID CLIMATE REFUGIA FOR PRIORITIZING RESTORATION IN A WARMER WORLD. Dan Isaak, U.S. Forest Service Rocky Mountain Research Station, Aquatic Sciences Laboratory, 322 E. Front St., Suite 401, Boise, ID 83702; disaak@fs.fed.us

Climate change in the Pacific Northwest has been gradually warming rivers and reducing snowpacks and runoff for several decades. Those trends are likely to continue for the foreseeable future and are particularly stressful to iconic cold-water fishes such as trout, salmon, and char. Identifying refuge habitats that are capable of absorbing future climate change while still supporting native populations is essential for protecting native biodiversity. If climate refuge habitats can be forecast with precision, their locations would also provide a framework for guiding restoration efforts and climate-smart planning. Toward that end, professionals from dozens of natural resource agencies have contributed stream temperature data to the NorWeST project (<https://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html>) to develop high-resolution climate scenarios. Thermal conditions represented by those scenarios can be combined with large species occurrence datasets to develop accurate distribution models and projections of species occurrence under current and future climate scenarios. Here, we highlight development of two such distribution models for bull trout and cutthroat trout as part of the Climate Shield project (<https://www.fs.fed.us/rm/boise/AWAE/projects/ClimateShield.html>), discuss current efforts to extend the approach to other salmonid species, and highlight how the information is being used to guide restoration efforts.

ORAL

THE CROWD-SOURCED NORWEST TEMPERATURE DATABASE AND MASSIVE MICROCLIMATE SCENARIOS FOR STREAMS AND RIVERS OF THE PACIFIC

NORTHWEST. Dan Isaak, Aquatic Sciences Laboratory, US Forest Service Rocky Mountain Research Station, 322 E. Front St., Suite 401, Boise, ID 83702; disaak@fs.fed.us

Climate change is warming streams and rivers across the Pacific Northwest and threatens investments made to conserve valuable cold-water fishes and other aquatic species. Efficient threat response requires prioritization of limited conservation resources and investments guided by accurate information about climate at scales relevant to species distributions within landscapes. With seed-grant funding from the North Pacific LCC and Great Northern LCC, we developed a database team that aggregated and organized most of the stream temperature data collected by >100 natural resource agencies throughout the western U.S. to create the NorWeST database that hosts >300,000,000 temperature recordings from >23,000 unique stream sites. A subset of those data were extracted from the database and used with a geostatistical spatial-stream-network (SSN) model ($r^2 \sim 0.90$; RMSPE $\sim 1.1^\circ\text{C}$) to predict mean August temperatures and map predictions at 1-km resolution for 36 historical and future scenarios in all streams and rivers. Temperature data summaries and scenarios are available in user-friendly formats through the NorWeST website (<http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.shtml>) and are frequently used to facilitate inter-agency coordination of monitoring, climate vulnerability assessments, and conduct new research on thermal ecology and temperature regimes. NorWeST information has been rapidly adopted by the aquatic community because of its accuracy, convenience of use, and development from data collected by the people working in local landscapes.

ORAL

OCCURRENCE, ABUNDANCE, AND TRENDS IN PINNIPEDS IN THE SALISH SEA. Steven

Jeffries, Dyanna Lambourn, Washington Department of Fish and Wildlife, 7801 Phillips County Rd. SW, Tacoma WA 98498; Pat Gearin, and Robert DeLong, Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle WA 98115; Steven.Jeffries@dfw.wa.gov

Four species of pinnipeds, harbor seals, northern elephant seals, California sea lions and Steller sea lions, are common in the Salish Sea. All these species have increased following passage of the MMPA. For harbor seals, numbers increased to about 16,000 animals in inland water stocks but have declined in recent years. Northern elephant seal numbers in the Salish Sea have been stable in low numbers for several decades with pupping occurring in several locations. Steller sea lion populations continue to increase range wide including sites in Washington with pups now present on the Olympic Peninsula coast. The California sea lion population has increased from 50,000 animals to nearly 300,000 today. About 60,000 California sea lion males disperse annually from their rookeries in California into Oregon, Washington, British Columbia and SE Alaska. Several thousand occur in the Salish Sea from fall to late spring. Two other species, northern fur seals which are common off the Washington coast and ribbon seals which are an arctic ice seal, have both been recorded from the Salish Sea in recent years but occur in low numbers or rarely.

UNIQUE INSIGHTS INTO ARBOREAL RODENT BEHAVIOR AND SPECIES INTERACTIONS USING REMOTE CAMERAS AT ARTIFICIAL NESTS.

Araya A. Jensen, Umpqua Community College, 1140 Umpqua College Rd, Roseburg, OR 97470; Damon B. Lesmeister, Kirsten M. Wert, Mark. A. Linnell, and James K. Swingle; USDA Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331 ajensen6@student.umpqua.edu

Remote cameras provide insights into animal behavior and species interactions by recording observations of secretive species that would otherwise be impossible to obtain. We mounted cameras above artificial nests installed in the live crowns of coniferous trees in young forest (20–50 years) as part of a long-term demographic study of arboreal rodents, primarily red tree voles (*Arborimus longicaudus*) and Humboldt's flying squirrels (*Glaucomys oregonensis*). During 2015–2016 we monitored 42 artificial nests at 17 sites with cameras for an average of 340 days \pm 30 SD, and during 2016–2017 we expanded to monitor 138 nests at 23 sites. Here we summarize data from the first year when flying squirrels were detected at 100% of artificial nests and tree voles at 57%. On average, flying squirrels visited artificial nests before tree voles (32.1 days \pm 57.7 SD compared to 76.7 days \pm 53.8 SD after installation), but tree voles were detected on more days (83.8 \pm 79.0 SD) compared to flying squirrels (29.5 \pm 25.8 SD). These differences were likely a result of tree voles having smaller home ranges, lower vagility, and more centralized foraging compared to flying squirrels. We also observed arboreal rodent behaviors of copulation, young rearing, nest building, and foraging. We confirmed two predation events of tree voles by flying squirrels and one by a short-tailed weasel (*Mustela erminea*), birds disturbing nests, and nest usurpation between rodent species. Remote cameras provide a powerful tool for recording activity patterns, behavior, and species interactions of arboreal rodents.

ORAL

EXAMINING MECHANISMS THAT EXPLAIN RECENT TRENDS IN ABUNDANCE OF SPRING CHINOOK AND SUMMER CHINOOK SALMON IN THE UPPER COLUMBIA RIVER.

McLain S. Johnson, Andrew R. Murdoch, Fish Program, Washington Department of Fish and Wildlife, 3515 Highway 97A, Wenatchee, WA 98801; mclain.johnson@dfw.wa.gov

The Upper Columbia River harbors three extant populations of spring Chinook salmon and three populations of summer Chinook salmon. From 1989 to 2016, both races have seen wide fluctuations in interannual spawner abundance. Annually, mean summer Chinook spawner abundance is tenfold that of spring Chinook (mean 12,572 vs. 1,241). We examined life history differences between these races that may explain abundance trends. Mean arrival date at Bonneville Dam for returning spring Chinook is considerably earlier (May 13) than summer Chinook (July 4). Conversion rates between hydroelectric projects are modestly higher (8%) for summer Chinook than for spring Chinook, with travel times from McNary to Rock Island faster for summer (5.12 days) compared to spring Chinook (8.87 days). These differences suggest reach-specific survival is variable across space and time and often dependent on river conditions. Natural-origin juvenile spring Chinook exhibit a yearling emigrant life history, whereas summer Chinook display as many as three juvenile life histories. These differences may benefit summer Chinook during outmigration, synchronizing with spill and spring run-off more favorably. Summer Chinook may also be exposed to fewer survival bottlenecks (e.g. avian and fish predation) than spring race due to emigration date and time spent rearing in tributaries. Evolving hatchery practices may also be influencing the hatchery program success, as summer Chinook programs typically have greater levels of pNOB and lower levels of pHOS. Successful conservation and recovery of Chinook salmon *Oncorhynchus tshawytscha* requires an understanding of life history characteristics to inform contemporary management actions.

CORDYCEPIN CONTENT IN COMMERCIAL MYCELIUM AND FRUITING BODY SUPPLEMENTS OF THE MEDICINAL FUNGI *CORDYCEPS MILITARIS*. Maya Kahn-Abrams, kahmay12@evergreen.edu, Dr. Lalita Calabria calabril@evergreen.edu; Department of Biology, The Evergreen State College, 2700 Evergreen Pkwy NW, Olympia, WA 98505

Cancer is the second leading cause of death globally and in the United States. The World Health Organization estimates three-quarters of the world's population relies on herbs and traditional folk medicines to treat diseases like cancer. *Cordyceps militaris* has long been used as a food and herbal medicine in Asia and contains cordycepin, a bioactive nucleoside found to inhibit tumor growth and metastasis. Recently it has become popular as commercially available powdered supplements made from both mycelium and mushroom fruiting bodies. The sale of fungal mycelium for its reputed health benefits is widespread, easier and cheaper to produce than mushrooms. However, there is much debate whether components from mushrooms or mycelium differ in composition and concentrations of bioactive compounds. We tested commercially available *C. militaris* mushroom and mycelium supplements for cordycepin using semi-quantitative thin-layer chromatography. We compared two commercially-available mycelium-based products, one grown on brown rice and the other grown on oats, with whole, dried mushrooms and a powdered aqueous extract made from mushrooms. For each product, an aqueous extract containing 0.50g dry weight of fungal material in 15 ml of distilled H₂O was heated to 40°C for 90 minutes and then left for 24hr at room temperature. Aqueous extracts were compared with a cordycepin standard on silica gel TLC plates with a solvent system of 60:15 methylene chloride: methanol. Results indicate cordycepin presence in detectable quantities in both mushroom supplements, while only mycelium grown on brown rice indicating cordycepin presence. All three products contain less than 0.25µg of cordycepin.

FOREST FLOOR MOSSES HOST NITROGEN FIXING CYANOBACTERIA IN TEMPERATE RAINFORESTS OF WESTERN WASHINGTON. Maya Kahn-Abrams, kahmay12@evergreen.edu; Dr. Lalita Calabria calabril@evergreen.edu; Department of Biology, The Evergreen State College, 2700 Evergreen Pkwy NW, Olympia, WA 98505

Nitrogen (N)-fixing cyanobacteria associate with bryophytes and provide N input into northern latitude forests and Pacific Northwest prairies. We are investigating if this association extends to ground-dwelling mosses of temperate rainforests by evaluating common species for presence of N-fixing cyanobacteria. We measured abundance of cyanobacteria colonies growing epiphytically on moss leaves by using epifluorescence and light microscopy to screen leaves for number of colonies. Three main cyanobacteria colony morphotypes were detected: chains, beads and clusters. Colonies were observed on 5 of the 8 moss species evaluated, and four species selected for further study: *Hylocomium splendens*, *Kindbergia oregana*, *Rhytidiadelphus loreus*, and *Rhytidiadelphus triquetrus*. Samples of target species were collected from plots representing two forest types 1) mixed hardwood dominated by *Alnus rubra* and *Acer macrophyllum* and 2) mixed conifer and hardwood dominated by *Pseudotsuga mensezii*, *Tsuga heterophylla*, *A. macrophyllum* and *A. rubra*. We used an acetylene reduction assay and gas chromatography-coupled with flame-ionization detection (GC-FID) to quantify N-fixation rates of moss-cyanobacteria symbiosis. 42.5% of the moss samples tested (n=40) displayed detectable levels of N-fixation. *K. oregana* and *R. loreus* exhibited the highest % of active samples with 50% (n=18) and 50.33% (N=12), respectively. *R. triquetrus* samples showed no fixation, despite the large sample size (n=8). Despite *H. splendens* small sample size (n=2), one active sample exhibited the second highest quantified fixation rate. We established that ground dwelling forest floor mosses host N-fixating bacteria, with preliminary quantitative data indicating that forest floor fixation rates may be significantly greater than those from PNW prairies.

A REVIEW OF BIOACTIVE COMPOUNDS IN YELLOW-CEDAR THAT PROTECT THE TREES AND POSSIBLY HUMAN HEALTH.

Rick G. Kelsey, USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331; Joseph J. Karchesy, Wood Science and Engineering, Oregon State University, Corvallis, OR 97331; M. P. González-Hernández, Department of Crop Production and Projects of Engineering, Santiago de Compostela University, 27002 Lugo, Spain; rkelsey@fs.fed.us

Yellow-cedar, *Callitropsis* (syn. *Chamaecyparis*) *nootkatensis*, is most abundant in coastal forests of southeast Alaska and western Canada, and has been used as a material resource for centuries by indigenous people. Each tree tissue synthesizes and stores different classes of compounds that function in their chemical defense. The foliage is dominated by monoterpene hydrocarbons, whereas the heartwood produces oxygenated monoterpenes and oxygenated sesquiterpenes along with one or more tropolones. Bark contains diterpenes and condensed tannins. Compounds in each chemical class have experimentally confirmed biological activity as a fungicide, bactericide, sporicide, acaricide, insecticide, general cytotoxicity, antioxidant or human anticancer agent. Organisms impacted by whole tissues, essential oils, extracts, or individual yellow-cedar compounds include ticks, fleas, termites, ants, mosquitoes, bacteria, a water mold, fungi and browsing animals. Chemical defense of the heartwood contributes to the longevity of some trees living in excess of 1000 years, and standing snags up to 100 years after death. Nootkatone, an oxygenated sesquiterpene in yellow-cedar heartwood, and also grapefruit, has proven to be a strong repellent and toxin for ticks and mosquitoes that vector human and animal diseases. Because of its grapefruit-like flavor, nootkatone is used in the food, flavor, fragrance, cosmetics and pharmaceutical industries, and is currently being developed as a commercial bio-pesticide. A lower cost, sustainable supply of “natural” nootkatone for many of its commercial uses will likely be obtained through enzymatic or microbial bioprocesses rather than extraction from plant tissues.

ORAL

CARBONIC ANHYDRASE ACTIVITY IN THE SYMBIOTIC SEA ANEMONE *ANTHOPLEURA ELEGANTISSIMA* IN DIFFERENT SYMBIOTIC STATES AND DIFFERENT SIZES. Jack C.

Koch, Department of Integrative Biology, Oregon State University, Corvallis, OR 97331; E. Alan Verde, Corning School of Ocean Studies, Maine Maritime Academy, Castine, ME 04420; Virginia M. Weis, Department of Integrative Biology, Oregon State University, Corvallis, OR 97331; kochja@science.oregonstate.edu

The sea anemone *Anthopleura elegantissima*, prominent member of the intertidal zone on the west coast of North America, can exist in three symbiotic states: a 'white' state where anemones principally lack symbionts; a 'brown' state with predominantly *Symbiodinium muscatinei*, or a 'green' state with primarily *Elliptochloris marina*. The enzyme carbonic anhydrase (CA) catalyzes the interconversion between CO₂ and HCO₃⁻¹ and is known to play a dynamic role in delivering CO₂ to symbionts embedded within host endoderm. To test the effect(s) of symbiotic state or anemone size on CA activity in hospite, appropriate *A. elegantissima* were collected near Anacortes, WA, flash frozen in liquid nitrogen in the field, and subsequently processed for CA. Regarding symbiotic state, brown anemones displayed significantly higher CA activity than either green or white anemones whereas anemone size showed a stepwise progression. Activity rates for CA, when normalized to anemone protein, were highest in small anemones and lowest in large anemones; furthermore, regression analysis showed a significant inverse correlation between anemone size and CA. From a primary productivity perspective, *Symbiodinium* has much greater rates than *Elliptochloris* so higher CA enzymatic functions in brown anemones are expected in order to provide them with unrestricted amounts of CO₂ to drive photosynthesis forward. The negative correlation between anemone size and CA activity is driven primarily by the significantly higher algal densities in smaller anemones that heightens the competition for obtaining the CO₂ within each host cell; as such, higher CA activity is required to provide adequate CO₂ for photosynthetic activity.

