

Looking back to plan forward: The relevance of history for today's environmental challenges



Valley of the Middle Fork of the Willamette River, from Mt. Pisgah, Photo by Daniel Gavin

91st Annual Meeting of the Northwest Scientific Association
March 2020
University of Oregon, Eugene, Oregon

Program and Abstracts Northwest Scientific Association 91st Annual Meeting

University of Oregon, Eugene
March 2020

(meeting cancelled due to coronavirus pandemic)

Cooperators

University of Oregon, Geography Department
University of Oregon, Erb Memorial Union
University of Oregon, Museum of Natural and Cultural History
Northwest Lichenologists



Thank You to all who helped!

The meeting planning would not have been possible without the generous support of our partners, planners and volunteers

NWSA Local Planning Committee

Dan Gavin, Local Program Chair, University of Oregon

Robin Leshner, US Forest Service (retired)

Jon Riedel, Geologist

Jeff Kane, Humboldt State University

Daphne Stone, Northwest Lichenologists

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Alejandro Brambila

Connie Harrington

Lucas Silva

Daphne Stone

Monique Wynecoop

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Chantel Saban

Elle Rise

NWSA Webmaster – Emily Wolfe

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David Conover, Vice President for Research and Innovation

Ruth Hyde, Membership and Visitor Services Manager,

Museum of Natural and Cultural History



I would like to thank those who contributed to making the 91st Annual Meeting a potential success. All continued to aid with planning the meeting from late fall as well as through late February when the likelihood of cancelling the meeting was increasing daily due to concerns with the emerging COVID-19 outbreak. It became clear we needed to cancel the meeting at the same time, nearly to the day, with the finalization of the last details of the program, food catering, and poster session. Here we are able to present a complete conference book of the meeting that would have been.

The College of Arts and Sciences provided a grant of \$3000, which was matched by the Department of Geography. These grants would have lowered registration fees for students and provided travel expenses for the recruited speakers. The Museum of Natural and Cultural History generously opened its doors to the NWSA conference attendees and provided an ideal venue for the banquet dinner. I thank Ruth Hyde and the entire museum staff for their assistance with the meeting.

Amanda Eriksen from UO Conference Services was a critical player in planning the meeting. Her proactive coordination was more efficient and comprehensive than I could have hoped for. The renovated Erb Memorial Union at the University of Oregon remains an excellent venue for NWSA meetings. I remain hopeful NWSA can return to Eugene for a future annual meeting.

–Dan Gavin, Department of Geography, University of Oregon

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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 2019-2020 Board of Directors

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LETTER FROM THE PRESIDENT OF THE ASSOCIATION

I'm pleased to present the Abstracts from the 91st Annual Meeting of the Northwest Scientific Association. The meeting was scheduled to be held for the first time at the University of Oregon in Eugene. Unfortunately, due to public health concerns related to COVID-19, the in-person meeting was cancelled. We regret having to do so as the opportunities for scientific exchange and interactions were lost. It is also unfortunate that the substantial efforts of the planning committee, especially the program chair, Dan Gavin, did not result in an in-person meeting. We hope to plan a future meeting in Eugene.

This document includes the planned program and sessions, and abstracts submitted for oral and poster presentations. Abstracts appear in alphabetical order of the last name of the first author, with notation for oral or poster presentation. It has been suggested that we should take advantage of some of the planning efforts associated with the cancelled meeting and host future webinars or other events based on previously planned sessions. If we decide to do so, we will post an announcement on our website (www.northwestscience.org) as well as communicate via email to members and those who had registered for the meeting or submitted abstracts.

Spring is a busy time for the NWSA Board of Directors and we have continued to function using email and teleconferences. Individual committees developed recommendations that were presented to the board for discussion and action at the March 24, 2020 meeting. The Board approved funding of several graduate student proposals that are posted on the website. The Board also approved a proposal to post "Accepted Articles" for upcoming issues of Northwest Science on our website upon request of authors; the entire manuscript will be visible for members only, whereas the title and abstract will be posted on the public portion of the website. We also approved a slate of candidates for new board members. Our By-Laws require new board members to be approved by the NWSA membership, and this is traditionally done during the annual business meeting held during the business lunch at our annual meeting. This year, all members will have a chance to vote on-line for new board members.

We also often thank people who have contributed to our organization during the last year during our annual meeting. I would like to acknowledge the substantial contributions of my fellow officers Gregg Riegel, Past President; Robin Leshner, Treasurer; and Jocelyn Aycrigg, Secretary as well as other NWSA board members. Thanks to retiring board members Chris Lauver and McLain Johnson for their service. Special thanks to Emily Wolfe, NWSA Webmaster, for her efforts on updating not only our website but also other online features, and upgrades to the website continues.

Publication of our journal *Northwest Science* is a key function of our society. Thanks to Dylan Fischer, our outgoing editor, for his contributions to our journal; running a journal takes much more time and patience than may be apparent from the outside. I would also like to welcome our new Chief Editor, Jessica Halofsky. She has been handling new submissions and looks forward to receiving additional submissions on a wide range of natural resource topics. She is interested in broadening the breath of topics the journal covers. Please contact her if you have questions. I also thank our current Editorial Board and Associate Editors for their contributions.

We plan to hold our next annual meeting March 16-19, 2021 at Humboldt State University in Arcata, CA. Please contact Jeff Kane, 2021 program chair, if you have ideas about potential special sessions, workshops, or field trips. jkane@humboldt.edu

If you are not a member of NWSA, I strongly encourage you to join. We welcome anyone interested in natural sciences in the northwestern United States and western Canada. Membership fees are low, and member benefits include journal subscription, reduced costs for student registration for the annual meeting, and access to BioOne, which allows members to access current and past issues of Northwest Science.

Sincerely,

Connie Harrington, President, Northwest Scientific Association

NWSA 91st Annual Meeting—Program Overview
University of Oregon, Eugene

*“Looking back to plan forward:
The relevance of history for today's environmental challenges”*

Keynote Address and Plenary Session

Special Sessions

Climate Change and Seed Sourcing
Managing for First Foods: Returning Human-adapted Ecosystems to the
Northwest

Technical Sessions

Climatic Variability, Ecohydrology, and Fire Ecology
Geology, Natural Hazards, and Paleoenvironments
Lichenology and Bryology
Wildlife and Restoration

Poster Session

Workshops

Lichenology and Bryology Workshop
Introduction to Manipulating and Visualizing Data in R
Introduction to QGIS

Banquet Presentation

Archaeology and Science at the Paisley Caves— by Dr. Dennis Jenkins
hosted by University of Oregon Museum of Natural and Cultural History

Field trips

Dorena Genetic Research Center and BLM's Tyrrell Orchard
The Changing Willamette Valley: From the Glacial Maximum to 2020
Northwest Lichenologists – Eagle's Rest, Bureau of Land Management

Keynote Address and Plenary Session

Keynote Address by Dr. Patrick Bartlein

Professor, Department of Geography, University of Oregon

*“The Real Controls of the Temporal and Spatial Variations of Climate
in the Pacific Northwest”*

Plenary Speakers:

Megan Walsh – Combining paleoecology and archaeology: what interdisciplinary research can tell us about Holocene human-landscape interactions in the Pacific Northwest

Madonna Moss – Tlingit Relationships with Sea Otters: What can we learn from zooarchaeology to acknowledge cultural heritage and inform wildlife management?

Lucas Silva – Expanding the spatiotemporal domains of modern ecology

Lauren Hallett – Looking back to move forward: the role of history in ecological restoration

Biographies of Keynote and Plenary Speakers



Pat Bartlein (Bart) is Professor of Geography at the University of Oregon. His research integrates a variety of types of paleoenvironmental data to build and validate environmental models from local to global scales. He contributed to the 1988 interdisciplinary COHMAP (Cooperative Holocene Mapping Project) and similar later programs that synthesize paleoenvironmental data. For example, the ongoing Paleoclimate Model Intercomparison Project uses paleoenvironmental data to evaluate current climate models

and therefore constrain future climate projections. Other recent work addresses the use of Earth System Models to evaluate several components of the climate system such as vegetation cover and the role of biomass burning over millennial time scales.

Patrick Bartlein’s research website: <https://pjbartlein.github.io>



Megan Walsh is an Associate Professor of Geography at Central Washington University. She is a biogeographer and paleoecologist interested in the late Quaternary environments of western North America and Central America, specifically the role of fire on the landscape. She uses high-resolution macroscopic charcoal and pollen analysis to reconstruct past changes in fire activity and vegetation and evaluate their relationship with

climatic variability and human activity. Megan's fieldwork has been in Oregon, Washington, Utah, Colorado, Montana, Idaho, and most recently Belize.

Megan Walsh's research website: <https://meganwalshpaleoecology.weebly.com>



Madonna L. Moss is Professor of anthropological archaeology at the University of Oregon. She has led and/or participated in multiple projects, including the Coffman Cove Community Archaeology Project. She is currently working with the Sitka Tribe on *The Archaeology of Herring: Reconstructing the Past to Redeem the Future* and with Sealaska Heritage Institute on "Did Tlingit

and Haida eat sea otters during the pre-contact period?" She has taught university courses for 30 years and has mentored dozens of graduate students. Books include *Northwest Coast: Archaeology as Deep History*, and *The Archaeology of North Pacific Fisheries*. Her current research is focused on how use of animal resources is foundational to the cultural identity and heritage of Indigenous groups, and how zooarchaeology can contribute knowledge to improve fish and wildlife management and simultaneously support Alaska Natives in their contemporary subsistence practices. Moss also serves as Curator of Zooarchaeology for the University of Oregon Museum of Natural and Cultural History.

Madonna Moss's research website: <https://blogs.uoregon.edu/mmoss/>



Lucas Silva is an assistant professor of Environmental Studies and Geography at the University of Oregon. His research bridges multiple disciplines to answer basic questions and improve applied knowledge of soil- plant-atmosphere interactions that govern ecosystems response to, and influence on, the environment. Research in his group focuses on carbon-water relations from organisms to landscapes, fusing theory, experimentation, and modeling techniques to inform natural climate solutions through land management, conservation, and restoration.

Lucas Silva's research website: <https://soilplantatmosphere.com>



Lauren Hallett is an assistant professor of Environmental Studies and Biology at the University of Oregon. She is a community ecologist aimed at producing “usable” science to improve ecosystem management and restoration. Using a combination of long-term data analysis, population modeling, and field experiments to this end. Her work spans a variety of systems, including working rangelands, serpentine grasslands, oak woodlands, alpine, and rivers.

Lauren Hallett's research website: <https://hallettlab.netlify.com>

Banquet Presentation

“Archaeology and Science at the Paisley Caves”

Dennis L. Jenkins, Ph.D, RPA
Director, Northern Great Basin Prehistory Project
Museum of Natural and Cultural History University of Oregon, Eugene



Dennis Jenkins is a Senior Research Associate at the Museum of Natural and Cultural History at the University of Oregon. He specializes in prehistoric archaeology of the Great Basin. He has taught and directed the UO’s Northern Great Basin archaeological field school since 1989. His research focuses on the first colonization of the Americas, obsidian sourcing and hydration, prehistoric shell bead trade, and settlement-subsistence patterns of the Northern Great Basin. He has conducted more than 100 site investigations throughout his career, publishing 7 books, 33 chapters, articles and reviews, >30 reports and contributions to reports, and given >50 papers at professional meetings. He directs Paisley Caves Archaeological Research Project in central Oregon where the UO field school recovered the oldest human remains

(14,000 year old DNA in coprolites) in North America. He has co-authored 3 articles in Science and his work has been profiled in more than 50 newspaper and magazine articles. He has appeared in 8 television documentaries, filming for History Channel, National Geographic, Oregon Public Broadcasting, and Canadian Broad Casting.

<https://mnch.uoregon.edu>

Special session: Climate Change and Seed Sourcing

Native grassland restoration has been about restoring degraded or remnant plant communities. Climate change poses a new challenge to restoration. Historical plant communities that are used as reference communities may not be viable in the future. Therefore, restoration practitioners are facing the question of how to select for plant materials that would persist now and in the future. Where do we source our seeds? Will the seeds adapt to projected climate? Is the native seed market viable? We welcome presentations about seed sourcing in any ecosystem context, but have a particular emphasis on grassland restoration efforts in the Willamette Valley and the Great Basin.

Session organizers: Lina Aoyama and Alejandro Brambila

Lynda Boyer – Native seed collection in the face of climate change

Thomas Kaye – Diversity is magic and partnerships work: emerging issues in selecting appropriate native plants for ecosystem restoration in the face of climate change

Nancy Shackelford – Species selection in seed-base restoration

Brad St. Clair – Web-based tools for determining seed sources for reforestation and restoration for current and future Climates

Vicky Erickson – Seed sourcing and deployment for a changing climate: highlights from USFS, PNW Region

Special session: Managing for First Foods: Returning Human-adapted Ecosystems to the Northwest

First foods, such as roots, berries, fish, big game, and water, refer to the traditionally gathered array of foods collected by tribal peoples in their seasonal round. In many places, natural resource managers and tribal communities are working together to restore first foods, motivated by the principle of human-nature reciprocity. This session will focus on the variety of applied science tools, methods, and technologies that restore the ecological processes of first foods. In addition, advancements that promote climate vulnerability adaptation are of interest. Tools could include traditional fire use, planting, thinning, and harvesting techniques.

Session organizers: Constance Harrington and Monique Wyncoop

Tony Farque – Preserving tradition: supporting traditional gathering practices on the Willamette National Forest

Keala Hagmann – Impact of substantially altered ecosystems in central and southcentral Oregon on availability of native foods

Constance Harrington – How will future climate alter the range and phenology of three culturally-important shrub species?

T. Abe Lloyd – Growing Roots: cultivating *Kwakwaka'wakw* estuarine root gardens on the central BC Coast

Todd Mitchell – Using traditional ecological knowledge to protect wetlands: the Swinomish Tribe's wetlands cultural assessment project

Sylvia Tatshama Peasley – The traditional cultural plants project moving forward 2020

Michelle Steen-Adams –The role of ethnohistory, traditional knowledge, and cultural fire regimes in first foods management: Applications to *Vaccinium membranaceum* in the eastside Cascades

Brandon Larrabee –Eating first foods again, for the first time

Technical session: Climatic Variability, Ecohydrology, and Fire Ecology

Michael Farinacci – Impacts of management on forest response to climate variability

Carlos Gonzalez – Hydraulic conductivity and vulnerability to cavitation of three Douglas-fir seed sources

Hilary Rose Dawson – Morphological and functional leaf trait responses to experimental drought in PNW grasslands

Maxwell Wrightman – Interactive effects of site conditions and competition dynamics on conifer seedling performance

Toby Maxwell – Species interactions and biogeochemical cycling drive shifting patterns in subalpine forest productivity across Oregon

James Johnston – A westside story: new cross-dated fire histories from the western Oregon Cascades

Jeffrey Kane – Season changes in dead fuel moisture following Douglas-fir removal in a northwestern California oak woodland

Technical session: Geology, Natural Hazards, and Paleoenvironments

Richard Waitt – Stratigraphy proves tens of last glacial Missoula floods through high tracts of channeled scabland

Daniel Gavin – Deglacial landforms and Holocene vegetation trajectories in the northern interior cedar-hemlock forests of British Columbia

Jon Riedel – Spatial pattern and frequency of debris flows in Stehekin, Washington

Elizabeth Davis – Tidal-marsh deposits inset into a lahar-runout delta above the Seattle Fault, Washington

Alex Dye – Do inequalities in road-based egress opportunities impact wildfire vulnerability for rural Pacific Northwest towns?

Gregory Retallack – Freshwater boron content of *Dickinsonia* and other problematic Ediacaran fossils

Chantel Saban – Paleoecological analysis using select coprolites and sediments recovered from Paisley Caves 2, Oregon

Technical session: Lichenology and Bryology

Meaghan Petix – Assessing Nitrogen Critical Loads at North Cascades National Park Service Complex

Adrienne Kovasi – Exploring new lichen biomonitoring tools: Comparing nitrogen concentrations in saxicolous lichens to those of *Letharia vulpina*

Jesse Manuel Graves – Isolation and Structural Elucidation of Red Pigments in Lipstick Lichen (*Umbilicaria phaea* var. *coccinea*)

John Villella – Using lichen communities as indicators of forest age and conservation value

Daphne Stone – The ranges of *Xanthomendoza hasseana* and *X. montana* appear quite separate

Roger Rosentreter – Grazing disturbance promotes exotic annual grasses by degrading soil biocrust communities

Miles Rozatti – Inter- and Intraspecific Variation in Water Holding Capacity and Specific Thallus Mass in Epiphytic Lichens on *Quercus garryana* in the Cascade-Siskiyou National Monument

Bruce McCune – Hydrologic buffering by natural rooftop mosses in Oregon

Technical session: Wildlife and Restoration

Calvin Penkauskas – Hogs and Hazelnuts: Creating a win-win for oak conservation and organic agriculture

Devin de Zwaan – Sex-specific migratory stopover behaviour has important implications for an alpine breeding songbird in the Pacific Northwest

Michael Lee – Effects of Culling on *Leptospira interrogans* Carriage by Rats

Daniel Donato – Spotted owl habitat in the fire-prone East Cascades of Washington: Evaluating past, present, and future sustainability

Michelle Krall – Effects of Livestock Exclusion on Stream Banks and Riparian Vegetation in Washington and Oregon

Emilia Omerberg – Assessment of mercury contamination in Washington lakes

Workshops

Introduction to Manipulating and Visualizing Data in R

Presented by Matthew Brousil and Michael Meyer

The R language and environment are open-source tools, which are widely-used for research in ecology, natural resources, and other scientific fields. This workshop will introduce several packages for manipulating data, including **tidyr** and **dplyr**. Attendees will then learn how to visualize data using the graphics package, **ggplot2**. The workshop is targeted at participants with novice level experience (i.e., can import data, knowledge of basic commands). Participants are expected to bring a laptop computer to the workshop with an up-to-date version of R installed. Installation of RStudio is also highly encouraged but not required.

