

Continuing the Scientific Legacy of the Corps of Discovery: A confluence of the Northwest's past, present, and future



90th Annual Meeting of the Northwest Scientific Association
March 26 – 29, 2019
Lewis-Clark State College, Lewiston, ID

View of the Lewiston/Clarkston Valley from the top of
the old spiral highway

Photo: Lewis-Clark State College

Program and Abstracts
Northwest Scientific Association
90th Annual Meeting

Lewis-Clark State College, Lewiston, Idaho
March 26 – 29, 2019

Held in Cooperation with

Lewis-Clark State College,
Division of Natural Sciences & Mathematics
Nez Perce Tribe
Northwest Lichenologists

Thank You to all who helped!

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

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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 2018-2019 Board of Directors

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Bend, Oregon

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WELCOME FROM THE PRESIDENT OF THE ASSOCIATION

Welcome to the 90th Annual Meeting of the Northwest Scientific Association! We are very excited to be at Lewis-Clark State College for our first time as we celebrate our 96th year as an Association. It is fitting that we meet in Lewiston Idaho, at the confluence of the Snake and Clearwater rivers, two significant river systems that define the upper boundaries of the inland northwest to the east and connect us ecologically, socially, and economically to the Columbia Basin to the west and beyond. We pay special tribute to Dr. William N. Laval, a beloved Professor of Geology at Lewis-Clark State College (1963-1995), whose enthusiasm and vision is the foundation for this meeting's theme, "*Continuing the scientific legacy of the Corps of Discovery: A confluence of the Northwest's past, present, and future*".

I want to acknowledge with a special thank you for Meeting Chair Matt Brady who agreed to take on hosting this meeting without really knowing what he got himself into! Jeannette Klobetanz, Assistant Director for Events & Campus Services assisted Matt as well as our tireless Treasurer, Robin Leshner, and the local planning committee, who worked over the last year to assemble speakers, orchestrating meeting logistics, meals, and countless details to make this event happen. Our NWSA Board of Directors and Webmaster have also been working behind the scenes by communicating information about the meeting, honors and awards, and reviewing student grant proposals. We are grateful to our generous sponsors and cooperators: Lewis-Clark State College, Estate of Dr. William N. Laval, Northwest Lichenologists, and the Nez Perce Tribe. This meeting could not happen without the generous support of the LCSC Division of Natural Sciences, Campus Services, Sodexo catering and the Red Lion Inn, plus volunteers—all contributing to make this a successful meeting. And we are pleased once again to have our epiphytic friends, the Northwest Lichenologists, be part of our annual meeting!

We are fortunate to have Dr. Cynthia Pemberton, Lewis-Clark State College President give our welcome opening remarks and very honored to have Allen Pinkham Sr., Nez Perce Elder, open our meeting with a prayer. Victor Kriss, former colleague of Laval's and Professor Emeritus of Lewis-Clark State College will share heartfelt stories and pay tribute to the life of William Laval.

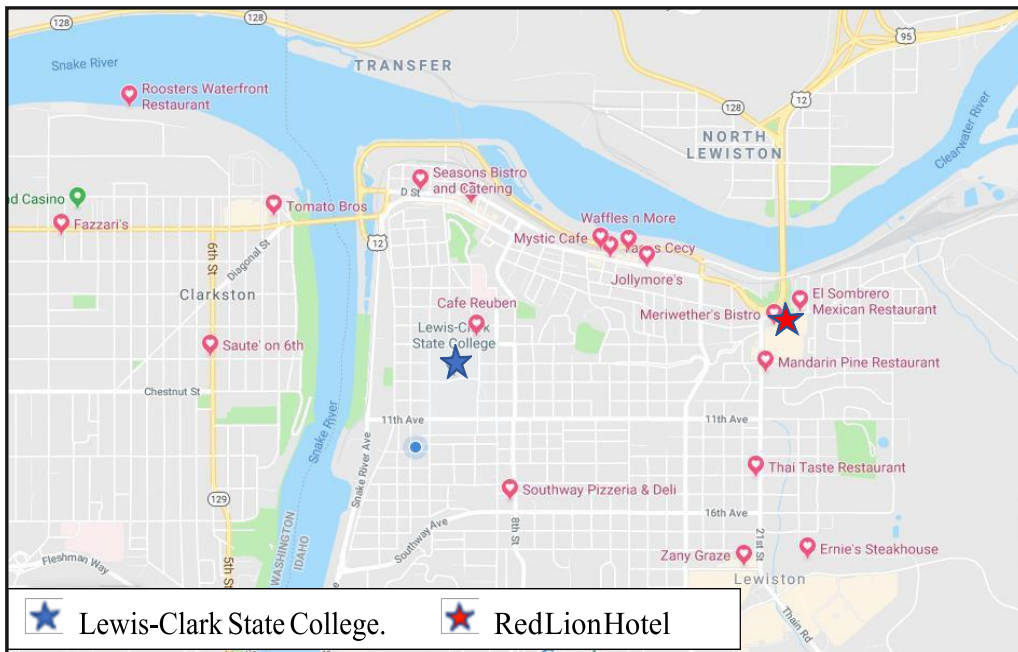
Our lineup of plenary speakers really is impressive as Robin Leshner boasts, "we ended up with literally *Rock Stars*"! We are honored to have Brian F. Atwater, (scientist emeritus U.S. Geological Survey) kick off our plenary session with his keynote address on "*Anecdotal Clues to the 1700 Cascadia Earthquake*", followed by fellow rock stars Jim O'Connor, and Nick Zenter. Please note we have dedicated a special issue of *Northwest Science* in honor of Dr. Laval that includes articles on the geology and natural history of the Columbia Basin, including some presentations at this meeting.

Our banquet speaker, Jack Nisbet—teacher, naturalist, and author will enliven us with his presentation "*Many Different Ways to Explore: Interpreting the Northwest after Contact*". What makes our annual meetings unique are the special sessions tied to local and regional issues. This year we focus on *Freshwater fisheries of the Northwest: past, present, and future directions*; *Northwest Native Foods: plants, fish and animals*; and *Conservation and restoration of Northwest ecosystems at risk: Palouse Prairie & Sagebrush*. Make sure you save some brain space for workshops on *Rising to New Heights: Drones, Data, and Science*; *Intro to Manipulating and Visualizing Data in R*; and *Untangling Usnea*. I am sure you will enjoy the always stimulating technical oral and poster sessions as well as our field trips! As I have said in the past, "what happens at Northwest Science does not stay at Northwest Science and that is good".