ORAL

OLYMPIC MUDMINNOW: LAYING A FOUNDATION FOR COLLABORATIVE

CONSERVATION. Lauren M. Kuehne, Julian D. Olden, School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98105; lkuehne@uw.edu

Olympic mudminnow (*Novumbra hubbsi*) are Washington State's only endemic fish, and one of only five species of mudminnow found worldwide. Despite ecological and cultural uniqueness and being listed as state "Sensitive" in 1999, lack of systematic research (often the plight of noncommercial endemic fish) has constrained attempts to better understand the conservation status for this species. In 2012, the US Fish & Wildlife Service and Washington State Department of Fish & Wildlife hosted a workshop for the purposes of communicating the current state of information related to Olympic mudminnow and inspiring new research efforts to address knowledge gaps.

Since 2012, the Freshwater Ecology and Conservation Lab at University of Washington has conducted multiple sampling and data synthesis efforts designed to strategically address critical knowledge gaps for Olympic mudminnow and allow an updated understanding of conservation status. These efforts include establishing occupancy and detection rates, refining sampling protocols, and developing a habitat suitability model to assess availability and constraints on habitat across the range. Most recently, we have synthesized data from more than 700 survey events contained in 20+ historical and recent datasets to develop the most complete information on Olympic mudminnow distribution, detection and occupancy over time, and co-occurrence with other fish species. We will present results from the synthesis, which lays the foundation for a regional collaborative monitoring and research program for this unique endemic species.

ORAL

ABANDONED MINE LAND IMPACTS ON TRIBUTARIES IN THE UPPER YAKIMA RIVER WATERSHED, EASTERN CASCADE, WASHINGTON. Scott Kugel, Department of Geography, 400 E University Way, Ellensburg, WA 98926 scott.kugel@cwu.edu

Effluent from abandoned mine lands (AMLs) in several drainages of the Eastern Cascades flows into the Yakima River. Similar sites in Idaho and Colorado are known producers of heavy metals and acid mine drainage. This research determined the effects of nine AMLs on water quality in four drainages. AMLs along Mineral Creek in the western portion of the study area, and along tributaries of the Teanaway River in the eastern portion each appear to cause an environmental impact on their respective watersheds due to the presence of an ore processing site. Archival work was conducted to gather general historic information. This was used to determine sites that were mined for gold, silver, or copper and contained a mill. Each site was characterized by physical features. Water and sediment samples were collected from above, at, and below each AML. Samples were analyzed for electrical conductivity, pH, and heavy metal content and evaluated to determine if the AMLs are sources of pollution as defined by EPA drinking water standards. Preliminary results appear to show that the mill sites along Mineral Creek and the Teanaway River have increased cadmium due to mining. Additionally, due to local geology, arsenic and lead were elevated above EPA standards throughout the study area, and the effects of acid mine drainage make these more bioavailable. These AMLs contribute to low discharge systems and the effluence from these sites will disproportionately impact them compared to larger downstream systems; however, it is unclear the effect they will have on either.

ORAL

THE DISTRIBUTION OF CORTICOLOUS LICHENS ON DANISH ANGIOSPERM TREES. Hanne M. E. Larsen, Department of Geosciences and Natural Resource Management, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, Denmark; Eric Steen Hansen, Natural History Museum of Denmark, University of Copenhagen, Øster Voldgade 5-7, 1350 København K, Denmark; Hanne N. Rasmussen, Department of Geosciences and Natural Resource Management, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, Denmark; hala@ign.ku.dk

In the forest ecosystem, the diversity and the distribution of corticolous lichens depend on several factors. One of these factors is tree species. The variation in the surface structure, chemical composition and pH of the bark creates different habitats for lichens communities. Furthermore, age related changes in bark properties along the tree stem create a gradient of habitats ranging from the older bark at the stem base to the newly formed bark at the top of the tree. Research on corticolous lichens has mainly focused on the lower and accessible part of the tree stem. The aim of this study is to examine the distribution of corticolous lichen species along the whole tree stem of seven Danish angiosperm tree species growing in Common Garden plantations established in 1973. Altogether, 24 trees of each tree species were felled in March 2015. Wood discs were cut out at regulated heights along the main stem of the trees and the bark on each wood disc examined for the presence or absence of lichens. Initial results show that some corticolous lichens prefer to grow on certain tree species and within certain height intervals along the tree stem. Further, the results show a difference in distribution and diversity of lichen species among the tree species. Identification of the distribution patterns according to height and tree species will be beneficial for future research on analyzing the influence of bark texture, pH, chemical composition and microclimatic conditions within tree and among tree species.

ORAL

INCORPORATING SPATIAL HETEROGENEITY IN TEMPERATURE INTO CLIMATE VULNERABILITY ASSESSMENTS FOR COASTAL PACIFIC STREAMS. Se-Yeun Lee, Climate Impacts Group, College of the Environment, University of Washington Box 355674 Seattle, WA 98195-5674; Aimee Fullerton, Northwest Fisheries Science Center, 2725 Montlake Blvd E, Seattle WA 98112; Joshua J. Lawler, School of Environmental and Forestry Sciences, University of Washington, Seattle WA 98195; Christian E. Torgersen, USGS Forest and Rangeland Ecosystem Science Center, Seattle WA 98195; leesy@uw.edu

Water temperature, a key driver of ecological processes in aquatic environments, is expected to warm as a result of climate change, stressing stream biota. Successful climate adaptation strategies will consider changes to spatial patterns in water temperature. We analyzed water temperature for 6,106 km of rivers to evaluate the characteristics of cold-water habitat for Pacific salmon and steelhead within the NPLCC. We used a dataset of river surface temperature measured using airborne thermal infrared (TIR) remote sensing and multiple models to: (1) characterize thermal heterogeneity (2) assess potential future thermal heterogeneity, and (3) illustrate salmon vulnerability in the Snoqualmie (Washington) and Siletz (Oregon) river watersheds. We found that cool-water habitat was prevalent at higher elevations and latitudes. As waters warm, the current distribution of cool patches will change, with downstream cool patches disappearing and warmer patches bisecting previously cool patches upstream. The vulnerability analysis suggested that thermal habitat conditions in August are already stressful and will remain so for salmon and steelhead in the Snoqualmie watershed. In the Siletz watershed, numerous cold patches previously accessible to salmon in the lower river reaches may disappear, making migration potentially more difficult in the future. Findings and datasets produced during this project will help resource managers in their quest to protect “sufficiently distributed” thermal refuges for Pacific salmon and steelhead, to identify locations where stream temperature patterns may be least/most responsive to climate change, and actions that will promote future thermal diversity best suited for conserving salmon and other aquatic resources.

POSTER

SUMMER UNDERGRADUATE RESEARCH FELLOWSHIPS: ECOPHYSIOLOGY OF CTENOPHORES. Stacia Krause Ledbetter, Maya Nabipoor, Erik V. Thuesen Evergreen State College, Laboratory 1, 2700 Evergreen Parkway NW, Olympia, WA 98505-0002; krasta20@evergreen.edu

These Evergreen Summer Undergraduate Research Fellowships, entitled ‘Ecophysiology of Ctenophores’, focused on supporting the DEEPC project (deepc.org), which is funded by the National Science Foundation. DEEPC (Diversity, Evolution and Ecophysiology of Ctenophores) is seeking to understand the phylogenetic diversity, genetic diversity, and functional diversity of ctenophores, also known as comb jellies. Enzymatic activities (V_{max}) of ctenophores were analyzed within the context of the visual interactions hypothesis. One hundred eighty-three enzyme assays were conducted on ctenophore specimens from Washington, California and Hawaii evaluating activities of creatine kinase (CK), citrate synthase (CS), malate dehydrogenase (MDH), and pyruvate kinase (PK). *Hormiphora californensis*, a surface dwelling species, had the highest overall measured enzymatic activities (MDH: 0.837 ± 1.49 , PK: 0.216 ± 0.309 , CK: 0.966 ± 1.845 , CS: 0.256 ± 0.344 (units per g, mean \pm SD, n=8 specimens, 16 assays). Another surface species, *Bolinopsis vitrea* samples had the lowest overall enzymatic activities: MDH: 0.081 ± 0.137 , PK: 0.034 ± 0.059 , CK: 0.046 ± 0.055 , CS: 0.011 ± 0.019 (n=11 specimens, 20 assays). Enzymatic activities of *Bathycytena chuni* and *Ocyropsis crystallina*, deep- and surface-living species respectively, are very similar supporting the visual interactions hypothesis which states that non-visual animals in the deep sea will have metabolic rates similar to related shallow-living species.

GRIMMIA LESHERAE, A PIONEER SPECIES IN LITTLE ICE AGE COMMUNITIES IN THE NORTH CASCADES OF WASHINGTON. Robin D. Lesher, U.S. Forest Service (retired), 4602 226th St SW, Mountlake Terrace, WA 98043; Nancy A. Fredricks, U.S. Forest Service (retired), 4118 NE 407th Ave, Washougal, WA 98671; Jan A. Henderson, U.S. Forest Service (retired), 21817 77th Place W., Edmonds, WA 98026; rlesher@frontier.com

A new bryophyte species, *Grimmia lesherae*, was discovered in 1998 in the Glacier Peak Wilderness within the Mt. Baker-Snoqualmie National Forest, Washington state, during field sampling for the ecological inventory conducted under the USFS Area Ecology Program. Henk Greven of the Netherlands described the specimen and included *Grimmia lesherae* in his monograph “*Grimmias of the World*” (2003). This species is known from only three locations in the Cascade Mountains, two in the North Cascades, and the third location discovered by Greven on Mt. Shasta at 9,000 ft elevation. A distinguishing characteristic of this species is the sporophyte stalk that twists to the left, apparently unique within this genus. The type locality was revisited in 2015 and 2016 to collect vouchers and explore the distribution and ecology of *G. lesherae* in the vicinity on Snowking Mountain, Washington. *Grimmia lesherae* is a pioneer species in Little Ice Age communities, recently deglaciated areas formed as climate has warmed following the end of the LIA (~150 ybp). Little Ice Age communities have low species diversity and cover. The type locality is in the subalpine zone at 5800 ft elevation on north aspect; here *G. lesherae* occurs on granitic rock, often in protected sites out of direct solar radiation. Suitable habitat was searched and *G. lesherae* was found in early seral raw rock habitat to more mature heather/huckleberry communities if suitable rock substrate was present, mostly in small single species patches. More work is needed to determine the rarity of this species.

**ECOLOGY AND DISTRIBUTION OF SALAL ON THE OLYMPIC NATIONAL FOREST:
USING A POTENTIAL HABITAT MODEL AND MAP TO ADDRESS SUSTAINABILITY**

ISSUES. Robin D. Leshner, U.S. Forest Service (retired), 4602 226th St SW, Mountlake Terrace, WA 98043; Jan A. Henderson, U.S. Forest Service (retired), 21817 77th Place W., Edmonds, WA 98026; Christopher D. Ringo, Dept. of Crop and Soil Science, 3017 Agricultural and Life Sciences Bldg., Oregon State University, Corvallis, OR, 97331; David H. Peter, U.S. Forest Service PNW Research Station, 3625 93rd Ave. SW, Olympia, WA 98512; rllesher@frontier.com

Salal (*Gautheria shallon*) is known to have been an important resource for Native Americans of the Northwest Coast. In recent years, it has become an important species in the floral trade and is extensively harvested on the Olympic Peninsula and elsewhere in the Pacific Northwest. To aid resource managers in addressing questions regarding sustainable harvest and management of this plant resource, a potential habitat model and map was developed and validated for salal to provide known distribution, habitat requirements, and the amount and distribution of potential habitat on the Olympic National Forest (ONF).

This environmental gradient model used Lorentzian functions with eight environmental variables plus Plant Association Group (PAG) to predict and map potential habitat at a 90-m pixel resolution. USFS ecology plots (n=1457) were randomly assigned to two sets: model building (70%) and model validation (30%). The most predictive variables were Elevation Plus Cold Air Drainage Effect, Soil Moisture, Precipitation at Sea Level and Shortwave Radiation.

A map was produced and validated that predicts the distribution of potential habitat for salal in four classes representing the likelihood of potential habitat where salal cover is expected to be $\geq 10\%$. High Likelihood Habitat has the greatest potential for salal occurrence and abundance and covers 195,752 acres or 31% of the ONF. Occupied acres (115,713) for this habitat class were calculated using plot distribution and salal abundance data. This habitat map provides resource managers with information on abundance and distribution of potential habitat for salal and can guide decisions regarding sustainable management.

ORAL

SPATIAL AND TEMPORAL PATTERNS OF JUVENILE ABUNDANCE AND ANNUAL GROWTH 10-YEARS POST-FIRE. Caitlin Littlefield, School of Environmental & Forest Sciences, University of Washington, Seattle, WA, 98195; clittlef@uw.edu

Understanding the temporal and spatial variability of post-fire forest recovery is critical to predicting how ecosystems may respond under changing climatic conditions and both where and when management may best influence ecosystem resilience. To explore the drivers and limiting factors of these temporal and spatial patterns, I inventoried 6300 juvenile conifers across a range of terrain positions 10 years after the Tripod Complex Fire, which burned in the lower-elevation and montane mixed conifer forests of Washington's Okanogan-Wenatchee National Forest. I stratified sites by several topographic indices that serve as proxies for energy and moisture balance to capture a range of emergent climatic conditions (or "topoclimate"). The major determinant of species presence and abundance was distance to conspecific seed source; for several species, certain topographic metrics were also important limiting factors. Establishment occurred during all ten years with moderate decreases in establishment rates for some species during hotter, drier growing seasons. Annual growth—as measured by distance between bud scars—was affected by growing season conditions, but moderated in some cases by topographic position. These results suggest that examining recovery immediately post-fire—particularly under unfavorable weather conditions—may paint an incomplete picture of post-fire establishment. These results also underscore the importance of seed source and highlight spatial configurations with relatively less robust juvenile recruitment where management that promotes recovery and reduces vulnerability to future disturbances may play an important role.

POSTER

ARE SUB-FOSSIL FORESTS IN AUBURN AND FIFE, WASHINGTON VICTIMS OF THE SAME EXPLOSIVE ERUPTION AT MOUNT RAINIER?—TESTING THE HYPOTHESIS WITH RADIOCARBON DATING AND TREE-RING ANALYSIS. Beverly K. Luke; Patrick T. Pringle; Ariel Quinn Moran, Centralia College, 600 Centralia College Blvd., Centralia WA 98531; beverly.luke@student.centralia.edu

In the mid-to-late 1990s and early 2000s, excavation sites in Auburn and Fife, Washington uncovered subfossil buried trees that were radiocarbon dated to ~1100 yr BP. These trees are likely victims of a lahar or lahar-generated flood that left a 0.5–2 m deep layer of andesitic sand and gravel in the Duwamish River valley ("Kent Valley") extending as far as the Ports of Seattle and Tacoma. A correlative volcanic ash layer at Mount Rainier having a similar radiocarbon age indicates that the lahar that surged down the White River and buried the trees was the product of a moderate-to-moderate-large scale, explosive eruption at the volcano. The lahar-deposited sand and gravel in the lowland near Auburn, Fife, and the Port of Seattle was likely left within days or weeks of the eruption. The thickness and extent of these deposits indicates catastrophic aggradation in the valley bottoms of the Puget Lowland. We are currently analyzing tree rings of polished wood samples from the Auburn and Fife sites in order to crossdate the subfossil trees and determine if these trees were victims of the same explosive eruption and corresponding lahar. Additionally, we investigated possible correlative laharic deposits at three upstream locations in search of organic matter for radiocarbon dating. Two subfossil seeds found in a peat layer 4–6 cm below one lahar unit ~12km upstream yielded dates of ~2,400 yr BP, therefore we interpret this upstream unit to be correlative with an older lahar 2200–2400 yr BP in age.