Introduction to QGIS

Presented by Dean Walton

University of Oregon Lorry Lokey Science & Technology Outreach Librarian

QGIS is an open-source free-to-use GIS program that competes with ArcGIS Pro and other ESRI products, and unlike ArcGIS it does not need a semi-continuous Internet connection. Come try out this software. Learn to georeference an aerial photograph on top of a satellite image, and learn the basics of drawing and attributing points, lines and polygons. QGIS is the perfect tool for long trips in the field with limited cell/internet service. In this workshop you will be viewing and editing spatial data on a computer in front you. The workshop will be held in the Price Science Commons Vizlab, and at 50 million pixels, this lab supports the highest resolution video screen in the State of Oregon

Lichen and Bryophyte Flora of Oak Woodlands — Identification Lab

Presented by Northwest Lichenologists

Poster Session

(presenting author shown– see Abstract section for complete abstract)

Plant Ecology	Ben Vierra	NEON Program canopy foliage sampling test effort using emerging unmanned aerial system technology
Managing for First Foods	Dean Dan Jr	Swinomish Generations Camas Project: a food sovereignty initiative to revitalize and reintroduce an important traditional food
Managing for First Foods	Brandon Larrabee	Reintroductions to First Foods
Managing for First Foods	Leslie Brodie	Climate impacts on culturally-important food-producing shrubs
Climatic variability and ecohydrology	Michael Town	Atmospheric and near-surface soil temperatures from the southern aspect of Mt. Baker for July 2018 - July 2019
Climatic variability and ecohydrology	Reed Cowden	Water use and competitiveness of <i>Senecio sylvaticus</i> in young <i>Pseudotsuga menziesii</i> plantations in western Oregon
Climatic variability and ecohydrology	Yianna Bekris	Budburst timing of four Pacific Northwest native shrubs in relation to air temperature
Climatic variability and ecohydrology	Schlyer Reis	Using tree rings to understand climatic drivers of juniper growth across the Great Basin
Ecology	Michael F. Meyer	Detecting and predicting pharmaceutical and personal care product (PPCP) accumulation in preserved bees in the Pacific Northwest
Ecology	Emily Wolfe	Culturable fungal endophyte communities of primary successional plants on Mount St. Helens, WA, USA
Fire Ecology	Oriana Chafe	Fires, shrubs, and the changing Arctic: What does the future look like for tundra ecosystems?
Plant Ecology	Madeleine Lopez	An assessment of conifer seed development, relative to timing of wildfire, for characterization of a regenerative mechanism
Plant Ecology	Paul Reed	Assisted migration may be necessary to save native prairie species from climate change
Plant Ecology	Erika Whitney	Can arbuscular mycorrhizal fungi protect <i>Rubus idaeus</i> from the effects of soil-borne disease or parasitic nematodes?
Plant Ecology	Heidi Zarghami	An assessment of the ecosystem benefits of street trees in Olympia, Washington

Restoration Ecology	Brad Trumbo	Site preparation and subsurface watering techniques enhance dry land restoration success
Restoration Ecology	Nicholas Kager	Engineered intervention vs natural processes in a modified hydrologic landscape
Wildlife Biology and Management	Christina Donovan	Oral transmission of <i>Leptospira interrogans</i> in urban brown rats (<i>Rattus norvegicus</i>): do rats shed leptospire in their saliva?
Wildlife Biology and Management	Cecily Bronson	Gastrointestinal parasites of stranded pinnipeds from northern Oregon and southern Washington
Invertebrate biology	Malorri Hughes	First molecular characterization and phylogenetic report for two parasitic nematodes: <i>Trichuris fossor</i> and <i>Ransomus rodentorum</i>
Invertebrate biology	Doug Nemeth	Freshwater mussel investigations in Idaho
Invertebrate biology	Ian Walker	Genetic relationships among Rocky Mountain ridged mussel (<i>Gonidea angulata</i>) populations
Invertebrate biology	Jeff Ansell	Integrative taxonomy of the terrestrial land snail, <i>Vespericola columbiana</i> (Polygyridae)
Invertebrate biology	Fin DeGeare	Greater than the sum of its parts: an exercise in integrative taxonomic characterization of the land snail <i>Ancotrema</i> (Haplotrematidae) in the Pacific Northwest
Lichenology and Bryology	Alida Melse	Lichens and mosses as biological indicators of nitrogen deposition in North Cascades National Park Service Complex
Geology and Geomorphology	Eric Brown	Testing potential triggering mechanisms of large Holocene rock avalanches, Whatcom County, Washington, USA
Geology and Geomorphology	Kelsay Stanton	Tectonic implications and deformation recorded by Pleistocene marine terraces above the Cascadia subduction zone, Willapa Bay, Washington
Paleoecology & Archaeology	Emmett Baber	Connely Caves augmented reality - Archie visualization for the masses
Paleoecology & Archaeology	Erin Herring	Tephra-mediated vegetation change observed in a 13,600-year record from the Northern Rocky Mountains, Idaho
Paleoecology & Archaeology	George Last	Case report of an abnormal mammoth rib from the Frenchman Hills – Tonnemaker Mammoth Site, Grant County, Washington
Paleoecology & Archaeology	Monika Ruwaimana	Tropical Peatlands in West Kalimantan: formation, carbon and Late Pleistocene-Holocene history

Field Trips

Dorena Genetic Research Center and BLM's Tyrrell Orchard –

Leader: Richard Sniezko.

Dorena Genetic Resource Center (DGRC) is a regional facility that promotes forest health through specializing in the development of populations of trees with disease resistance (primarily to non-native diseases), studies in forest genetic and tree breeding activities. It may be the largest facility of its kind in the U.S. and perhaps the world.

The Changing Willamette Valley: From the Glacial Maximum to 2020 –

Leaders: Daniel Gavin, University of Oregon and Megan Walsh, Central Washington University

Oak woodlands dominated the Willamette Valley for much of the Holocene, but are currently a very endangered habitat. Current restoration efforts to increase oak woodland are exemplified by the efforts of The Nature Conservancy and Lane County Parks. We will visit two natural areas and a research site on this tour from Eugene into the eastern edge of the Coast Range. Attendees will receive printed guides to aid discussion at each site.

Lichenologist Field Trip: Eagle's Rest –

Leaders: Northwest Lichenologists

The trip is a visit to a small piece of BLM land south of Dexter Lake in Lane County, OR. It will take us about 45 minutes, all on paved roads, to get there. The Eagle's Rest is a small rocky knob with exposed rock and mossy areas on the south exposure, beautiful second growth forest on the north side. The hike is a short steep (but switchbacked) hike up through Douglas-fir forest, then as we go higher there are large hemlocks and a bit of grand fir. At the top we emerge into the open with waist-high oaks and manzanita, rock outcrops and mossy terraces. Total hike time is about 30 minutes without stopping (about ½ mile). On our way there we will follow Lost Creek and see *Usnea longissima* and patches of *Alnus* and *Acer macrophyllum*. If we have time after Eagle's Rest we may stop along the road to check out these other habitats.

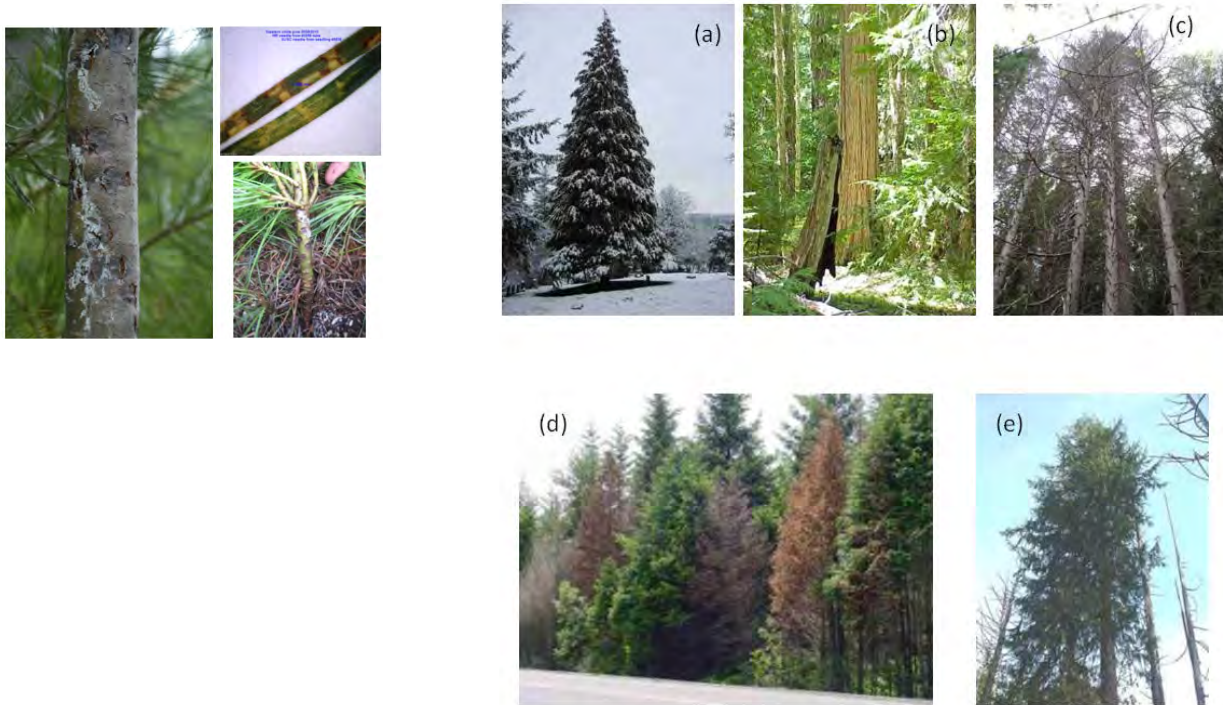
Dorena Genetic Resource Center FIELD TRIP

USDA Forest Service – Pacific Northwest Region (Region 6)

NW SCIENCE: March 27, 2020 fieldtrip

Dorena Genetic Resource Center (DGRC) is a regional facility that promotes forest health through specializing in the development of populations of trees with disease resistance (primarily to non-native diseases), studies in forest genetic and tree breeding activities. It may be the largest facility of its kind in the U.S. and perhaps the world. Although primarily serving Oregon & Washington, it has projects serving much of the West, including Canada, and also Hawaii. Current white pine blister rust resistance projects on-site involve all 8 species of white pines native to the western U.S. (including one NSF funded project) – and note, the aecial stage of the rust is often out in March; the program to develop populations of Port-Orford-cedar (POC) with *Phytophthora lateralis* resistance may be the fastest moving tree resistance program in the world – and currently there are 1000's of genotypes (from throughout the range of the species) on-site in innovative containerized seed orchards (and March is pollination time for POC). Several new technologies for expediting resistance work are also being tested. Recently started resistance and genetic variation projects include species such as tanoak, Oregon ash, and Pacific madrone. DGRC is also possibly the repository of the largest collection of conifer seedlots from individual trees anywhere; it coordinates the national tree climbing program; and it undertakes restoration projects with native plants.





Selected Publications

Sniezko, RA, Johnson, JS, Reeser, P, Kegley, A, Hansen EM, Sutton, W, Savin DP. 2020. **Genetic resistance to *Phytophthora lateralis* in Port-Orford-cedar (*Chamaecyparis lawsoniana*) – Basic building blocks for a resistance program.** *Plants, People, Planet.* 2: 69– 83. <https://doi.org/10.1002/ppp3.10081>

Sniezko, RA; Koch, J. 2017. **Breeding trees resistant to insects and diseases: putting theory into application.** *Biol Invasions* . doi:10.1007/s10530-017-1482-5

Sniezko, RA,, Kegley, A; Savin, DP.2017. **Ex situ genetic conservation potential of seeds of two high elevation white pines** . *New Forests* 48:245-261. doi:10.1007/s11056-017-9579-3

National Academies of Sciences E, and Medicine. 2019. *Forest Health and Biotechnology: Possibilities and Considerations.* Washington, DC: National Academies Press.

Whitebark Pine – resistance to white pine blister rust and use in restoration



Inoculation trial of whitebark pine



Restoration of whitebark pine (*Pinus albicaulis*) at Crater Lake National Park

The Changing Willamette Valley: From the Glacial Maximum to 2020

Field excursion at the Northwest Science Annual Meeting

9:00 AM to 2:00 PM, Friday March 27.

Leaders: Daniel Gavin, University of Oregon
Megan Walsh, Central Washington University

Oak woodlands dominated the Willamette Valley for much of the Holocene, but are currently a very endangered habitat. Current restoration efforts to increase oak woodland are exemplified by the efforts of The Nature Conservancy and Lane County Parks.

We will visit two natural areas and a research site on this tour from Eugene into the eastern edge of the Coast Range. Attendees will receive printed guides to aid discussion at each site.

Travel will be by car-pool arranged on the morning of the trip. Those registered for the trip will be contacted to arrange meeting time and place.

Handouts will be provided showing key science findings at these sites.

Stop 1: Nature Conservancy Willow Creek Site, Rathbone Road.

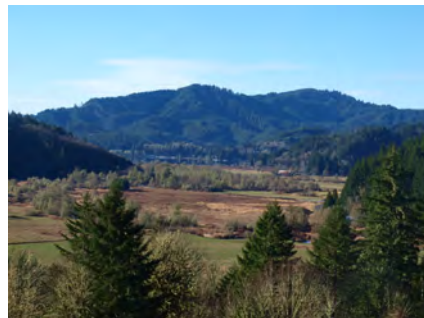
We will be met by Amanda Rau, Oregon/Washington Fire Manager for the Nature Conservancy

Stop 2: Coyote Creek Area, Oregon Department of Fish and Wildlife

Discussion of valley vegetation, disturbance regimes, and Holocene history

Stop 3: Triangle Lake and Little Lake

40,000-year old lake provides records of geomorphic history (erosion regime), fire history, vegetation history, and climate history with unique insights into ice-age environments in the Oregon Coast Range.



ABSTRACTS

NWSA ORAL AND POSTER PRESENTATIONS

*(Arranged alphabetically by last name of presenting author; presenting author indicated with * if not first author)*

POSTER

INTEGRATIVE TAXONOMY OF THE TERRESTRIAL LAND SNAIL, VESPERICOLA COLUMBIANA (POLYGYRIDAE). Jeff Ansell, Robert Leesemann, Francisco Solis Abarca, Aidan Gorman, Lalita M. Calabria, Clarissa Dirks, The Evergreen State College, 2700 Evergreen Parkway NW, Olympia, WA 98505; ansjef19@evergreen.edu

Land snails in the family Polygyridae have their greatest diversity along the west coast of North America. The genus *Vespericola* (I. Lea, 1839) occurs from Alaska to west central California and can be characterized by their fragile, brown shells often covered with periostracal hairs by a well-reflected lip margin often with apertural teeth. Unfortunately, species-level identification from shells alone is not possible and dissection and study of the anatomical features of the genitalia is required for positive identification of the species. The widely distributed species *Vespericola columbiana*, has numerous described subspecies of questionable taxonomic ranking, one of which is of conservation concern in Oregon (*V. columbiana* subsp. *depressa*). Prior studies on *Vespericola columbiana* have used a combination of genital tract and shell morphology or genitals and radula but to date no one has used a combination of genital tract, shell morphology, radula and genetics to describe the integrative taxonomy and evolution of *Vespericola columbiana*. To address the taxonomic distinctness of *Vespericola columbiana* and its proposed subspecies, our research team conducted a phylogenetic analysis of the mitochondrial CO1 gene from specimens collected from the Opal Creek Wilderness, Marion county Oregon, Sequest State Park, Cowlitz County WA and assembled published sequences from genbank. We performed dissections to obtain genital tracts and SEM images of radula and took measurements and photographs of shells for all specimens collected. We present the integrative taxonomy of the gastropod, discussing the morphological traits regarding the shell, genital tract, radula in relation to the CO1 phylogenetic tree.

POSTER

CONNELY CAVES AUGMENTED REALITY - ARCHIE VISUALIZATION FOR THE MASSES. Emmett Baber, Glimmer Technologies; Chris Calef, Glimmer Technologies; Makaela O'Rourke, Oregon State University; Dennis Jenkins, University of Oregon Museum of Natural and Cultural History; emmettbaber@gmail.com

This project is a visualization test of the artifacts in an archaeological site using augmented and virtual reality (AR). The WebXR standard has been recently released and is more accessible than previous AR/VR formats. This project is hosted on a web page, and does not require apps or special software to view. Most modern phones can pull it up and view it. This project is using data from Connely Caves, pulled from the open source ArchieDB application. Further work is planned to make artifact models, selection of artifacts, and more ways to view the site.

THE REAL CONTROLS OF THE TEMPORAL AND SPATIAL VARIATIONS OF CLIMATE IN THE PACIFIC NORTHWEST. Patrick J. Bartlein, Department of Geography, University of Oregon, Eugene, OR 97403; bartlein@uoregon.edu

The climate of the Pacific Northwest is generally thought to be governed by the interplay among a small set of atmospheric and oceanic “modes” (frequently reoccurring patterns), and the location of the region with respect to large-scale circulation features. It is well known for example, that precipitation comes from storms that develop in the Gulf of Alaska, and spatial variations are governed by the latitude of the jet stream; fires are more frequent in years with low precipitation, and relative humidity is a good predictor of flammability; year-to-year and decadal variations in climate are governed by independent variations in ENSO and the PDO; the last glacial maximum was markedly colder than present; and so on. However, most of those ideas are incomplete, or simply wrong.

Over the past decade, there have been major advances in gridded “reanalysis” data sets and climate-model simulations that now provide hundreds of climate variables which can be used to understand the mechanisms behind the temporal and spatial variations of climate. These data sets allow us to see that atmospheric moisture in the PNW comes from Indonesia, and its spatial patterns are governed by vertical motions in the atmosphere. Fires are only weakly related to precipitation, but are strongly related to temperature and vapor-pressure-deficit (of which relative humidity is a symptom, not a control). The PDO appears to simply be a filtered version of ENSO, and it possible to identify months, seasons and years at the last glacial maximum that have present-day analogues (and vice-versa).

BUDBURST TIMING OF FOUR PACIFIC NORTHWEST NATIVE SHRUBS IN RELATION TO AIR TEMPERATURE. Yianna Bekris, Leslie Brodie, Dryw Jones, USDA Forest Service, Pacific Northwest Research Station, Olympia Forestry Sciences Laboratory, 3625 93rd Ave SW, Olympia, WA 98512; yianna.s.bekris@usda.gov

Native shrubs are an important food source for pollinators, other animals, and humans; furthermore, they are economically valuable as forest products. The phenology of these shrubs influences the behavior of animals and humans in relation to these plants, and changes in their phenology can be disruptive to these patterns of behavior. For a given plant species, the timing of phenological events is largely determined by temperature and photoperiod. While the annual cycle of photoperiod is consistent at a specific location, observed trends demonstrate that average air temperature is increasing and will likely continue to increase. What effect will this have on the phenology of native shrubs? We installed a small pilot study in a Douglas-fir stand near Olympia, WA to explore this question. Thirteen native shrub species were monitored weekly from 2015 through 2019, and air temperature data were obtained from a weather station near the study site. Our analysis focuses on four shrub species: Indian plum (*Oemleria cerasiformis*), salal (*Gaultheria shallon*), beaked hazelnut (*Corylus cornuta*), and red huckleberry (*Vaccinium parvifolium*). Across these four species, we found warmer mean winter temperature to be

significantly related to earlier reproductive budburst and warmer mean spring temperature to be significantly related to earlier incidence of both vegetative and reproductive budburst. Warmer mean annual temperatures were significantly related to later vegetative and reproductive budburst dates. Our small dataset will be useful in combination with other datasets such as those in the National Phenology Network.

ORAL

NATIVE SEED COLLECTION IN THE FACE OF CLIMATE CHANGE. Lynda Boyer, Native Plant Manager, Heritage Seedlings Inc. 4194 71st Ave SE Salem, OR 97317; lboyer@heritageseedlings.com

The Willamette Valley has seen a reduction in almost 99% of its native prairie habitat. The most vulnerable populations of native plants are on roadsides and unprotected private lands. Collection of seed from these populations from the entire ecoregion is therefore imperative. Not only to ensure these genetics are not lost, but to help develop a supply of genetically diverse native plant material for restoration of prairie ecosystems especially in the face of climate change uncertainties. Most restoration ecologists are supportive of using materials source from within an ecoregion; however, a new conversation may have to begin whether to expand that to include collections from adjacent ecoregions where there is overlap in species and habitat type. The latter would be challenging from a growers perspective since many seed buyers may not accept seed sourced outside the ecoregion making it economically unappealing.