Sincerely,

Gregg Riegel, NWSA President

LC VALLEY LOCAL INFORMATION

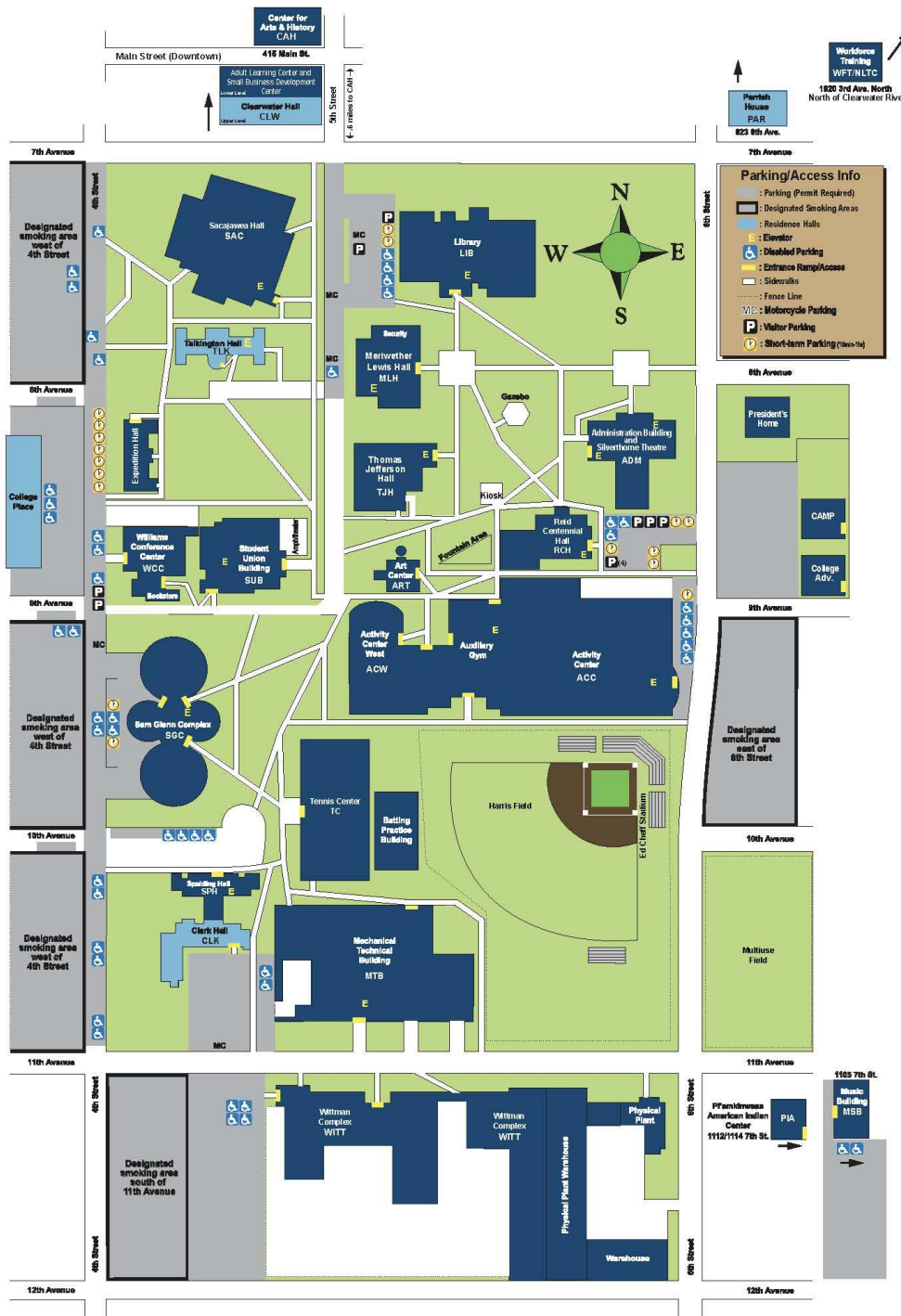


RECOMMENDED PLACES TO EAT:		
<p>Near Campus (walking distance)</p> <ul style="list-style-type: none"> • Café Reuben • Southway Pizza <p>Clarkston:</p> <ul style="list-style-type: none"> • Fazzari's Pizza • Roosters • Saute' on 6th • Tomato Bros 	<p>Downtown:</p> <ul style="list-style-type: none"> • Brava's • Jollymore's • Main St Grill • Mystic Café • Season's Bites and Burgers • Taco Cecy • Waffles n' More 	<p>Thain Road:</p> <ul style="list-style-type: none"> • Ernie's Steakhouse • El Sombrero • Mandarin Pine • Meriwether's Bistro • Thai Taste • Zany Craze

<p>THINGS TO DO IN LC VALLEY:</p> <ul style="list-style-type: none"> • Visit Hell's Gate State Park/Jack O'Connor Center • Take a stroll on the Levee • Drive up Spiral Highway and take in the Valley view at top • Visit the Nez Perce Historical Museum at Spalding, ID • Relax with a drink from one of the local breweries or vineyards
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<p>LOCAL EVENTS:</p> <ul style="list-style-type: none"> • Riverport Brewery Trivia Night Tues, March 26th, 6pm 1509th St. Clarkston, WA • WAA Corks for a Cause Thurs, March 28th, 6pm Free Admission Lindsay Creek Vineyards 3107 Powers Ave. Lewiston, ID More Info 	<ul style="list-style-type: none"> • Fish & Wildlife Film Festival Thurs, March 28th Free Admission 875 Perimeter Drive Moscow, ID, 83844 208.885.8605 More info <p>MORE INFO on the LC Valley: LC Valley Visitor's Guide: https://visitlcvalley.com/visitor-guide/</p>
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LEWIS-CLARK STATE COLLEGE



**Northwest Scientific Association - 90th Annual Meeting
Lewis-Clark State College, Lewiston, ID
Wednesday March 27, 2019**

Time	Admin Bldg Lobby (AM) SAC Hall Lobby (PM)	Silverthorne theater capacity 392	SAC 112	SAC 115	SAC 208	SAC 144	SAC 148	Williams Conference Center								
7:30-8:00	Registration	Welcome and Introductions: NWSA President, LCSC President, Nez Perce Elder, Honoring William Laval; Outstanding Scientist award Keynote Address - Brian Atwater BREAK Plenary Speaker 1: Jim O'Connor Plenary Speaker 2: Nick Zentner Questions and Discussion	reserved for talk prep	reserved for talk prep	reserved for talk prep	reserved for talk prep	reserved for talk prep	reserved for talk prep								
8:00-8:50																
8:50-9:50																
9:50-10:20																
10:20-11:05																
11:05-11:50																
11:50-12:00																
12:00-1:20									LUNCH (on your own)							
1:20-1:40									Registration		Palouse/Steppe Special Session	Geology	Wildlife	Drone Workshop	reserved for talk prep	Poster Session setup
1:40-2:00											BREAK					
2:00-2:20	Palouse/Steppe Special Session	Geology	Wildlife	Drone Workshop	reserved for talk prep	Poster Session setup										
2:20-2:40																
2:40-3:00																
3:00-3:20																
3:20-3:40																
3:40-4:00																
4:00-6:00								Poster Session (attended)								
6:00-9:30	Presentation by Jack Nisbet "Many Different Ways to Explore: Interpreting the Northwest after Contact" Banquet at the Red Lion - Lewiston															

**Northwest Scientific Association - 90th Annual Meeting
Lewis-Clark State College, Lewiston, ID
Thursday March 28, 2019**

Technical Sessions Time	SAC Hall Lobby	SAC 112	SAC 115	SAC 144	SAC 148	SAC 208	SAC 216	MLH 240	Williams Conference Center					
800-810	Registration	<i>load presentations</i>	<i>load presentations</i>	<i>load presentations</i>	<i>reserved for talk prep</i>	<i>load presentations</i>	Poster Session							
810-830		Ecology	Native Foods Special Session	<i>load presentations</i>		<i>reserved for talk prep</i>				Fisheries Special Session				
830-850				Lichens and Bryophytes										
850-910		Ecology	Native Foods Special Session	Discussion Forum: <i>What are the most suitable biocrusts for active restoration projects?</i>	<i>reserved for talk prep</i>	Fisheries Special Session								
910-930														
930-950														
950-1020														
1020-1040		Ecology	Native Foods Special Session	Discussion Forum: <i>What are the most suitable biocrusts for active restoration projects?</i>	<i>reserved for talk prep</i>	Fisheries Special Session								
1040-1100														
1100-1120														
1120-1140														
1140-1200		Registration	Registration	NWSA Business LUNCH at Williams Conference Center										
1200-200				Fire Ecology	Native Foods Special Session	Panel Discussion				BREAK	Fisheries Special Session	Untangling <i>Usnea</i> Northwest Lichenologists Workshop	R workshop	Poster Session
200-220														
220-240														
240-300														
300-320	Fire Ecology			Native Foods Special Session	Panel Discussion	BREAK	Fisheries Special Session	Untangling <i>Usnea</i> Northwest Lichenologists Workshop	R workshop	Poster Session				
320-340														
340-400														
400-420														
420-440	Fire Ecology			Native Foods Special Session	Panel Discussion	BREAK	Fisheries Special Session	Untangling <i>Usnea</i> Northwest Lichenologists Workshop	R workshop	Poster Session				
440-500											<i>Poster take down</i>			

NWSA 90th Annual Meeting - Program Overview

Lewis-Clark State College

Sacajawea Hall (SAC), Williams Conference Center (WCC), & Meriwether Lewis Hall (MLH)

Tuesday, March 26th

2:00 pm – 5:00 pm NWSA Spring Board Meeting (MLH 220)
6:00 pm – 9:30 pm Welcome Social (Red Lion, Lewiston)

Wednesday, March 27th

8:00 am – 8:50 am Welcomes, Introductions, & Outstanding Scientist Award (Silverthorne)
8:50 am – 9:50 am **Keynote Address:** Dr. Brian Atwater, *Anecdotal clues to the 1700 Cascadia earthquake*
Plenary session:
10:20 am – 11:05 am Dr. Jim O'Connor, *The Bonneville Landslide and Bridge of the Gods—Folklore, Forests, and Floods*
11:05 am – 11:50 am Mr. Nick Zentner, *Eastern Washington's Greatest Hits....Geologically*
1:20 pm – 4:00 pm **Special session:** Conservation & Restoration of Ecosystems at Risk: Palouse Prairie and Sagebrush in the Northwest (SAC 112)
Technical session: Wildlife Biology (SAC 208)
Technical session: Geology (SAC 115)
Workshop: Rising to New Heights: Drones, Data, & Science (SAC 144)
4:00 pm – 6:00 pm **Poster session** (attended) with social & appetizers (WCC)
6:30 pm – 9:30 pm **Banquet** with Author Jack Nisbet, *Many Different Ways to Explore: Interpreting the Northwest after Contact* (Red Lion)

Thursday, March 28th

8:10 am – Noon **Technical session:** Ecology (SAC 112)
Special session: Native Foods: Plants, Fish, and Animals (SAC 115)
Special session: Freshwater Fisheries of the Northwest: Past, Present, and Future Directions (SAC 208)
8:50 am - Noon **Technical session:** Lichens & Bryophytes, Discussion Forum to follow (SAC 144)
12:00 – 2:00 pm **NWSA Business Lunch and Annual Meeting of the Corporation (WCC)**
2:00 pm – 4:40 pm **Technical session:** Fire Ecology (SAC 112)
Special session: Northwest Native Foods: Plants, Fish, and Animals (SAC 115)
Special session: Freshwater Fisheries of the Northwest: Past, Present, and Future Directions (SAC 208)
Workshop: Introduction to Manipulating and Visualizing Data in R (MLH 240)
Workshop: Untangling *Usnea*, Northwest Lichenologists (SAC 216)

Friday, March 29th

Field trips:
Nez Perce Fish Acclimation Facility Tour
Clearwater Canyon Cellars – Science Tour & Tasting
Geology of Hells Canyon Jet Boat tour
Canyon crusts (Northwest Lichenologists tour)

Wednesday morning, March 27

Keynote and Plenary Session

Silverthorne Theater, Administration Building

Welcomes

- 8:00** **Gregg Riegel, NWSA president** Welcome and Introductions, Opening Remarks
- 8:10** **Dr. Cynthia Pemberton, LCSC President** Welcoming remarks
- 8:20** **Allen Pinkham Sr., Nez Perce Elder** Welcoming prayer
- 8:30** **Victor Kriss** - Honoring William Laval
- 8:40** **Gregg Riegel, NWSA President** Introduce Outstanding Scientist

Keynote Address & Plenary Session

Moderator: Patrick Pringle

- 8:50** **Brian Atwater** – Anecdotal clues to the 1700 Cascadia earthquake

- 9:50** **BREAK**

- 10:20** **Jim O'Connor** – The Bonneville Landslide and Bridge of the Gods—Folklore, Forests, and Floods

- 11:05** **Nick Zentner** – Eastern Washington’s Greatest Hits...Geologically

- 11:50** **Questions & Discussion**

- 12:00** **LUNCH**

Dr. Brian Atwater, Keynote Speaker

NWSA Outstanding Scientist for 2019



Brian Atwater is recognized as an outstanding scientist in the Pacific Northwest. He not only has wide recognition in his field, but his influence also extends into other fields of science. Atwater is widely recognized by professionals in the fields of architecture, engineering, and public safety. Even beyond that, he is recognized by a broad cross-section of the general public as a scientist of exceptional achievement. He changed the way people in the Pacific Northwest think about and understand the risks of earthquakes and tsunamis. Brian Atwater's greatest contribution could be a legacy of saving lives by promoting greater geological awareness and earthquake vigilance.