ORAL

LIFE HISTORY STRATEGIES, MOVEMENT PATTERNS, AND GROWTH RATES OF ANADROMOUS COASTAL CUTTHROAT TROUT IN SOUTH PUGET SOUND. Gabe Madel, Andrew Claiborne, Hannah Faulkner, Riley Freeman, James Losee, Washington Department of Fish and Wildlife, 1111 Washington St. SE, Olympia, WA 98501; gabriel.madel@dfw.wa.gov

Anadromous coastal cutthroat trout fuel an economically important recreational fishery in the marine waters of Puget Sound. While anadromous cutthroat are highly valued by anglers, information regarding biological attributes such as life history strategies, seasonal movement patterns, and growth rates is lacking relative to other native salmonids in Puget Sound. Over the last two years, biologists have captured over 700 anadromous cutthroat trout in South Puget Sound as part of an ongoing research project to investigate these biological attributes. Individuals were PIT tagged and sampled for scales, length, and weight and this was paired with the installation of stationary PIT arrays in a key spawning tributary. These tools have provided insight into marine and freshwater movements, spawning migrations and timing, growth rates, iteroparity, and other attributes. Anadromous cutthroat in South Puget Sound display a range of life histories. Some of the variability includes a range of 1 to 3 years spent in freshwater before emigrating to the sound, and 1 to 2 years spent in marine waters before undergoing the 1st spawning migration. Individuals exhibited relatively high site fidelity for a marine environment demonstrated by an overall recapture rate of 15% for the study. Other individuals undertook relatively large spawning migrations across inlets to a natal spawning tributary, which demonstrates the range of movement patterns in South Puget Sound. Information on growth rates will be discussed further. The results from this study will help inform decisions made by fisheries managers to maintain healthy populations of anadromous cutthroat in Puget Sound.

ORAL

LANDSCAPE CONSERVATION COOPERATIVES – PAST AND FUTURE COLLABORATIONS. Mary Mahaffy and John Mankowski, U.S. Fish and Wildlife Service, 510 Desmond Dr. SE, Olympia, WA 98501 mary_mahaffy@fws.gov

Landscape Conservation Cooperatives (LCCs) were initiated in 2010 to work across national and international boundaries to sustain natural and cultural resources in the face of a changing climate and other global changes. They were designed to operate in a non-regulatory manner and as voluntary partnerships across the landscape. The work of LCCs was supported in the past through the Department of Interior; however, continued funding from the sponsoring agencies is likely changing. LCCs have demonstrated a willingness among diverse interests to come together, set shared priorities and work collectively to achieve common goals while also working within the constraints of each organization's missions, expertise, and authorities. Products of these efforts have included various geospatial data products, decision support tools, climate adaptation planning, and incorporating Traditional Ecological Knowledge where desired by owners. Partners across the nation have voiced their interest in seeing collaborative work continue in some form.

POSTER

GEOGRAPHIC VARIATION IN VOCALIZATIONS OF AMERICAN PIKAS (*OCHOTONA PRINCEPS*) IN SOUTHWESTERN OREGON AND NORTHERN CALIFORNIA. Suphasiri

Muttamara, Stewart Janes, Department of Biology, Southern Oregon University, 1250 Siskiyou Blvd., Ashland, OR 97520; muttamars@sou.edu

The distribution of American pika (*Ochotona princeps*) populations in the southwestern Oregon is poorly known and their range is highly fragmented. Isolated, small populations within this region could be vulnerable to loss of genetic diversity and prone to extirpation. Vocalizations have been used to study connectedness among populations. Variation in calls may result from independent evolutionary or cultural histories and indicate the degree of isolation among populations. The purpose of this study was to determine if calls by individuals among populations in southwestern Oregon differ with respect structural features and frequency. Pika calls were recorded between June and November 2017 from seven sites in the southern Cascades including Cascade-Siskiyou National Monument (two sites), Crater Lake National Park, Lava Beds National Monument, Mountain Lakes Wilderness, and Sky Lakes Wilderness (two sites). Over 100 calls from more than 30 individuals were recorded over the study period. Preliminary results indicate a lack of geographic variation in vocalizations indicating either relatively recent isolation of populations or that a low level of connectivity among population exists.

ORAL

INTEGRATED FLOODPLAIN MANAGEMENT IN WASHINGTON STATE: HOW CAN WE MAKE IT MORE RESILIENT? Guillaume Mauger, Climate Impacts Group, College of the

Environment, University of Washington, Box 355674, Seattle, WA 98195-5674; Haley Kennard, WA Sea Grant Hershman Fellow, Makah Office of Marine Affairs; Julie Morse, The Nature Conservancy; gmauger@uw.edu

Floodplains are home to a wide range of economic, cultural, and natural resources. Although there is a strong desire to include climate change into these planning efforts, very little guidance has been developed to help incorporate climate impacts into planning and design. This is further complicated by weak or non-existent coordination among the various agencies, jurisdictions, and interests that have a stake in floodplain management. This talk will describe a recent assessment – from the perspective of agency-level flood risk managers – of ways to better integrate climate change in floodplain management. The work was focused on the Washington State Silver Jackets (WA SJ), an inter-agency group aimed at coordinating among flood risk management agencies: FEMA, Army Corps, USGS, National Weather Service, and the Washington State Departments of Ecology, Transportation, and the Emergency Management Division. Based on our findings, we developed a climate resilience and flood risk management workplan focused on the following five themes: (1) improved projections of future flood impacts, (2) resources to support local planners, (3) improved coordination among agencies, scientists, and local floodplain managers, (4) improved public engagement, and (5) streamlined planning processes. Specific workplan actions were prioritized by the WA SJ team at a workshop in early June 2017, and the group is already taking action to fund and begin work on these priorities. Ultimately, the goal of this work is to widen the community of practice around climate-resilient integrated floodplain management through strengthened connections between agencies and locals, increased capacity, and improved technical resources for decision-makers.

ORAL

ASSESSING A FRESHWATER MUSSEL POPULATION IN A BACKCHANNEL OF THE WILLAMETTE RIVER. Celeste A. Searles Mazzacano, CASM Environmental, LLC, 5914 SE Knight St., Portland OR 97206; Travis Williams, Willamette Riverkeeper, 1515 SE Water Ave., suite # 102, Portland, OR 97214; cmazzacano@gmail.com

We assessed the diversity, density, and viability of a large freshwater mussel population in a one-mile channel behind Norwood Island in the upper Willamette River, OR. Semi-quantitative surveys across large areas were combined with quantitative searches in a subset of the habitat (double sampling with excavation) to detect buried adults and juveniles. Shell length of all mussels in excavated quadrats was measured as a surrogate for age. A total of 1,140 *Margaritifera falcata* (Western Pearlshell) and six *Anodonta oregonensis/kennerlyi* (Oregon/Western Floater clade) were found. *Anodonta* were confined to more stable gravel/sand substrate near the upstream end of the island; *M. falcata* were abundant in the upstream and downstream portions of the channel, in softer, sandier habitat than typical for this species. Measured *M. falcata* were older (larger) adults, with only 7.3% in smaller size classes (<10 cm) and no juveniles. The mean proportion of the population that was buried (32.9%) was greater than expected for *M. falcata*, and many mussels were buried deeply. The relationship between the true number of mussels in a quadrat to those visible at the surface (i.e., burial factor) was 1.54, which corresponds to a density of 46.3 mussels/m². This *M. falcata* population appears to be non-viable, with many older individuals and no reproductive replacements. Many factors can cause reproductive failure in native mussels, and unnatural flow conditions, lowered bed stability, and seasonal presence of appropriate host fish for mussel glochidia may all be impacting this population.

ORAL

STERILITY AS A WAY OF LIFE IN THE LICHEN GENUS CLADONIA. Bruce McCune, Department of Botany and Plant Pathology, 2082 Cordley Hall, Oregon State University, Corvallis OR 97331. mccuneb@oregonstate.edu

Cladonia has a range of life history strategies, with some species having routine sexual reproduction, producing podetia tipped by apothecia. Other species rarely produce apothecia. While some of those primarily asexual species are fruticose, such as reindeer lichens, others have taken the opposite strategy, with a largely squamulose growth form, rarely producing apothecia or podetia. Because squamulose *Cladonia* species are hard to identify, most lichenologists avoid collecting them. Some of those species are readily recognized and ecologically important, colonizing soil in dry and cold environments. For example, *Cladonia macrophyllodes* is a species in open montane to subalpine forests and commonly occurs as extensive mats of just squamules. *Cladonia pocillum* commonly occurs with only infrequent podetia as a component of biological soil crusts in grasslands and steppe, while *C. borealis* is frequent present as only squamules in exposed subalpine and alpine habitats. *Cladonia luteoalba* is a rather rare but widespread squamulose species that occurs parasitically on other *Cladonia* species. An undescribed species is present in grasslands of the Great Plains from Minnesota to Montana and south to Kansas, forming small *Toninia*-like squamules. Furthermore, in the “acid shale woodlands” of eastern Montana, there appears to be an additional large-squamulose species similar in form to the European *C. foliacea*, but differing from that species in chemistry and DNA sequences. I hypothesize that these primarily squamulose species have been selected for reproduction by fragmentation and dispersal by animals as effective life history strategies in open environments with low competition.

ORAL

PACIFIC NORTHWEST COASTAL CONSERVATION BLUEPRINT. Tom Miewald, M.

Mahaffy, J. Mankowski, M. Kearney, North Pacific Landscape Conservation Cooperative, 510 Desmond Dr. SE, Suite 103 Lacey, WA 98503; L. Debruyckere, Creative Resource Strategies, LLC, 6159 Rosemeadow Lane NE Salem, OR 97317; thomas_miewald@fws.gov

The Pacific Northwest Coast Ecoregion Conservation Blueprint (“Conservation Blueprint”) is a collaborative, landscape-scale conservation planning effort to align conservation efforts and achieve landscape-scale goals in response to impacts such as climate change and regional population growth. The study area encompasses the North Pacific coastal ecoregion of Oregon and Washington. The Conservation Blueprint project was initiated by the North Pacific Landscape Conservation Cooperative in 2016. Through a series of workshops with local, state, NGO and federal partners, a general framework for the project was developed, focusing on the convening of stakeholders, assessing landscape conditions, and threats and collaborative strategy development. This presentation will address progress on the effort, as well as future plans and lessons learned to date. Progress will be addressed around 4 major elements: 1) a social network analysis of collaboration in the region, 2) a gap analysis of conservation efforts in the region, 3) an assessment of habitat connectivity and 4) a series of workshops to identify landscape-scale strategies to address connectivity and resiliency in the ecoregion.

POSTER

SMALL MAMMAL MICROHABITAT USE AND SPECIES COMPOSITION OF A WILDLIFE CROSSING STRUCTURE COMPARED WITH NEARBY FOREST. Lindsay S. Millward;

Kristina A. Ernest, Ph.D., Department of Biological Sciences, Central Washington University, 400 E University Way, Ellensburg, WA 98926-7537; lindsay.millward@cwu.edu

Expanding transportation corridors have fractured ecosystems in many areas of the world, with consequent restrictions on the movement of organisms. Wildlife crossing structures (WCS) can improve the permeability of roads, allowing animals to move through connectivity barriers. Small mammals are especially vulnerable to the effects of reduced connectivity because of their limited mobility; however, few studies have focused on their use of WCS. This study was conducted at the Hyak WCS under Interstate-90 in central Washington’s Cascade Range. The focal WCS of this study was intentionally designed to mimic natural habitat characteristics through the installation of habitat features such as rock piles, large fallen logs, snags, and brush piles. Our objective was to use mark-recapture, track tubes, and wildlife cameras to evaluate whether small mammal use of these habitat features would help improve connectivity from the nearby forest to the WCS. The results of a generalized linear model with Poisson distribution indicated a greater abundance of generalist species and lower richness near the crossing structure compared to the adjacent forest. Additionally, small mammals used the four habitat features (rock piles, brush piles, fallen logs, and open space) equally within the trapping grid. Two years post construction the WCS contains a small subset of the expected number of local species. However, we expect the number of small mammal species using the crossing structure to increase in the future. The results of this study provide baseline data, offer a snapshot of small mammal crossing structure use, and suggest habitat improvements for upcoming connectivity projects.

ORAL

MONITORING OF JUVENILE CHINOOK SALMON RESTORATION PROJECTS IN SOUTH LAKE WASHINGTON USING NIGHT SNORKEL SURVEYS. Zachary J. Moore, Roger A. Tabor, United States Fish and Wildlife Service, 510 Desmond Drive SE, Lacey, WA 98503;

Zachary.moore@FWS.gov

A key component of habitat restoration projects is biological monitoring to establish the effectiveness of the project. Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*) are currently listed as threatened under the Endangered Species Act and many restoration projects have been designed to improve their habitat in lotic and lentic environments. Recently, the Washington Department of Natural Resources completed a large restoration project in the south end of Lake Washington by removing the non-functioning Shuffleton Power Plant flume structure and replacing it with a gently sloping shoreline with small substrates and the placement of engineered log jams. Additionally, habitat in two non-natal tributaries in south Lake Washington, lower Mapes and Taylor creeks, have been or are scheduled to be restored to benefit juvenile Chinook salmon. The objective of our study was to use nighttime snorkel surveys to monitor the abundance of juvenile Chinook salmon at each site before and after the restoration projects to compare how fish populations are responding to the restoration efforts. Our preliminary results indicate that the shoreline restoration efforts have been largely successful. For example, Chinook salmon counts from 2015 to 2017 at the flume site were more than nine times greater than the pre-restoration surveys from 2011 to 2013. Also, juvenile Chinook salmon extensively used lower Mapes Creek that was recently daylighted. This information will inform future salmonid restoration efforts within urban environments and provide a framework for juvenile salmonid recovery in highly impacted areas.

POSTER

RADIOCARBON DATING AND DENDROCHRONOLOGY INVESTIGATION OF A ~530CE SUBFOSSIL FOREST AT KENT, WASHINGTON. A. Quinn Moran; Patrick T. Pringle; Beverly K. Luke, Centralia College Science Dept., 600 Centralia College Blvd., Centralia WA 98531;

Arielmoran1220@gmail.com

We conducted a dendrochronological investigation of subfossil trees along the Green River floodplain in Kent, Washington. Previous investigations correlated upstream lahar-derived deposits along the White River and the andesite-rich sand and gravel that buried the trees at Kent with one of two eruptive events at Mount Rainier dated at ~1,600–1,400 cal yr B.P. (Sisson and Vallance, 2008). Of eleven trees studied, eight were Douglas-fir (*Pseudotsuga menziesii*). The samples were mounted, sanded, polished, and scanned at 0.01mm resolution. Use of ImageJ software, Cofecha for analysis of measurements, and visual examination/cross-dating methods revealed likely correlations among five of the subfossil trees, which probably died in spring. Possibly correlative, but undated lahar deposits were investigated upstream of Enumclaw at Mud Mountain Dam and a terrace along the White River ~9 km upstream. At the latter location, two seeds recovered from a peat deposit 2–4 cm below a clay-poor lahar deposit yielded radiocarbon ages of ~2,400 yr B.P. Using the 1in/100 yr accumulation rate calculated from older peat deposits at the outcrop, we infer that the clay-poor lahar is likely from one of two earlier Summerland eruptive episodes of Mount Rainier, 2,500–2,400 yr B.P. or 2,200 yr B.P (Sisson and Vallance, 2008) and not with deposits that buried the Kent forest ~530CE. We will conduct further tree-ring analysis of the Kent buried forest to assemble a provisional floating chronology for this cohort of subfossil trees and continue to investigate upstream lahar deposits to better characterize this moderate-to-moderate-large scale eruptive event.