POSTER

CLIMATE IMPACTS ON CULTURALLY-IMPORTANT FOOD-PRODUCING SHRUBS. Leslie C. Brodie, USDA-Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue SW, Olympia, WA 98512; Janet S. Prev y, U.S. Geological Survey, 2150 Centre Ave, Bldg C, Fort Collins, CO 80526; Jacob Strunk, Constance A. Harrington, USDA-Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue SW, Olympia, WA 98512; leslie.brodie@usda.gov

Fruit-producing shrubs such as thinleaf huckleberry (*Vaccinium membranaceum*), beaked hazelnut (*Corylus cornuta*), Oregongrape (*Mahonia aquifolium*), and salal (*Gaultheria shallon*) are an important component of social history and traditional tribal diets in the Pacific Northwest. The fruits of these shrubs are also an important food source for foraging wildlife and pollinators, and serve as the basis for both non-tribal harvesting and small-scale commercial operations. Land managers have a strong interest in preserving and restoring these culturally important plant species across the Pacific Northwest. To aid monitoring, management, and restoration plans, we initiated a project exploring and predicting the ranges and the timing of flowering and fruiting of these species. A bibliography and collection of web links were also created to aid those looking for further information by gathering it in one location. An important component of the project was to make the information engaging and accessible to those outside the scientific community. An Esri ArcGIS Story Map was created to showcase the many types of information produced during the course of the project in an interactive environment (<https://www.fs.usda.gov/pnw/science-stories/northwest-huckleberry-and-other-nuts-and->

berries). The visitor can use “slider” maps to explore predicted changes from current suitable habitat to those 35 or 65 years in the future under two different climate change scenarios. Also easily accessible from within the Story Map are maps depicting changes in time of flowering and fruiting, an interactive bibliography, and links to many other relevant websites.

POSTER

GASTROINTESTINAL PARASITES OF STRANDED PINNIPEDS FROM NORTHERN OREGON AND SOUTHERN WASHINGTON. Cecily Bronson, Dalin N. D’Alessandro, Dr. Deborah A. Duffield, Department of Biology, Portland State University, Portland, OR 97201; Cecily2@pdx.edu

Parasite prevalence and diversity are useful indicators of ecosystem health and stability, therefore, studying parasite prevalence on sentinel species, like marine mammals, may provide important information about the status of the entire marine ecosystem. A comprehensive survey of the parasites infecting stranded pinnipeds (seals and sea lions) along the Oregon coast has not been completed since 1978. Another survey would contribute to the historical record of naturally occurring marine parasites and assist in the monitoring of the health and stability of the marine ecosystem off the Oregon coast. The Duffield lab coordinates the Northern Oregon/Southern Washington Marine Mammal Stranding Program (NOSWSP) and through this partnership, a repeat survey is ongoing. Using the NOSWSP necropsy database and tissue samples, we are assessing the prevalence and diversity of parasites found in five species of pinnipeds — California sea lions (*Zalophus californianus*), Steller sea lions (*Eumetopias jubatus*), harbor seals (*Phoca vitulina*), Northern elephant seals (*Mirounga angustirostris*), and Guadalupe fur seals (*Arctocephalus townsendi*). Discussed here are the methods and preliminary findings from the examination of 41 gastrointestinal tracts from stranded pinnipeds. Early findings show; (1) parasitism was found in 85% of examined hosts, (2) they are infected with thorny-headed worms (acanthocephalans), round-worms (nematodes) and tapeworms (cestodes) and, (3) polyparasitism occurred in 54% of the hosts.

POSTER

TESTING POTENTIAL TRIGGERING MECHANISMS OF LARGE HOLOCENE ROCK AVALANCHES, WHATCOM COUNTY, WASHINGTON, USA. Eric R. Brown, Douglas H. Clark, Department of Geology, Western Washington University, 516 High Street, Bellingham, WA 98225; browne41@wwu.edu

Triggering mechanisms of large rock avalanches have been widely debated. Common explanations include accelerations during earthquakes, increased pore-water pressure from heavy precipitation, or recent glacial or fluvial debuttrussing of hillslopes. In this study, I test these hypotheses using radiocarbon (^{14}C) and cosmogenic radionuclide exposure dating (^{10}Be CRN) to compare the collapse ages of a suite of large Holocene rock avalanche deposits in Whatcom County, WA. All but one of the slides originate in Chuckanut Formation, a highly deformed and friable unit comprising thick beds of sandstone alternating with thinner beds of shale and coal. The coal and shale layers create planes of weakness making slopes highly susceptible to failure. If these slides were triggered by earthquakes, the collapse ages should overlap with known local

or regional paleoseismic events. Conversely, other triggers should show different temporal distributions: glacial debuitressing should cluster towards the beginning of deglaciation, whereas precipitation triggering or fluvial debuitressing should display more stochastic temporal pacing. At this time, I have collected three sediment cores from bogs in two of the landslide deposits. Each core contains woody debris near the base suitable for ^{14}C dating. In addition, I plan to analyze ten boulders from the debris fields of three of the landslides for ^{10}Be CRN dating. We anticipate results from these analyses by the summer of 2020.

POSTER

FIRES, SHRUBS, AND THE CHANGING ARCTIC: WHAT DOES THE FUTURE LOOK LIKE FOR TUNDRA ECOSYSTEMS?

Oriana Chafe, Dr. Lucas Silva, Environmental Studies Program, University of Oregon, Eugene, OR 97043; Dr. Margaret Torn, Climate and Ecosystem Science Division, Lawrence Berkeley National Laboratory, Berkeley, CA, 94720; Dr. Amy Breen, International Arctic Research Center, University of Alaska Fairbanks, Fairbanks, AK 99775; ochafe@uoregon.edu

The climate of the Arctic is changing at twice the rate of the global average with repercussions that span across the region and world. In addition to local-scale impacts, modification of the arctic ecosystem further amplifies global climate change through a strengthening of positive feedback cycles (for example: decreased surface reflectance and release of greenhouse gases from thawing permafrost soils). As a direct effect of arctic warming, woody shrubs are currently expanding into and throughout tundra ecosystems. Shrub expansion significantly modifies environmental conditions and increases permafrost thaw. However, the factors that control shrub expansion are not well understood. This research examines the way in which landscape disturbances (such as tundra fire and thermokarst) increase the rate of shrub expansion by facilitating seedling establishment. Field surveys conducted across a fire chronosequence in the Alaskan Arctic show ten-fold increases in seedling density in comparison to unburned tundra. Additionally, through a manipulative seed-addition and landscape disturbance experiment, this research shows that increases in the rate of seedling establishment are linked to environmental changes that further increase susceptibility to permafrost thaw. Rates of ongoing vegetation change in the Arctic are significantly increased by disturbance events, exacerbating climatic change through an intensification of positive feedback cycles.

POSTER

WATER USE AND COMPETITIVENESS OF *SENECIO SYLVATICUS* IN YOUNG *PSEUDOTSUGA MENZIESII* PLANTATIONS IN WESTERN OREGON.

Reed J. Cowden, Carlos Gonzalez-Benecke, Maxwell Wightman, Vegetation Management Research Cooperative, Oregon State University, Corvallis, OR 97331; rcowden21@gmail.com

This study quantified the effects of an invasive species, *Senecio sylvaticus*, on soil moisture and Douglas-fir water stress at three sites of varying conditions across western Oregon. Water use dynamics were measured using Time Domain Reflectometry soil moisture probes. Soil moisture probes surrounded by higher levels of *Senecio* had much higher rates of soil water depletion than those with less cover demonstrating the competitiveness and rapid resource utilization of

Senecio. The degree of cover impact on Douglas-fir drought stress was more pronounced at each site during periods when Available Soil Water was depleted. For example, fractional available soil water was reduced by 40% in August, from .6 to .2, with a *Senecio* cover of only 20% at the Sweet Home site. This effect was consistent with the other two sites, but not to the same degree. There were also significant differences in the abundance and phenotype of *Senecio* growing across the sites. Differences in site conditions and *Senecio* abundance affected the degree of competition that newly planted seedlings experienced as a result of *Senecio* presence. This was measured using predawn and midday water potential. The Douglas-fir showed an elevated response to *Senecio* presence in sites where water was a limiting factor. These differences were significant for all four sampled months (June: $P=.039$; July $P<.0001$; August: $P<.0001$; September $P<.0001$) at the dry site in Veneta. Overall, in areas with a high abundance of *Senecio*, competition for soil moisture caused elevated water stress in the Douglas-fir seedlings.

POSTER

SWINOMISH GENERATIONS CAMAS PROJECT: A FOOD SOVEREIGNTY INITIATIVE TO REVITALIZE AND REINTRODUCE AN IMPORTANT TRADITIONAL FOOD. Todd A. Mitchell, Nicole Casper, *Dean Dan Jr., Heidi Bock, Department of Environmental Protection, Swinomish Tribe, LaConner, WA 98257; Joyce LeCompte, Westland Gardens LLC, Olympia, WA; dpdan@swinomish.nsn.us

Camas is one of the most important cultural foods in Coast Salish territory. The nutritious bulb of this deep blue-purple flower is valued for its sweet flavor and energizing qualities. Many Native families traditionally traveled great distances and camped for several weeks to dig large amounts of bulbs. People actively tended the prairies where camas existed to maintain the plant. It also allowed for traditional knowledge transfer between specific groups of people. This knowledge could include harvesting techniques, landscape management, cooking methods, and effective food storage for long winter months. Coast Salish oral traditions involving Camas, are a testament to our historical record as Coast Salish peoples. While early non-Native settlers witnessed entire prairies of camas many of the camas areas have been developed or dug up for other crops.

Today there are few camas on and near the Swinomish Reservation and it is not part of the everyday diet. Until recently, camas was thought extinct on the Swinomish Reservation but small populations have been found including at the newly acquired Kukutali Preserve, a Tribal State Park on the Reservation. With finding these small populations, the Tribe has renewed interest in traditional foods and traditional foods management techniques.

In order to increase access to local, healthy and traditional foods, this project focuses on how to bring back camas growing and management to the Swinomish Reservation. Through experimentation with different resource management techniques including traditional techniques, we will develop a viable strategy for the increasing camas production on the Swinomish Reservation.

ORAL

TIDAL-MARSH DEPOSITS INSET INTO A LAHAR-RUNOUT DELTA ABOVE THE SEATTLE FAULT, WASHINGTON. Elizabeth J. Davis, Department of Earth and Space Sciences, University of Washington, Seattle, WA 98195; Eileen Hemphill-Haley, Humboldt State University, 1 Harpst Street, Arcata, CA 95521; edav@uw.edu

In what is now industrial Seattle, as little as a century elapsed among uplift of a lahar-runout delta, post-uplift incision to sea level, and a consequent advent of tidal marshes. The uplift accompanied a large Seattle Fault earthquake previously dated to 900–930 CE. Features raised as much as 6 m include a delta that the White River, loaded with sand from Mount Rainier, had recently built across the fault. On 19th-century maps, remnants of this uplifted deltaic plain form forested terraces beside a narrow estuary. Today, estuarine deposits crop out at low tide in windows through rip-rap along the Duwamish Waterway above the main reverse strand of the Seattle Fault. Complete sequences pass upward from sand and mud of scarcely vegetated flats, through peaty deposits of brackish marshes, to pasture soil where marshes were diked, and to spoils from waterway dredging. The marshes are evidenced by growth-position remains of salt-tolerant plants and by diatom assemblages. The plant remains—leaf bases attached to rhizomes of *Triglochin maritima*, and corms attached to culm bases of *Bolboschoenus maritimus*—provide limiting minimum ages for post-earthquake incision and for the earthquake itself: 1018 +/- 28, 1014 +/- 27, 994 +/- 27, 951 +/- 30 ¹⁴C yr BP. These ages and others constrain the timing of at least three earthquakes, and may bear on the timing of human occupation as described by prior investigators at Basketry Hat (45KI23), a Duwamish archaeological site. I am grateful for guidance from Brian Atwater.

ORAL

MORPHOLOGICAL AND FUNCTIONAL LEAF TRAIT RESPONSES TO EXPERIMENTAL DROUGHT IN PNW GRASSLANDS. Hilary Rose Dawson; Toby Maxwell; Lucas Silva, Institute of Ecology and Evolution, University of Oregon, 272 Onyx Bridge, Eugene, OR 97403; hrosedawson@gmail.com

The Pacific Northwest is predicted to face greater drought conditions in the near future. This expected to negatively impact grassland productivity, therefore, affect essential ecosystem functions (e.g. carbon sequestration and food production). This study aims to improve understanding of how drought stress affects 18 different plant species. By analyzing morphological and functional traits including specific leaf area (SLA), water-use efficiency (WUE), and leaf C:N in plants grown in control and simulated drought conditions (i.e., in replicated control vs rain exclusion plots) along three different sites spanning a 520 km latitudinal gradient, we identified unexpected responses to drought. Specifically, we found a significant negative correlation between SLA and WUE (r^2 66%, $P < 0.0001$) in which annuals and perennials were at the low and high ends of the spectrum, respectively, whereas no relationship was observed for SLA and C:N ($P > 0.05$). Rain exclusion treatment had no consistent effect on the traits across all sites. Overall, perennial plants were on average 41% more water efficient than annuals and grasses 46% more efficient than forbs, while perennial

grasses were 107% more efficient than the annual forbs, with small variations in response to rain exclusion (decrease of up to 11% between treatment and control plots) within sites.

ORAL

SEX-SPECIFIC MIGRATORY STOPOVER BEHAVIOUR HAS IMPORTANT IMPLICATIONS FOR AN ALPINE BREEDING SONGBIRD IN THE PACIFIC NORTHWEST.

Devin R. de Zwaan, Department of Forest and Conservation Sciences, University of British Columbia, 2424 Main Mall, Vancouver, BC, Canada V6T 1Z4; Scott Wilson, Wildlife Research Division, Environment and Climate Change Canada, Pacific Wildlife Research Centre, Delta, BC, Canada V4K 3N2; Elizabeth A. Gow, Department of Integrative Biology, University of Guelph, Guelph, ON, Canada N1G 2W1; Kathy Martin, Department of Forest and Conservation Sciences, University of British Columbia, 2424 Main Mall, Vancouver, BC, Canada V6T 1Z4; drdezwaan@gmail.com

How birds use the landscape throughout the full-annual cycle is critical to understanding the processes that shape individual fitness and population dynamics. Using northern stopover sites may be energetically costly but can provide competitive advantages like optimal arrival time at the breeding grounds with associated carry-over effects on reproduction. Using archival geolocators, we tracked the migration of 17 Horned Larks (*Eremophila alpestris*; 8 males, 9 females) from an alpine population in northern B.C., Canada (54.8°N), to address the drivers and consequences of variation in stopover behaviour. All individuals were short-distance migrants, overwintering east of the Cascades in Washington and Oregon. Males spent more time farther north and arrived ~6 days earlier at the breeding site in spring. Greater breeding effort delayed autumn departure for females, who in-turn demonstrated flexible migration behaviour by increasing migration speed and decreasing stopover use, while males maintained consistent stopover behaviour regardless of departure date. Spring stopover durations were surprisingly long (average 41 d; range 21–66 d). The use of prolonged stopovers was associated with greater nest success and productivity (~1.8 more fledglings), but periods of extreme cold at northern stopover sites had negative consequences for offspring development and reproductive success. Extended spring stopovers may therefore be a key component of the annual life-cycle for alpine breeding larks. I will discuss the potential importance of prolonged spring stopovers and sex-specific flexibility in migration strategies for the future of alpine or arctic breeding songbirds.

POSTER

GREATER THAN THE SUM OF ITS PARTS: AN EXERCISE IN INTEGRATIVE TAXONOMIC CHARACTERIZATION OF THE LAND SNAIL *ANCOTREMA* (HAPLOTREMATIDAE) IN THE PACIFIC NORTHWEST.

Fin DeGeare, Madeleine Woodard, Marisa D. Fisher, Nacia Magass, Clarissa Dirks, Lalita M. Calabria, The Evergreen State College, 2700 Evergreen Parkway NW, Olympia, WA 98505; degdan27@evergreen.edu

The Haplotrematidae (Baker, 1925) is a family of terrestrial gastropods that reaches its greatest diversity along the Pacific Northwest coast of North America. The classification of the two major Haplotrematidae genera, *Ancotrema* (Baker, 1931) and *Haplotrema* (Ancey, 1881), has historically challenged researchers due to similarities in major morphologic and overlapping

geographical ranges. Species level distinctions have also proven difficult for the genus *Ancotrema*, where prior attempts to separate *Ancotrema hybridum* and *Ancotrema sportella* using genital tract imaging and shell morphology showed no meaningful variation in these traits, leading to synonymizing of these taxa. Given these challenges, our research team set out to examine genetic relationships among species of *Ancotrema* and *Haplotrema* using sequenced mitochondrial CO1 genes. We collected samples from Opal Creek Wilderness, Marion County, Oregon and Seaquest State Park, Cowlitz County, Washington and used them along with published sequences from GenBank to construct a phylogenetic tree. Morphological data from examinations of the shell, genital tract and radula of each snail were collected and described, and then compared with the phylogenetic analyses. These data represent an integrative taxonomic approach to terrestrial gastropod identification that should help to clarify our understanding of snail diversity and conservation efforts in the Pacific Northwest.

ORAL

SPOTTED OWL HABITAT IN THE FIRE-PRONE EAST CASCADES OF WASHINGTON: EVALUATING PAST, PRESENT, AND FUTURE SUSTAINABILITY.

Daniel C. Donato, Joshua S. Halofsky, Derek J. Churchill, Danielle Munzing, Washington Department of Natural Resources, 1111 Washington St SE, Olympia, WA 98504; Peter Singleton, USDA Forest Service PNW Research Station, 1133 N Western Ave, Wenatchee, WA 98801; Van R. Kane, Jonathan T. Kane, University of Washington, School of Environmental & Forest Sciences, Seattle, WA 98195; daniel.donato@dnr.wa.gov

A major challenge in managing dry forests of the Pacific Northwest is balancing habitat for late-successional species (e.g., northern spotted owl [NSO]) with forest health and climate-adaptation treatments (e.g., fire, fuels). These two objectives typically call for entirely different forest structures – the former dense and multi-storied, the latter relatively open with discontinuous canopies. To inform forest management pursuing this balance in Washington’s East Cascades, we are using a combination of LiDAR data, historical data, simulation modeling, and spatially explicit climate projections to ask: 1) how eastside NSO nesting habitat is structured at both stand and landscape scales, 2) how much habitat can likely be sustained given regional disturbance regimes, and 3) where on the landscape habitat will be most sustainable given climate change. LiDAR analysis of NSO nest sites compared to the available landscape suggests suitable habitat is characterized primarily by stands of tall trees with dense canopy cover; other metrics assessed were either highly correlated with these or relatively unimportant. Suitable habitat was relatively abundant, and in larger patches, within 300 m of nest sites (but was not wall-to-wall), and was largely similar in abundance and pattern to the available landscape at larger home range scales (1300-3000 m radii). Simulation of historical fire regimes (corroborated by historical forest inventories) suggests suitable habitat abundance would fluctuate between ~16-26% of the landscape over time. Assessment of relatively climate-change-stable habitat locales is ongoing. These results suggest the potential to intermix late-successional habitat and disturbance/climate-resilient forest structures at both fine and coarse scales.

ORAL TRANSMISSION OF *LEPTOSPIRA INTERROGANS* IN URBAN BROWN RATS (*RATTUS NORVEGICUS*): DO RATS SHED LEPTOSPIRES IN THEIR SALIVA?