Brian Atwater is a scientist emeritus with the U.S. Geological Survey and an affiliate professor at University of Washington, with degrees from Stanford University and University of

Delaware. In the early 1980s he mapped granitic rocks and counted ice-age floods in northeast Washington. Since 1985 he has specialized in natural hazards. His findings hastened consensus that the Pacific Northwest is subject to great earthquakes and associated tsunamis. He also helped clarify earthquake and tsunami hazards in Japan, Chile, the northeast Indian Ocean, and the Caribbean. Publications include a book on Japanese evidence for a North American earthquake, and public-safety booklets based on tsunami survivors' accounts from Chile, Indonesia, and Pakistan.

Brian Atwater's field is the Quaternary geology and geologic history of the Pacific Northwest, most notably that of past great earthquakes and tsunamis. Atwater is further noted for his studies of Ice Age floods in the Pacific Northwest, the natural history of San Francisco Bay, and the history of past great earthquake tsunamis of South America, the Caribbean, Japan, and the Indian Ocean. Many of his publications are landmarks of pioneering significance. He has inspired other scientists and also engineers because his work has redefined the nature and frequency of dramatic geologic events and associated natural (ecological) disturbances as well as the implications of such events on pre-settlement peoples and cultures. And he has enthusiastically taken science outreach about earthquake science and past earthquakes to broad audiences via many interviews, books, and field trips for both professional societies and meetings as well as for governments and institutions.

Atwater's 1987 publication in *Science*, "Evidence for Great Holocene Earthquakes along the Outer Coast of Washington State", provided the first solid evidence that the Pacific Northwest had a history of colossal subduction zone earthquakes of magnitude 9 or greater. He has followed up on this work with various collaborators to produce supporting research that established a history of similar earthquakes back thousands of years, remarkably, precisely dating the most recent one to a single day, January 26, 1700. In 2000, Brian Atwater and Eileen Hemphill-Haley were awarded the Geological Society of America's prestigious Kirk Bryan Award for their 1997 paper, "Recurrence intervals for great earthquakes of the past 3,500 years at northeastern Willapa Bay, Washington," U.S. Geological Survey Professional Paper 1576, 108. https://www.northwestscience.org/resources/Atwater_short_CV.pdf

Biographies of plenary speakers



Nick Zentner teaches geology at Central Washington University in Ellensburg. He received his BS in Geology from University of Wisconsin and MS in Geology from Idaho State University. His current video projects include “Nick on the Rocks” produced for PBS TV station throughout the Pacific Northwest, and “Downtown Geology Lectures” produced for YouTube by CWU. nickzentner.com



Jim O’Connor is a Research Geologist at the U.S. Geological Survey in Portland, Oregon. His primary research focus is landscape evolution, mainly involving rivers and floods. He’s also interested in the intersection of landscapes and people, and the history of those interrelations. He’s a Fellow of the Geological Society of American and has written numerous scientific articles, monographs, and general-audience features about floods, rivers, glaciers, and the history of geology, chiefly focused on the Columbia River Basin. He majored in Geological Science at University of Washington and earned M.S. and Ph.D. degrees at University of Arizona. Since 1991, he has worked at the U.S. Geological Survey, intent on improving

understanding of the processes and events that shape the remarkable and diverse landscapes of our planet.

My USGS website is: <https://www.usgs.gov/staff-profiles/jim-e-oconnor>

Wednesday afternoon, March 27

Special session: Conservation & Restoration of Ecosystems at Risk: Palouse Prairie and Sagebrush in the Northwest

Moderator: Janelle Downs

Room: SAC 112

- 1:20 **R. Rosentreter** – Biocrust species and traits most suitable for restoration projects.
- 1:40 **M. Nicolli** – Rapid invasion by the annual grass *Ventenata dubia* into protected area low-elevation Sagebrush steppe
- 2:00 **A. Sondenaa** – Conservation of the endangered Palouse Prairie: fragments and fractions
- 2:20 **P. Pavek** – Establishing native forbs in existing CRP using no-till techniques in northern Idaho: comparison of drills and seedbed preparations
- 2:40 **Break**
- 3:00 **J. Jensen** – Palouse Prairie establishment in field-to-prairie conversion and pollinator-forb field enhancement
- 3:20 **B. Erhardt** – Prairie Reconstruction on the Palouse
- 3:40 **S. Woodley** – Palouse Prairie Conservation and Restoration: Levels of infestation, seed consumption, and the effect of environmental site conditions on two insect biological controls for yellow starthistle (*Centaurea solstitialis*)

Technical session: Geology

Moderator: Keegan Schmidt

Room: SAC 115

- 1:20 **R. J. Carson** – Missoula floods filled Wallula Gap tributaries
- 1:40 **K. Stanton** – Pre-late Wisconsin valley-glacier erratics between Leavenworth and Peshastin, Wenatchee Valley, Washington
- 2:00 **R. Waitt** – Erratics and silt deposits as evidence of late Wisconsin Missoula outburst floods in lower Wenatchee and Columbia valleys, Washington
- 2:20 **G. Last** – Ice-rafted erratics from an iceberg feature at the Coyote Canyon Mammoth site, Kennewick, Washington
- 2:40 **Break**
- 3:00 **R. Love** – The last occurrence of the Columbian mammoth in North America: was the extinction human caused or related to climate change?
- 3:20 **P. Pringle** – Research update on the use of radiocarbon dating and tree-ring analysis on Subfossil forests killed by Lahars or volcanic eruptions from Mount Rainier, Washington State, USA
- 3:40 **R. Lewis** – Non-traditional (Biological) applications for geologic maps

Wednesday afternoon, March 27

Technical session: Wildlife

Moderator: Jocelyn Aycrigg

Room: SAC 208

- 1:20 **T. M. Linscott** – Genomic and geologic patterns of ornamentation in *Oreohelix*
- 1:40 **A. Rankin** – The role of historical and contemporary processes on genetic diversity in *Anguispira* snails of the northern Rocky Mountains.
- 2:00 **E. Strand** – Modeling summer habitat selection by Rocky Mountain elk (*Cervus elaphus*) in north-central Idaho.
- 2:20 **D. Gour** – Genetic diversity & population structure of the pygmy rabbit in northern Utah
- 2:40 **Break**
- 3:00 **M. Wilkins** – Variation in behavioral traits within and between wild and captive-born Vancouver Island marmots (*Marmota vancouverensis*)
- 3:20 **A. Stahl** – Mapping legal authority to conserve riparian corridors for clean water, fish, and wildlife
- 3:40 **D. Lachman** – Drone-mounted digital cameras provide unbiased estimates of nest survival for colonial nesting waterbirds

Workshop: Rising to new heights: Drones, data, and science **Room:** SAC 144

Time: 1:20 – 4:00

Capacity: 26 people

Moderators: Gina Wilson & Jennifer Hinds

Unmanned Aerial Systems are developing at a rapid pace and changing the way in which we collect and use scientific data. This is an introductory workshop covering a broad range of topics on the use of drones in natural resources. Participants will gain an understanding of important regulations regarding the operation of drones, the airspace, and weather/terrain factors for successful operations when collecting data. The format for the workshop will include a combination of lecture and hands on activities (no flying) for flight planning and processing drone captured data.