POSTER

INTER-SEASONAL AND INTERANNUAL SHIFTS OF PACIFIC WREN TERRITORIES.

Christina Muller-Shinn; Alison R. Styring; Kellene Collins; Allison Swan; James Titus; Lucas Campbell; The Evergreen State College, 2700 Evergreen Parkway NW, Olympia, WA 98505; mullershinn@gmail.com

The Pacific Wren (*Troglodytes pacificus*) is a small North American wren with a strong preference for mature wet forests. Though it is common in suitable habitat, it is sensitive to fragmentation and its numbers may be declining. As part of a long-term study of Pacific Wren life history strategy, we studied the abundance and territoriality of this species from October 2016 through the end of the breeding season in July 2017. Data were compared to previous surveys at the same site, which occurred in 2014 and 2015. Ten 40-meter transects were established and surveyed in order to estimate abundance. Territory mapping was also used to compare abundance estimates and to determine the seasonality of territorial behavior. Population densities remained relatively stable throughout the year and among years, with the exception of an influx of territorial males in the very early phases of the breeding season. Territory maps from 2014, 2015, and 2017 revealed relatively similar territory configurations from year to year suggesting a level of permanence to territories at the site.

ORAL

SPOTTED WING DROSOPHILA, A NEW PEST OF HIGH ELEVATION VACCINIUM SPECIES IN THE PACIFIC NORTHWEST.

Todd Murray, Washington State University, PO Box 646248, Pullman, WA 99164-6248; Dalila Rendon, Oregon State University, 3005 Experiment Station Drive, Hood River, Oregon 97031; tmurray@wsu.edu

In 2013, multiple reports of insect-infested huckleberries were made from recreational and commercial pickers harvesting near the Indian Heaven Wilderness Area of the Gifford Pinchot National Forest of Washington State. After diagnosis, berries were confirmed to be infested by the Spotted Wing Drosophila, *Drosophila suzukii* Matsumura (Diptera: Drosophilidae), a recently introduced pest of commercial blueberries and other crops. As a result, a three-year survey was initiated to document this new pest in high elevation Vaccinium species in both the Gifford Pinchot National Forest and in the neighboring Mount Hood National Forest in Oregon. Presence of adult flies were determined through use of baited traps and huckleberry infestation was documented through physical berry harvests. Adults were collected in baited traps from all locations sampled, including the highest elevation sampled (1377m). Adults were also reared out of harvested huckleberries from eighteen samples including the highest sampled elevation (1570m). In some cases, infestation rates were as high as 47% of the harvested berries. In 2016 and 2017, host plant and fruit fly phenology was documented in Mt. Hood NF in order to better understand the movement, colonization or establishment of this newly introduced, exotic insect in high elevation huckleberries. In 2016, most adult flies were trapped in late season, at elevations between 900 m and 1200 m. Seventy-six percent of the huckleberry batches collected in July, August and September were infested, at elevations between 920 m and 1420 m. In 2017, *D. suzukii* populations were very low and yielded little data.

ORAL

BRACE YOURSELVES, RUSTIES ARE COMING: RAPID INVASION OF RUSTY CRAYFISH, ORCONECTES RUSTICUS, IN THE COLUMBIA RIVER BASIN. Julian D. Olden, Mathis L. Messenger, School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98105; olden@uw.edu

Crayfish are among the most widely introduced freshwater taxa worldwide, yet still have a relatively recent history in parts of western North America. Following their introduction, invasive crayfish can impart ecological impacts across entire ecosystems due to their polytrophic feeding habits and potential to spread rapidly and reach extremely high local abundances. Despite continued invasion and mounting ecological impacts, effective management of nonnative crayfish is still challenged by limited funding and inadequate forecasting tools. Here, we combined extensive field surveys with a spatially-explicit individual-based model to hindcast and forecast the invasion of the rusty crayfish *Orconectes rusticus* in the John Day River, a major tributary of the Columbia River and only known occurrence in the western United States. In the ~20 years since their presumed date of introduction, rusty crayfish rapidly spread throughout the JDR watershed at rates exceeding 15 km/year. Model predictions suggest, likely conservatively, the population of rusty crayfish is least 48 million individuals (including juveniles) and occupy at least 705 km of river throughout the in the JDR basin. We demonstrate how more rapid responses to the initial invasion would have resulted in an opportunity to slow the invasion spread, and evaluate trade-offs in future management strategies aimed at controlling the invasion of rusty crayfish in the future. Without a large-scale mobilization of resources, we predict that rusty crayfish will reach the mainstem of the Columbia River in 2025 at the latest, with a population exceeding 350 million individuals and further occupying critical salmon habitat.

ORAL

TRANSLOCATION OF MAZAMA POCKET GOPHERS: A 5-YEAR UPDATE AND RECOMMENDATIONS FOR POTENTIAL FUTURE TRANSLOCATIONS. Gail S. Olson, Washington Department of Fish and Wildlife, 1111 Washington St. SE., Olympia, WA 98501; gail.olson@dfw.wa.gov

At the 2013 meeting of the Northwest Scientific Association, I presented results from the first 3 years of a translocation study of Mazama pocket gophers (*Thomomys mazama*) conducted in Thurston Co., WA from 2009-2014. Here I present additional results from the full study, including population parameter estimates of cohort- and sex-specific survival, total abundance, and the population rate of change (λ). Post-translocation monitoring confirmed population establishment within 5 years of initial releases. However, it took approximately that long for the size of the new population to exceed the number of individuals translocated. Initially the population grew at a rapid rate ($\lambda > 2$), but in more recent years population numbers appear to have stabilized, with λ estimates near 1. Based on results from all years of this study, I make recommendations for future pocket gopher translocation projects, including release methods, numbers of individuals to move, factors to consider in evaluating release sites, post-release monitoring, and projected costs.

GRAY WHALE DISCOVERY AND ADOPTION OF FEEDING GROUNDS IN NORTHERN**PUGET SOUND IN SPRING.** Alie Perez and John Calambokidis, Cascadia Research Collective, 218½ W 4th Ave., Olympia WA 98501; APerez@cCascadiaResearch.org

Every spring, a regular group of identified gray whales (termed the Sounders) return to the waters around Whidbey Island to feed. The first two individuals adopting this strategy were identified in 1990, with four more animals joining them in 1991. Those animals have returned almost every year from March through May to these same waters. In 1999 and 2000, another half-dozen whales joined this group bringing the total to almost a dozen that return annually. Most have been determined to be males though a few females also regularly return though typically with gaps in their occurrence every 3-4 years that may be the years they have a calf, since none of them have been seen with a calf in northern Puget Sound. These animals are not part of the Pacific Coast Feeding Group that spends the spring, summer, and fall in the Pacific Northwest, they instead appear to continue their migration north to more Arctic feeding areas after the spring-feeding. At least one individual has been extending its stay past the spring in recent years. The years when this core group of whales discovered and adopted these areas were during periods of apparent food stress with higher number of strandings of emaciated gray whales and also more apparently unhealthy whales wandering through the Salish Sea. We speculate that the Sounders represent some of these whales that were in poor condition that motivated them to travel off the migration and seek alternate prey before continuing their migration north and that now choose to return to annually given the abundant prey.

FUNCTION OVER FORM: SUSTAINABILITY AND NATURAL RESOURCES IN A WARMER**WORLD.** David L. Peterson, University of Washington, School of Environmental and Forest Sciences, Box 352100, Seattle, WA 98195; wild@uw.edu

By the mid-21st century, a warming climate will transform large landscapes by facilitating the interaction of multiple stressors and periodic pulses of disturbance over space and time. Traditional conservation practices that focus on species protection and setting targets based on historical range of variability will have limited success in the future, because extreme events will cause significant changes in aquatic and terrestrial ecosystems. Focusing on structure and function, rather than species composition, will be critical for achieving conservation goals, sustaining ecosystem services, and moderating undesirable effects of climate stress. In order to anticipate and adapt to increased warming and disturbances, it is imperative that we (1) move from steady-state/equilibrium thinking to dynamic/non-equilibrium thinking, (2) use effective terminology to communicate about natural resources and climate change (e.g., future range of variability), (3) use robust tools and frameworks (e.g., process-based models) to determine potential ecological effects, and (4) transition from ecological restoration to managing for resilience under future climatic conditions. Recent examples of climate-informed conservation practice in the Pacific Northwest demonstrate that the process of increasing resilience to climate stressors is moving forward. Our ability to adapt to future climate challenges will be directly proportional to the rate at which climate-change thinking becomes a standard component of sustainable resource management.

ORAL

IMPLEMENTING CLIMATE CHANGE ADAPTATION IN FOREST ECOSYSTEMS OF SOUTHWEST OREGON. David L. Peterson; Jessica E. Halofsky, University of Washington, School of Environmental and Forest Sciences, Box 352100, Seattle, WA 98195; wild@uw.edu

In much of the Pacific Northwest, the effects of climate change on forest ecosystems will be driven mainly by drought and wildfire. To minimize the negative effects of climate change, resource managers require tools and information to assess climate change vulnerabilities and to develop and implement adaptation actions. We developed an approach to facilitate development and implementation of climate change adaptation options in forest management that included: (1) establishment of a science-management partnership, (2) climate change education in multiple formats, (3) science-based assessment of vulnerabilities to climate change, (4) hands-on development of adaptation options, and (5) application of tools to incorporate climate change in planned projects. Using this approach, we improved local understanding of the potential effects of climate change in the Rogue Basin of southwest Oregon (Klamath-Siskiyou Ecoregion), and facilitated evaluation of proposed management activities in the context of climatic stressors. Engaging resource managers throughout the project increased ownership of the process and outcomes, as well as the applicability of adaptation options to on-the-ground actions. Science-management partnerships can effectively incorporate evolving science, regardless of the sociopolitical environment, promoting timely progress in adapting to climate change.

POSTER

IDENTIFICATION OF A DARK SEPTATE FUNGUS THAT FORMS A SYMBIOTIC ASSOCIATION WITH ARTEMESIA TRIDENTATA. Erika Petzinger, Roger Rosentreter, Marcelo Serpe, Department of Biological Sciences, Boise State University, 1910 W University Dr, Boise, ID 83725; erikapetzinger@u.boisestate.edu

In previous work, we isolated a dark septate fungus from *Artemisia tridentata* (big sagebrush) roots. In this study, we used partial sequences from three genes to identify this fungus. Based on phylogenetic analyses, the isolated fungus appears to be a non-described species within the *Darksidea* genus or a closely related sister group. The *Darksidea* is within the family Lentitheciaceae in the Pleosporales and the Ascomycota. To investigate the nature of the symbiotic association, we analyzed the root tissues colonized by the fungus and the effect of inoculation on seedling growth under *in vitro* conditions and in soil. The hyphae of the fungus penetrated the epidermis, cortex, and vascular cylinder and were detected in between and inside root cells. After two month of growth *in vitro*, non-inoculated and inoculated seedlings had similar root lengths and fresh weight. However, dry weight was higher in non-inoculated than inoculated seedlings ($p < 0.05$). In soil, inoculation did not affect the fresh weight of seedlings. Based on the results *in vitro* and in soil, the effect of the isolated fungus on sagebrush seedlings was somewhat affected by the growing environment and ranged from slightly parasitic to commensalistic.

POSTER

PACIFIC LAMPREY IN PUGET SOUND AND WASHINGTON COAST STREAMS. Miranda Plumb, U.S. Fish and Wildlife Service, Western Washington Fish and Wildlife Conservation Office, 510 Desmond Dr. SE, Lacey, WA 98506. Miranda.Plumb@fws.gov

Current knowledge of the status of Pacific lamprey (*Entosphenus tridentatus*) in the Puget Sound and Washington Coast is variable. Historically, Pacific lampreys were thought to be distributed wherever salmon and steelhead occurred. However, limited data exists for Pacific lamprey in these areas. An assessment was conducted, in 2011 and is being updated in 2018, to track known habitat requirements, abundance, historic and current distribution, threats to the species, and to identify conservation actions, research, monitoring and evaluation needs. There is a lack of data for the Washington Coast and Puget Sound; where demographic and threat data exist abundance of Pacific lamprey was characterized as 'rapidly declining'. Threats include adult and juvenile passage, stream and floodplain degradation, and reduced stream flows. New information has become available after dam removals, from supplemental information gathered from salmon smolt traps, and partner outreach. Improved occupancy and distribution knowledge has come from a study using modified detection and occupancy techniques for stream populations to conduct field sampling for juvenile lamprey presence in selected watersheds. Expanding known information on Pacific lamprey in the Puget Sound and Washington Coast relies on voluntary involvement of various Native American Tribes, federal, state, local government agencies, non-profit groups, and others. We hope to fill data gaps in Pacific lamprey distribution, abundance, population trends, local threats and potential reasons for decline. The assessment information will assist with developing and implementing conservation and restoration actions.

ORAL

MECHANISTIC MODELS OF INDIVIDUAL GROWTH AND CAPACITY: HABITAT RESTORATION FOR CHINOOK AND STEELHEAD JUVENILES. Karl M. Polivka¹, Joseph R. Mihaljevic² and Shannon M. Claeson¹. ¹ U.S. Forest Service, Pacific Northwest Research Station, 1133 N. Western Ave., Wenatchee WA 98801 ² Dept. of Ecology and Evolution, University of Chicago, 1101 E. 57th St., Chicago IL 60637. kpolivka@fs.fed.us

In-stream habitat restoration effectiveness studies that rely upon the observation of occupancy of restored habitat relative to unrestored habitat often show inconsistent and limited effects of restoration, as we have observed in a multi-year study of restoration in the Entiat River, Washington. Thus, we used extensive comparative sampling of juvenile Chinook and Steelhead in unrestored habitat in restored reaches, reference reaches, either unrestored or with natural structures, and mark-recapture assays, to detect a positive fish response to restoration. Comparative sampling indicated that restoration may increase the capacity of a stream reach 1.5-2.5 fold, depending on geomorphic valley segment, year, species, and individual reach. Mark-recapture assays led to observations of both behavioral and individual growth patterns with implications for both habitat capacity and individual fitness-correlated traits. For Chinook, occupied, restored pools had around 4-fold greater capacity for density-dependent immigration compared with unrestored pools, as indicated by a fit of a modified Ricker model; however the confidence interval around this estimate is fairly large. A mechanistic growth model fit to size-over-time and recapture data showed that early parr-stage individuals of both species experienced a growth benefit to occupying restored pools, but this did not result in larger fish by the end of the season. Nevertheless, these growth benefits may have survival implications early in the rearing season, and/or for vulnerable size classes. Thus, we show the importance of these conceptual models in ecology for evaluating in-stream habitat restoration.