Christina M. Donovan, Department of Zoology, University of British Columbia, 4200-6270 University Boulevard, Vancouver, BC, Canada V6T 1Z4; Michael J. Lee, Kaylee A. Byers, Chelsea G. Himsworth, Canadian Wildlife Health Cooperative British Columbia, 1767 Angus Campbell Road, Abbotsford, BC, Canada V3G 2M3; Julie Bidulka, Animal Health Centre, British Columbia Ministry of Agriculture, 1767 Angus Campbell Road, Abbotsford, BC, Canada V3G 2M3; David M. Patrick, School of Population and Public, University of British Columbia, 2206 E Mall, Vancouver, BC, Canada V6T 1Z7; christina.donovan96@gmail.com

Leptospirosis is considered the most widespread and ubiquitous zoonotic disease today, with recent decades showing a rise in urban epidemics. Rats (*Rattus* spp.) are considered to be the primary urban carrier of *Leptospira interrogans*, the causative agent of leptospirosis. Previous studies suggest that rats are more likely to carry *L. interrogans* if they have bite wounds, however it is unknown whether rats shed the bacteria in their saliva. To evaluate whether rats shed the bacteria in their saliva, we trapped 137 Norway rats (*Rattus norvegicus*) across 36 city blocks in Vancouver, Canada and tested their urine and saliva for *L. interrogans*. Of the rats which tested positive for *L. interrogans* in their urine (n = 81), only one rat tested positive in their saliva indicating that active shedding of leptospires in saliva is unlikely to occur. Instead, it is possible that bite wounds serve as a means for contact with leptospires from rat urine in the environment. Future studies should seek to further investigate the role of rat interactions in the spread of *L. interrogans* in order to better understand public health risks.

ORAL

DO INEQUALITIES IN ROAD-BASED EGRESS OPPORTUNITIES IMPACT WILDFIRE VULNERABILITY FOR RURAL PACIFIC NORTHWEST TOWNS?

Alex W. Dye, U.S. Forest Service Pacific Northwest Research Station, Corvallis, OR 97333; John B. Kim, U.S. Forest Service Pacific Northwest Research Station, Corvallis, OR 97333; Karin L. Riley, U.S. Forest Service Rocky Mountain Research Station, Missoula, MT 59801; alex.w.dye@gmail.com

For rural communities in the western United States, wildfire is an annual threat. In many severe events, evacuation is one possible course of action to gain safety from an advancing wildfire. Most evacuations occur in a personal vehicle along the surrounding road network; the quality of this network is a critical component of a community's wildfire vulnerability. Here, we conduct a regional-scale screening of wildfire evacuation vulnerability for 175 rural towns in Oregon and Washington with high wildfire exposure. We characterize each town's surrounding road network to construct four simple metrics: 1) the number of paved lanes leaving town that intersect a fixed-distance circular buffer; 2) the variety of lane directions available for egress; 3) the area that can be reached within a minimum distance while constrained only to travel along the paved road network; and 4) the average annual burn probability of the surrounding landscape through which evacuation will occur. We then combine metrics to create an overall composite score for each town. Using maps and tabular data, we examine spatial patterns, advantages, and

disadvantages of each metric. All metrics are poorly intercorrelated, indicating that using just one measure of egress vulnerability may not fully capture road network characteristics and that a multi-metric geographic analysis may better reveal egress limitations.

ORAL

SEED SOURCING AND DEPLOYMENT FOR A CHANGING CLIMATE: HIGHLIGHTS FROM USFS, PNW REGION. Vicky J. Erickson, Regional Geneticist, US Forest Service, Pacific Northwest Region, 72510 Coyote Rd., Pendleton, OR 97801; vicky.erickson@usda.gov

Climate variability and change pose increasing risk to the health, diversity, and productivity of national forests and grasslands in the Pacific Northwest. Natural regeneration alone may no longer be adequate for achieving management objectives, and natural rates of migration may be insufficient for keeping pace with changing climates. Seeding and planting are important mitigation tools for re-aligning species and populations to survive and thrive in changing unpredictable climates and altered habitats and disturbance regimes. This presentation describes USFS efforts in the Pacific Northwest to modify forest tree seed sourcing and deployment protocols to shift emphasis from using only seed from local sources, to selecting seed (or a portion of the seed) based on similarities with projected future climate or to climate changes that have already occurred in the recent past. This work is greatly facilitated by use of the Seedlot Selection Tool (SST, <https://seedlotselectiontool.org/sst>) to analyze which seed sources will be best adapted to a given planting site, or which planting sites will be most suitable for a given seed source. The USFS climate-based seed sourcing strategy focuses on near-term climate projections (10-20 year planning horizon) to reduce uncertainty and risk, while emphasizing use of plant material sources that will be optimally adapted to environmental conditions during the highly vulnerable early stages of seed and seedling establishment. Information will be presented on proposed enhancements to SST to streamline spatial analyses for determining where there are gaps (e.g., no future climate analogue) or projected shortfalls in seed sources for a particular species or geographic area. Analyses will be invaluable for prioritizing out-year seed collections and coordinating with other national forests and landowners for seed needs for the near future and beyond.

ORAL

IMPACTS OF MANAGEMENT ON FOREST RESPONSE TO CLIMATE VARIABILITY. Michael Farinacci, Department of Geography, University of Oregon, 1251 University of Oregon, Eugene, OR 97403-1251; Lucas Silva, Environmental Studies Program, Department of Geography, Institute of Ecology and Evolution, University of Oregon, 1251 University of Oregon, Eugene, OR 97403-1251; lsilva7@uoregon.edu

Climate projections suggest increased droughts for much of the Pacific NW region in the near-future, which is expected to lead to large-scale forest die-offs. Forest thinning is often proposed to reduce competition and mitigate drought stress, but that effect has yet to be tested in long-term experiments. To test these effects, we examined tree- and stand-level sensitivity to climate in Douglas-fir forests. To this end, we relied on three watersheds with differing styles of forest

management at the HJ Andrews Experimental Forest near Blue River, Oregon. Specifically, we sought to answer two questions: First, what are the effects of forest thinning and clear cuts on the climate sensitivity of Douglas-fir trees and how is that effect related to differences in structure and function relative to old-growth forests? Second, how is tree-level variation in growth related to stand-level climate sensitivity under different management regimes? Preliminary results show a marked growth decline in average basal area increment (BAI) beginning after an unusually dry year, 2010, for trees in managed stands, a trend not displayed by trees in old-growth stands. Based on correlation coefficients generated for the relationship of climate and hydrologic variables, and standardized tree-ring widths, we conclude that old-growth stands buffered the effects of climate variability on tree growth. Our ultimate goal is to link this research to metrics of drought resistance and carbon-water budgets to better understand how interactions between climate and forest management affects the overall health, productivity, and water yields of PNW forests.

ORAL

PRESERVING TRADITION: SUPPORTING TRADITIONAL GATHERING PRACTICES ON THE WILLAMETTE NATIONAL FOREST. Tony Farque, Annmarie Kmetz, Claire Bennett, Sweet Home Ranger District, Willamette National Forest, Sweet Home, OR 97386; tony.farque@usda.gov

For over fifteen years, the Sweet Home Ranger District on the Willamette National Forest has worked with the Confederated Tribes of Siletz and the Confederated Tribes of Grand Ronde to restore traditionally utilized huckleberry and camas fields. Guided by traditional and modern science, the landscape has positively responded to the pruning, burning and planting undertaken to provide places for resource gathering of native foods.

As climate change threatens to change the landscape, the District resource staff have begun to consider locations of viability for first foods in the future. Utilizing climate models, botanical data and landscape evaluation, the search for new cultivation locations has begun to ensure continued traditional gathering practices on the National Forest.

ORAL

DEGLACIAL LANDFORMS AND HOLOCENE VEGETATION TRAJECTORIES IN THE NORTHERN INTERIOR CEDAR-HEMLOCK FORESTS OF BRITISH COLUMBIA. Daniel G. Gavin, Ariana White, Department of Geography, University of Oregon, Eugene, OR 97403; Richard Hebda, Royal British Columbia Museum, Victoria, BC, Canada V8W 9W2; Paul Sanborn, Ecosystem Science and Management Program, University of Northern British Columbia, Prince George, BC, Canada V2N 4Z9; dgavin@uoregon.edu

The northern Rocky Mountain Trench of eastern British Columbia is a broad valley mantled by glaciolacustrine terraces supporting a complex mix of mesic-temperate (“interior wetbelt”) forests that are strongly affected by terrain and substrate. Neither the geomorphic history during early-Holocene deglaciation nor the vegetation history of the origin of the *Tsuga heterophylla* and *Thuja plicata* populations in the interior wetbelt forest is well understood. Sediment cores

were obtained from two lakes, 10 km apart and occupying different terraces (83 m elevational difference) and compared to existing fire-history and paleoclimate reconstructions. Radiocarbon dates and a mapped terrain classification indicate the upper terrace formed as a lacustrine and glaciofluvial kame terrace hundreds of years prior to a lower terrace formed by glaciolacustrine sediments of a proglacial lake. The minimum limiting ages of these terraces correlate with dated jökulhlaup deposits of the Fraser River. The upper site's first detectable pollen at > 11.0 ka was dominated by light-seeded pioneer taxa (Poaceae, *Artemisia*, and *Populus*) followed by a peak in *Pinus* and finally dominance by *Betula* at 10.2 ka. Pollen data suggest an earlier invasion of *T. heterophylla* than previously understood. Wetlands on extensive poorly drained glaciolacustrine soils promoted the persistence of boreal taxa and open forests (e.g., *Picea mariana*) while the better-drained upper kame terrace promoted development of closed-canopy shade-tolerant taxa. Invasion and expansion of mesic cedar-hemlock taxa progressed since at least the middle Holocene but was highly constrained by edaphic controls.

ORAL

HYDRAULIC CONDUCTIVITY AND VULNERABILITY TO CAVITATION OF THREE DOUGLAS-FIR SEED SOURCES. Carlos A. Gonzalez-Benecke, Department of Forest Engineering, Resources and Management, Oregon State University, Corvallis, OR; Julia Kachanova, University of Padova, Italy; carlos.gonzalez@oregonstate.edu

The xylem hydraulics and resistance to cavitation of different Douglas-fir genotypes has been scarcely reported despite being an important trait influencing drought resistance. The magnitude of genetic control over these traits is also not well understood and may be important for efforts to breed drought resistant Douglas-fir genotypes. In this study we measure xylem hydraulic conductivity and vulnerability to cavitation of Douglas-fir seedlings from three contrasting seed sources developed by Weyerhaeuser Co. The seed sources tested demonstrated significantly different vulnerability to cavitation curves indicating differences in inherent drought resistance. Seedlings from the Inland seed source reached 50% loss of conductivity at -3.5 MPa, while seedlings from the Coast and Cascade seed sources reached the same amount of cavitation at -2.4 MPa. This indicates higher drought resistance for the Inland seed source. There were no differences in xylem hydraulic conductivity and no correlation between drought resistance and xylem transport efficiency, indicating a lack of trade-off between safety and efficiency of water transport. Seedling physiology can be used to characterize genetic material for drought resistance, helping to improve seedling deployment programs. A simplified method for determining vulnerability to cavitation curves is proposed

ORAL

ISOLATION AND STRUCTURAL ELUCIDATION OF RED PIGMENTS IN LIPSTICK LICHEN (*UMBILICARIA PHAEA* VAR. *COCCINEA*). Jesse Manuel Graves, Eli Livezey, Evergreen State College, 2700 Evergreen Pkwy NW, Olympia, WA 98505; John Villella, Siskiyou Biosurvey, Eagle Point, OR 97524; Lalita M. Calabria, The Evergreen State College, 2700 Evergreen Pkwy NW, Olympia, WA 98505; grajes18@evergreen.edu

Recent metagenomic studies have demonstrated that many lichens commonly associate with a complex consortium of non-photosynthetic bacteria and other fungi. This raises question about which symbiont is responsible for producing the multitude of secondary metabolites found in lichens. *Umbilicaria phaea* Tuck. is an umbilicate lichen common on basaltic rock throughout western continental North America. It occurs as two distinct varieties differentiated by the bright red thallus of the more uncommon variety, *U. phaea* var. *coccinea*. The red variety is almost exclusively restricted to arid portions of the Klamath region in California and Oregon, where it can be found growing intermixed with the more common brown variety. Despite striking difference in pigmentation, the chemistry of *U. phaea* var. *coccinea* remains elusive. In an effort to characterize the secondary metabolites responsible for the red pigmentation of *U. phaea* var. *coccinea* our research group has undertaken chemical investigations of both varieties of *U. phaea* collected from the Cascade-Siskiyou National Monument, Oregon. Acetone extracts were analyzed by ultra-performance liquid chromatography coupled with high-resolution mass spectrometry (UPLC-HRMS). Separation of pigments was achieved through preparative thin layer chromatography (TLC). Purified compounds were further characterized using UV, IR and NMR spectroscopy. This research is one component of a larger project to understand the biosynthetic origin of the red pigment in *U. phaea* var. *coccinea*. When used in conjunction with metagenomic data, the chemical data presented here should help to improve our understanding of the lichen symbiosis as a whole.

ORAL

IMPACT OF SUBSTANTIALLY ALTERED ECOSYSTEMS IN CENTRAL AND SOUTHCENTRAL OREGON ON AVAILABILITY OF NATIVE FOODS. Keala Hagmann, Applegate Forestry LLC and University of Washington, Paul F. Hessburg, Pacific Northwest Research Station, USDA-FS, Wenatchee, WA 98801; Andrew G. Merschel, Department of Forest Ecosystems and Society, College of Forestry, Oregon State University, 3200 SW Jefferson Way, Corvallis, OR 97333; School of Environmental and Forest Sciences, University of Washington, Box 352100, Seattle, WA 98195; K. Norman Johnson, Department of Forest Ecosystems and Society, Oregon State University, 321 Richardson Hall, Corvallis, OR 97331; Debora L. Johnson, Applegate Forestry LLC, 28831 Tampico Road, Corvallis, OR 97330; Matthew J. Reilly, Department of Biological Sciences, Humboldt State, University, 1 Harpst Street, Arcata, CA 95521; hokulea@uw.edu

In fire-prone environments in the western US, the landscapes which traditionally supported native foods have been substantially altered by more than a century of fire exclusion and other changes in land management and resource use. Increases in forest density and abundance of young trees not only impact plant and animal habitat directly under the forest canopy, they may

also substantially reduce water quantity and quality downslope in non-forest ecosystems, like meadows and fish-bearing streams. We used multiple existing and recently acquired records to quantify changes in fire-excluded forests. Numerous early twentieth-century inventories and surveys provide extensive coarse-scale information about forest structure and composition prior to intentional fire exclusion. We complemented these early records with details about historical forest structure and composition at finer spatial scales from more recently acquired records. Early timber inventories provided a record of conifers > 15 cm dbh from a systematic sample of 10-20% of >500,000 ha. Early- and mid-20th century stereo aerial photography provided wall-to-wall coverage of vegetation conditions for entire subwatersheds. Gridded tree-ring reconstructions covering >80,000 ha provided records of frequency and size of historical fires. We compared this multi-proxy record of historical conditions with contemporary conditions. Modern forest structure and composition depart substantially from those historically maintained by large, frequent fires. Recent fires have exacerbated rather than remedied those departures. Historical conditions maintained widespread resistance and resilience to wildfire and drought, even during the extreme droughts, extensive fire years, and bark beetle outbreaks of the early 20th century.

ORAL

HOW WILL FUTURE CLIMATE ALTER THE RANGE AND PHENOLOGY OF THREE CULTURALLY-IMPORTANT SHRUB SPECIES? Constance A. Harrington, USDA Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue SW, Olympia, WA 98512; Janet S. Prevey, U.S. Geological Survey, 2150 Centre Ave, Building C, Fort Collins, CO 80526; Lauren E. Parker USDA California Climate Hub, John Muir Institute of the Environment, University of California Davis, One Shields Avenue, Davis, CA 95616; connie.harrington@usda.gov

Shrubs are important first foods as many species produce berries and nuts which have been traditionally harvested by tribal members. Climate change is shifting both habitat suitability (where plants grow) and the timing of events, such as flowering and fruiting. In this study we asked how both the distribution and phenology of three native food-producing shrubs, beaked hazelnut (*Corylus cornuta*), Oregongrape (*Mahonia aquifolium*), and salal (*Gaultheria shallon*), might shift as climate changes. To address this question, we compared large scale climate data with species location data and also developed thermal-sum models for the timing of flowering and fruit ripening for these species. Modelling efforts showed extreme minimum temperature, climate moisture deficit, and mean summer precipitation were predictive of climatic suitability across all three species. Our models project substantial reductions in habitat suitability across the lower elevation and southern portions of the species' current ranges in the future but the results differ somewhat depending on the species and amount of predicted climate change. Thermal-sum phenology models for these species indicate that flowering and the ripening of fruits and nuts will occur sooner by an average of 25 days by the mid-21st century, and 36 days by the late-21st century using models which predict large changes in future climate. While we can't alter the effects of climate directly, management activities that could be helpful include monitoring effects in traditional harvesting areas, planting in new areas with predicted high future suitability, or reducing moisture stress by removing plants competing with desired species.

TEPHRA-MEDIATED VEGETATION CHANGE OBSERVED IN A 13,600-YEAR RECORD FROM THE NORTHERN ROCKY MOUNTAINS, IDAHO.

Erin M. Herring, Daniel G. Gavin, Department of Geography, University of Oregon, 1251 University of Oregon, Eugene, OR 97403; eherring@uoregon.edu

Vegetation composition in the Pacific Northwest (PNW) has been influenced by climate and natural disturbances. The relationship between climate, fire, and vegetation has been well researched in many paleoecological studies. Other natural disturbances such as volcanic eruptions have not received this scrutiny, especially in different forest environments in the PNW. Tephra layers from the eruptions of Mt. St. Helens (0.5 cm thick; ca. 40 years ago), Glacier Peak (20 cm; ca. 13,400 years ago) and Mt. Mazama (141 cm; ca. 7,600 years ago) were identified in a 10 m lake sediment core recovered from Dismal Lake in northern Idaho. Pollen and macrofossils were used to reconstruct the vegetation of the region for the last 13,600 years. Variation in pollen assemblages was scaled to two axes by using nonmetric multidimensional scaling (NMDS) using the Bray-Curtis dissimilarity index on the 17 most abundant pollen types using square-root transformed pollen percentages. Comparison before and after each tephra deposit shows that a large change in vegetation occurred after the deposition of thick (>20 cm) tephra layers from the eruptions of Glacier Peak and Mt. Mazama. This appears to be the first record that demonstrates the role of tephra at inciting abrupt vegetation change and modifying long-term vegetation trajectories in Pacific Northwest forests.