Needed equipment: Laptop running Windows 10 or MacOS High Sierra, Google chrome, WiFi connection

4:00-6:00 Poster Session (attended) and Social with appetizers

WCC

6:30–9:30 Evening Banquet with guest speaker, author **Jack Nisbet** at Red Lion

Wednesday afternoon, March 27

Poster Session and Social – Williams Conference Center

Poster set-up noon to 4:00 pm

4:00-6:00 pm (attended); Thurs 8:00 am - 4:00 pm

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

M. Amara	LATE PLEISTOCENE MAMMOTH REMAINS AND THEIR GEOLOGIC CONTEXT IN THE FRENCHMAN HILLS, GRANT COUNTY, WASHINGTON
R. Bartlett	A DECADE OF UNDERSTORY COMMUNITY DATA IN A MATURE SECOND-GROWTH FOREST IN WESTERN WASHINGTON
E. Bugge	DECREASING N ₂ FIXATION IN <i>LOBARIA OREGANA</i> IS LIKELY CAUSED BY ANTHROPOGENIC EMISSIONS
A. Cleveland	IMPACTS OF MT MAZAMA ASH ON THE BEHAVIOR OF LATAH CREEK FLOODPLAIN SOIL, SPOKANE, WASHINGTON
E. Di Meglio	EVALUATION OF DECADAL CHANGES IN VEGETATION AND LICHEN COMMUNITY STRUCTURE IN RELATION TO METAL CONCENTRATION AND CLIMATE ALONG THE RED DOG MINE HAUL ROAD IN CAPE KRUSENSTERN NATIONAL MONUMENT, ALASKA
K. Duckett	NOBLE GAS CONCENTRATIONS, AND A REEVALUATION OF CARBON AGE DATES FOR AQUIFERS OF THE SOUTH FORK PALOUSE RIVER BASIN, IDAHO AND WASHINGTON, USA
T. Gittelsohn	LEAF AREA INDEX MEASUREMENTS DEPEND ON SITE PRODUCTIVITY AND THINNING IN THE INLAND NORTHWEST.
J. A. Henderson	A LANDSCAPE MODEL FOR PREDICTING AND MAPPING POTENTIAL NATURAL VEGETATION OF WASHINGTON STATE
E. Joshi	A GREENHOUSE STUDY ON EFFECT OF CLASS B RECLAIMED WATER ON GROWTH AND EXOENZYME ACTIVITY IN <i>POPULUS TRICHOCARPA</i>
M. Lesiecki	PRIORITIZING ROAD TREATMENTS FOLLOWING WILDFIRE
R. McCarley	THE WILD WILD (NORTH)WEST: ASSESSING FUTURE LAND USE AND CLIMATE CHANGE IN WILDERNESS AREAS OF THE NORTHWESTERN U.S.
M. Meyer	VULNERABILITY OF ROTIFER AND COPEPOD NAUPLII PREY TO COPEPOD PREDATION IN FLATHEAD LAKE (MT)

H. Moon	HOW DO YOU ACCURATELY MEASURE BEDDING IN A MONOTONOUS PILE OF BASALT LAVA FLOW ROCKS? INSIGHTS IN EXCITING APPLICATIONS OF MATHEMATICS
L. Ngenzi	QUANTIFYING THE ACCURACY OF LANDSAT DERIVED SURFACE WATER INDICES FOR ESTIMATING SMALL RESERVOIR WATER SURFACE AREA IN THE VOLTA RIVER BASIN (WEST AFRICA)
C. Rabe	LONG-TERM EVALUATION OF FITNESS AND DEMOGRAPHIC EFFECTS OF A CHINOOK SALMON SUPPLEMENTATION PROGRAM
B. Rodgers	INVESTIGATING THE POSSIBILITY OF SPECIATION IN <i>STEREOCAULON SPATHULIFERUM</i>
W. Sandlin	PASSIVE METAL REMOVAL SYSTEM UTILIZING ZEOLITE FOR INITIAL TREATMENT OF SEASONAL ACID ROCK DRAINAGE - NEW TECHNOLOGY FOR ENHANCING PASSIVE TREATMENT SYSTEMS
R. Saylor	MACHINE LEARNING MODELS OF MONARCH BUTTERFLIES BREEDING IN PALOUSE PRAIRIE
D. K. Schalck	SPATIAL AND TEMPORAL OVERVIEW OF HIGH POTASSIUM INTRUSIONS IN IDAHO
K. Schmidt	HOW DO YOU ACCURATELY MEASURE BEDDING IN A MONOTONOUS PILE OF BASALT LAVA FLOW ROCKS? INSIGHTS FROM THE MIOCENE COLUMBIA RIVER BASALT GROUP
J. Shaw	CONTACT METAMORPHISM, MINERALIZATION, AND DETRIAL ZIRCON INTERPRETATION FROM SILVER HILL SPOKANE WASHINGTON
B. Slothower	ORGANIC NITROGEN TURNOVER AS AN INDICATOR OF FOREST PRODUCTIVITY
J. Stitt	WOOD DECAY FUNGI COMMUNITIES ASSOCIATED WITH WOODPECKER CAVITIES IN PONDEROSA PINE SNAGS OF THE EASTERN CASCADES
E. Strand	PALOUSE PRAIRIE-FOREST ECOTONE: THEN, NOW, AND IN THE FUTURE
M. Thurston	QUANTIFYING HABITAT STRUCTURE IN WESTERN GREBE COLONIES
K. Townsend	PRESENCE OF NORTHERN IDAHO GROUND SQUIRRELS <i>UROCITELLUS BRUNNEUS</i> INFLUENCES BY OTHER SMALL MAMMALS SPECIES AND ENVIRONMENTAL FACTORS
J. Trujillo	A FIELD GUIDE TO GRASSES AND GRASS-LIKE PLANTS OF IDAHO
D. Westlind	BURN SEASON AND INTERVAL EFFECT PONDEROSA PINE GROWTH AND WESTERN PINE BEETLE MORTALITY IN THE BLUE MOUNTAINS OF OREGON
U. Wijayratne	GLOBAL OBSERVATION RESEARCH INITIATIVE IN ALPINE ENVIRONMENTS (GLORIA): FIRST YEAR DATA FROM THE WALLOWA MOUNTAINS OF OREGON

Banquet speaker

“Many Different Ways to Explore: Interpreting the Northwest after Contact” by Jack Nisbet



In the wake of Lewis and Clark’s brief visit to the Columbia River drainage, it took a wide range of approaches to flesh out a geographic and scientific portrait of the extended region. This slide presentation will focus on how fur agent David Thompson, horticultural collector David Douglas, and prospector John Leiberger used their own particular talents to make contributions to the larger picture.

Spokane-based teacher and naturalist Jack Nisbet is the author of several collections of stories that explore the human and natural history of the Northwest, including *Ancient Places* and *Visible Bones*. He has also written award-winning biographies of fur agent David Thompson (*Sources of the River*) and plant collector David Douglas (*The Collector*). Nisbet’s latest book, *The Dreamer and the Doctor*, traces the unlikely adventures of John and Carrie Leiberger around the Northwest and beyond. For more information visit www.jacknisbet.com



David Thompson ca 1826, Map of North America from 84° West, Sheet 5 (detail), National Archives, London



Sarah Drake 1833
Brown's Peony *Paeonia brownii*
Edward's Botanical Register

Thursday, March 28

Technical session: Ecology

Moderator: Andrea Woodward

Room: SAC 112

- 8:10** **B. Luff** – The influence of ENSO anomalies on stream flow metrics across the contiguous United States
- 8:30** **D. Schmitz** – Poorman-Balm mine complex reclamation—a multidisciplinary venture
- 8:50** **K. Magori** – Disease ecology of *Dermacentor* ticks at Turnbull National Wildlife Refuge
- 9:10** **J. Kane** – Effectiveness of girdling treatments in a conifer-encroached Oregon white oak woodland
- 9:30** **H. Kesting** – Insect herbivory drives community structure and primary succession on Mount Saint Helens
- 9:50** **BREAK**
- 10:20** **A. Woodward** – Long-term success of seedlings establishing in subalpine meadows, Olympic National Park
- 10:40** **G. Riegel** – Development and utilization of a riparian ecological type classification for monitoring long term livestock grazing effects in central Oregon

12:00 – 2:00 **NWSA Business Lunch – Williams Conference Center**

Technical session: Fire Ecology

Moderator: Nancy Johnston

Room: SAC 112

- 2:00** **J. Bastow** – The impacts of a wildfire in a semi-arid grassland on soil nematodes and organic matter over four years
- 2:20** **R. McCarley** – Quantifying above-ground biomass consumption and demonstrating land-landscape linkage between fuel consumption and energy release: a case study of the Pole Creek fire in Oregon
- 2:40** **C. Martorano** – Long-term effectiveness of fuel reduction treatments in oak and chaparral stands of northern California
- 3:00** **K. Johnston** – The entire landscape needs relief from fire-deficit: Past, present, and future of the Metolius Research Natural Area, Oregon
- 3:20** **BREAK**
- 3:40** **A. Boag** – Growing up: Post-fire conifer establishment trajectories in eastern Oregon
- 4:00** **L. Hu** – Volatile organic compounds and other air pollutants from western U.S. wildlife smoke
- 4:20** **N. Johnston** – Volatile organic compounds and particulate matter during the 2017-2018 wildfire seasons in the Lewis-Clark valley

Thursday, March 28

Special session: Freshwater Fisheries of the Northwest: Past Practices, Current Issues, and the Future of Fisheries