KEEPING WATER ON THE LANDSCAPE: PLANTS AND BEAVERS TO THE (SELF-SERVING) RESCUE? Michael M. Pollock, NOAA, Northwest Fisheries Science Center, 2725 Montlake Blvd. E, Seattle, WA 98112; michael.pollock@noaa.gov

Beavers build dams that create hydric environments that favor riparian and emergent wetland vegetation, with important consequences for the retention of water storage in alluvial valleys. In contrast, many land-use activities practiced by humans have the opposite effect, creating conditions that favor more xeric plant communities and that facilitate more rapid drainage of water from landscapes. Climate change has highlighted the need to reconsider “drainage-friendly” land-use practices and to consider alternative practices that more strongly emphasize water storage. A paradigm shift is beginning to emerge, moving away from thinking of stream systems as “drainage networks” towards thinking of them as water storage networks or aquatic habitat networks. In this new view, the physically-based perspective of stream systems as conduits shaped by and built for transporting sediment and water, is replaced with the biologically-based view of highly evolved networks of living communities with multiple mechanisms for retaining water on the landscape. These evolved characteristics allow hydric species to manipulate their environment, giving them a competitive advantage over more xeric potential competitors. This emerging paradigm has significant consequences for stream restoration and watershed management.

COLLECTING INFORMATION ON IMPERILED INSECTS IN WASHINGTON STATE: TWO PROJECTS TO SURVEY FOR BUTTERFLIES AND BUMBLE BEES WITH CITIZEN NATURALISTS. Ann Potter, Washington Department of Fish and Wildlife, P.O. Box 43141, Olympia, WA 98504-3200; ann.potter@dfw.wa.gov

In 2017, Washington Department of Fish and Wildlife initiated a project with the Washington Butterfly Association to collect information on five butterfly species of greatest conservation need (SGCN) in eastern Washington. Although the species were known to be imperiled, most observation records were decades old, and few historical sites had been resurveyed. Our goal was to collect information to support current assessments of conservation status. Project objectives were to improve and update knowledge of SGCN distribution and the number and size of SGCN butterfly populations, and to opportunistically collect key life history information. We held classroom and field-based training sessions on butterfly survey protocols and the focal species, with over 60 participants attending three focal species field trips. A small, but dedicated group of citizen naturalists conducted 37 additional survey visits in 2017 for four of the five species; 11 historical locales were revisited, with the focal species detected on five, and 12 new locales were surveyed, with the focal species located on five. Plans are currently underway to continue this joint project in 2018. WDFW will be initiating a new project in 2018 with The Xerces Society for Invertebrate Conservation to create a bumble bee atlas for Washington. Citizen naturalists will play a large role in collecting and submitting bumble bee records for the atlas project.

ORAL

MAKING BEAUTIFUL GRAPHICS IN R. Janet Prevéy, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue SW, Olympia, WA, 98512-1101; jprevey@fs.fed.us

This presentation will showcase R packages and techniques to make manuscript-quality maps and associated graphs that highlight important statistical and spatial relationships in your data. I'll discuss best practices for making visuals in R that are informative, but also pleasing to the eye. We will work through several examples of code for creating manuscript-quality visuals in Rstudio using the following packages: ggplot, ggmap, viridis, and Rcolorbrewer. Information on how to export and save high resolution graphics will also be presented.

ORAL

CHANGING PHENOLOGY OF NORTHWESTERN SHRUBS. Janet Prevéy and Constance Harrington, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue SW, Olympia, WA, 98512-1101; jprevey@fs.fed.us

How is the timing of flowering and fruiting of northwestern shrubs changing as the climate changes? To address this question, we utilized a wide variety of citizen scientist and USFS monitoring plot data to identify climate variables that best predicted the timing of flowering and fruit ripening of several culturally important food-producing shrubs: huckleberry, salal, Oregon grape, and hazelnut. We used this synthesized dataset to develop models of the timing of flowering and fruiting for the four species, and to predict how the timing of fruiting would change in the future. We found that flowering dates of all species were best predicted by mean or maximum spring temperatures, whereas timing of fruit ripening was best predicted by mean summer temperature and accumulated growing degree days. Preliminary phenology models for these species indicate that the ripening of fruits and nuts will advance an average of 25 days by 2055 based on climate projections for a business-as-usual emission scenario. Additionally, we found that flowering dates for at least one species have already advanced considerably over the recent past. An exceptionally long record of flowering observations (1963- 2016) of Oregon grape in Salem, Oregon shows that flowering has already advanced by 5 days per decade, with flowering occurring an average of 50 days earlier now than it did in the 1960s. These large shifts in phenology have the potential to greatly alter trophic relationships, plant-pollinator interactions, and the timing of traditional harvests in the future.

ORAL

INTEGRATING CLIMATE CHANGE INTO THE DESIGN AND PERMITTING OF WATER CROSSING STRUCTURES.

Timothy Quinn, George Wilhere, Jane Atha, Lynn Helbrecht, Habitat Science Division, Washington Department of Fish and Wildlife 600 Capitol Way North, Olympia, WA 98501-1091. Ingrid Tohver, Climate Impacts Group, University of Washington, John Wallace Hall, 3737 Brooklyn Ave. NE, Seattle, WA, 98105. Timothy.Quinn@dfw.wa.gov

The Washington Department of Fish and Wildlife (WDFW) provides design standards for fish passable water crossing structures (culverts and bridges) and permits the installation of those structures in much of the State. However, none of WDFW's actions to ensure fish passage through water crossing structures address possible changes in hydrology resulting from climate change. We evaluated WDFW's culvert design to identify potential sensitivities to climate change. We identified stream bankfull width as the primary culvert design parameter that was sensitive to climate change. To understand the potential impacts of climate change on fish passage through culverts, we estimated changes in future bankfull widths from projected changes in future bankfull discharge. We estimated hydrological changes across Washington State using an ensemble of 10 statistically downscaled global climate models under the A1B climate scenario. The spatial resolution of these regional projections was 1/16° grid cells. We compared projections of bankfull width for two future time periods, 2040s and 2080s, to bankfull widths estimated from simulations of historical bankfull discharge. Our projections indicate that in both time periods bankfull discharge and bankfull width will increase in about 80% of Washington State, although the magnitude of change varies by ecoregion. Mean percent change in bankfull width between historical and future periods can be used to adjust the bankfull width used in a culvert's design, and the distribution of bankfull width projections based on the 10 climate change models can be used to indicate the risk of failure due to an undersized culvert.

ORAL

ROOT DISEASE CAUSED TREE MORTALITY IN WESTERN WASHINGTON FORESTS: HIGHLIGHTING THE IMPACTS OF A SIGNIFICANT DISTURBANCE.

Amy C. Ramsey, Dan Omdal, Forest Health Program, Washington Department of Natural Resources, 1111 Washington St SE, Olympia, WA 98501; amy.ramsey@dnr.wa.gov

In western Washington (WA) forests, root disease is one of the primary disturbance agents and can reduce the structural integrity of the base and roots of a tree, reduce growth, cause host mortality and increase tree susceptibility to wind throw and insect damage. These impacts can occur across a wide range of host species, tree ages, site conditions and locations, and may result in property loss, public safety concerns and unexpected trajectories to forest stand development in infested areas. Root diseases are often underrepresented in forest health related aerial and ground surveys and are often ignored when considering management activities on a site, resulting in missed opportunities to mitigate the impacts of these disturbance agents. This presentation discusses the assessment results of four, primarily Douglas-fir sites across western Washington impacted by Armillaria root disease (caused by *Armillaria* spp.) and Laminated root rot (caused by *Phellinus sulphurascens*). Symptoms and damage at each site ranged from trees with thinning crowns to wind throw and entire tree mortality, and the damage was found occurring in patches and/or scattered throughout stands. Results varied across assessed sites, with findings including the identification of root disease in 95% of survey plots on a site that was recently commercially thinned, in 30% of the survey plots on another recent commercially thinned site and root disease causing tree mortality on at least 25% of the acreage of a site that will be harvested soon.

WESTERN WHITE PINE DISEASE RESISTANCE IN WESTERN WASHINGTON: OPERATIONAL PLANTING AND THE LATEST IN RESISTANT STOCK TYPES. Amy C. Ramsey, Dan Omdal, Forest Health Program, Washington Department of Natural Resources, 1111 Washington St SE, Olympia, WA 98501; Richard Sniezko, Doug Savin, Dorena Genetic Resource Center, USDA Forest Service, 34963 Shoreview Drive, Cottage Grove, OR; amy.ramsey@dnr.wa.gov

Western white pine (WWP) is a wide-ranging forest tree species of high economic and ecological value. However, due to several factors, including the inadvertent introduction of the non-native fungal pathogen *Cronartium ribicola* Fisch. (the cause of white pine blister rust (WPBR) disease), there have been extreme levels of mortality in many natural populations of WWP, and a greater reluctance to use this species in reforestation. The objective of this study was to examine current WPBR infection levels in operational plantings of WWP and compare those results to the most recent data from a series of WWP field trials examining a diverse set of WPBR resistant families. Results were then used to determine if there were WWP stock types available that had greater resistance to WPBR than are currently being planted operationally. The rust resistant field trials provide key information on the efficacy of rust resistance over time, as well as the adaptability of different seed sources of WWP in a changing climate. Results have shown an average of 34% of the trees across all operationally planted sites had WPBR infections causing or likely to cause mortality. Among the 36 seedlots examined in the resistance field trials, five seedlots had an average of 10-20% mortality causing and likely to cause mortality infections and four seedlots had an average of less than 10% infections. The data suggests that there are WWP seedlots available with greater WPBR resistance levels than are currently being planted operationally.

BLUE LEGACY: THE RAPID RETREAT OF GLACIERS FROM WASHINGTON'S NATIONAL PARKS. Jon Reidel, North Cascades National Park, 810 State Route 20, Sedro-Woolley, WA 98284. Jon.Riedel@nps.gov

North Cascades, Olympic, and Mount Rainier national parks contain more than 400 glaciers, including massive valley glaciers flowing from Mount Olympus and Mount Rainier and hundreds of smaller cirque and hanging glaciers. Glaciers are valued as habitat, recreation sites, reservoirs of cold fresh water, and indicators and recorders of climate change. They are extremely sensitive to climate warming due to the effect of higher air temperature on melt and accumulation. Snow and ice dominated landscapes are also subject to positive feedback that accelerates warming as reflective snow and ice are replaced by energy-absorbing rock surfaces.

Photographs spanning the last century in the three parks are powerful reminders of the sensitive response of glaciers to climate change. Images taken in the early and mid-20th Century and recently reveal stunning losses of 53% glacial cover at North Cascades, 52% at Olympic, and 39% at Mount Rainier. More recent comparisons indicate that glaciers at Olympic National Park are shrinking faster than those in the Cascades. From 1982 -2015 glacial cover declined 43% at Olympic compared to 20% at North Cascades. The loss of the glaciers has had an impact well beyond the mountain parks. Skagit River is Puget Sound's largest watershed at 8000 km² and holds 377 glaciers. Since 1959 the basin has lost about 19% of its glacial cover and 3.01 ± 0.69 km³ of glacial ice water equivalent. The diminished glacial reservoir has resulted in a 24 ± 9 % decline in summer streamflow on the lower Skagit River.

Regional glacial history based on radiocarbon dated moraines and till provide a deeper perspective on modern climate change. The glacial chronology indicates that the Little Ice Age advance was the largest in the Holocene (last 10,000 years). Emergence of ancient Native American artifacts and rooted stumps and logs from beneath receding glaciers and snowfields suggest that glaciers today are less extensive than they have been for several thousand years.

TREE SPECIES DIVERSITY EFFECTS ON PRODUCTIVITY IN A NORTHWEST FOREST.

Anchal Rikhi; Irene Gribble; Evergreen State College, 2700 Evergreen Parkway NW, Olympia WA 98505; anchalrikhi@gmail.com

Temperate Pacific Northwest forests typically hold a very large mass of living biomass per acre (approaching five hundred tons) and may store more biomass carbon (C) per unit area than most other ecosystems. Biotic factors such as plant community composition and diversity can influence the usage and cycling of C, which in turn affects the levels of ecosystem productivity. Using a series of ten intensive monitoring plots (from the Evergreen Ecological Observation Network), diameter at breast height (DBH) of trees was measured and allometric equations were utilized to calculate biomass accumulation and basal area at the individual and plot level. Using these metrics we found a negative correlation between basal area and species diversity as well as a negative relationship between biomass accumulation and species diversity. These results are likely due to scale related and disturbance factors, as well as environmental fluctuations. Exploring the diversity-productivity relationship in Northwest temperate forests is essential for understanding carbon cycling and productivity in these ecosystems. This information can be used in carbon budgeting and influence broader sustainability and land-use decisions.

TRENDS IN THE HEALTH OF WHITEBARK PINE POPULATIONS IN NORTH CASCADES NATIONAL PARK SERVICE COMPLEX AND MOUNT RAINIER NATIONAL PARK.

Regina M. Rochefort, North Cascades National Park Service Complex, State Route 20, Sedro-Woolley, WA 98284; Shay Howlin, Lacey Jeroue, Western Ecosystems Technology, Inc., Environmental & Statistical Consultants, 200S. Second Street, Laramie, WY 82090; John Boetsch, National Park Service - North Coast & Cascades Network, Olympic National Park, 600 East Park Avenue Port Angeles, Washington 98362; Lise P. Grace, National Park Service - North Coast & Cascades Network, North Cascades National Park Service Complex, State Route 20, Sedro-Woolley, WA 98284; regina_rochefort@nps.gov

Whitebark pine (*Pinus albicaulis* Engelm.) is a key component of subalpine and alpine ecosystems in the northern Cascades. The species survival is threatened by white pine blister rust, mountain pine beetles, fire exclusion, and climate change. We monitored trees in permanent plots in two national parks three times between 2004 and 2016. Blister rust rates of infection increased in North Cascades National Park Service Complex from 32% in 2004 to 51% in 2016 and from 18% to 38% in Mount Rainier National Park. Mortality increased from 7% to 21% in North Cascades National Park Service Complex and 38% to 44% in Mount Rainier National Park. Annual mortality rates were calculated for three time periods: 2004-2009, 2009-2015/2016, and 2004-2015/2016. Signs of mountain pine beetle were rare and limited to a few trees in individual plots. Although reproductive trees were found in most stands, densities were low and regeneration was dominated by subalpine fir.

ORAL

BIOCRUST COMMUNITY COMPOSITION IN GRAZED AND UNGRAZED WINTERFAT

VEGETATION TYPE. Roger Rosentreter Boise State University, Biology Department, 1910 University Dr. Boise, ID. 83709, **Heather Root**, Botany Department, Weber State University, Ogden, UT, 84403. Roger.rosentreter0@gmail.com

Winterfat (*Krascheninnikovia lanata*) is a low growing shrub in the Chenopod family that is common in arid lands in the northern hemisphere. In fine silty soils, it is often the dominant vascular plant. The common name comes from the fact that sheep gain weight when eating this plant even in the winter season. Due to heavy sheep grazing, however, the extent of the winterfat vegetation type has decreased in western North America, with unknown effects on associated biological soil crust communities. We sampled plots in winterfat vegetation type on public lands in Idaho, USA. We found that it can support robust biocrust communities with cover sometimes exceeding 35-40%. Biocrust biodiversity and vigor differed in grazed and ungrazed sites. The ungrazed site had more species of mosses and the twisted moss (*Syntrichia ruralis*) was 4-8 inches high around the base of the shrubs. Several lichen species were more abundant in the ungrazed plots including *Acarospora schleicheri*, *Aspicilia aspera*, and *Endocarpon loscosii*. Grazed winterfat site had more bare ground, more bur-buttercup (*Ceratocephala testiculata*) and wider spaces between shrubs, as well as more Russian thistle (*Salsola* spp.) and tumble mustard stalks (*Sisymbrium altissimum*). The grazed site also had lower biocrust diversity with fewer late successional biocrusts and the moss did not grow as tall around the base of the shrubs. Our study suggests that this vegetation type has the potential to support diverse and robust biocrust communities, and that grazing is associated with weedier vascular plants and negative impacts on the biological soil crusts.