FIRST MOLECULAR CHARACTERIZATION AND PHYLOGENETIC REPORT FOR TWO PARASITIC NEMATODES: *TRICHURIS FOSSOR* AND *RANSOMUS*

***RODENTORUM*.** Malorri R. Hughes, Department of Biology, Portland State University, 1719 SW 10th Avenue SRTC Rm 246, Portland, OR 97201; malorri@pdx.edu

The parasitic nematodes *Trichuris fossor* and *Heligmosomoides thomomyos* have been described from *Thomomys* (Rodentia: Geomyidae) hosts using only morphological features. Due to the high degree of phenotypic plasticity observed in parasites, this study aimed to use molecular data to verify species delineations and to construct hypotheses for their phylogenies. Phylogenetic tree hypotheses were generated from 18S ribosomal or COI mitochondrial gene sequences using maximum likelihood and Bayesian inference methods. The *Trichuris fossor* sequences formed a distinct subclade within the *Trichuris* clade with high support in both analyses. *Heligmosomoides thomomyos* trees differed based on the gene used, suggesting further studies are warranted to understand the evolutionary history of this species. Studies such as this help properly quantify biodiversity and generate data that can be used to learn about gene flow among parasite populations and, when used in conjunction with host DNA, shed light on host-parasite associations and processes such as cospeciation and coevolution.

BANQUET PRESENTATION

ARCHAEOLOGY AND SCIENCE AT THE PAISLEY CAVES. Dennis Jenkins, Museum of Natural and Cultural History, University of Oregon, Eugene, OR 97403; djenkins@uoregon.edu

Luther Cressman's 1938-1940 excavations at the Paisley Caves in south central Oregon discovered evidence suggesting that human occupation of the caves was contemporaneous with now extinct Late Pleistocene megafauna some 12,000 to 15,000 years ago. However, it was not until more recent developments in radiocarbon dating and ancient DNA analysis that he was finally proven correct. This presentation explains the scientific processes and results of archaeological investigations at the Paisley Caves, bringing the audience the most up-to-date information about the evidence for the association of humans and Pleistocene animals in Oregon's high desert country more than 14,000 years ago. Dating of camel and horse bones, artifacts, twigs, and dried human feces containing Native American DNA between 12,900 and 14,500 years ago indicates that people lived in the caves and apparently hunted mammoth, camels, horses, and other animals at the end of the Pleistocene period. This colorful slide show takes the audience through the scientific processes involved in proving the case for pre-Clovis (>13,500 years) human occupations at the now world-famous Paisley Caves in south-central Oregon.

ORAL

A WESTSIDE STORY: NEW CROSS-DATED FIRE HISTORIES FROM THE WESTERN OREGON CASCADES. James Johnston, Oregon State University, College of Forestry, 140 Peavy Hall, 3100 SW Jefferson Way, Corvallis, OR 97333; james.johnston@oregonstate.edu

Douglas-fir forests of the Pacific Northwest west of the Cascades Mountains ("the westside") have enormous ecological, economic, and cultural significance. But there has been little empirical research that characterizes historical fire disturbance dynamics in these forests. Cross-dated fire histories are almost totally lacking. In contrast to the frequent, non-standing replacing fire regimes that characterize dry forests of the interior American West and southern Cascades-Sierra Cordillera, managers and scientists assume that succession in westside forests—among the moistest and most productive forests in North America—is often uninterrupted by fire for centuries. We reconstructed fire histories from 1500-1900 CE at 16 different sites within the western-central Oregon Cascades that span the full productivity gradient present within our region. We found extraordinary variability in mean fire return intervals ranging from 5 years to 200 years. Fire return intervals for old-growth Douglas-fir/western hemlock forests were significantly shorter than predicted by theory. Some old-growth stands had experienced as many as ten non-standing replacing fires over the 400 years between stand initiation and the beginning of fire suppression efforts. The longest fire free period in almost all stands sampled was during the last 100 years of modern forest management. This research has important implications for managers focused on habitat conservation, carbon cycling, and fire suppression.

ENGINEERED INTERVENTION VS NATURAL PROCESSES IN A MODIFIED HYDROLOGIC LANDSCAPE. Nicholas Kager, Deputy THPO, Coeur d' Alene Tribe, PO Box 408, Plummer, ID 83851; nkager@cdatribe-nsn.gov

Hepton Lake is a body of water behind a constructed levee along a natural river impacted by a dam on the Coeur d'Alene Reservation. The lake was drained with pumps to facilitate farming and in the 1990s the levee breached, either through flooding or perhaps dynamite. The NRCS, Coeur d'Alene Tribe, and other agencies are now proposing repairing the breach while managing flows, passively or actively, to mitigate the invasive fish and plants endemic to this warm water enclave communicating with the naturally cold-water system of the St. Joe River. Engineering has not been able to fully answer questions regarding real world functioning of the proposed constructed intervention or no action alternatives. Natural processes are changed by the upstream effects of Post Falls Dam. It appears that the no action alternative, allowing the breach to either heal or the constructed levee to continue to erode, may ultimately provide a better resolution and more native species habitat, but the timeline is unacceptable to the majority non-indigenous milieu on the reservation.

ORAL

SEASON CHANGES IN DEAD FUEL MOISTURE FOLLOWING DOUGLAS-FIR REMOVAL IN A NORTHWESTERN CALIFORNIA OAK WOODLAND. Jeffrey M. Kane, Madeline A. Lopez, Department of Forestry and Wildland Resources, Arcata, CA 95521; jkane@humboldt.edu

Fuel moisture is a major driver of fire behavior and effects in most fire-prone ecosystems. The absence of fire has dramatically altered forest structure in many western US ecosystems prompting the need for fuels reduction treatments. However, previous research characterizing the impacts of forest structure on fuel moisture is highly varied, likely due to differences in climate, forest type, and other factors. We investigated changes in live and dead fuel moisture across the fire season (May to October) in Douglas-fir encroached, thinned, and intact Oregon white oak-California black oak woodland stands of northwestern California where climate is moderated by fog and a stronger maritime influence. Dead fuel moisture for most surface fuel types (litter, 1 hr, and 10 hr) was on average 40 to 90% higher in encroached stands than in intact stands and 20 to 40% higher than in thinned stands, with the largest differences detected on the shoulder seasons (late spring and fall). Our results indicate that forest structure was associated with fuel moisture content differences in an Oregon white oak-California black oak woodland ecosystem of northwestern CA. Thinning treatments were effective at reducing dead fuel moisture content that resulted in conditions more similar to intact stands, which can help aid the reintroduction of fire by expanding the time period conducive to meet fuel reduction and other ecological objectives.

ORAL

DIVERSITY IS MAGIC AND PARTNERSHIPS WORK: EMERGING ISSUES IN SELECTING APPROPRIATE NATIVE PLANTS FOR ECOSYSTEM RESTORATION IN THE FACE OF CLIMATE CHANGE. Thomas N Kaye, Institute for Applied Ecology, 563 SW Jefferson Ave, Corvallis, OR 97333; tom@appliedeco.org

Habitat degradation and loss have accelerated globally, resulting in loss of biological diversity and species endangerment at unprecedented scales. Restoring habitats that provide ecosystem services necessary for all life is crucial, especially as Earth's climate changes. Plant diversity is now clearly a fundamental driver of ecosystem services and the maintenance of diversity of other organisms, and native plant diversity is needed because invasive plants tend to reduce diversity and homogenize vegetation on the landscape. One of the biggest hurdles to habitat restoration is the availability of seeds of native plants to provide a diverse and resilient base of the food chain. The Willamette Valley Native Plant Materials Partnership was formed in 2012 with over 20 partners to increase the availability of locally sourced, genetically diverse seed. This presentation will describe the partnership and its approach and present the results of recent published and unpublished research on local adaptation, successful creation of diverse regional seed admixtures, the importance of landscape context, and innovative species selection strategies. Seeding with native plants is one of the few reliable methods of restoring diversity at all ecosystem levels, even in the face of climate change and controversial novel ecosystems. Therefore, selecting and sourcing the right plants for restoration sites is vital for the successful establishment of diverse and resilient native ecosystems and promoting ecosystem function.

ORAL

EXPLORING NEW LICHEN BIOMONITORING TOOLS: COMPARING NITROGEN CONCENTRATIONS IN SAXICOLOUS LICHENS TO THOSE OF *LETHARIA VULPINA*. Adrienne Kovasi, Bruce McCune, Department of Botany and Plant Pathology, Oregon State University, 2082 Cordley Hall, Corvallis, OR 97331; Sarah Jovan, USDA Forest Service, PNW Research Station, Portland, OR 97204; kovasia@oregonstate.edu

A nitrogen (N) deposition and elevational gradient extends from the Central Valley of California into the Sierra Nevada. We conducted preliminary work along this gradient on a transect from Fresno northeast through the Sierra National Forest to the high Sierras. The easternmost portion of this gradient falls in Class 1 wilderness areas, of which the Wilderness Act of 1964 compels the US Forest Service (USFS) to "preserve wilderness character". The extent to which this is being achieved can be determined by monitoring air quality as an agent of ecological change. In 2019 we sampled along this gradient, collecting bulk samples of saxicolous lichen species and *Letharia vulpina* for elemental analysis. The research question is whether N accumulates in these saxicolous lichens proportionally along this gradient as it does in *L. vulpina*. In addition, we compiled and analyzed all of the existing data on saxicolous lichen elemental content in the western U.S., as well as that for *L. vulpina* from the extensive USFS Air Resources Management lichen elemental analysis database. These data showed a weak positive correlation between %N of saxicolous lichens and *L. vulpina* when comparisons are restricted to multiple samples from the same sites. Furthermore, different species and growth forms of saxicolous lichens had

different rates of N accumulation. We attribute some of the variation in N content to differences in sampling methodology, including field methods, cleaning, and instrumentation.

ORAL

EFFECTS OF LIVESTOCK EXCLUSION ON STREAM BANKS AND RIPARIAN VEGETATION IN WASHINGTON AND OREGON. Michelle Krall, Christopher Clark, Cramer Fish Sciences, Watershed Sciences Lab, 1125 12th Ave NW, Suite B-1, Issaquah, WA 98027; Phil Roni, Cramer Fish Sciences, Watershed Sciences Lab, 1125 12th Ave NW, Suite B-1, Issaquah, WA 98027; School of Aquatic and Fishery Sciences, University of Washington, 1122 NE Boat Street, Seattle, WA 98105; Kai Ross, Cramer Fish Sciences, Watershed Sciences Lab, 1125 12th Ave NW, Suite B-1, Issaquah, WA 98027; michelle.krall@fishsciences.net

Exclusion of livestock to protect and improve riparian and stream habitat is a widespread restoration technique in the Pacific Northwest. Since 2004, the Washington State Salmon Recovery Funding Board and the Oregon Watershed Enhancement Board have been evaluating 12 livestock exclusion projects using a before-after control-impact design. Sites were monitored once before restoration implementation and several years after implementation on a rotating schedule (years 1, 3, 5, and 10). Monitoring included surveys to measure bank erosion, bank canopy cover and riparian vegetation structure, pool tail fine sediment, and assessment of fencing function. Results indicate that livestock exclusion projects significantly reduced bank erosion and bare ground. Bank erosion in impact reaches decreased from an average of 44% preproject to 11% by year 10. Overall bare ground in impact reaches was over 1.5 times lower in year 10 compared to preproject. Many projects had intact fencing, but there were instances where fencing was not fully functioning as intended across sampling years, allowing livestock access into the exclusion. The lack of response for many monitored metrics is likely the result of several factors including: limitations of the sampling protocols, evidence of livestock grazing in impact reaches, lack of stratification, control reaches that were not well matched with impact reaches, and the lack of additional years of preproject data. However, despite these limitations, we still measured significant decreases in bank erosion and bare ground. Future livestock exclusion monitoring should focus on ensuring compliance, better monitoring oversight, and the use of more quantitative protocols.

ORAL

EATING FIRST FOODS AGAIN, FOR THE FIRST TIME. Brandon M. Larrabee, Bureau of Indian Affairs, 911 NE 11th AVE, Portland, OR 97232 and Healthy Traditions, Confederated Tribes of Siletz Indians, 201 SE Swan AVE, Siletz, OR 97380; brandon.larrabee@bia.gov

I will present about the work I did this past summer for my Tribe (Confederated Tribes of Siletz Indians) and how important it is to reconnect our peoples back with our First Foods. I worked gathering Huckleberries and Yampah in the crests of the Cascade Range as well as gathering Camas seeds with our youth at the foot of Table Rock. Foods drove our day to day life, culture and were responsible for our people's strong resiliency. Reconnecting with our first foods will reconnect our people with culture, creator, and wellness. My presentation will reflect these

beliefs and hopefully make people aware of the importance of first foods, and, Indigenous Food Sovereignty.

POSTER

CASE REPORT OF AN ABNORMAL MAMMOTH RIB FROM THE FRENCHMAN HILLS – TONNEMAKER MAMMOTH SITE, GRANT COUNTY, WASHINGTON.

George V. Last, Mid-Columbia Basin Old Natural Education Sciences (MCBONES) Research Center Foundation, 33585 South Clodfelter Road, Kennewick, WA 99338, and Washington State University – Tricities, Richland, WA 99354; Katherine Newhall-Perry, Rosalie Faubion, Neil L. Mara, Mid-Columbia Basin Old Natural Education Sciences (MCBONES) Research Center Foundation, 33585 South Clodfelter Road, Kennewick, WA 99338; Bax R. Barton, Mid-Columbia Basin Old Natural Education Sciences (MCBONES) Research Center Foundation, 33585 South Clodfelter Road, Kennewick, WA 99338 and Burke Museum of Natural History and Culture, 4300 15th Ave. NE, Seattle, WA 98105; gvlast@charter.net

A deformed rib from a Columbian mammoth (*Mammuthus columbi*), was found among other bones excavated from the Tonnemaker Hill Farm in the Frenchman Hills near Royal City, Grant County, Washington. The deformity consists of hypertrophic bone formation localized toward the distal (sternal) end of the rib. The circumference of the lesion is nearly twice that of the medial circumference of the rib specimen. The lesion was found intact *in situ*, but came apart during cleaning, fitting together only loosely thereafter. This lesion is consistent with an incompletely healed fracture or a fracture nonunion with pseudarthrosis (false joint) formation. Gross examination and review of computerized tomography scan images of the proximal aspect of the rib, as well as cursory inspection of the other skeletal remains, has yet to reveal definitive evidence of other bony abnormalities. We surmise, therefore, that this fracture was the result of blunt trauma to a healthy animal. This, to our knowledge, is the first report of a rib fracture with incomplete healing or false joint formation in a *M. columbi* individual in the Pacific Northwest. We suspect the incidence of rib fractures among *M. columbi* is greater than the literature suggests and encourage examination of existing collections for evidence of similar findings.

ORAL

EFFECTS OF CULLING ON *LEPTOSPIRA INTERROGANS* CARRIAGE BY RATS.

Michael J. Lee, School of Population and Public Health, University of British Columbia, BC, Canada V6T 1Z3 and Canadian Wildlife Health Cooperative Abbotsford, BC, Canada V3G 2M3; Kaylee A. Byers, Department of Interdisciplinary Studies, University of British Columbia, BC, Canada V6T 1Z2 and The Canadian Wildlife Health Cooperative Abbotsford, BC, Canada V3G 2M3; Christina M. Donovan, Department of Zoology, University of British Columbia, BC, Canada V6T 1Z4; Julie J. Bidulka, British Columbia Ministry of Agriculture, Abbotsford, BC, Canada V3G 2M3; Craig Stephen, University of Saskatchewan, Saskatchewan, Canada S7N 5B4; David M. Patrick, British Columbia Centre for Disease Control, BC, Canada V5Z 4R4 and School of Population and Public Health, University of British Columbia, BC, Canada V6T 1Z3; Chelsea G. Himsworth, School of Population and Public Health, University of British Columbia, BC, Canada V6T 1Z3 and Canadian Wildlife Health Cooperative Abbotsford, BC, Canada V3G 2M3 and British Columbia Ministry of Agriculture, Abbotsford, BC, Canada V3G 2M3; michaeljosephlee2@gmail.com

Urban Norway rats (*Rattus norvegicus*) are a reservoir for the zoonotic bacterium, *Leptospira interrogans*. Research shows that transmission among rats may be associated with social structures and interactions. We hypothesized that, through a disruption of those established structures and interactions, cull-based rat control efforts could influence the epidemiology (e.g., transmission) of *L. interrogans* among the surviving rats. To test this, we compared the odds of *L. interrogans* carriage before and after kill-trapping interventions performed on wild rat populations in 12 study sites in the Downtown Eastside neighborhood of Vancouver, Canada. We found that, within the area where the intervention took place, rats caught after the intervention had a significantly greater odds of carrying *L. interrogans* (OR_{adj}=9.55, 95% CI 1.75-78.31) compared to rats caught in the period prior to the intervention. No effect was observed in control sites or in city-blocks flanking the intervention blocks. Our results suggest that human interventions have the potential to impact and even increase the prevalence of certain zoonotic pathogens within rat populations.

ORAL

GROWING ROOTS: CULTIVATING KWAKWAKA 'WAKW ESTUARINE ROOT GARDENS ON THE CENTRAL BC COAST.

T. Abe Lloyd, Environmental Science Department, Huxley College of the Environment, Western Washington University, Bellingham, WA 98226; arcadianabe@yahoo.com

Estuaries are a bread basket of every coastal First Nation's traditional territory. The *Kwakwaka 'wakw* people, inhabiting the Central Coast of British Columbia, traditionally cultivated the edible roots of several high estuarine salt marsh species in a garden system called *taki 'lakw*. My graduate research employed ethnographic methods to learn from an ancestral steward, Clan Chief *Kwaxsistalla*, about how the *taki 'lakw* was traditionally managed. Under *Kwaxsistalla*'s guidance, I then used empirical methods to test the effects of soil cultivation and weeding on the productivity of one edible species, Pacific silverweed (*Argentina egedii*) in the Kingcome River estuary. After one growing season, I measured a significant increase in the

number of *Argentina* roots in plots that were tilled, and plots that were tilled and weeded, relative to control plots. However, the size of the roots significantly declined and there was no change in overall root biomass. More noteworthy than the statistical results of my short term study, is the awareness that First Peoples have been actively stewarding estuaries for thousands of years, and the disruption of this legacy correlates strongly with the ecological collapse of several coastal estuaries. In essence, humans can maintain healthy coastal ecosystems while simultaneously eating them.

POSTER

AN ASSESSMENT OF CONIFER SEED DEVELOPMENT, RELATIVE TO TIMING OF WILDFIRE, FOR CHARACTERIZATION OF A REGENERATIVE MECHANISM.

Madeline Lopez, Jeffrey M. Kane; David F. Greene, Department of Forestry and Wildland Resources, Humboldt State University, 1 Harpst St, Arcata, CA 95521; mal745@humboldt.edu

Climatic change is altering current disturbance regimes, such that warm conditions are increasing fire frequency, severity, and size in many regions. Persistence of tree species without fire adaptive traits is threatened as fire frequency and burn area increase. Although, there is post-fire evidence of dense, non-serotinous recruitment at great distances, questioning if seed dispersal from the live burn edge could be solely responsible. Conifer seed maturation occurs prior to the reflex of cone scales, and if cone scales adequately protect seeds during the flaming front, then an aerial seed source following fire is available for recruitment in a process termed “facultative serotiny”. To address our proposed regenerative mechanism, we collected female coniferous cones every two weeks of the growing season (June-September 2019), to assess seed development. Preliminary findings of the three species have indicated that 30% seed viability is reached around 1900 to 2200 degree days (late August-mid September). This research aims to characterize the regenerative mechanism utilized among non-serotinous conifers, through examination of seed maturation timing, in relation to accumulating degree-days, for three northeastern California conifers. Additionally, we will investigate the timing of lightning and human caused fires, to compare with the timing of seed maturation to understand what percentage of area burned occurs after a portion of the first seeds mature. Insights from our research will aid in elucidation of future regeneration predictions and modeling, identify the timing of fires that will promote sufficient post-fire regeneration, and provide a better basis for understanding a previously uncharacterized regenerative mechanism.