Moderator: Jensen Hegg

Room: SAC 208

- 8:10** **A. Fremier** — The influence of spawning fish on river profiles and potential speciation over geologic timescales
- 8:30** **P. Anders** — Long-term multi-trophic responses to seasonal nutrient addition in the Kootenai River, Idaho and British Columbia
- 8:50** **K. Tiffan** — Recent additions to the food web of Lower Granite Reservoir: welcomed guests or unwanted party crashers?
- 9:10** **J. Jorgensen** — Quantitative Food Web Analysis to Detangle Density Dependence in Co-limited Habitats
- 9:30** **H. Wingerter** — Variation of resource selection due to seasonally induced inter-cohort competition in steelhead (*Oncorhynchus mykiss*)
- 9:50** **BREAK**
- 10:20** **J. Erhardt** — Smallmouth bass diet and Chinook salmon mortality along the Snake River continuum
- 10:40** **S. Matsaw** — Let the old ones speak: forgotten native freshwater mussels contributing to stream benthic communities
- 11:00** **A. Chase** — Living rocks: mollusks of the Pacific Northwest
- 11:20** **C. Caudill** — Ancient swimmers in a modern world: Pacific lamprey migration in the Columbia River basin
- 11:40** **S. Hanchett** — Evaluating the influence of past experience on swimming behavior and passage success in adult Pacific lamprey
- 12:00 – 2:00** **NWSA Business Lunch** – Williams Conference Center
- 2:00** **K. Strickler** — Challenges and strategies for environmental DNA sampling in streams
- 2:20** **L. Caldwell** — The use of eDNA to identify extent of fish occupancy
- 2:40** **R. Dunbeck** — Movement response of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) to carcasses of Rainbow trout (*O. mykiss*) and Pacific lamprey (*Entosphenus tridentatus*)
- 3:00** **K. Gillies-Rector** — Otolith analysis reveals variable juvenile growth and migration in Chinook salmon experiencing different environmental conditions
- 3:20** **BREAK**
- 3:40** **M. Dobos** — Life history diversity of wild steelhead (*Oncorhynchus mykiss*) attributing to long-term persistence in the Lochsa River basin
- 4:00** **B. Bowersox** — Examining life history shifts and genetic composition in a hatchery steelhead population with implications for fishery and ocean selection

Thursday, March 28

Special session: Northwest Native Foods: Plants, Fish, and Animals

Moderator: Monique Wynecoop

Room: SAC 115

- 8:10** **S. Hoagland** – Intertribal timber council: tribal research needs and priorities assessment
- 8:30** **N. Kager** – Schitsu’umsh contemporary food sovereignty
- 8:50** **J. Wagner** – Linguistic evidence of dietary transition: the case of the Schitsu’umsh
- 9:10** **L. Campbell** – S’yiṭn khwe Schitsu’umsh: Decolonizing Coeur d’Alene food traditions
- 9:30** **N. S. Tatshama Peasley** – Indian Carrots (*Perideridia gairdneri*) and the effects of fire on the Colville Reservation, 2016-18
- 9:50** **BREAK**
- 10:20** **C. Harrington** – How will the range of black huckleberry change in the future?
- 10:40** **C. Gray** – Resource partitioning between foraging bears and tribal harvest of huckleberries on the Flathead Indian Reservation
- 11:00** **P. Moses** – Huckleberry Restoration after Wildfire on the Colville Reservation, 2016-18
- 11:20** **M. Wynecoop** – Exploring a multi-disciplinary approach to incorporating traditional knowledge into fuels treatments
- 11:40** **K. Matthews** – Restoration Strategies for (*Camassia quamash*) on the Weippe Prairie: A Case Study in Progress

12:00 – 2:00 **NWSA Business Lunch** – Williams Conference Center

- 2:00** **S. Matsaw** – More-than-human relatives: how the natural world teaches and informs our epistemologies of land-based knowing
- 2:20** **Panel Discussion:** Tribal perspectives, recommendations, and research needs for promoting tribal food sovereignty and responsible management of traditional foods and places
- 3:20** **BREAK**

Thursday morning, March 28

Technical session: Lichens and Bryophytes

Moderator: Bruce McCune

Room: SAC 144

- 8:50** **B. McCune** – A Probabilistic Interactive Key for *Hypogymnia* in North America
- 9:10** **A. Pipp** – Conducting the First Non-Vascular Surveys in Mussellshell County, Montana
- 9:30** **R. Smith** – Global Biomass of Ground Dwelling Lichens and Mosses
- 9:50** **BREAK**
- 10:20** DISCUSSION – Lichen Poster Discussion
- 10:40** PANEL DISCUSSION – What are the Most Suitable Biocrusts for Active Restoration Projects?

12:00 – 2:00 **NWSA Business Lunch** – Williams Conference Center

Thursday afternoon Workshops

Workshop: Untangling *Usnea* —Northwest Lichenologists **Room:** SAC 216

Time: 2:00 pm – 4:30pm **Capacity:** 24 people **Moderators:** Daphne Stone

This workshop will focus on *Usnea*, one of the most common and difficult genus of lichens in the Pacific Northwest. The workshop will demonstrate use of the Daphne's recently published booklet "*Usnea* in the Pacific Northwest" that succinctly illustrates twenty-four species found in the area. We will provide identified specimens so participants can familiarize themselves with the species. Participants are encouraged to bring their own specimens to identify. Bring your copy of McCune and Geiser 2009 and \$12 to buy the booklet.

Workshop: Intro to Manipulating and Visualizing Data in R **Room:** MLH 240

Time: 2:00 pm – 4:30 pm **Capacity:** 24 people **Moderators:** Matt Brousil, Leigh Latta, &

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.

Needed equipment: Participants should bring their own computer if possible, although there will be PC's available for those without one.

Friday, March 29

NWSA Field Trips

“Geology of Hells Canyon” - Jet Boat Tour

Hells Canyon of the Snake River exposes a spectacular geologic history of part of the inland Pacific Northwest including much of the Paleozoic-Mesozoic exotic island arc complex represented by the Wallowa terrane and the overlying Miocene Columbia River Basalt Group. This one-day trip will explore the anatomy of the Wallowa island arc by jet boat including its plutonic basement, extensive volcanic sequences, and capping sedimentary rocks, along with faults and Columbia River basalt exposures within “North America’s deepest gorge.”

Leave from **Hells Gate Marina** at **8:00 am** and return to marina at **3:30 pm**. Contact Keegan Schmidt klschmidt@lcsc.edu if you need a ride to Hells Gate Marina, or for additional information about the field trip.

Capacity: require **minimum of 19 registrants** to run the field trip, **maximum 44**
Cost: **\$120.00 (includes lunch)**; field guide available at additional cost on site

“Nez Perce Fish Acclimation Facility Tour”

The Nez Perce Tribe’s Department of Fisheries Resource Management offers a unique look into the recovery of Fall Chinook back into the Snake River basin. The Fall Chinook population plummeted after the construction of the four Lower Snake River Dams. The Hells Canyon Complex completely cut off all anadromous fisheries from the Upper Snake River. The Nez Perce Tribe worked with a Fall Chinook migration limited by the fish ladders around hydroelectric power systems. The tour of the Tribe’s fish acclimation facility located at Cherry Lane, Idaho is a success story and continues to play an important role for the Tribe’s culture and way of life, while meeting the demands of a sport fishery.

The tour will leave from **LCSC Williams Conference Center parking lot at 8:30 a.m.** We are asking that you carpool to cut down on traffic. A Nez Perce Tribal Fisheries vehicle will lead the cars to the Cherry Lane Hatchery. The tour will end before lunchtime.

For information contact Aaron Miles, Sr. at 2moon@nezperce.org

“Clearwater Canyon Cellars – Science Tour and Tasting”

Come taste the wines of Clearwater Canyon with winemaker, owner and wine scientist Coco Umiker. You will have the chance to tour the cellar and vineyard during your visit and ask geeky wine questions in a laid back atmosphere. Coco completed her PhD in the Enology program at Washington State University and is excited to share with you how wine is a perfect blend of art and science.

Cost: \$10

Capacity: 25 people; meet in **parking area West of Sacajawea Hall @ 10:00** to carpool

“Canyon Crusts” led by Northwest Lichenologists

This field trip will visit sites in Hells Canyon National Recreation Area to explore the diversity of soil and saxicolous crustose lichens found in this unique habitat. This will also give participants a chance to practice identification using Bruce McCune's newly published tome "Microlichens of the Pacific Northwest". The location will be in low-elevation locations within a 30-60 min drive from Lewiston. Meet at **8:00 am** in **parking lot West of Sacajawea Hall** to carpool.

ABSTRACTS

NWSA ORAL AND POSTER PRESENTATIONS

(Arranged alphabetically by last name of presenting author)

LATE PLEISTOCENE MAMMOTH REMAINS AND THEIR GEOLOGIC CONTEXT IN THE FRENCHMAN HILLS, GRANT COUNTY, WASHINGTON. **Mark S. Amara,**

Moses Lake, WA 98837-9076; George V. Last, MCBONES Research Center Foundation, Kennewick, WA 99338-9328; Luke Tonnemaker, Kole Tonnemaker, Tonnemaker Hill Farm, Royal City, WA 99357; Bax R. Barton, Burke Museum of Natural History and Culture and Quaternary Research Center, University of Washington, Seattle, WA 98195-1360; gvlast@charter.net

Mammoth bones were discovered while plowing a field on the Tonnemaker Hill Farm in the Frenchman Hills north of Royal City, Washington. Salvage operations recovered at least 40 identifiable skeletal elements. Their context in the soil profile indicates the bones were deposited along the shoreline of one of the last (Missoula) Ice Age floods. Included were the skull, molars, mandible, vertebrae, ribs, leg and foot bones, and a tusk fragment. The bones are not articulated but are clearly in a small area, and are from a single individual. Three distinct tephra layers were found in slack water Ice Age flood deposits beneath the bones. Tephra glass analyses corroborated that the two lowermost tephra layers were Mount St. Helens set S tephra (So and Sg) dated to 16 ka. The uppermost tephra showed considerable compositional variability. Optically stimulated luminescence analyses of samples beneath the lowermost tephra produced an age of 19.9 \pm 5.3 ka (at 2 σ) while analysis of a sample above the uppermost tephra produced an age of 16.4 \pm 2.8 ka (at 2 σ). The mammoth remains lie in sediments that are less than 16 ka in a mixture of Ice Age flood deposits and loess. It is unclear whether the mammoth's carcass was deposited by one of the last Ice Age flood events, or if the animal died there later. It is likely the skeleton was exposed, spread by scavengers, and the sediments reworked by wind, water, and bioturbation.