POSTER

SEASONAL AND SPATIAL VARIATION OF SOIL RESPIRATION IN A PACIFIC

NORTHWEST SECOND-GROWTH FOREST. Shayna Rossiter; Claire Cook; Sydney Baker; Dylan Fischer; Evergreen State College, 2700 Evergreen Pkwy NW, Olympia WA, 98505; shaynarossiter@yahoo.com

This study looks at ten of forty-four fixed plots of soil respiration for a fall season from the forest floor at the Evergreen Ecological Observation Network (EEON). Carbon soil respiration is a three-part process of autotrophic respiration, rhizosphere microbes, and respiration of heterotrophic decomposers. Soil respiration plays an immense role on whether the forest is acting as a carbon sink or source. Soil CO₂ efflux (NCER) was measured in 10 plots in fall 2017 and in 5 plots in January 2018. This data is compared to previous data collected from 2008-2015 to see if there is a trend in higher efflux rates of CO₂. With these comparisons to prior data, will possibly show no relative increase in CO₂ efflux.

ORAL

DOLPHINS IN INLAND WASHINGTON STATE WATERS: ARE WARMER WATER SPECIES EXPANDING INTO OUR REGION? Laurie Shuster, David Anderson, Jessie Huggins, Annie Douglas, Nathan Harrison, John Calambokidis, Cascadia Research Collective, 218½ W 4th Ave., Olympia WA 98501; Susan Berta, Orca Network, 485 Labella Vista Way, Freeland WA 98249; laurie.shuster@gmail.com

Historically, Pacific white-sided dolphins have been the only dolphin species commonly sighted in the inland waters of Washington. However, other dolphin species have been sighted frequently in recent years, with some animals displaying longer-term residency patterns. A pair of Risso's dolphins, normally found offshore, were regularly sighted in South Puget Sound 2011-12. Common dolphins and bottlenose dolphins typically inhabit warmer temperate and tropical waters and are not usually present north of California; however, sightings of live dolphins and dead stranded individuals have been increasing. Common dolphins were sighted in 2003, 2011-12, and 2016-17, with strandings occurring in inland waters in 2012 and 2017 and on the outer coast in 2006, 2010, and 2014-16. These sighting and stranding events are proximal to El Niño periods. Since June 2016, several long-beaked common dolphins have remained in Puget Sound (generally 5-20 individuals reported). Bottlenose dolphins have been sighted in 1998, 2008, 2009, 2010 and 2011, and strandings occurred in 1988, 2010, 2011. Beginning in September 2017, bottlenose dolphins were sighted regularly in inland waters of WA and BC, with timing and locations suggesting 5-6 animals. One animal was a well-known coastal bottlenose dolphin last seen in March 2017 in Sonoma County, California, and has been part of the northern expansion of the bottlenose dolphin range occurring since the El Niño event of 1982. These species feed on similar prey (small schooling fish and squid) therefore, continued patterns of long term warming trends may increase the occurrence of these and other warm-water species in the future.

ORAL

INFRASTRUCTURE MANAGEMENT AND CLIMATE CHANGE ON THE OLYMPIC NATIONAL FOREST; ADAPTATION STRATEGIES FOR ROAD MANAGEMENT. Bill Shelmerdine, Olympic National Forest, 1835 Black Lake Blvd SW. Olympia WA 98512; bshelmerdine@fs.fed.us

The Olympic National Forest (ONF) manages more than 600,000 acres of forested lands in the Olympic Peninsula Province of Western WA. This includes over 2000 miles of road providing access for a variety of uses including recreation, commercial, habitat management, watershed restoration, and others. Most of this road system was constructed prior to 1990, and used primarily for timber management and logging. In recent years many roads have received limited maintenance and are in need of reconstruction. Road drainage and stream crossings are problematic especially if unmaintained and are particularly susceptible to flood damage and extreme runoff events. Policy changes for road management in recent years have changed the way we assess and manage roads. These changes include updating standards and guidelines, integrating science based analysis, and identifying a minimum road system that is ecologically and financially sustainable. In 2009 Olympic National Forest, Olympic National Park, Forest Service PNW Research Station, and the University of Washington Climate Impacts Group collaborated to examine and develop adaptation strategies for climate change and road management. Geomorphic setting, precipitation zones, modeling predicted changes in peak flows, and stream crossing design standards and methods were examined in this effort. A number of adaptation options were identified for road management associated with climate change predictions. A strategy consisting of the following elements: 1) prioritization to the highest value resource areas, 2) limiting infrastructure assets in high risk areas, 3) robust systems design, and 4) focusing additional design resources on susceptible areas, holds promise for sustainable road management.

RARE EARTH ELEMENTS AS A GEOGRAPHICAL TRACER IN THE COLUMBIA RIVER BASIN VIA MULTICOLLECTOR INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY.

Steve Shen, Pacific Northwest National Laboratory, 902 Battelle Blvd, Richland, WA 99354; Coley Smith, Indiana University, 1001 East 10th Street Bloomington, IN 47405-1405; Eirik J. Krogstad; Timothy J. Linley; Jill M. Janak; Megan K. Nims, Pacific Northwest National Laboratory, 902 Battelle Blvd, Richland, WA 99354; steve.shen@pnnl.gov

Rare earth elements (REEs) are a chemically coherent group that are found in specific concentration patterns in crustal materials. Due to weathering in water-rock interactions, water samples are imprinted with the REE signature of their local and upstream geology. These REE patterns provide insight on bedrock geology within geologically complex river basins and can be utilized as a tracer if this geology is well-known; pilot scale work on sectioned bones (cleithra) in resident fish demonstrate that REE patterns vary across the growth axis and can be indicative of movement or habitat use over time. Precise REE concentrations (ranging from 0.6 ppt to 6 ppb utilizing isotope dilution) and Nd isotopic compositions in Columbia River water were obtained at Pacific Northwest National Laboratory via Multi-Collector Inductively Coupled Plasma Mass Spectrometry (MC-ICP-MS), with sample reproducibility of REE concentrations being ~1%. Chemical separation through column chromatography provided discrete separation of REEs to minimize isobaric interferences and oxide formation within runs. Normalized REEs in river water samples collected between 2015 and 2017 from the tributaries of the Columbia River show that highly precise river water REE signatures can be used as a data set that is highly orthogonal to more commonly used signatures such as the $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$. Combinations of such data could allow greater resolution on discerning the migratory patterns of certain fish species within the Columbia River Basin of the Pacific Northwest USA.

EFFECTS OF CURRENT FOREST PRACTICES ON ORGANIC MATTER DYNAMICS IN HEADWATER STREAMS AT THE TRASK RIVER WATERSHED, OREGON.

Laura J. Six, Weyerhaeuser NR Company, PO Box 420, Centralia WA 98531; Maryanne Reiter, Weyerhaeuser NR Company, PO Box 275, Springfield OR 97477; Peter James, Weyerhaeuser NR Company, 698 12th St SE, Ste 220, Salem OR 97301; and Robert E. Bilby, Weyerhaeuser NR Company, 220 Occidental Ave S, Seattle WA 98104; laura.six@weyerhaeuser.com

Organic matter (OM) dynamics in headwater streams are heavily influenced by streamside vegetation. The delivery, storage and transport of terrestrial material are primary drivers of both biotic and abiotic instream processes. Logging along headwater streams can cause shifts in the type and quantity of OM in these systems. Our research, as part of the larger Trask Watershed Study examining the effects of forest practices on headwater stream ecosystems, examined trends in litter input, coarse and fine particulate OM transport, and coarse particulate OM storage following harvest under three treatment intensities: complete clearcut, clearcut with buffer, and clearcut with scattered tree retention. The amount of OM (leaves, needles, and small wood) delivered to streams decreased only after complete clearcut; the buffered and scattered leaf tree sites were similar to reference sites. Instream OM storage of leaf and needle material increased after harvest when a buffer or scattered leaf trees were retained, but the transport of particulate OM did not significantly differ with any harvest treatment. While the remaining trees at harvest sites with buffer or scattered retention continue to provide input equivalent to reference streams, this increase seems to be held in storage rather than immediately transported downstream. Our research demonstrates that the intensity of forest management can significantly alter instream processes, and management decisions should consider OM dynamics to fully realize the impact of harvest intensity in headwater streams.

ORAL

WILD FOOD CONSUMPTION, VALUATION, AND OBSERVATIONS OF ENVIRONMENTAL CHANGE AMONG MONTANA HUNTERS, ANGLERS, AND HARVESTERS OF WILD EDIBLE PLANTS.

Erin Smith; Selena Ahmed; Carmen Byker Shanks, Department of Health & Human Development, Montana State University, P.O Box 173540, Bozeman, MT 59717; Margaret Eggers, Center for Biofilm Engineering, P.O Box 173980, Bozeman, MT 59717; Virgil Dupuis, Salish Kootenai College Extension, 58138 US Highway 93, Pablo, MT 59855; smitherinmae@gmail.com

Environmental and land use change are impacting rural and tribal communities in Montana who utilize wild foods for subsistence and cultural value. The purpose of this research is to characterize wild food consumption, value, and observations of environmental change among hunters, anglers, and harvesters of wild plant foods. A mixed methods approach was used to conduct an online survey which was distributed across the state. Additionally, we interviewed community members on a rural Indian reservation in Western Montana to better understand impacts to wild foods in a tribal community. 218 participants completed the online survey and 30 completed qualitative interviews. Of the 218 survey participants, 81.7% (n=179) were hunters, 85.3% (n=186) were anglers, and 69.7% (n=152) harvested wild plant foods. Hunting and fishing were associated with high rates of wild game and fish consumption ($p < 0.001$), and roughly half of hunters and anglers consume wild game and fish at least once a week. Wild foods were highly valued among participants with 88.1% (n=192) agreeing that wild foods contribute to dietary quality, and 69.2% (n=151) agreeing that wild foods contribute to their cultural identity. Environmental observations included a change in the distribution of fish (n=81) and wild edible plants (n=82), the types of wild game available (n=73), and the water quality of lakes and rivers (n=77). Finally, 80.3% (n=175) of participants felt concerned that there may be decreasing availability of wild foods in the future. Qualitative interviews are undergoing the coding process and will be analyzed by the end of February.

ORAL

LICHEN OR NOT: RECOGNIZING THE LIMITS OF FUNGAL DNA AND RESTORING THE LICHEN AS THE OBJECT OF STUDY BY LICHENOLOGISTS.

Toby Spribille, University of Alberta, Biological Sciences, CW405, Edmonton, AB Canada T6G 2R3; toby.spribille@ualberta.ca

Ever since the recognition that lichens are a chimera of at least two organisms, lichen biologists have disagreed on whether one partner or multiple partners are responsible for coding for the characteristic lichen thallus form of each species. Eventually a rule was adopted bestowing this power solely on the fungus, and tethering the naming of the lichen to that partner alone: the lichen-as-fungus paradigm. The biological evidence to support this was never unequivocal, but a rule was a rule. Now countless name changes are being implemented to retrofit the naming of lichen symbioses to a 68-year-old set of untested assumptions owing to fungal DNA evidence. I will briefly explore three aspects of emerging lichen biology that question the lichen-as-fungus paradigm: first, evidence that lichen symbioses “speciate” faster than their ascomycete fungal components; second, evidence that lichen fungi, like lichen algae, can be promiscuous with respect to the lichens they occur in; and finally, emerging evidence that single-celled microbes are involved in shaping the lichen symbiotic outcomes we traditionally think of as lichen species. Future lichen symbiosis research will have to decide between sticking with an old rule set or asking “what is the biological reason this lichen looks and acts the way it does?”

DIET ANALYSIS OF RAINBOW TROUT FROM SPIRIT LAKE, MOUNT ST. HELENS: AN INDICATOR OF NEW ZEALAND MUD SNAIL INVASION IN A POST-ERUPTION ENVIRONMENT.

Hamish Stevenson, Carri J. LeRoy, The Evergreen State College, The Evergreen State College, 2700 Evergreen Parkway NW, Olympia, WA 98505; Charlie Crisafulli, US Forest Service, 42218 NE Yale Bridge Rd, Amboy WA 98601; steham19@evergreen.edu

Since the eruption of Mount St. Helens (1980), the natural ecological succession of many species has been closely monitored. Spirit Lake, located on the north side of the volcano, experienced devastating effects from the blast, killing all living biota and dumping massive amount of organic and inorganic debris into the lake. In the early 1990's, a thriving population of Rainbow trout (*Oncorhynchus mykiss*) was found by researchers surveying the lake. While this species was present in the lake before the eruption, it is theorized that their introduction was unauthorized. In order to better understand the dynamics of this stocked population, as well as its impact on invertebrate communities in the lake, a diet analysis was conducted to quantify the frequency and abundance of prey items within trout stomachs. Identifiable prey items were grouped into 13 categories based on taxonomic order. These prey items were compared against trout size classes and years sampled, in order to identify general feeding patterns, prey availability, and prey community structure. We found differences in feeding preferences among size classes, as well as increased taxonomic richness of prey items with size. Additional patterns show fluctuations in dietary composition regarding origin of food source (terrestrial vs aquatic) in relation to year, a finding that is complemented by similar research conducted on this population of trout. In addition to identifying dynamics of this *O. mykiss* population, recent samples (2016) have contained a highly invasive species, *Potamopyrgus antipodarum*, commonly known as the New Zealand Mud Snail.

IDENTIFICATION OF ASCOMYCETE AND BASIDIOMYCETE SYMBIONTS IN *CLADONIA MACILENTA* USING INTEGRATIVE TAXONOMY.

Heather Stewart-Ahn, Lalita M. Calabria, The Evergreen State College, Science Department, 2700 Evergreen Parkway NW, Olympia, WA 98505; stehea17@evergreen.edu

Cladonia is a taxonomically challenging genus; it is a highly speciose group found worldwide and species level identification often requires detailed chemical and morphological investigations. Here we present an integrative taxonomic approach for identifying red-apotheciate *Cladonia* common to conifers in the Pacific Northwest. We collected specimens and identified them using morphological and chemical spot testing methods. Next, we performed molecular-based identification of both ascomycete and basidiomycete fungal symbionts using a DNA extraction kit followed by PCR amplification using ascomycete and basidiomycete-specific primers. We initially identified one specimen as *Cladonia transcendens* based on the morphological and chemical spot testing data. However, a BLAST search of GenBank data for the ascomycete sequence indicated multiple high fidelity matches that did not include *C. transcendens*. Based on these data we revised our identification from *C. transcendens* to *C. macilenta*, which displayed the highest scoring GenBank match consistent with the morphological and chemical features of our specimen. These two species can easily be confused by novice lichen observers due to their overlapping chemical and morphological similarities. Additionally, our basidiomycete sequence data matched 98% on GenBank to an uncultured clone in the Cyphobasidiales— a newly discovered Order of basidiomycete yeasts found across diverse lineages of lichens recently described by Spribille and co-workers (2016). To our knowledge this is the first report of basidiomycete yeasts in *C. macilenta* or in any red-apotheciate *Cladonia* species. This study highlights the value of combining morphological, chemical, and molecular phylogenetic data for identification of taxonomically challenging groups such as *Cladonia*.