ORAL

SPECIES INTERACTIONS AND BIOGEOCHEMICAL CYCLING DRIVE SHIFTING PATTERNS IN SUBALPINE FOREST PRODUCTIVITY ACROSS OREGON. Toby M.

Maxwell, Department of Biology, Institute of Ecology & Evolution. University of Oregon, Eugene, OR 97703; Lucas C.R. Silva, Department of Geography, Institute of Ecology & Evolution. University of Oregon, Eugene, OR 97703; tmaxwell@uoregon.edu

Trees can adjust to natural climate fluctuations by efficiently regulating leaf carbon and water exchange; however, the rapid pace of human induced climatic change threatens the ability of forests to sequester carbon and resist drought. While these limits are often characterized at the

scale of an individual tree, or a plot, this research seeks to characterize regional scale drivers of forest productivity across the state of Oregon. We use subalpine forests as a model system as their positioning at the edge of the habitable zone makes them responsive to climate. Due to that sensitivity, most studies rely on precipitation and temperature data to explain differences between sites, however, we employ a biogeochemical, topographic, and phenotypic data to explore a wider variety of controls on tree-line responses to climate change. We found that despite the common notion that subalpine forests are expanding uphill due to a warming climate, that this trend has halted in recent years, and currently, only about half of tree-lines are growing more quickly, while others are stable, or declining in growth rate. We find that annual precipitation normals, and not inter-annual climate variability explain this shift, and that sites with either high soil N nitrogen, or high nitrogen availability are growing more quickly than others, indicating stable site features, and nutrient limitation as previously unappreciated, yet important mechanisms for understanding tree-line change. Our work shows the value of merging biogeochemistry, landscape ecology, and geomorphology to generate an enhanced understanding of functional responses to climate change.

ORAL

HYDROLOGIC BUFFERING BY NATURAL ROOFTOP MOSSES IN OREGON. Bruce McCune, Claire Whittaker, Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331; Teryk Morris, Linn-Benton Community College, 6500 Pacific Blvd. SW, Albany, OR 97321; mccuneb@oregonstate.edu

Hydrologic buffering occurs at a wide range of scales on the planet from water balance in the environment of a single seed on the soil surface to whole continents. The potential role of natural moss mats in urban hydrobuffering is all but ignored. In cool oceanic climates mosses naturally colonize rooftops. Rooftop mosses have long been targeted by chemical treatment campaign by roofing contractors, the insurance industry, and homeowners, despite lacking evidence that mosses degrade rooftops. Chemical treatments with heavy metals and other toxins are delivered to our streams and aquifers. We compared hydrologic and biologic conditions of a mossy roof with a comparable bare roof in the rainy season of the oceanic climate of western Oregon, U.S.A. The moss mat on a 25-year old roof included 14 species of bryophytes and 4 species of macrolichens, with an average cover on N and E facets of 76%. The moss mat had an oven-dry mass averaging 0.8 kg/m² with water storage at saturation of 4 liters/m². Water holding capacity of individual moss genera ranged from 500 to 800%. The moss mat provided hydrologic capacitance. Maximum daily evaporation rates were approximately 4 liters/m². Very light rains produced zero runoff from the mossy roof. Days with rainfall of 0.15 inches produced runoff 15% of the precipitation input; heavy rain on a saturated rooftop runoff yielded 96% of precipitation input. We conclude that naturally mossy rooftops have considerable potential for reducing runoff in rainy winter weather.

LICHENS AND MOSSES AS BIOLOGICAL INDICATORS OF NITROGEN DEPOSITION IN NORTH CASCADES NATIONAL SERVICE COMPLEX.

Alida Melse, Meaghan Petix, R. Dave Evans, School of Biological Sciences, Washington State University, PO Box 644236, Pullman, WA 99164-4236; alida.melse@wsu.edu

Excess nitrogen (N) deposition can have adverse effects on ecosystems, leading to species loss and decline. N content and N isotope composition in lichens and mosses can be used to determine deposition levels and sources. This study focused on N deposition in the North Cascades National Park Service Complex (NOCA) using mosses and lichens. We hypothesized that a N isotope composition ($\delta^{15}\text{N}$) gradient would be found reflecting fossil fuel emissions on the western side of NOCA and agricultural activities on the eastern side of NOCA. We further hypothesized that $\delta^{15}\text{N}$ measured in mosses would match that of the nearest anthropogenic nitrogen source more closely than $\delta^{15}\text{N}$ in lichens. Eight samples each of one moss species and three lichen species were collected from 15 locations spatially distributed across NOCA. $\delta^{15}\text{N}$ content and isotope composition were measured in each sample. Our results show that a $\delta^{15}\text{N}$ gradient occurs from west to east in both the lichen and moss species. The western plots had more negative $\delta^{15}\text{N}$ values that are associated with agriculture whereas the $\delta^{15}\text{N}$ values for the eastern plots were more positive. We also observed an elevational gradient where $\delta^{15}\text{N}$ values were more negative at lower elevations and more positive at higher elevations. Overall, this data does not support our hypothesis in that the observed $\delta^{15}\text{N}$ gradient indicated more contributions from fossil fuels on the eastern side of NOCA and more contributions from agriculture on the western side of NOCA.

DETECTING AND PREDICTING PHARMACEUTICAL AND PERSONAL CARE PRODUCT (PPCP) ACCUMULATION IN PRESERVED BEES IN THE PACIFIC NORTHWEST.

Michael F. Meyer, School of the Environment, Washington State University, Pullman, WA 99164; Matthew R. Brousil, Center for Environmental Research, Education, & Outreach, Washington State University, Pullman, WA 99164; Elias H. Bloom, Department of Entomology, Michigan State University, East Lansing, MI 48824; Benjamin W. Lee, Department of Entomology, Washington State University, Pullman, WA 99164; Madison L. Armstrong, Department of Entomology, Washington State University, Pullman, WA 99164; David W. Crowder, Department of Entomology, Washington State University, Pullman, WA 99164; Stephanie E. Hampton, School of the Environment, Washington State University, Pullman, WA 99164; michael.f.meyer@wsu.edu

Sewage released from wastewater can introduce pollutants into environmental systems. Among potential co-contaminants within sewage byproducts, pharmaceuticals and personal care products (PPCPs) have been studied for both their usefulness as sewage indicators and their possible effects as emerging toxicants. The study of PPCPs in aquatic systems has demonstrated their environmental pervasiveness and capacity to elicit biological responses, even at minute concentrations (e.g., $\mu\text{g/L}$). In contrast, terrestrial systems are poorly represented, despite terrestrial museum collections offering spatially and temporally extensive research opportunities.

We analyzed preserved bee specimens (*Agapostemon texanus*, *Apis mellifera*, *Bombus vosnesenskii*) to detect PPCPs in samples that were collected across an urban-to-rural gradient near Seattle, USA between 2014 and 2016. Caffeine, 1,7-dimethylxanthine, cotinine, and acetaminophen/paracetamol were detected across all three bee taxa. The probability of detection, however, was species-dependent, with *B. vosnesenskii* (50%), *Agapostemon texanus* (44%), and *Apis mellifera* (26%) samples having detectable PPCP concentrations. When relating PPCP probability of detection with site-specific data, such as organic management, bee abundance, species richness, and soil characteristics, our data suggest that predicting PPCP accumulation in bees is complex, but can be accurately predicted. Together, these results suggest that an array of physical, chemical, and biological processes likely concentrate PPCPs, thereby increasing probability of detection.

PLENARY

TLINGIT RELATIONSHIPS WITH SEA OTTERS: WHAT CAN WE LEARN FROM ZOOARCHAEOLOGY TO ACKNOWLEDGE CULTURAL HERITAGE AND INFORM WILDLIFE MANAGEMENT? Madonna Moss, Department of Anthropology, University of Oregon, Eugene, OR 97403; mmoss@uoregon.edu

Sea otters (*Enhydra lutris*) were once common in the North Pacific but were extirpated from southeast Alaska by about A.D. 1830. In the 1960s, sea otters were re-introduced and now their populations are rapidly increasing. Today, sea otters and people are competing for some of the same commercially important invertebrates. After having been absent for nearly 150 years, the re-entry of sea otters into the food web has unsettled people who make their living from the sea. While some communities perceive sea otters as a threat to their economic livelihoods, some environmentalists view the return of sea otters as restoration of the marine ecosystem. The federal Marine Mammal Protection Act (1972) authorizes any Alaska Native who resides in Alaska to harvest sea otters for the purpose of subsistence provided that the harvest is not wasteful. Some are seeking to define “traditional” Tlingit use of sea otters as not only utilizing their pelts, but as consuming them as food: in their view both of these conditions have to be met before Alaska Natives would be entitled to harvest sea otters. This project investigates the zooarchaeological and ethnoarchaeological evidence as to whether Tlingit ancestors consumed sea otters as food in the past.

ORAL

USING TRADITIONAL ECOLOGICAL KNOWLEDGE TO PROTECT WETLANDS: THE SWINOMISH TRIBE’S WETLANDS CULTURAL ASSESSMENT PROJECT. Todd A. Mitchell, Nicole J. Capser, Jen Willup, Department of Environmental Protection, Swinomish Tribe, LaConner, WA; tmitchell@swinomish.nsn.us

Traditional wetland physical assessments do not adequately identify tribal cultural values of wetlands and thus not adequately protecting for cultural uses. The Swinomish Wetlands Cultural Assessment Project has developed a cultural module that can be incorporated into wetland assessments to better inform wetland protections. Local native knowledge was gathered about

the traditional uses of 99 plant species. A cultural module was developed based on the presence of plants in several use categories including: construction, ceremonial, subsistence, medicinal, common use, plant rarity, and place of value for each wetland. The combined score of the cultural and physical modules provides an overall wetland score that relates to proscribed buffer protection widths through the Tribe's wetland protection law. We hope this innovative method can serve as a model in combining traditional cultural values with scientific methods to help promote the breadth of knowledge our ancestors possessed into modern practical environmental protection.

POSTER

FRESHWATER MUSSEL INVESTIGATIONS IN IDAHO. Doug Nemeth, John Erhardt, Frank Mullins, Michael Murray, Chris Griffith; USFWS IFWCO, 276 Dworshak Complex Dr., Orofino, ID 83544; douglas_nemeth@fws.gov

Freshwater mussels are an integral component in many aquatic ecosystems but their populations are declining rapidly throughout North America. In Idaho, basic biological information such as distribution, abundance, and demographics of native mussels is limited. The U.S. Fish and Wildlife Service's Idaho Fish and Wildlife Conservation Office (IFWCO) Mussel Investigations project provides recurring dedicated effort to conserve and better understand mussel distribution, abundance, demographics, and trends in Idaho.

GOAL: Conserve Idaho's native freshwater mussels.

Objective 1. Document mussel species and their locations in Idaho's 14 ecological sections.

Objective 2. Determine and monitor abundance and demographics of freshwater mussels in Idaho.

Objective 3. Develop accurate methods of estimating mussel abundance.

Objective 4. Support mussel translocation efforts.

During 2019 statewide surveys, the IFWCO surveyed 30 streams in 54 distinct locations encompassing 6 ecosections with 15,613 mussels observed in 56 kilometers surveyed during Phase 1 index surveys of relative abundance (Objective 1). Quantitative Phase 2 demographic sampling (quadrats with excavation) will be conducted during 2020 in representative mussel aggregations identified during Phase 1 surveys. Phase 1 surveys will continue in different ecosections during 2020. We also completed Phase 1 index sampling in the upper Lolo Creek watershed (Clearwater River basin) used as our "experimental" watershed. We surveyed 69.5 contiguous kilometers of stream in the watershed observing over 164,000 western pearlshell mussels. The data collected from this effort will be used to evaluate the spatial distribution of mussels and consider the utility of various mussel survey techniques to provide accurate data (Objectives 2 and 3). The IFWCO also supports translocation efforts by other agencies through PIT tagging mussels for follow-up monitoring prior to translocation (Objective 4).

ORAL

ASSESSMENT OF MERCURY CONTAMINATION IN WASHINGTON LAKES. Emilia V. Omerberg, The Evergreen State College, Candidate for Masters of Environmental Studies. 4720 16th Ave SE. Lacey, WA 98503; eomerberg@gmail.com

Mercury contamination in aquatic systems is a global concern. In the State of Washington, fish are a major food source and bioaccumulation and biomagnification of mercury from primary consumers (zooplankton) to fish and subsequently to humans is cause for concern. In humans, exposure to mercury causes cognitive and hearing loss, impairs motor functions and neurologic development, and can even cause death. Some seasonal variation in mercury load has been observed in both the water column and in fish tissues, but little research has been done on mercury variation in zooplankton. In order to assess seasonal mercury in primary consumers, I analyzed mercury concentration in zooplankton from three lakes in Washington over the span of three months, including after the fall turnover and de-stratification of the lakes. I chose zooplankton because of their ubiquity in aquatic systems, their status as keystone species, and the role they serve as the entry point for mercury into the trophic system. Results will describe changes within each lake over time, as well as comparisons between the three lakes. Knowing when mercury loads are lowest in zooplankton, we can ascertain when levels in fish might be low and therefore when human consumption is safer.

ORAL

THE TRADITIONAL CULTURAL PLANTS PROJECT MOVING FORWARD 2020
SYLVIA TATSHAMA PEASLEY AND PENDLETON MOSES
HISTORY/ARCHAEOLOGY PROGRAM, CONFEDERATED TRIBES OF THE
COLVILLE RESERVATION. Sylvia Tatshama Peasley, Pendleton Moses, Cultural Plants Program, History & Archaeology, Confederated Tribes of the Colville Reservation, P.O. Box 150, 21 Colville Street, Nespelem, WA 99155; sylvia.peasley@colvilletribes.com

In 2012, the Colville Business Council initiated the Traditional Cultural Plants Project to survey and map populations of cultural plants on the Reservation, and to create a herbarium to house collected voucher specimens of all plants. The rationale behind this project was to provide information to tribal gatherers on where to access foods and medicines, and to improve management of cultural (and sometimes rare) plant populations faced with potential damage from logging, grazing, agriculture or development. Field surveys and the herbarium collection began in 2013, with rudimentary mapping technology. In 2016, we started monitoring important food and medicine plants for the effects of fire and climate change. By early 2017, the H/A Program's new GIS analyst brought us state-of-the-art mapping technology – we now take a point or trace a polygon on an iPad with ESRI/Collector software, to be uploaded to a secure website. Information includes details on the size and health of the cultural species being mapped, habitat details, disturbances and more. Surveys have expanded into the vast Traditional Territories. We now collect data on the effects of fire and climate change for our focus species from permanent transects using ESRI/Survey 123. We work on additional contracts that involve mapping, monitoring and even creating a field guide. We have become absorbed with learning

traditional skills, such as working with Indian hemp, and re-constructing tools used to process the fibers.

ORAL

HOGS AND HAZELNUTS: CREATING A WIN-WIN FOR OAK CONSERVATION AND ORGANIC AGRICULTURE.

Calvin Penkauskas, Dr. Lauren Hallett, Alejandro Brambila, Department of Environmental Studies, University of Oregon, 5223 University of Oregon, Eugene, OR 97401; Taylor Larson, My Brothers' Farm, 84674 Cloverdale Rd, Creswell, OR 97426; Betsey Miller, Department of Horticulture, Oregon State University, 2750 SW Campus Way, Corvallis, OR 97331; cpenkaus@uoregon.edu

The hazelnut (*Corylus avellana*) has been an agricultural success in Turkey and more recently in the United States – with Oregon producing over 99% of hazelnuts grown in the US, approximately 4% worldwide. Filbertworm (*Cydia latiferreana*) is the key economic pest in the Pacific Northwest and accounts for a major source of pesticide use on organic hazelnuts. Oregon white oak (*Quercus garryana*) is a native host for filbertworm, and oak woodlands maintain source populations that re-infest orchards. The majority of remnant oak woodlands are on private agricultural land and hazelnut producers are incentivized to clear oaks from their property to minimize crop infestation. This is of concern because Oregon white oak's native range has reduced over 95% since the 1800's, and oaks are an important keystone species in the region. Domesticated pigs (*Sus domesticus*) have historically been used to glean fallen fruit from orchard floors and are efficient woodland grazers. Our team conducted a two-year study investigating how silvo-pasturing pigs affects filbertworm emergence in an Oregon white oak woodland and an adjacent organic hazelnut orchard. We found that there was significantly lower filbertworm emergence in the grazed woodland with a significant reduction of infested acorns. These results support our hypothesis that grazing pigs in oak woodlands reduces filbertworm emergence by interrupting its life-cycle, primarily by the removal of infested acorns from the forest floor. Vegetation thinning by prescribed burns in conjunction with attentive grazing may alleviate some competition vulnerability, reduce feral-hog susceptibility, increase grazing efficacy, and potentially mitigate invasive species.

ORAL

ASSESSING NITROGEN CRITICAL LOADS AT NORTH CASCADES NATIONAL PARK SERVICE COMPLEX.

Meaghan I. Petix, School of Biological Sciences and WSU Stable Isotope Core Facility, Washington State University, Pullman, WA 99164; Michael D. Bell, Air Resources Division, National Park Service, Lakewood, CO 80225; R. Dave Evans, School of Biological Sciences and WSU Stable Isotope Core Facility, Washington State University, Pullman, WA 99164; meaghan.petix@wsu.edu

Anthropogenic nitrogen (N) deposition (N_{dep}) contributes globally to disruptions in nutrient cycling, ecosystem functioning, and shifts in community composition. National Park Service (NPS) lands, including the North Cascades National Park Service Complex (NOCA), contain ecosystems that are potentially sensitive to N_{dep} . Accurate measurements of N_{dep} are needed to determine N critical loads, levels of N_{dep} that can be sustained without adverse biological effects.

However, model estimates have a high degree of uncertainty, especially in mountainous regions such as NOCA. The N concentration of epiphytic lichens can be utilized to monitor N_{dep} because their relationship can be modeled for a given region, and their N stable isotope composition can assess contributions of different N pollution sources. This study will determine which ecosystems in NOCA are affected by N_{dep} and identify predominant sources of N emissions. We established 30 plots across NOCA to determine lichen community composition and N content and stable isotope composition. We found levels of N_{dep} increased moving east in the northern portion of the park. There was not a strong relationship for lichen N content along an elevational gradient, but N stable isotope composition tended to be higher with increasing elevation. Nitrogen stable isotope composition was very negative, ranging from -0.7 to -10.6 ‰, and varied among lichen species. This study is in the second year and will incorporate lichen community composition and atmospheric chemistry models in a GIS framework in the future.