ORAL

LONG-TERM MULTI-TROPHIC RESPONSES TO SEASONAL NUTRIENT ADDITION IN THE KOOTENAI RIVER, IDAHO AND BRITISH COLUMBIA. **Paul J.**

Anders, Cramer Fish Sciences, Moscow, ID 83843; Charlie Holderman, Genevieve Hoyle, Kootenai Tribe of Idaho, Bonners Ferry, ID 83805; Gretchen Kruse, Free Run Aquatic Research, Hayden, ID 83835; Ryan Hardy, T.J. Ross, Idaho Department of Fish and Game, Coeur d'Alene, ID 83815; Bahman Shafii, College of Agricultural and Life Sciences, University of Idaho, Moscow, ID 83844-2337; William J. Price, College of Agricultural and Life Sciences, University of Idaho, Moscow, ID 83844-2337; G. Wayne Minshall, Stream Ecology Center, Department of Biological Sciences, Idaho State University, Pocatello, ID 83209; Ken I. Ashley, British Columbia Institute of Technology, Burnaby, British Columbia, Canada V5G 3H2; Peter. R.B. Ward. Ward and Associates and Department of Civil Engineering, University of British Columbia, Vancouver, British Columbia, Canada V6N 3B6; anders@fishsciences.net

The Kootenai River is a 700 km international 7th-order large river-floodplain system that begins and ends in British Columbia with smaller portions occupying parts of Idaho and Montana. In both states and countries, the river has experienced dramatic habitat loss, degradation, and cultural oligotrophication following impoundment, land use changes, channelization, and extensive loss of floodplain form and function. To mitigate cultural oligotrophy (P-limitation), seasonal (June 1-September 30) whole-river nutrient addition began in Idaho at the ID-MT border using liquid ammonium polyphosphate fertilizer (10:34:0; N:P₂O₅:K₂O) with an in-river

dosing target concentration of 1.5 ug/L total dissolved phosphorus (TDP) in 2005 and a 3.0 ug/L TDP dosing target during 2006 and all subsequent years (through 2018).

The Kootenai Tribe of Idaho, Idaho Department of Fish and Game, and many other entities have implemented a series of monitoring and evaluation programs since the early 2000s to evaluate the effects of nutrient addition on water chemistry (TN, NO₃+NO₂, TP, TDP, TN:TP), nutrient uptake, and the abundance, biomass, and diversity of periphyton, plankton, benthic macroinvertebrate, and fish communities in various upstream control and downstream treatment reaches before and after nutrient addition. We present results of long-term multi-trophic responses as reported by six published and several additional ongoing studies. Nutrient concentrations peaked at the dosing site and were rapidly attenuated by biological uptake. These results were supported by significant increases in downstream chlorophyll accrual rates, and the abundance, biomass, and diversity of many taxa groups within the periphyton, plankton, benthic macroinvertebrate, and fish communities.

ORAL

ANECDOTAL CLUES TO THE 1700 CASCADIA EARTHQUAKE. Brian F. Atwater, U.S. Geological Survey at University of Washington, Seattle, WA 98195-1310; atwater@usgs.gov

Historical narratives tell of ocean waves and land-level changes that bear on the 1700 Cascadia earthquake. In an example from Japan, a village headman puzzled over stealth waves from a tsunami of remote origin in 1700. Nearer to its source the tsunami may correspond to a sea flood that was recounted at Neah Bay in 1864. As for land-level changes, a pioneer naturalist invoked gradual sinking to explain dead trees in tidal marshes that he visited in southwest Washington during 1854–1855. He may have been unaware that Chilean shores had changed level suddenly, during earthquakes near Valparaíso in 1822 and near Concepción in 1835.

ORAL

MODELING SUMMER HABITAT SELECTION BY ROCKY MOUNTAIN ELK (*CERVUS ELAPHUS NELSONI*) IN NORTH-CENTRAL IDAHO. Tara Ball, Idaho Department of Fish and Game, 3316 16th. St., Lewiston, ID 83501; *presented by* Eva Strand, Department of Forest, Rangeland, and Fire Sciences, University of Idaho, 875 Perimeter Drive MS 1135, Moscow ID, 83844-1135; tara.ball@idfg.idaho.gov

Rocky Mountain elk (*Cervus elaphus nelsoni*) populations in the Clearwater River Basin in north-central Idaho have declined due to increasing human occupancy, habitat alterations, and increased predation. Growing evidence suggests summer nutrition is especially critical for individual fitness and population dynamics. To understand how Rocky Mountain elk select summer habitat to optimize nutritional needs, lactating females were collared in the Clearwater River Basin to monitor body condition and reproduction. Using GPS locations and resource selection functions (RSFs), I evaluated a series of habitat variables to identify key indicators of summer habitat selection on the Craig Mountain Wildlife Management Area (CMWMA). I found that in the months of July and August, elk selected for habitats that were predicted to support sticky purple geranium (*Geranium viscosissimum*), that were more frequently burned, and that had greater 30-year normal minimum precipitation and available soil water supplies. Elk also exhibited less selection for habitats with greater shrub canopy cover. The presence of herbaceous plant species and wildfire disturbance were the most informative variables for

predicting summer habitat selection by elk on the CMWMA. Management strategies that re-open matured forest canopies which are currently limiting herbaceous understory vegetation, will be useful for enhancing the nutritional quality of elk summer habitat. Considerations for non-native plant infestations in areas of highly recurrent and severe wildfires will also be important.

POSTER

A DECADE OF UNDERSTORY COMMUNITY DATA IN A MATURE SECOND-GROWTH FOREST IN WESTERN WA. Ryan Bartlett and Dylan Fischer, Evergreen Ecological Observation Network, The Evergreen State College, 2700 Evergreen Pkwy NW, Olympia, WA 98505; ryanbartlett777@gmail.com

Ecological succession remains an important area of study in Northwest forests. Several studies suggest that understory communities can continue to be dynamic even in the later stages of succession. It is often assumed that overstory exert a strong control on understory communities, yet some long-term observations in old-growth ecosystems have challenged this idea. We use a 10-year data set from a permanent plot network to explore the dynamics of understory communities in a mature second-growth temperate forest in western Washington. We examine communities with regard to stand age, canopy structure, proximity to pathogens, and overstory canopy type. Changes in overstory structure were minimal over the course of the study and understory communities were stable in cover - dominated by *Polystichum munitum* and *Gaultheria shallon*. Diversity also remained relatively unchanged. Species abundance declined by 23% and there were significant changes in percent cover for several individual species. Community composition was significantly associated with canopy roughness, forest overstory type, and deciduous versus conifer canopy cover. However, community composition was not associated with stand age or the presence of *Phellinus weirii* (a well-known fungal pathogen). Individual exotic invasive species displayed dynamic shifts with *Ilex aquifolium* increasing by 200% and *Hedera helix* decreasing by 90%. *Geranium robertianum* was found in seven plots, with no recorded occurrences before this year. In these mature forests, understory plant communities exhibited stability, despite changes in diversity metrics. Dramatic changes in invasive species suggest more community changes may be on the horizon for these otherwise stable forest understories.

ORAL

THE IMPACTS OF A WILDFIRE IN A SEMI-ARID GRASSLAND ON SOIL NEMATODES AND ORGANIC MATTER OVER FOUR YEARS. Justin Bastow, Department of Biology, Eastern Washington University, 258 SCI, Cheney, WA 99004; jbastow@ewu.edu

Fire is the most common disturbance in arid regions, and is expected to become more common in many areas as a result of climate change. In this study, I followed the impacts of a wildfire on soil nematodes, moisture and organic matter (SOM) in a semi-arid grassland for four years, using paired burned and unburned sites. Immediately following the fire, bacterivorous, fungivorous and herbivorous nematodes in burned sites were 49, 73, and 76 % less abundant than in unburned reference sites. The recovery of bacterivores and fungivores took more than three years, and herbivores did not recover during the study period. Burned sites also had 22 % less SOM than unburned sites over the study period and lower soil respiration 14 months after the fire. Soil moisture was also lower in burned sites for at least 14 months. Nematodes at this site were more

negatively impacted by the fire, and took longer to recover, than nematodes in most published studies of soil responses to wildfires. The slow recovery of nematode abundances may be related to the exacerbation of moisture limitation at burned sites in this semi-arid region. Changes in fire regime may, therefore, have widespread impacts on soil food webs and processes in semi-arid climates.

ORAL

GROWING UP: POST-FIRE CONIFER ESTABLISHMENT TRAJECTORIES IN EASTERN OREGON. **Angela E. Boag**, Cooperative Institute for Research in Environmental Sciences, University of Colorado Boulder, 4001 Discovery Drive, Boulder, CO 80303; angela.boag@colorado.edu

Given the recent increase in the frequency of large wildfires in western North America, managers and researchers seek information on forest resilience and recovery trajectories. The speed and density at which juvenile conifers establish post-fire is pertinent both to fuels management planning, in cases of overabundant regeneration, as well as to decisions surrounding restoration and replanting in sites with limited post-fire tree establishment. In order to understand post-fire recovery trajectories in the Blue Mountains of eastern Oregon, we destructively sampled ponderosa pine and Douglas-fir seedlings and saplings in 8 sites that burned between 1996 and 2007 on the Umatilla and Malheur National forests. We collected stem disc and core samples from over 300 individuals and determined establishment year using dendrochronological methods. Juvenile conifer densities varied widely between sites, from 600 to over 10,000 juveniles per hectare. Establishment timing also varied between sites; in some burned areas peak establishment occurred within the first 5 years post-fire, while in other sites peak establishment occurred 10-15 years post-fire. These results suggest burned areas with few seedlings 10 years post-fire may not necessarily face long-term regeneration limitation. We discuss how these findings compliment recent studies measuring post-fire juvenile conifer size and density across the Blue Mountains, and the ways this information may assist managers and researchers in the Intermountain West.