SMARTPHONE LIDAR CAN MEASURE KEYSTONE HABITAT STRUCTURES FOR**WILDLIFE STUDIES. Jessica M. Stitt**, Leona Svancara, Lee Vierling, Kerri Vierling, University of Idaho, Moscow, ID 83844; jstitt@uidaho.edu

While remote sensing technologies can increasingly measure a wide array of environmental characteristics, they are sometimes limited at finer spatial resolutions necessary for wildlife studies. Keystone structures are features that play a disproportionately large role in structuring community composition, and some (e.g. snags, tree cavities) often occur over small spatial extents. We tested a handheld lidar device that interfaces with smartphones called Spike® by IkeGPS to determine its accuracy in measuring tree and cavity dimensions. The Spike app allows users to take a photo of a target and measure its dimensions on their phone or tablet. We measured diameter at breast height (DBH) of trees with a standard tape measure and took Spike photos of the same tree from distances up to 50m away in conifer forests in Washington and Idaho. Correlations between Spike and tape measurements for DBH were high ($r = 0.98$, $n=103$), as were correlations between Spike measurements and known dimensions of 4 tree cavity sizes (ranging from 3 to 12cm wide), when measured at various heights, angles, and distances from the cavities ($n=294$; $r > 0.91$). Spike is a low-cost, portable technology that non-invasively measures features small in size and difficult to access, showing the potential of handheld lidar to aid in future research, education, and outreach efforts across a wide range of fields. At the rate these technologies continue to develop, Spike and similar devices may herald the advent of powerful and practical tools to remotely explore our world from the palm of our hand.

PREPARING OUR INFRASTRUCTURE FOR A NEW HYDROLOGIC CYCLE. Ronda Strauch,Northwest Climate Science Center, University of Washington, 3737 Brooklyn Ave. NE, Seattle, WA, 98105; rstrauch@uw.edu

Warming atmospheric temperatures directly affect the hydrologic cycle. Shifts in the hydrologic cycle lead to changes in precipitation patterns, such as form, timing, and intensity. Our local infrastructure is designed for our local hydrology; therefore, hydrological shifts can expose obsolete designs and lead to infrastructure vulnerability. Transportation infrastructure provides an essential foundation for livable communities, land management, and national security. However, transportation infrastructure is particularly vulnerable to altered hydrology at stream crossings, low-lying areas, and coastlines. Because hydrologic changes vary spatially, regionally tailored solutions are needed to address local context and specific impacts. Although transportation agencies have generally prioritized climate change mitigation (i.e., emissions reduction) over adaptation activities, adaptation is beginning to be considered in both planning and implementation phases, particularly in the wake of devastating and costly storms. Increasing infrastructure resilience is challenging, but progress has been made in identifying vulnerable assets, capitalizing on events, developing new design tools, and collaborating in risk-reduction solutions. Institutionalizing climate change consideration in practice and bridging the gap between climate science and engineering provide a path forward.

ORAL

R PACKAGES & GIT VERSION CONTROL. Jacob Strunk 3625 93rd Ave SW, Olympia, WA 98512. jstrunk@fs.fed.us

This presentation demonstrates the use of R for package creation in the RStudio software, as well as how to manage version control with Git & GitHub. The RStudio software greatly eases both package creation and version control. Package creation is a great way to repurpose code for future use or sharing code, saving lots of time individually, and reducing redundancy. Git is a versioning tool that helps track changes to code. Git helps in developing new code, in debugging, and (at times) in returning to an older more stable version of code. Linking Git with the online repository GitHub facilitates collaboration amongst computers and users, and makes sharing code simple.

ORAL

LIFE HISTORY OBSERVATIONS OF LANDLOCKED ADFLUVIAL CHINOOK SALMON PRIOR TO THE REINTRODUCTION OF ANADROMOUS SALMONIDS. Kathryn T. Sutton, Samuel J. Brenkman, Olympic National Park, kathryn_sutton@nps.gov

Pacific salmonids (*Oncorhynchus* spp.) vary in life history and degree of anadromy but information on populations inhabiting fresh water throughout their life cycle is limited. We confirmed the presence of a self-sustaining population of adfluvial Chinook Salmon *O. tshawytscha* upstream of century old hydroelectric dams in the Skokomish River system, Washington. Snorkel, redd, and juvenile trapping surveys revealed their life history attributes prior to planned reintroductions of anadromous salmonids above the dams. Adult Chinook Salmon in Lake Cushman (a reservoir) were large-bodied (mean length, 610 mm; mean weight, 5.4 kg), up to 4 years of age, and migrated into the inlet river to spawn in October and November. Annual peak counts of adult spawners were chronically low (35 or less) based on interannual snorkel surveys since 1994. Chinook Salmon parr (N=780; mean length=105 mm) of a single cohort were captured (June-August) at the upper dam and had faded parr marks and bright, silvery coloration typical of smolts. Our study confirmed that Chinook Salmon reared and reproduced exclusively in freshwater and suggested a life history pattern most closely resembling anadromous fall-run Chinook Salmon. We reviewed annual hatchery release records from 1926-2016 and found no evidence of Chinook Salmon being planted above the dams, in contrast to landlocked Chinook Salmon occurring in Oregon and California reservoirs. These adfluvial Chinook Salmon may be descendants of the native Skokomish River anadromous population, including fish from below the dam, and represent adaptations to the reservoir after dam construction. Lake Cushman Chinook Salmon are federally threatened, the only reported landlocked population in Puget Sound and coastal Washington, and may represent a unique evolutionary legacy worthy of protection.

ORAL

EFFECT OF ARTIFICIAL NIGHTTIME LIGHTING ON THE PHOTOTAXIC BEHAVIOR OF SUBYEARLING SALMONIDS IN LENTIC NEARSHORE AREAS. Roger A. Tabor, Alex T. C. Bell, Zachary J. Moore, U.S. Fish and Wildlife Service, 510 Desmond Drive SE, Suite 102, Lacey, WA 98503; Scott Stolnack, Daniel W. Lantz, King County Department of Natural Resources and Parks, 201 South Jackson Street, Suite 600, Seattle, WA 98104; David A. Beauchamp, U.S. Geological Survey, 6505 NE 65th Street, Seattle, WA 98115; Lyle L. Britt, NOAA Fisheries, 7600 Sand Point Way, Seattle, WA 98115; John Green, Tim Robinson, RGB Optics, Seattle, WA 98115; roger_tabor@fws.gov

Artificial nighttime lighting is a common condition especially in urban areas; however, the consequences of this lighting on aquatic ecosystems are often poorly understood. Artificial nighttime lighting has been shown to affect the behavior of many aquatic organisms, including juvenile salmonids (*Oncorhynchus* spp.). They may be attracted to lighting (positive phototaxis) which may increase their risk to predation. We conducted field experiments in the nearshore area of two urban lakes (Lake Washington and Lake Sammamish) in western Washington to test the attractive quality of lighting on subyearling salmonids. In 2014 and 2015, we examined the effects of three light intensities: 1) no light, 2) dim light (maximum, 5.0 lux), and 3) bright light (maximum, 50.0 lux) on nearshore fish abundance, which we compared to abundances from control nights without light treatments. For each month (March to May), the total number of subyearling salmonids was greater on the lighted night than they were on the control night. In both lakes, most subyearling salmonids were collected in the bright-light treatments, an intermediate amount in the dim-light treatments, and few in the no-light treatments. In 2017 and 2018, we tested the effect of different types of lights (primarily LED lights with different spectra) using the same light intensity. Thus far, we have not detected significant differences among different types of lights. We believe the prudent management goal would be to minimize artificial nighttime lighting as much as possible to reduce potential predation risk especially where ESA-listed salmonids are present.

ORAL

VALUE OF LICHENS: AND ARTIST'S PERSPECTIVE. Koa A. Tom, 1100 10th Ave E, Seattle, WA 98102. entomologist@gmail.com

In my photographs, I use lichens to comment on humanity. Lichens are abundant, ubiquitous and diverse just as people are. Further, lichens are composed of multiple life forms, and live with and amongst other lifeforms and objects, just like people. Lichens, however, are less destructive or noticeable to most folks than humanity tends to be. Hence, I use humanity to make lichens more accessible. Art is a means of perpetuating values. Ergo, to keep lichens in humanity's lexicon, I make analogies between the two. I try to find scenes where lichens interact with the human world to reveal our similarities, and in jest. From my photographs, I hope people become appreciative of lichens or see them in a new way—and see themselves anew.

YEASTS IN THE CORTEX OF *LETHARIA* LICHENS. **Veera Tuovinen**, Biological Sciences CW 405, University of Alberta, Edmonton, AB T6G 2R3 Canada; Stefan Ekman, Museum of Evolution, Uppsala University, Norbyvägen 16, SE-752 36 Uppsala, Sweden; Göran Thor, Department of Ecology, Swedish University of Agricultural Sciences, P.O. Box 7044, SE-750 07 Uppsala, Sweden; Toby Spribille, Biological Sciences CW 405, University of Alberta, Edmonton, AB T6G 2R3 Canada; Hanna Johannesson, Department of Organismal Biology, Uppsala University, Norbyvägen 18D, SE-752 36 Uppsala, Sweden; tuovinen@ualberta.ca

Since the late 1800s, mycologists have detected fungi above and beyond the assumed primary mycobionts from healthy lichens. Furthermore, recent next generation sequencing studies have demonstrated that a diverse microbial community, including bacteria and fungi, is ever present. However, it is often unknown to what extent any one of the microbes is specific to a certain lichen species, and their presence has been considered more or less extrinsic to the symbiosis. We used shotgun sequencing to study thalli of four species of *Letharia* lichens and detected a third fungal genome in all studied specimens. We aimed to identify this fungus and study its frequency in North American and European populations of *Letharia*. We used molecular markers to place the fungus into a phylogenetic context and PCR to screen its frequency in 308 thalli. In addition, we used fluorescent *in situ* hybridization and confocal laser scanning microscopy to simultaneously visualize and localize different fungi present in *Letharia*. We detected two species, *Tremella lethariae* and *Tremella* sp. B, to be present in 95 % of the studied specimens. The former is frequent in North America and the latter in Europe. The yeast stage of these fungi prevails in the *Letharia* cortex, whereas sexual stages and hyphae are formed only rarely. Several fungal species are metabolically active in the *Letharia* cortex, and their contribution to this structurally important lichen layer deserves further study.

STRESS-MEDIATED EFFECTS OF WOLVES ON FREE-RANGING LIVESTOCK: CAN PREY GUT MICROBIOME PREDICT STRESS RESPONSE IN PREDATOR-PREY INTERACTIONS?

Azzurra Valerio, Mariacristina Valerio, Luca Casadei, Robert Wielgus, School of the Environment, Washington State University, Pullman, WA 99164; azzurra.valerio@wsu.edu.

As Wolves (*Canis lupus*) recolonize across their former range in western North America, encounters with free-ranging livestock are expected to increase in frequency. Understanding the physiological state of livestock, as a response to stress imposed by the presence of predators (stress-mediated effects), will help with predicting the total effect of predators on their prey beyond direct consumption (density-mediated effects).

Fecal glucocorticoid (GCM) is widely used to measure stress response, but provides inconclusive results, particularly when applied to a finer resolution of spatio-temporal variation in predation risk (i.e., wolf-livestock encounters). Since the impact of external stressors (i.e., wolf encounters) on the body influences ultimately the physical and metabolic state of the animal, we purpose to investigate: 1) if the fecal metabolome extracted from Cattle (*Bos taurus*) fecal samples changes in relation to different spatial/temporal proximity to Wolves; 2) if other extrinsic and intrinsic variables may affect Cattle metabolic profiles.

Between 2014 and 2016, we collected 452 fecal samples from 55 Cows fit with GPS collars in 8 different livestock herds, and 8 Wolves in 4 wolf packs in Washington. Cattle metabolic profiles were extracted from fecal samples by mean of ¹H-Nuclear Magnetic Resonance. Our results clearly show that significant metabolic pathway shifts occur between livestock herds grazing in highly impacted wolf areas and low impacted wolf areas (p<0.0001). Moreover, we could identify the subsets of metabolites correlated with wolf presence under different environmental conditions. We conclude that in close proximity to Wolves the metabolism of Cattle changes.

HERBICIDES IN INVASIVE NON-NATIVE PLANT MANAGEMENT. Viktoria Wagner,

University of Alberta, Department of Biological Sciences, Edmonton, AB T6G 2E9, Canada; Pedro M. Antunes, Department of Biology, Algoma University, 1520, Queen Street East, Sault Ste. Marie, ON P6A 2G4, Canada; Michael Irvine, Forest Guides and Silviculture Section, Crown Forests and Lands Policy Branch, Ontario Ministry of Natural Resources and Forestry, 70 Foster Drive, Suite 400, Sault Ste. Marie, ON P6A 6V5, Canada; Christine McManamen, Cara R. Nelson, Department of Ecosystem and Conservation Sciences, Franke College of Forestry and Conservation, University of Montana, Missoula, MT 59812, USA. viktoria.wagner@ualberta.ca

Herbicides are commonly used in invasive non-native plant management (INPM). However, there is little published information on non-target effects or magnitude of usage in natural areas management. We surveyed governmental agencies and commercial agro-statistic companies to estimate herbicide usage in INPM in wildlands of North America. In addition, we conducted greenhouse and field experiments to test how two commonly used broadleaf-specific herbicides, aminopyralid and picloram, could potentially affect seed germination of native grassland plants. We found in our survey that in 2010, ca. half a million hectares of public wildlands were sprayed in the U.S., amounting to 201 tons of active ingredients. Our greenhouse and field experiments showed that herbicides lost specificity at the seed stage, lowering germination of both dicot and monocot species alike. In our garden experiment, seed germination declined in spring-treated but not in fall-treated plots. In addition, herbicide applications up to 11 months prior to seeding improved germination in only six of the ten species tested. Our study is the first to estimate the magnitude of herbicide usage in INPM in public wildlands. Our results indicate that non-target outcomes of herbicide usage in INPM may have been underestimated. As such, we consider that land managers, public groups and scientists could benefit from increased efforts to collect and archive data on herbicide usage, including efficacy and costs of INPM in public wildlands. Furthermore, we recommend that restoration practitioners carry out site-specific trials prior to seeding in order to avoid adverse effects for desired native plants.

MONITORING RESTORATION OF COASTAL TEMPERATE RAINFOREST – METHODS

AND FIVE YEAR RESULTS. Anthony M. Waldrop, Chris Clatterbuck, Carla Cole, Lewis and Clark National Historical Park, 92343 Fort Clatsop Rd., Astoria, OR 97103; awaldrop18@gmail.com, chris_clatterbuck@nps.gov

Lewis and Clark NHP began a forest restoration program in 2012 to accelerate the development of former industrial timber lands into late successional coastal temperate rainforest. To adaptively manage forest treatments, the park adopted a monitoring program to track if the restoration was meeting objectives. Park staff established 56 plots (20 x 20 meters) from 2012 to 2017 throughout various forest stand types to collect data on overstory and understory vegetation, coarse woody debris, snags, and recruitment. Plots are scheduled to be revisited every 5 years after treatments. Our monitoring methodology is presented here as an example of one way to monitor active restoration of forest lands. We re-visited a subset (n = 27) of plots in 2017 which allowed for our first analysis of forest conditions after the 2012 treatments. Preliminary results show that forest conditions are moving along the desired trajectory, with increased growth of herbaceous plants and shrubs, increased presence of snags and coarse woody debris habitat, and shifting demographics of overstory vegetation towards fewer, larger trees, and the emergence of a secondary canopy of young trees. Data collected from the thinned 15 year old forest stand type indicate that further treatments may be needed because the density of trees is continuing to inhibit understory growth and the transition of the forest out of the competitive exclusion stage. The continued collection of data over the next few decades will provide park managers with the information needed to prescribe any additional interventions.