POSTER

ASSISTED MIGRATION MAY BE NECESSARY TO SAVE NATIVE PRAIRIE SPECIES FROM CLIMATE CHANGE. Paul B. Reed, Laurel E. Pfeifer-Meister, Bitty A. Roy, Bart R. Johnson, Graham T. Bailes, Aaron A. Nelson, Scott D. Bridgham, University of Oregon, Eugene, OR 97403; Megan L. Peterson, University of Georgia, Athens, GA 30606; William F. Morris, Duke University, Durham, NC 27708; Daniel F. Doak, University of Colorado, Boulder, CO 80309; preed@uoregon.edu

Climate change poses an existential threat to plant species with restricted geographic ranges. However, climatically favorable habitat may exist at higher latitudes if species can reach such locales. We used a three-year climate manipulation experiment at three sites spanning a natural latitudinal climate gradient in the Pacific Northwest to examine the impacts of climate change on the demography of six native perennial prairie species planted near or beyond their northern range boundaries. At each site, 20 plots were divided evenly into controls and three climate treatments: drought, warming, and warming+precipitation. Each year, we measured rates of survival, growth, and reproduction to calculate population growth rates (λ) for each species. We found that warming negatively affected λ relative to controls at sites within a species' current range, but along with drought, positively affected populations of the two range-restricted species beyond their current northern limits. Thus, climate change appears to make current ranges less hospitable, but beyond ranges more hospitable. These results support predictions that ranges will need to shift with climate change as populations within current ranges become increasingly vulnerable to decline. The taxa we studied are core species in an endangered ecosystem of the Pacific Northwest, suggesting that restoring for future climates will be critically important. If species are not capable of dispersing beyond their leading edges on their own, assisted migration may need to be considered in regional restoration efforts.

USING TREE RINGS TO UNDERSTAND CLIMATIC DRIVERS OF JUNIPER GROWTH ACROSS THE GREAT BASIN. Schyler Reis, Lucas Silva, Department of Geography, University of Oregon, OR 97331; schyllerr@uoregon.edu

Juniper woodlands are dynamic ecosystems; increasing and decreasing in geographic range as temperature and precipitation patterns varied over the last 12,000 years. However, recent expansion of juniper woodlands is not well understood. Recent changes in juniper range have been attributed to land use change. The role of climate dynamics has received little consideration in analyses of juniper woodland expansion and large-scale management actions intended at juniper woodland reduction. The goal of this study is to understand how regional variability in precipitation and temperature have affected juniper tree growth over the past 120 years, across the entirety of its range. We utilize tree ring cores collected *in situ*, along with previous western juniper (*Juniperus occidentalis*) studies from the International Tree-Ring Data Bank, to examine the growth responses of western juniper trees (n=492) to monthly and seasonally resolute climate variables obtained from the PRISM climate data set. A multivariate analysis shows groupings of sites by growth response that form geographic patterns distinct from those formed when sites are ordinated by climate alone. We hypothesize that edaphic properties play a role in modulating tree growth response to climate. An analysis using a moving window correlation function of tree-ring growth and seasonally resolved temperature and precipitation data shows divergent correlations across sites with a period of convergence in patterns of tree growth response dynamics to temperature and precipitation from approximately 1950-1980 at all sites. The possibility of spatiotemporal extrapolation of these results across the Great Basin is discussed.

ORAL

FRESHWATER BORON CONTENT OF *DICKINSONIA* AND OTHER PROBLEMATIC EDIACARAN FOSSILS. Gregory J. Retallack, Department of Earth Sciences, University of Oregon, Eugene, OR 97403.

Boron content is an indicator of paleosalinity for Mesozoic and Cenozoic clayey sediments, but is compromised by clay diagenesis in deeply-buried sediments of Paleozoic and Ediacaran age. This study of North American, Russia and Australian, Paleozoic and Ediacaran fossils showed tight covariance of B (ppm) and K (wt %), confirming common wisdom that boron is carried largely by illite-smectite clays. Ratios of B/K greater than 40 $\mu\text{g/g}$ distinguish modern marine and freshwater sediments, but this discrimination threshold declines to 21 $\mu\text{g/g}$ for sequences with bituminous coal just below the anchimetamorphic zone, and to 5 $\mu\text{g/g}$ for sequences within the anchimetamorphic zone toward greenschist facies. Marine-non-marine threshold B/K values can be predicted from Weaver and Kübler indices of illite crystallinity, as a measure of B depletion during deep burial and metamorphism. Deviations from that expectation ($\Delta\text{B/K}$ -Weaver and $\Delta\text{B/K}$ -Kübler) are positive in marine rocks, and negative in non-marine rocks. Trilobites, stromatolites and other marine fossils were correctly identified as marine by this proxy, and fossil land plants identified as non-marine, though in some cases by small margins. Cryogenian to Devonian vendobionts (*Dickinsonia*, *Arumberia*, *Rangea*, *Pteridinium*, *Ernietta*, *Aspidella*, *Rutgersella*, *Protonympha*) are indistinguishable from Devonian to Triassic plants,

and significantly different from trilobites, brachiopods, ammonites and other securely marine fossils.

ORAL

SPATIAL PATTERN AND FREQUENCY OF DEBRIS FLOWS IN STEHEKIN, WASHINGTON. Jon L. Riedel, Sharon Sarrontonio, North Cascades National Park, 7280 Ranger Station Road, Marblemount, WA 98267; riedeljon7@gmail.com

We examined the frequency, magnitude, and spatial patterns of debris flows at multiple spatial scales in North Cascades National Park, with a focus on the lower Stehekin River valley (SRV). Debris flow activity across the park is asymmetrical, with nearly 2/3 of 1300 debris cones built from southwest-facing valley walls. Within SRV, we identified 113 debris flows since 1978 on 303 debris cones; 73 were from south-to-southwest facing slopes. Southwest-facing mountain slopes are generally more prone to debris flows because of less soil and limited vegetation cover due to solar exposure and more-frequent fire activity. Three of 34 debris flow systems in lower SRV are best characterized as debris flood systems with large basins ($>15 \text{ km}^2$), and lower stream (13°) and debris cone ($5\text{-}10^\circ$) slopes. Thirty true debris flow 31 systems have debris cone slopes $>10^\circ$. Three alluvial fans have surface slopes $<5^\circ$. We sampled charcoal from soil surfaces buried by ancient debris flows to determine flow frequency during the past 2,000 years. Twenty-one radiocarbon ages and historic events on seven systems give an average debris flow recurrence interval (RI) of ~ 400 years. Systems with abundant sediment supply have a smaller RI. Rainfall triggering 15 recent debris flows in lower SRV included summer cloudbursts in 2010 and 2013, and a fall 2015 rain-on-snow event. The summer storms had peak intensities of 7-9 mm/hour and sustained rainfall of 8-11 hours. The fall 2015 event on Canyon Creek occurred after 170 mm of rain in 78 hours.

ORAL

GRAZING DISTURBANCE PROMOTES EXOTIC ANNUAL GRASSES BY DEGRADING SOIL BIOCRUST COMMUNITIES. Heather T. Root, Botany Department, Weber State University, Ogden, UT 84401; Jesse E. D. Miller, Department of Biology, Stanford University, Stanford, CA 94304; and Roger Rosentreter*; Biology Department, Boise State University, Boise, ID 83725; roger.rosentreter0@gmail.com

Exotic invasive plants threaten ecosystem integrity, and their success depends on a combination of abiotic factors, disturbances, and interactions with existing communities. In dryland ecosystems, soil biocrusts (communities of lichens, bryophytes, and microorganisms) can limit favorable microsites needed for invasive species establishment, but the relative importance of biocrusts for landscape-scale invasion patterns remains poorly understood. We examine effects of livestock grazing in habitats at high risk for invasion to test the hypothesis that disturbance indirectly favors exotic annual grasses by reducing biocrust cover. We present some of the first evidence that biocrusts increase site resistance to invasion at a landscape scale and mediate the effects of disturbance. Biocrust species richness, which is reduced by livestock grazing, also appears to promote native perennial grasses. Short mosses, as a functional group, appear to be particularly valuable for preventing invasion by exotic annual grasses. Our study suggests that

maintaining biocrust communities with high cover, species richness, and cover of short mosses can increase resistance to invasion. These results highlight the potential of soil surface communities to mediate invasion dynamics and suggest promising avenues for restoration in dryland ecosystems.

ORAL

INTER- AND INTRASPECIFIC VARIATION IN WATER HOLDING CAPACITY AND SPECIFIC THALLUS MASS IN EPIPHYTIC LICHENS ON *QUERCUS GARRYANA* IN THE CASCADE-SISKIYOU NATIONAL MONUMENT. Miles Rozatti, Lalita Calabria, The Evergreen State College, 2700 Evergreen Pkwy NW, Olympia, WA 98505; Jesse E. D. Miller, Dept. of Biology, Stanford University, Stanford, CA 94305; John Villella, Siskiyou Biosurvey LLC, Eagle Point, OR 97524; rozmil15@evergreen.edu

Epiphytic lichens are diverse and ecologically important in forest ecosystems worldwide. Lichens are poikilohydric organisms, and their water content is therefore more sensitive to environmental change than vascular plants, making them useful ecological indicators. However possible implications of species-specific hydration traits are still incompletely known. We examined the interspecific variation of water holding capacity (WHC) and specific thallus mass (STM) for 20 commonly occurring epiphytic lichen species collected from Oregon White Oak (*Quercus garryana*) across 52 plots in the Cascade-Siskiyou National Monument in Jackson County, Oregon. We also measured the intraspecific variation in WHC and STM for a subset of seven species. Lichens functional trait data was analyzed according to lichen growth forms and photobiont partners. We found that foliose and cyanolichen growth forms had higher WHC than the fruticose lichens. STM was not a significant driver of WHC in hair lichens but rather growth form was a more important predictor of WHC. When sampled intraspecifically, we found that *Evernia prunastri* had greater variance as well as higher averages of WHC and STM than *Letharia vulpina*. Given that lichen functional traits are likely to be important in driving ecological processes in the same way plant functional traits are, understanding the variation of STM and WHC within lichen species communities can inform us how communities might respond to changing climate conditions.

POSTER

TROPICAL PEATLANDS IN WEST KALIMANTAN: FORMATION, CARBON AND LATE PLEISTOCENE-HOLOCENE HISTORY. Monika Ruwaimana, Daniel G. Gavin, Department of Geography, University of Oregon, Eugene, OR 97403; Gusti Z. Anshari, Environmental Science, Universitas Tanjungpura, JL. Prof. Dr. H. Hadari Nawawi, Pontianak, Indonesia, 78124; mruwaima@uoregon.edu

Tropical peatlands in South East Asia have functioned for thousands of years as a long-term carbon reservoir. However, large scale forest fires over the last three decades have greatly degraded the peatlands releasing their carbon. This has brought international attention to their impact on global carbon dynamics. However, fundamental properties of tropical peatlands remain poorly understood, thus we conducted an exploratory and descriptive analysis on the formation of, and carbon and fire history of the tropical peatlands.

Tropical peatlands can be divided into two categories, coastal and inland—that established following sea-level stabilization during the mid-Holocene or are constrained by climate respectively. Our basal radiocarbon indicates formation of coastal peatlands around 4.5 ka and inland peatlands around 47.8 ka. A synthesis of new and existing peat basal dates across Borneo show a hiatus during a cool and dry period from 30 to 20 ka. Despite this hiatus during which peat potentially degraded, the inland peat is still exceptionally deep, averaging 10.2 m and containing 4390 Mg C/ha, indicate that it is one of the most carbon-dense ecosystems in the world.

Inland peat charcoal counts show three different fire regimes: zero to few which probably indicated the natural fire regime; 10-20 count which probably connected to either the emergence of farming practice or the formation of the ENSO; and >50 count indicating the modern fire regime. Coastal peat charcoal only shows two fire regimes, natural and modern, but with count >200, indicating more severe disturbance on the coastal peatlands.

ORAL

PALEOECOLOGICAL ANALYSIS USING SELECT COPROLITES AND SEDIMENTS RECOVERED FROM PAISLEY CAVES 2, OREGON. Chantel V. Saban, Erin Herring, Department of Geography, 107 Condon Hall, University of Oregon, Eugene, OR 97403; csaban@uoregon.edu

Rock shelters and caves often preserve rich records of local paleoecological conditions. However, caves can be limited in how much of an environmental area the preserved materials reflect. Coprolites can expand this paleoecological window by revealing a more open-area pollen signature captured as an organism moves beyond the cave boundaries. Our objective was to assess paleoenvironmental conditions in and around the Paisley Caves by comparing pollen taxa and abundances between sediments and coprolites. Our study compared pollen recovered from mammalian coprolites to pollen found in coprolite-associative sediments. The materials represent a period of marsh expansion in the Summer Lake basin during a period between the terminal Pleistocene through the mid-Holocene.

By using nonmetric multidimensional scaling to compare two independent axes of variation our results showed distinct differences between sedimentary and coprolite pollen. Our results showed a higher variability of both pollen concentrations and taxa present in the coprolites compared to the sediments. The variability in the coprolites is consistent with feces being "spiked" with variable amounts of pollen in the gut resulting from being inhaled and ingested during movement, making coprolite pollen representative of a brief temporal window while cave sediment samples integrated a decade or more of pollen deposition. These differences highlight the usefulness of identifying and comparing passive and active proxies for interpreting paleoecological variability.

ORAL

SPECIES SELECTION IN SEED-BASE RESTORATION. Todd E. Erickson, School of Plant Biology, University of Western Australia, WA 6009; Gustavo Paterno, Departamento de Ecologia, Universidade Federal do Rio Grande do Norte; Katharine Suding, Department of Ecology and Evolutionary Biology, University of Colorado Boulder, CO 80309; nshack@uvic.ca

The challenge of reintroducing plant species into degraded landscapes is arguably the biggest scientific hurdle in meeting restoration policy initiatives. Clearing this hurdle will require a global coordinated effort: reintroduction of desired plant species is typically done via seed addition, and recruitment via this added seed is often extremely low. Seed-based recruitment and early survival are often very sensitive to climate variation, with species life history strategies (e.g. generation time, life expectancy) predictive of early stage responses to climate variation. Yet, beyond this very general understanding of a connection between climate and recruitment, surprisingly little is known. The Global Arid Zone Project is an emerging, grassroots organization that is pooling seed-based restoration outcomes worldwide for a broader understanding of restoration drivers. The resulting database contains over 100 individual projects in 16 countries, and contains seed-based recruitment and survival data for 483 species globally. Here, we assess whether the match between species estimated climate and functional niches can predict recruitment dynamics at the site level. We focus on readily available distribution and climate information, coupled with key functional traits that are generalizable and accessible for species globally. Findings highlight the importance of careful species selection, and provide potential recommendations for coping with predicted climate shifts.

ORAL

WEB-BASED TOOLS FOR DETERMINING SEED SOURCES FOR REFORESTATION AND RESTORATION FOR CURRENT AND FUTURE CLIMATES. Brad St. Clair, US Forest Service Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; Bryce Richardson, US Forest Service Rocky Mountain Research Station, 1221 South Main Street, Moscow, ID 83843; Nikolas Stevenson-Molnar, Conservation Biology Institute, 136 SW Washington Ave #202, Corvallis, OR 97333; brad.stclair@usda.gov

Healthy, productive ecosystems require diverse plant populations that are adapted to the climates in which they are growing. The concept of local adaptation has been recognized as a critical component to reforestation success and forest productivity for nearly a century, leading to the development of seed zones and seed movement guidelines for forest trees, and, more recently, non-tree restoration species. Fixed-boundary seed zones, however, assume that climates are static over time, which is no longer the case. We present two web-based tools, the Seedlot Selection Tool and the Climate-Smart Restoration Tool, that allow users to specify climatic transfer distances for climate variables that are important for determining adaptation of plant populations to growing environments. The tools map the locations of the climates that fall within the climatic transfer distances for current climates and the future climates of three different time periods in the 21st century. They may be used to show the locations of seedlots that may be suitable to a planting site, or the locations of planting sites suitable for a seedlot. The Climate-Smart Restoration Tool also includes an option to use results from genetic studies to map multi-variate

climates related to adaptive traits in common garden studies. Results indicate that although native populations may be expected to be adapted to local climates in the near-term, they may be expected to be maladapted by mid- to late-century with adapted populations found at great distances. Assisted migration may be required to ensure continued forest productivity and restoration success.

POSTER

TECTONIC IMPLICATIONS AND DEFORMATION RECORDED BY PLEISTOCENE MARINE TERRACES ABOVE THE CASCADIA SUBDUCTION ZONE, WILLAPA BAY, WASHINGTON. Kelsay M. Stanton, Juliet G. Crider, Department of Earth and Space Science, University of Washington, Johnson Hall RM-070, 4000 15th Ave NE, Seattle, WA 98195-1310; kelsst@uw.edu

Uplifted Pleistocene marine terraces along Grays Harbor and Willapa Bay, Washington provide insight into long-term coastal deformation related to the Cascadia subduction zone. We investigate the degree of deformation using detailed, 1:24,000 scale geologic mapping and GIS-based geomorphic analyses, coupled with optically stimulated luminescence dating of the terrace deposits. At least four marine terrace sets, ranging in age from late to early Pleistocene, suggest uplift from unrecovered strain related to convergence. Estuarine deposits compose the terraces, which therefore represent constructional surfaces deposited near sea-level. Geomorphic analyses reveal a spatial difference in preserved terraces, with higher terraces preserved south of Grays Harbor but not along eastern Willapa Bay. Terraces also display gently sloping surfaces, probably the result of gradual long-term uplift related to subduction as estuarine sediments were deposited.

ORAL

THE ROLE OF ETHNOHISTORY, TRADITIONAL KNOWLEDGE, AND CULTURAL FIRE REGIMES IN FIRST FOODS MANAGEMENT: APPLICATIONS TO *VACCINIUM MEMBRANACEUM* IN THE EASTSIDE CASCADES. Michelle M. Steen-Adams, Susan Charnley, Mark Adams, Kendra Wendel, Pacific Northwest Research Station, USDA Forest Service, 620 SW Main Street, Suite 502, Portland, OR 97205; Rebecca McLain, Institute for Sustainable Solutions and National Policy Consensus Center, 1600 SW 4th Avenue, Suite 110, Portland State University, Portland, OR 97207; michelle.steen-adams@usda.gov

A central challenge of returning human-adapted ecosystems to the Northwest lies in reinvigorating the social-ecological processes that historically maintained a community's first foods. In this study, we collaborated with the Confederated Tribes of Warm Springs (CTWS), who reside in the eastside Cascades, to generate knowledge regarding restoration of forest resilience and first foods. We examined ethnohistorical and ecological data resources to characterize the CTWS' traditional knowledge and cultural fire regimes. Our methods featured innovation of an integrative landscape ecological- anthropological research design, which featured three ecological zones, for two reasons: (1) to promote a participatory process between tribal community members and scientists; (2) to enhance the geographical precision of the various cultural fire regimes within the CTWS' seasonal round area. Our analysis revealed a

pronounced cultural fire regime in the moist mixed conifer zone, as structured by traditional knowledge regarding thinleaf huckleberry (*Vaccinium membranaceum*). Specifically, our analysis enabled characterization of traditional knowledge system elements (practices; culture; the seasonal round; ecological principles) that historically maintained huckleberry productivity. Our analysis also indicated restoration applications at nested spatial scales (site-scale; landscape-scale). Practices to promote thinleaf huckleberry restoration include: maintenance of canopy openings, either through frequent application of low-severity fire or silvicultural treatments that approximate the cultural fire regime (site-scale application); management across ownerships and a broad spatial extent (10,000's hectares) (landscape-level application); and engagement of the holders of traditional knowledge. In addition, our study's sustained, 5-year period of collaboration revealed insights about the process of partnership-building between scientists and tribal communities.