ORAL

EXAMINING LIFE HISTORY SHIFTS AND GENETIC COMPOSITION IN A HATCHERY STEELHEAD POPULATION WITH IMPLICATIONS FOR FISHERY AND OCEAN SELECTION. **Brett Bowersox**, Idaho Department of Fish and Game, 3316 16th St., Lewiston, ID 83501, Matthew Corsi, Idaho Department of Fish and Game, 2885 W Kathleen Ave, Coeur d'Alene, ID 83815, Joshua L. McCormick, Idaho Department of Fish and Game, 1414 E. Locust Lane, Nampa, ID 83686, Timothy Copeland, Idaho Department of Fish and Game, 600 S. Walnut St., Boise, ID 83707, Matthew Cambell, Idaho Department of Fish and Game, 1800 Trout Rd., Eagle, ID 83616; brett.bowersox@idfg.idaho.gov

Steelhead trout, *Oncorhynchus mykiss*, populations exhibit significant variation in life-histories and Dworshak hatchery stock steelhead exhibit unique life-history characteristics compared to other Columbia River basin hatchery stocks. Maintaining these unique characteristics is of conservation and fishery management importance. We evaluated changes within the Dworshak hatchery stock ocean age composition and length at age from run years 1978 to 2016 using samples collected from commercial gillnet fisheries, sport fisheries, and the hatchery trap. In addition, we analyzed genetic composition of the stock by comparing the wild founding stock

collected in 1969 to recent returns. On average, steelhead became younger across the study with fewer three-ocean fish and increases in proportion of one-ocean fish. Length at ocean age decreased for all ocean ages however, the decrease was not significant in one-ocean fish. Both age composition and length at ocean age exhibited gear dependent effects with larger and older fish in gillnets and the sport fishery compared to the hatchery rack. Neutral genetic diversity, measured from a panel of single nucleotide polymorphic markers, showed no changes between a sample of fish representing the original founders and the present day population. Life history shifts observed in Dworshak hatchery stock steelhead were likely influenced by a variety of factors including gear selectivity and changing ocean conditions. Decreases in age structure and length at ocean age will have implications for broodstock management in the hatchery and provides evidence that similar trends may be occurring within wild steelhead stocks.

POSTER

DECREASING N₂ FIXATION IN *LOBARIA OREGANA* IS LIKELY CAUSED BY ANTHROPOGENIC EMISSIONS. Elise Bugge, R. Dave Evans, Meaghan Petix, Stable Isotope Core Facility, Washington State University, Pullman, WA 99163; Bruce McCune, Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97333; elise.bugge@wsu.edu

Nitrogen (N)-fixation is the dominant natural source of N in Pacific Northwest ecosystems, but low N₂-fixation rates result in N limitations to net primary productivity. However, anthropogenic emissions of N have increased globally due to agriculture and burning of fossil fuels. Long term N deposition has adverse effects such as eutrophication, soil acidification, and loss of biodiversity. In Pacific coastal ecosystems, epiphytic lichen communities are a dominant source of N₂-fixation, but exceedance of the critical load of N from deposition may decrease N₂-fixation by epiphytic lichens. Here, we test the hypothesis that atmospheric N deposition from anthropogenic sources is decreasing N₂-fixation by the cyanolichen, *Lobaria oregana*. We tested the hypothesis by measuring the N stable isotope composition ($\delta^{15}\text{N}$) of herbarium lichen specimens from 1899 to current day. A $\delta^{15}\text{N}$ of 0 ‰ indicates N₂-fixation, negative values represent agricultural emissions while positive values indicate N originating from fossil fuel emissions. Lichen $\delta^{15}\text{N}$ suggests N₂-fixation was the dominant source of N until the 1970's. A large increase in $\delta^{15}\text{N}$ in the 1970's corresponds to the completion of I-5 and rapid development along the I-5 corridor. Lichen $\delta^{15}\text{N}$ values that correspond to fossil fuel emissions have steadily increased to present, but large spatial variation exists due to localized sources. This suggests that over the short term, anthropogenic N deposition is causing a decrease in N₂-fixation by *Lobaria oregana*. The long term consequences are a likely shift from N sensitive, to N tolerant species.

THE USE OF EDNA TO IDENTIFY EXTENT OF FISH OCCUPANCY. Lucius Caldwell, Scott Blankenship, Genidaqs-Cramer Fish Sciences, 3300 Industrial Blvd., Suite 100, West Sacramento, CA 95691; Gregg Schumer, Genidaqs-Cramer Fish Sciences, 3300 Industrial Blvd., Suite 100, West Sacramento, CA 95691; Dan Bingham, Fish Ecology Lab-Cramer Fish Sciences, 7525 NE Ambassador Pl., Suite C, Portland, OR 97220; Lindsey Belcher, Fish Ecology Lab-Cramer Fish Sciences, 7525 NE Ambassador Pl., Suite C, Portland, OR 97220; lucius.caldwell@fishsciences.net

We conducted a parallel methodology study evaluating the ability of targeted eDNA sampling to identify fish-bearing streams and habitat breaks within small, fish-bearing, headwater streams. Our study focused efforts on 47 segments within 14 stream networks across southern Washington State. We conducted standard “protocol surveys” that included backpack electrofishing streams to locate fish, plus simplified longitudinal profiles and habitat surveys to characterize streams and quantify potential habitat breaks. Concurrent with our protocol survey, we collected 105 water samples for eDNA analysis from 57 sites across our 47 segments. Site selection was based on survey extent, fish observations, and field identification of potential habitat breaks. These 57 sites included 11 positive control sites (fish observed above sample), 27 presumed negative test sites (no fish observed above sample), and 19 unknown status test sites (no observations at the time of collection, subsequent validation using protocol survey). We found that qPCR analysis of these waterborne eDNA samples returned correct results for 10/11 of positive control sites (sensitivity = 91%) and 27/27 of presumed negative sites (specificity = 100%) for an overall correct assignment of 97% of the sites. Next, we explored the use of water samples collected at the downstream extent of a protocol survey to predict fish occupancy in 19 unknown status test sites. We found that qPCR analysis of eDNA samples collected at the downstream survey boundary accurately predicted 100% of subsequent protocol survey fish observations (19/19 negatives and 1/1 positive). When considering all known-status cases (controls and tests), the conditional probability of subsequently observing fish, given a positive qPCR eDNA result, was 100%, and the conditional probability of subsequently not observing fish, given a negative qPCR eDNA result, was 98%. Thus, we found that eDNA analysis offers the ability to identify extent of fish occupancy within small, headwater streams.

S’YILN KHWE SCHITSU’UMSH: DECOLONIZING COEUR D’ALENE FOOD TRADITIONS.

Leanne Campbell, Cultural Tourism Coordinator, Coeur d’Alene Casino/Resort, 37914 S Nukwalqw St, Worley, ID 83876; Nicholas Kager, Deputy THPO; Jill Wagner THPO; Coeur d’Alene Tribe, P.O. Box 163, Plummer, ID 83851; lcampbell@cdacasino.com

The Schitsu’umshlsh, Coeur d’Alene people’s, traditional foods and foodways are diverse, adaptive and integrated into the whole of Schitsu’umsh lifeways. The Schitsu’umsh Calendar, developed by the community over a matter of years, reflects that integrated adapted diversity. The seasons are based on foods and other traditional resources and linked to living areas, travel methods, and ceremonies. Language is key to the understanding. The calendar represents the cyclical nature of life and traditional knowledge; a move against colonization. Contemporary life presents challenges to carrying on these traditions.

MISSOULA FLOODS FILLED WALLULA GAP TRIBUTARIES. Robert J. Carson, Department of Geology, Whitman College, Walla Walla, WA 99362places; carsonrj@whitman.edu

At Wallula Gap the Columbia River bottom has an elevation of 90 m; ice-rafted granitic erratics sit as high as 340 m on the gap's rim, so one or more floods were >250 m deep. As the Missoula floods entered the gap from the Pasco Basin, erosion created miniature scablands on both sides. Downstream, the floods filled at least five tributary valleys to as high as 260 m near the gap; these eddy-bar-like fills slope up the tributary valleys at gradients as steep as 120 m/km, reaching as high as 345 m. The fills are quite unlike the typical gravel bars across the mouths of tributary valleys along the routes of the Bonneville and Missoula floods. The maximum length of these gravel fills is at least 2.9 km, with volumes as large as at least 0.03 km³. The gullies dissecting the fills reveal cobbles and boulders of greater than 99% basaltic composition; the coarse gravels host intermittent fine-grained slackwater sediments. The gullies are all on the northeast sides of the fills, indicating that the flood currents deposited more sediment on the southwestern sides. In post-flood time, between 5 and 95% of the gravel fills have been eroded, with alluvial fans at the base of the gullies. Mazama tephra in the fans indicates more erosion and deposition occurred before 7600 years ago than afterward.