ORAL

COLLABORATING ACROSS BORDERS TO ADAPT TO CHANGE IN CASCADIA. Jen

Watkins, Conservation Northwest and Cascadia Partner Forum, 1829 10th Ave W, Suite B, Seattle, WA 98119; jwatkins@conservationnw.org

Formed by practitioners in the summer of 2012, the Cascadia Partner Forum fosters a network of natural resource practitioners working with the Great Northern and North Pacific Landscape Conservation Cooperatives to build the adaptive capacity of the landscape and species living within it. Cascadia is a term that has been used to define different geographies that include the Cascade mountain range and surrounding communities. The Cascadia Partner Forum defines Cascadia as a transboundary region shared between Washington and British Columbia, from Mount Rainier in the south to Mount Truax up north, and from Puget Sound in the west to the Okanogan Highlands out east. Climate change will have profound impacts on both the human and natural communities of Cascadia, from declining snowpack and increasing wildfire to shifting habitat availability for native species. The scale and pace of these changes will require a historic effort by public and private partners to identify and implement actions that will help human and natural communities adapt. While it is imperative to keep working towards reduce our contribution of greenhouse gasses into the atmosphere through climate mitigation, we must also increase the resiliency of our natural and human communities to respond to change and disturbance. The identification of a shared set of priority issues, a vision for a resilient Cascadia, and a regional climate adaptation strategy that builds off the wealth of existing plans and science for directing independent and collaborative efforts will be critical to ensuring a sustainable and biodiverse Cascadia into the future.

ORAL

INTEGRATING CLIMATE CONSIDERATIONS IN DEVELOPING A SUSTAINABLE ROAD SYSTEM ON THE MOUNT BAKER SNOQUALMIE NATIONAL FOREST. Jen Watkins,

Conservation Northwest and Cascadia Partner Forum, 1829 10th Ave W, Suite B, Seattle, WA 98119; Rhonda Strauch, NW Climate Science Center, Box 355674 Seattle, WA 98195; George Wooten, 226 W 2nd Ave, Twisp, WA 98856; jwatkins@conservationnw.org

Roads of all kinds from highways to gravel single lane routes provide valuable access to the landscape of Cascadia. Access to our public lands is necessary for land and species management, recreation, and enjoyment. Roads also can pose natural resource risks to the landscape as well from reducing watershed health and security habitats for wildlife to providing vectors that facilitate the spread of invasive plants. Identifying a balanced sustainable road system that provides needed access to our landscape while ensuring healthy watersheds and habitats today and into a changing future is an important adaptation strategy. In identifying a system is sustainable over time, vulnerabilities to the road system from projected climate change impacts must be considered. In support of the development of a Sustainable Roads Strategy on the Mount Baker Snoqualmie National Forest, we conducted two analyses to identify the watersheds on the national forest with roads projected to experience the greatest risks to the existing road system and the road segments projected to be most vulnerable. Our analyses found that more than 300 miles of roads are located in watersheds projected to experience a 50% increase in 100-year floods by 2040s. Increases in precipitation falling as rain, reduced snowpack, and more intense winter storms drive projections for higher soil moisture and increasing landslide hazard during winter and in spring at higher elevations. And by 2040, reduced snowpack is projected to allow access to some areas more than three weeks earlier than historically.

VARIABLES ASSOCIATED WITH POST-FIRE ATTACK BY RED TURPENTINE AND WESTERN PINE BEETLE ON PONDEROSA PINE IN THE PACIFIC NORTHWEST. Douglas

J. Westlind and Rick G. Kelsey, USDA Forest Service, Pacific Northwest Research Station, Forestry Sciences Laboratory, 3200 SW Jefferson Way, Corvallis, Oregon 97331 USA; dwestlind@fs.fed.us

Wildfires and prescribed fires create stressed trees that survive their burn injuries, but have a greater likelihood of attack by bark beetles than uninjured trees. In this study, logistic regression was used to determine what fire-injury variable, or variable combination best predicts attack by red turpentine beetle (RTB; *Dendroctonus valens*) and western pine beetle (WPB; *Dendroctonus brevicomis*) within the first 3 post-fire years. Tree damage variables and beetle attacks were measured from a mix of wild and prescribed fires in the Pacific Northwest. Diameter breast high (DBH), bole scorch proportion (BSP), pre-fire live crown proportion (LCP), bole char severity (BCS), and crown scorch proportion (CSP) were all significant predictors of attack by both beetle species. Models using BSP or DBH were the best predictors, yet predictive ability was poor (concordance indexes all < 0.60; scale 0 to 1.0). Due to management concerns for perpetuating large pines, the analysis was repeated on a subset of trees ≥ 53.3 cm DBH. The BSP model worked best for these large trees, with fair predictive ability (concordance indexes of 0.69 and 0.72 for RTB and WPB, respectively). For all analyses, models with variable combinations failed to improve predictive ability over models using BSP alone. Predicting RTB or WPB beetle attacks on fire-injured ponderosa pine is difficult, but here a model using BSP gave the best results, especially applied to large trees. This is consistent with our related studies demonstrating that RTB are attracted to ethanol produced in heat stressed bole tissues when released to the atmosphere combined with host tissue monoterpenes.

AN INTERDISCIPLINARY APPROACH TO UNDERSTANDING EVOLUTIONARY

PHYSIOLOGY IN CTENOPHORA. Telissa M. Wilson, Tiffany S. Bachtel, Erik V. Thuesen, The Evergreen State College, 2700 Evergreen Parkway NW, Olympia, WA 98505; Jacob Winnikoff, Steve D.V. Haddock, M.B.A.R.I., 7700 Sandholdt Road, Moss Landing, CA 95039; wiltel16@evergreen.edu

Ctenophores, or “comb jellies”, are a phylum of gelatinous marine predators that inhabit all oceans from sea level to ~7 km deep, where ambient pressure reaches up to 700 atm. Hydrostatic pressure has a strong influence on animal physiology, and most proteins do not function optimally over a pressure range of hundreds of atm. Recent 18S phylogenies suggest that ctenophores have adapted to and from life in the deep sea multiple times. The physical changes to protein structure that influence pressure adaptation are unknown in these organisms. In addition, many ctenophore species are difficult to study due to high costs associated with sampling and specimen fragility. Integrating molecular, genetic and physiological methods, we have begun to assess the functional diversity of ctenophore metabolism by cloning the glycolytic enzyme pyruvate kinase (PK) [EC 2.7.1.40] from several species living across a depth gradient. We then expressed these PK orthologs in *E. coli* and assayed their activities under pressure. These methods provide (1) the ability to produce unlimited amounts of protein from a single small individual and (2) the option of site-directed mutagenesis, which can be used to reveal sequence features that confer pressure resistance. The PK orthologs of species that inhabit similar vertical ranges can display unique pressure tolerance characteristics. Phylogenetically, our results indicate that adaptation to moderate depth (a few 100 m) is not necessarily convergent. We hope this novel in vitro study design utilizing physiological and molecular genetic methods will benefit other eco-physiologists who work with rare or hard-to-study organisms.

POSTER

HOME RANGE AND TERRITORY USE IN THE PACIFIC WREN (*TROGLODYTES PACIFICUS*). William Wiskes; Alison R. Styring, The Evergreen State College, 2700 Evergreen Parkway NW, Olympia, WA 98505; wiswil17@evergreen.edu

Understanding how species use space is an important component of effectively understanding life history strategy. These are simple, straightforward processes which allow for very thorough data collection. The primary objective of this study was to compare non-breeding home range size with breeding season territory size in a population of color-banded Pacific Wrens in a lowland temperate rainforest site in Olympia, Washington. Using the minimum convex polygon (MCP) method along with documented territorial behavioral, we estimated home ranges for a portion of the individuals on the site. Average home range size was ca. 0.6 ha (0.43 – 1.22). This compares with an average breeding territory size of ca. 1 ha (range = 0.26 – 1.9). During the winter when individuals are not defending territories, home ranges of individuals overlapped, which differs dramatically from breeding season territories where boundaries are intensively maintained.

POSTER

VARIATION IN FOLIAR FUNGAL ENDOPHYTE COMMUNITIES OF *ALNUS RUBRA* ACROSS A METROPOLITAN AREA. Emily R. Wolfe, Daniel J. Ballhorn, Department of Biology, Portland State University, P.O. Box 751, Portland, OR 97207; emwolfe@pdx.edu

In the Pacific Northwest, *Alnus rubra* (red alder) is a common deciduous tree species especially prevalent in riparian corridors and disturbed sites, including metropolitan areas undergoing land use changes and development. Importantly, red alder is also considered a bioindicator for ozone pollution, and, like all plants, harbors a diverse endophyte community that may interact with aerial pollutants. In this study, we surveyed foliar fungal endophyte communities in red alder leaves from the metropolitan area of Portland, Oregon, USA using culture-based techniques, and found that communities differed significantly by site (PERMANOVA, $F_{3,56}=2.86$, $p=0.001$). Our results suggest proximity to different point sources of air pollution—most likely in conjunction with other site characteristics—was sufficient to influence fungal endophyte community composition in red alder leaves. Future studies should examine species interactions in urban or more impacted environments to better understand endophyte community ecology, and if there are consequences for afterlife ecosystem processes such as leaf litter decomposition.

ORAL

THE NON-RANDOM DISTRIBUTION OF EPIPHYTES IN TEMPERATE RAINFOREST TREES. Carrie L. Woods, L; McKinley Nevins; Emma Didier, Biology Department, University of Puget Sound, 1500 N. Warner St., Tacoma, WA 98416-1088; cwoods@pugetsound.edu

In temperate rainforests on the Olympic peninsula in Washington State, large broad-leaved trees such as bigleaf maple (*Acer macrophyllum*) support many epiphytes including mosses and lichens, whose biomass can be four times that of their host trees. Yet, little is known about what factors directly influence the distribution of epiphytes within trees. We surveyed epiphytes in different trunk and branch zones in six *A. macrophyllum* trees in the Hoh river watershed. We measured temperature and relative humidity using dataloggers and canopy cover using densimeters in each zone of each tree. We also measured branch or trunk diameter, canopy humus depth, and height for each zone in each tree where we conducted our surveys. We tested the hypothesis that variations in substrate characteristics and resources in the maple trees would influence the distribution of epiphytes. We found non-random distribution patterns among the tree zones, such that particular species dominated particular zones. For example, *Rhytidiadelphus loreus* dominated the inner crown branch zones while *Metaneckera menziesii* was most abundant on the trunk zones. We found little variation in temperature, relative humidity, and canopy cover among tree zones, but significant variations in canopy humus depth. We hypothesize that finer scale surveys of habitat heterogeneity within these trees would elicit a better understanding of the factors that influence epiphyte distributions.

POSTER

THE EFFECTS OF REINDEER LICHEN (*CLADONIA* SPP.) AQUEOUS EXTRACTS ON PRAIRIE PLANT SEED GERMINATION AND SEEDLING GROWTH. Michael Zirpoli, Heidi Steinbach, Lalita Calabria. The Evergreen State College, 2700 Evergreen Parkway NW, Olympia WA 98502; zirmic27@evergreen.edu

Successful germination and growth of native prairie plants is of critical importance to restoration of endangered South Puget Sound prairies. Few studies have focused on allelopathic effects of lichens in prairie ecosystems. State-listed and regionally-rare, reindeer lichens (*Cladonia* spp.) form extensive mats at certain prairie sites, reaching up to 68% cover in infrequently burned areas. In this study, we conducted a series of seed bioassays examining effects of aqueous extracts of *Cladonia ciliata* var. *tenuis* and *Cladonia portentosa* sub. *pacifica* on native and non-native plants, including *Achillea millefolium*, *Collinsia parviflora*, *Festuca roemerii*, *Hypochaeris radicata* and *Plantago lanceolata*. All plants are associates of *Euphydryas editha taylori* (federally-endangered) or host *Castilleja levisecta* (federally-threatened). We collected lichens at Mima Mounds Natural Area Preserve and prepared 24hr soak and pour-over filtrate aqueous extracts. Seeds (n=10) were grown in petri dishes treated with 2ml lichen extract (n=12) or DI control (n=12) and placed in growth chamber at a 12-12hr; 11°C/19°C cycle. *F. roemerii* seeds treated with lichen extracts exhibited higher total average length and percent germination compared to DI control (p=0.02), with *C. portentosa* 24hr treatment having the greatest effect (p<0.01). *H. radicata* seeds treated with lichen extracts exhibited higher total length with varied germination compared to DI control (p<0.001); effects most pronounced in *C. ciliata* pour-over filtrate (p<0.001). Bioassays on other plant species did not exhibit statistically significant positive or negative effects. Results show species-specific positive allelopathy between lichens and prairie plants, highlighting an understudied ecological role reindeer lichens play in prairie ecosystems.

ORAL

RED TREE VOLE RESPONSE TO ARTIFICIAL NESTS: TESTING THE LACK-OF-STRUCTURE HYPOTHESIS. Damon B. Lesmeister, Mark A. Linnell, and **James K. Swingle**, USDA Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR, 97331; John D. Bailey, Oregon State University, College of Forestry, 317 Snell Hall, Corvallis, OR; jswingle@fs.fed.us

Red tree voles are small arboreal rodents of conservation and management concern that are endemic to coniferous forests of western Oregon and northwestern California. Tree voles primarily occur in old forests (>80 years) and build their nests on sturdy foundations. It is unknown if the relative lack of complex branch and bole structure (broken tops, forked trunks, densely-space limb whorls) that provide nest foundations limit tree vole occupancy in young forests (20–80 years). In 2015, we installed 429 artificial nests at 17 young forest sites that were adjacent to old forest. Of the 414 artificial nests examined in 2016 (15 were occupied by wasps or hornets), 30% were used by tree voles. Overall, 12% of artificial nests were occupied when they were examined, mostly by adult females (85%) that were raising young (61%). We modeled 1) tree vole use by comparing the number of natural nests within 5.6 m plots located in 2015 to artificial nest use in 2016, 2) distance from old forest, 3) vole nests in adjacent artificial nests <75 m, 4) other arboreal rodent use of artificial nests <75 m, and 5) plot-level mean tree height. Results indicated that tree vole use of artificial nests were positively influenced by proximity to natural nests located at time of installation and to artificial nest use nearby (<75 m) but there was no distance to old forest effect. Our results provide support for the lack-of-structure hypothesis as a primary driver for limited occupancy of young forests by tree voles.

ORAL

HOW AND WHY TO CALCULATE RESILIENCE: RESPONSES TO BURIAL BY UNDERSTORY PLANTS. **Donald B. Zobel**, Department of Botany and Plant Pathology, Oregon State University, Corvallis OR 97330; Joseph A. Antos, Department of Biology, University of Victoria, Victoria BC V8W 3N5 Canada; zobeld@science.oregonstate.edu

Resilience is often mentioned by ecologists but seldom quantified. Determining the magnitude of resilience improves our understanding of succession following disturbance. We calculated resilience and related indices that describe changes in understory plant communities in old-growth conifer forests during 30 years following burial by tephra (aerially-transported volcanic ejecta) from the 1980 eruption of Mount St. Helens. We defined inertia as the ratio of post-disturbance plant importance (e.g., cover) to pre-disturbance importance and resilience as the ratio of the subsequent successional increase in importance to the decrease in importance caused by the disturbance. Inertia and resilience were lower for plants that (1) were small versus large, (2) received deep versus shallow tephra, and (3) grew where tephra fell on snow versus in snow-free areas. Resilience was higher for shoot density than for cover and varied significantly among environments more often for diversity than for density or cover. Resilience increased with time for most measures of importance and most plant types, but leveled off after 20 years in some cases. Relative values of inertia and maximal resilience observed during the 30 year study differed among growth forms and species; herbaceous species differed substantially whereas major shrubs did not. Herbs were adversely affected most by tephra depth; shrubs, more by presence of snow. In 2010, cover remained significantly correlated with inertia. Using indices of resilience and related concepts allowed us to draw a more complete picture of this succession than would have been possible otherwise.