ORAL

THE RANGES OF *XANTHOMENDOZA HASSEANA* AND *X. MONTANA* APPEAR QUITE SEPARATE. Daphne Stone, Department of Botany and Plant Pathology, Oregon State University, Cordley Hall, 2701 SW Campus Way, Corvallis, OR 97331; daphstone@gmail.com

Although *Xanthomendoza hasseana* and *X. montana* look very similar, they are clearly two species, distinguishable by septum width. The general range of *Xanthomendoza montana* is east of the Cascade Mountains, while *X. hasseana* is found west of the Cascades. From previous studies it is not clear where the ranges of the species overlap, and what kind of habitat allows sympatry. We examined *X. hasseana* and *X. montana* specimens from the Forest Inventory and Analysis (FIA) collections, measured spores and septa from each and mapped their locations. The ranges of the two species appear to be distinctly not overlapping.

POSTER

ATMOSPHERIC AND NEAR-SURFACE SOIL TEMPERATURES FROM THE SOUTHERN ASPECT OF MT. BAKER FOR JULY 2018 - JULY 2019. Michael S. Town, Science Department, Lakeside School, Seattle, WA 98125; Logan Searl, Languages Department and Upper School Outdoor Program Coordinator, Lakeside School, Seattle, WA 98125; michael.town@lakesideschool.org

Here we present annual cycles of atmospheric and near-surface soil temperature data collected along the southern aspect of Mt. Baker from July 2018 - July 2019. Sixteen Maxim iButton temperature sensors were deployed to nine different locations along a common southern ascent of Mt. Baker. Temperature sensors were set out in arrays of opportunistic combinations of buried, shaded, and unshaded locations, and collected data at intervals of 4.25 hours. The summer diurnal temperatures observed at Schriebers Meadow (1200. m) ranged from 10°C to 30°C, while winter diurnal temperatures observed at the same location were -15°C to 0°C. The temperature arrays can be used to derive snow extent (Lundquist and Lott, 2008) and act as a proxy for insolation (Lundquist and Huggett, 2008), algorithms for which have been developed using iButton data collected on school grounds. All temperature data presented here were collected as part of a novel, symbiotic partnership between three existing programs at Lakeside

School, an independent high school in Seattle, WA. The symbiosis between our science internship, outdoor, and service learning programs stems from mechanisms related to external relevance, sense of purpose, and stable logistics.

POSTER

SITE PREPARATION AND SUBSURFACE WATERING TECHNIQUES ENHANCE DRY-LAND RESTORATION SUCCESS. Brad Trumbo, US Army Corps of Engineers, 201 N 3rd Ave, Walla Walla, WA 99362; bradly.a.trumbo@usace.army.mil

In 1975, The US Army Corps of Engineers, Walla Walla District (Corps) drafted the Lower Snake River Fish and Wildlife Compensation Plan (Comp Plan) to guide mitigation for hunter and angler opportunity lost to inundation from the lower Snake River dams. Habitat development and enhancement were major Comp Plan components emphasizing palustrine scrub-shrub (PSS) and palustrine forest (PF) riparian. Post-inundation site conditions were generally incompatible with riparian habitat types requiring unsustainable irrigation. With over 40 years of lessons learned, a recent effort to establish quality PSS and PF habitats was conducted 2016 - 2019. Corps Habitat Management Units, Central Ferry and Rice Bar, received 16.1 and 8.1 hectares of restoration, respectively. The Corps contracted with EAS in Richland, WA, to develop an aggressive site preparation plan including geophysical surveys and excavation. Geophysical surveys located water table depth, informing plans to move 1-2 meters (m) of soil to tap in PF species such as coyote willow (*Salix exigua*) and black cottonwood (*Populus trichocarpa*). The PSS species such as gray rabbitbrush (*Ericameria nauseosa*) and basin big sagebrush (*Artemisia tridentata*) received individual watering tubes into their roots with bi-weekly hand watering. Overall plant survival was monitored for 15 months with final estimates ranging from 76-86% among sites and planting events, exceeding some historic efforts by more than 40%. While plant growth was not monitored, black cottonwood was observed growing more than 3m in the first season.

POSTER

NEON PROGRAM CANOPY FOLIAGE SAMPLING TEST EFFORT USING EMERGING UNMANNED AERIAL SYSTEM TECHNOLOGY. Ben Vierra, Jessica Zemaitis, National Ecological Observatory Network, 1211 SE Cardinal Court, Suite 120, Vancouver, WA 98683; Dave Durden, Samantha Weintraub, National Ecological Observatory Network, Suite 100, 1685 38th Street, Boulder, CO 80301; bvierra@battelleecology.org

The National Ecological Observatory Network [NEON] is a long-term, continental-scale, open-data effort to characterize ecosystem change over time. The program is funded by the National Science Foundation and operated by Battelle. Among other data collection efforts, NEON tracks changes in chemical and physical properties of sun-lit foliage over time. The need to collect sun-lit foliage samples at the network's tallest-stature forest sites, such as at the Wind River Experimental Forest [WREF] near Carson, WA, presents a significant technical obstacle. In July 2019 NEON conducted an Unmanned Aerial System (UAS) based canopy foliage sampling campaign at the WREF site to test the feasibility of using this emerging technology at NEON's tall-stature forested sites. The collection device used in this effort was developed and provided

by the DeLeaves company. UAS-based sampling was found to be safe and efficient, with samples from trees up to 50 m tall able to be collected within 10 minutes per sample after an initial site-setup period. In contrast, concurrent use of a line launcher (frequently used at other NEON field sites) required 20 minutes to 2 hours per sample, could not reach samples from as high in the canopy, and subjected field staff to more hazards (for example, pulling down larger limbs from tall heights). The only major technical limitation of the DeLeaves UAS-based sampling system observed during this sampling effort was effective range from the base station (approximately 150 m).

ORAL

USING LICHEN COMMUNITIES AS INDICATORS OF FOREST AGE AND CONSERVATION VALUE. Jesse E. D. Miller, Department of Biology, Stanford University, Palo Alto, CA 94305; John C. Villella*, Siskiyou Biosurvey LLC, Eagle Point, OR 97524; Daphne Stone, Stone Ecosurveys LLC, Eugene, OR 97405; Amanda Hardman, US Forest Service, John Day, OR 97845; john.c.villella@gmail.com

Evaluating the conservation value of ecological communities is critical for forest management but can be challenging because it is difficult to survey all taxonomic groups of conservation concern. Lichens have long been used as indicators of late successional habitats with particularly high conservation value because lichens are ubiquitous, sensitive to fine-scale environmental variation, and some species require old substrates. However, the efficacy of such lichen indicator systems has rarely been tested across broad geographic regions, and their reliability has not been established with well-replicated quantitative research. In this study, we develop a continuous lichen conservation index representing epiphytic macrolichen species affinities for late successional forests in the Pacific Northwest, USA. This index classifies species based on expert field experience and is similar to the coefficient of conservatism that is widely used for evaluating vascular plant communities in the central and eastern USA. We then use a large forest survey dataset from the Cascade Range of Oregon and Washington, USA, to test whether the community-level lichen conservation index is related to forest stand age.

We find that the lichen conservation index has a positive, linear relationship with forest stand age when averaged at the community level. In contrast, lichen species richness has a weak, unimodal relationship with forest stand age; thus, it is not a useful indicator. We also find that the lichen conservation index has a stronger relationship with forest stand age than the richness of old growth indicator species or the proportion of old growth indicator species in the community when old growth indicator status is a binary classification. Thus, our continuous ranking system appears to have substantial advantages over existing old forest lichen indicator systems that classify species as either old growth forest indicators or not. Our findings highlight that lichen communities can be useful indicators of late successional habitats of conservation concern, and that indicator systems based on expert experience can have strong biological relevance.

STRATIGRAPHY PROVES TENS OF LAST-GLACIAL MISSOULA FLOODS THROUGH HIGH TRACTS OF CHANNELED SCABLAND. Richard B. Waitt, U.S. Geological Survey, 1300 SE Cardinal Ct., #100, Vancouver, WA 98683; waitt@usgs.gov

Dozens of late Wisconsin Missoula-flood beds, each separated by varved beds, prove that each gigantic Missoula flood lays but one major graded bed. Critics have for many years billed the evidence for repeated Missoula floods as being only low-energy deposits confined to low routes. Stratigraphy of gravel bars and backflood deposits show that numerous high-energy floods swept down high scabland tracts. Pine Coulee exposes 12 flood beds near the upper limit of flooding into the Cheney-Palouse scabland. About 25 separate gravel-bearing floods backflooded from this tract into Willow Creek. Rhythmic backflood beds in Tucannon valley record at least 25 floods down this tract. Rhythmic beds record at least 21 separate such floods that backflooded far up Snake valley. Intercalated Mount St. Helens ash shows many of these floods were the same as backwashed Walla Walla and Yakima valleys. Former cuts showed 22 or more beds by separate floods that from Portland basin swept over Lake Oswego trough into Tualatin valley. Thickening Purcell Trench ice dammed Lakes Missoula that released giant floods once every few to several decades. Okanogan ice closed three western floodways before reopening one. This changing geography shifted routings of successive floods. New 2-D hydraulic models governed by shallow-water-flow equations show Missoula floods under different geographic conditions flooded high scabland tracts nearly to the upper limits of field evidence. Channels blocked in succession gave different channels peak discharges during different floods. No one Missoula flood could inundate all floodways up to the limits shown by evidence.

POSTER

GENETIC RELATIONSHIPS AMONG ROCKY MOUNTAIN RIDGED MUSSEL (*GONIDEA ANGULAA*) POPULATIONS. Ian R. Walker, Dept. of Earth, Environmental & Geographical Sciences, and Department of Biology, Okanagan Campus, University of British Columbia, Kelowna, BC, Canada V1V 1V7; Karen E. Mock, Jim Walton, Molecular Ecology Laboratory, Department of Wildland Resources, Quinney College of Natural Resources, Utah State University, NR 338, 5230 Old Main Hill, Logan, UT 84322-5230; Steven F. R. Brownlee, Dept. of Earth, Environmental & Geographical Sciences, and Department of Biology, Okanagan Campus, University of British Columbia, Kelowna, BC, Canada V1V 1V7; Jon H. Magerøy, Norwegian Institute for Nature Research (NINA), Gaustadalléen 21, NO-0349 Oslo, Norway; Greg Wilson, Conservation Science Section, British Columbia Ministry of Environment and Climate Change Strategy, P.O. Box 9338, STN PROV GOVT, Victoria, BC, Canada V8W 9M1; ian.walker@ubc.ca

The Rocky Mountain Ridged Mussel (also known as the Western Ridged Mussel) is a mollusc native to Canada (Okanagan Valley of British Columbia), and the western United States (ID, WA, OR, NV, CA). In Canada it is considered endangered by the Committee on the Status of Endangered Wildlife in Canada. In the United States, its status varies among states, ranging from vulnerable to critically imperiled. To establish genetic relationships among Canadian populations and their American counterparts, Rocky Mountain Ridged Mussels collected from throughout

much of the western United States, and southern British Columbia, Canada were analysed genetically for both mitochondrial haplotypes and microsatellite markers. Mitochondrial haplotypes demonstrate that the Canadian mussels are little differentiated from those collected elsewhere in the Columbia River watershed, whereas haplotypes unique to the Klamath and Chehalis River systems demonstrate a longer history of isolation and genetic divergence. Microsatellite data support the unique nature of the Chehalis River populations, but also reveal a long genetic gradient stretching from the Klamath River of northern California, north through Oregon and eastern Washington, to the Okanagan Valley of southern British Columbia, Canada. In the Okanagan Valley, microsatellite data provide some evidence of restricted gene flow between populations at the north and south ends of Okanagan Lake, and above and below Okanagan Falls.

PLENARY

COMBINING PALEOECOLOGY AND ARCHAEOLOGY: WHAT INTERDISCIPLINARY RESEARCH CAN TEACH US ABOUT HOLOCENE HUMAN-LANDSCAPE INTERACTIONS IN THE PACIFIC NORTHWEST. Megan K. Walsh, Department of Geography/Cultural and Environmental Resource Management Program, Central Washington University, 400 E. University Way, Ellensburg, WA 98926; megan.walsh@cwu.edu

Understanding the role fire played in maintaining ecosystems prior to Euro-American settlement is key to restoring landscape resiliency and viability in the Pacific Northwest. To do this, site-specific fire histories that illustrate changes on centennial to millennial-length timescales are needed. More important, perhaps, is developing a better understanding of the past relationships that existed between fire activity and the factors that influenced its occurrence, frequency, and severity. This is especially true if fire history records are to be used to project how fire activity might change in light of future climate change. While fairly straightforward methods exist to assess fire history within the context of past climatic variability, it is less clear how to evaluate these within the context of past human activity. Presented here are sediment core-based fire and vegetation histories, along with a synthesis of existing archaeological records, from three areas of the Pacific Northwest: the Willamette Valley (OR), Mount Rainier National Park (WA), and the eastern Cascades (WA). These case studies illustrate the complicated relationships that exist between fire, vegetation, climate, and humans in the Pacific Northwest, particularly during the late Holocene. The results support the idea that humans favored fire-modified environments, and in some cases significantly influenced landscape patterns as a source of fire ignitions. The goal of presenting this research is to encourage researchers to use an interdisciplinary approach when investigating human-environment interactions in the Pacific Northwest, which will likely require developing novel methodologies for combining paleoecological, archaeological, and additional sources of information.

CAN ARBUSCULAR MYCORRHIZAL FUNGI PROTECT *RUBUS IDAEUS* FROM THE EFFECTS OF SOIL-BORNE DISEASE OR PARASITIC NEMATODES? Erika J.

Whitney, Rebecca A. Bunn, Department of Environmental Science, Western Washington University; Lisa W. DeVetter, Department of Horticulture, Washington State University; whitnee@wwu.edu

Crop inoculation with beneficial microbes, such as arbuscular mycorrhizal fungi (AMF), can improve resilience to pests and pathogens. While many crops form symbioses with AMF, not all benefit from inoculation. We assessed whether inoculating *Rubus idaeus* cv. Meeker (red raspberry) with AMF could (1) affect plant growth, (2) improve plant resistance to the pathogen *Phytophthora rubi* and parasitic nematode *Pratylenchus penetrans*, and (3) if the source of AMF matters. We ran a 6-month, full factorial greenhouse experiment (4 inoculum x 4 pathogen, 10 reps). Plants first received AMF from a constructed community, the uncultivated *Rubus parviflorus* rhizosphere, commercial farm *R. idaeus* rhizosphere, or no AMF. All plants received small microbes (<11 μ m) from mixed inocula. After 2.5 months, plants were introduced to either no pests, *P. rubi*, *P. penetrans*, or both. Plants receiving AMF inoculum had 5.1% higher leaf chlorophyll compared to un-inoculated controls, yet they had unchanged or reduced biomass. The density of *P. penetrans*/g root was 55% lower for those plants which also received *P. rubi*, suggesting an interaction between these organisms. We found no evidence that mycorrhizal inoculum altered nematode densities in roots or soil. However, a lack of biomass or nutrient differences in plants receiving *P. rubi* and *P. penetrans* indicates we did not achieve pest/pathogen densities that impact plant growth. Thus, further research is needed to determine whether AMF from any source can ameliorate the effects of pests/pathogens on *R. idaeus* crops.

ORAL

INTERACTIVE EFFECTS OF SITE CONDITIONS AND COMPETITION DYNAMICS ON CONIFER SEEDLING PERFORMANCE. Maxwell G. Wightman, Carlos A. Gonzalez-Benecke, Claudio A. Guevara, Department of Forest Engineering Resources and Management,

Oregon State University, 1500 SW Jefferson Way, Corvallis, OR 97331; maxwell.wightman@oregonstate.edu

Competition between planted conifer seedlings and competing vegetation can restrict seedling growth and induce mortality. Forest vegetation management (FVM) reduces the cover of non-desired vegetation allowing seedlings to more effectively capture site resources and has been shown to increase the survival and growth of Douglas-fir and western hemlock. These responses, however, tend to be site specific and there are still large gaps in understanding how interactions between site conditions and competition dynamics influence conifer seedling performance. The Competition and Site Interactions Experiment (CoSInE) is investigating the influence of a common set of FVM treatments on planted conifer seedling survival, growth and ecophysiological responses across a range of climatic and soil conditions in the Pacific Northwest in order to develop a mechanistic understanding of FVM responses. The CoSInE study includes 2 intensively measured research sites, one for western hemlock (WH) and one for Douglas-fir (DF). Measurements being conducted at these sites include: soil moisture and

weather dynamics, seedling growth, seedling predawn and midday water potential, and vegetation growth dynamics. A distinct summer drought period was observed at both sites during each of the measurement years and this drought was more intense and lasted longer at the drier inland DF site than the coastal WH site. FVM treatments significantly reduced the drought stress of Douglas-fir seedlings when compared to the control, but this effect was much less pronounced at the coastal site. Mortality was high in untreated DF plots and functions were developed to predict seedling mortality rate based on vegetation cover.

POSTER

CULTURABLE FUNGAL ENDOPHYTE COMMUNITIES OF PRIMARY SUCCESSIONAL PLANTS ON MOUNT ST. HELENS, WA, USA. Emily R. Wolfe, Robyn Dove, Cassandra Webster, Jacob Loveless, Daniel J. Ballhorn, Department of Biology, Portland State University, PO Box 751, Portland, OR 97207; emwolfe@pdx.edu

While a considerable amount of research has explored plant community composition in primary successional systems, little is known about the microbial communities colonizing pioneer plant species. Fungal endophytes are ubiquitous within plants, and may play major roles in early successional ecosystems. Specifically, endophytes have been shown to affect successional processes, as well as alter host stress tolerance and litter decomposition dynamics—both of which are important components in harsh environments where soil organic matter is still scarce. In order to determine possible contributions of fungal endophytes to plant colonization patterns, we surveyed six of the most common woody species on the Pumice Plain of Mount St. Helens (WA, USA)—a model primary successional ecosystem—and found low frequencies of isolation (<15%), low species richness, and low diversity. However, while diversity did differ among woody species, we found no evidence of temporal shifts in community composition.

POSTER

AN ASSESSMENT OF THE ECOSYSTEM BENEFITS OF STREET TREES IN OLYMPIA, WASHINGTON. Heidi Zarghami, Kathleen Saul, Master of Environmental Studies, The Evergreen State College, 2700 Evergreen Pkwy NW, Olympia, WA 98505; Heidizarghami@gmail.com

Urban forests provide a number of ecosystem services, including improved air quality, stormwater processing, cooling, and health benefits to the community. The ecosystem services provided by urban forests are considered by the literature to be an important component of city planning to become more sustainable and resilient. To date, the City of Olympia has not yet considered assessing the ecosystem services of the urban street trees, specifically how much these trees contribute to the health of the community and the environment in a given year. This study aims to resolve this gap in research by answering the question: What are the ecosystem services of the street trees in the downtown urban area in Olympia, Washington? This study calculates the annual air quality, stormwater, energy savings, and carbon storage capabilities. The study utilizes GIS and Raster data from the City of Olympia's Urban Forestry Department of the locations and conditions of the 2,500 street trees. Using iTree Streets software to quantify the annual fiscal benefits and ecosystem services of the city's street trees, this study also includes a

geospatial analysis with GIS mapping software. The results of this thesis yield a more comprehensive benefits assessment, including a cost-benefit analysis, of street trees for the City of Olympia. The implications of this study have the potential of supporting future allocations of funds for improved tree maintenance and community tree stewardship programs.