ANCIENT SWIMMERS IN A MODERN WORLD: PACIFIC LAMPREY MIGRATION IN THE COLUMBIA RIVER BASIN. Christopher C. Caudill, Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID 83844; Matthew L. Keefer, Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID 83844; and Mary Moser, Fish Ecology Division, Northwest Fisheries Science Center, 2723 Montlake Blvd E., Seattle, WA 98112; caudill@uidaho.edu

Pacific lamprey (*Entosphenus tridentatus*) is a culturally and ecologically significant native fish that has declined in abundance and range since European colonization. Dams and river regulation have been implicated in the decline, in part because fish passage design focused on salmonid fishes during the 20th century. Over the past two decades, we have investigated Pacific lamprey passage behavior and have been iteratively developing and testing, installing and monitoring fishway modifications and alternative passage structures at lower Columbia River dams to aid efforts at improving migration to interior Columbia River spawning sites. We have examined behavior in experimental flume and field settings at scales of centimeters to 100s of km using a variety of imaging, biotelemetry, and genetic technologies. Structural and operational changes to fishways have included reducing velocities at night to increase passage rate of nocturnal lamprey while providing adequate conditions for diurnally migrating salmonids, development of novel lamprey passage systems exploiting the unique climbing abilities of lamprey, and testing use of refuge boxes by lamprey that provide shelter within fishways during daylight hours. A central component of these efforts has been effectiveness monitoring and testing mechanistic hypotheses. Overall, the results demonstrate: 1) Pacific lamprey have remarkable swimming and migratory capacities; 2) knowledge of lamprey behavior can be used to design novel and effective fishways; and 3) the migration system of lamprey continues to present challenges for researchers and managers.

LIVING ROCKS: MOLLUSKS OF THE PACIFIC NORTHWEST. Anna Chase, William H. Clark, Orma J. Smith Museum of Natural History, The College of Idaho, Caldwell Idaho 83605; Barry Bean, Idaho Power; acrobaticchase@gmail.com

The goals of this study were to determine taxa richness in the lower Boise River, Ada and Canyon Counties, Idaho, U.S.A. to describe the spatial distribution and mean population density of mollusks in the lower Boise River, to compare abundances of the different taxa present, as well as to add collected voucher specimens to the Orma J. Smith Museum of Natural History collection at The College of Idaho. Twenty-five sites were sampled between Lucky Peak Dam and the confluence of the Boise and Snake Rivers during this survey. Sampling took place between June 14 and September 10, 2016. Samples were fixed with tobacco, preserved in 75% ethanol, and identified to the lowest possible taxon. Fourteen genera from eight families were collected.

IMPACTS OF MT MAZAMA ASH ON THE BEHAVIOR OF LATAH CREEK FLOODPLAIN SOIL, SPOKANE, WASHINGTON. Aaron B. Cleveland, Richard L. Orndorff, Department of Geology, Eastern Washington University, Cheney, WA 99004; aaroncleveland@eagles.ewu.edu

The eruption of Mt. Mazama nearly 7,700 years ago blanketed the Pacific Northwest in volcanic ash and resulted in the formation of Crater Lake in southwest Oregon. Remnants of this volcanic ash outcrop in the Spokane, WA area as localized channel and basin deposits that are, in some locations, as much as one to two meters in thickness. We tested Mt. Mazama ash from the Latah Creek area of Spokane (adjacent to the Latah Fault) for its geotechnical engineering properties according to ASTM standards. We determined the specific gravity, Atterberg limits, particle size distribution, and the optimum water content for compaction. We conducted a series of unconfined compressive strength tests on pure Mt. Mazama ash and pure Latah Creek soil. We then tested the strength of Latah Creek soil with the addition of Mazama ash interbeds. The compacted Mazama ash was significantly stronger than Latah Creek soil. When Mazama ash was added as an interbed to the Latah Creek soil, the ultimate strength of the soil increased, with the largest increase occurring with the ash as the middle lift. Finally, we demonstrated that both Mazama ash and Latah Creek soil are susceptible to liquefaction when saturated. Ash beds underlay areas undergoing development in Spokane, so understanding their engineering properties is vital to predicting the long-term stability of surface infrastructure.

EVALUATION OF DECADAL CHANGES IN VEGETATION AND LICHEN COMMUNITY STRUCTURE IN RELATION TO METAL CONCENTRATION AND CLIMATE ALONG THE RED DOG MINE HAUL ROAD IN CAPE KRUSENSTERN NATIONAL MONUMENT, ALASKA.

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Cape Krusenstern National Monument is in northwestern Alaska and is traversed by the DeLong Mountain Transportation System haul road. The haul road is the only route for transportation of concentrated zinc (Zn) and lead (Pb) ore from the Red Dog Mine to the marine port site. The mine is ~50 km northeast of the Monument and is one of the largest Zn mines in the world. In 2001, high metal levels in the moss *Hylocomium splendens* were attributed to fugitive ore dust released during transport. Since then, the mine has implemented measures to reduce fugitive dust. In 2006, vegetation and lichen community data were collected and a decrease in heavy metal levels in mosses were documented. In 2017, we remeasured the 2006 sites with the goals of (1) analyzing spatial patterns and change in metal levels of Zn, Pb and nickel (Ni) from 2006 to 2017, and (2) analyzing change in vegetation and lichen communities from 2006 to 2017. Here, we present preliminary results of goal (1) from 39 plots where heavy metal concentrations have not changed significantly during the 10-year study period. Assuming that dust control methods have reduced deposition rates, our results suggest long-term persistence of metals in the vegetation. Preliminary results of goal (2) indicate an increase in cover from 2006 to 2017 in all groups of organisms studied: mosses, lichens and vascular plants. This may be due to the shifting of tundra habitat to shrubland habitat through a ‘greening’ process attributed to climate change.

ORAL

LIFE HISTORY DIVERSITY OF WILD STEELHEAD *ONCORHYNCHUS MYKISS* ATTRIBUTING TO LONG-TERM PERSISTENCE IN THE LOCHSA RIVER BASIN.

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Resiliency of *Oncorhynchus mykiss* is attributed to their diverse life history with varying timing and occupancy in both freshwater and saltwater habitats. Management decisions for returning adult steelhead (anadromous form) requires the understanding of the complex life history of steelhead populations. However, few long-term, complete datasets for steelhead are available. One such dataset accounts for timing, abundance, length, age, and survival of wild juvenile steelhead of a subpopulation in the Lochsa River in Idaho from 1995 through 2018. Adult detections in the hydrosystem and information collected at an adult weir were used to determine the same metrics for adults returning to spawn. We examined this dataset to delineate the diversity of steelhead in Fish Creek and how such information can be used to improve adult return predictions for management purposes. Estimated juvenile emigration varied from 8,611–75,109 (mean = 28,515), and estimated adult returns varied from 16 (SE = 5.7) in 2018 to 452 (SE = 3.6) in 2015. Survival to Lower Granite Dam varied between the seasons in which juvenile steelhead were PIT tagged. Timing and ages of juveniles to Lower Granite Dam were

also highly variable. Twelve different freshwater and saltwater age combinations have been identified in adult steelhead returning to spawn with total adult ages that varied ranged from three to seven years old. Findings will help inform managers the best methods for estimating important parameters of returning adults and will aid in determining the best management practices for the perpetuity of wild Idaho steelhead.

POSTER

NOBLE GAS CONCENTRATIONS, AND A REEVALUATION OF CARBON AGE DATES FOR AQUIFERS OF THE SOUTH FORK PALOUSE RIVER BASIN, IDAHO AND WASHINGTON, USA. Kyle A. Duckett, Jeff B. Langman, Department of Geologic Sciences, University of Idaho, Moscow, ID 83844, USA; Duck7892@vandals.uidaho.edu

Aquifers in the South Fork Palouse River Basin are hosted within the fractured basalts of the Columbia River Basalt Group and the interbedded sediments of the Latah Formation. The residence time of groundwater, and associated rate of recharge, to the deep aquifer of this multiple aquifer system is a primary interest to local water managers. Prior investigations of the deep groundwater have indicated low values of percent modern carbon and elevated alkalinity and $\delta^{13}\text{C}$ values compared to shallower groundwater. The groundwater residence time suggested by the uncorrected carbon age dates implies a recharge rate much slower than hypothesized from the relatively large groundwater withdrawals. No inputs of dead carbon have been identified, but the disconnect between carbon age dates and groundwater withdrawals appear to indicate an unidentified dead carbon source. Elevated alkalinity in deep groundwater can be attributed to dead carbon sources and can be correlated with elevated $\delta^{13}\text{C}$ values, elevated ^4He concentrations, and elevated $^3\text{He}/^4\text{He}$ ratios, measured as part of this study. Elevated $\delta^{13}\text{C}$ values support a deep CO_2 source likely associated with the emplacement of the Columbia River basalts, which are historical expressions of the modern Yellowstone hotspot. The hotspot has been found to exude relatively high He and an associated high $^3\text{He}/^4\text{He}$ ratio, as well as a significant amount of CO_2 . A geologic source of CO_2 would explain the low modern carbon values and the long residence times, and a correction of carbon age dates could produce residence times more aligned with the observed groundwater withdrawals

ORAL

MOVEMENT RESPONSE OF JUVENILE CHINOOK SALMON (*ONCORHYNCHUS TSHAWYTSCHA*) TO CARCASSES OF RAINBOW TROUT (*O. MYKISS*) AND PACIFIC LAMPREY (*ENTOSPHEBUS TRIDENTATUS*). Ryan A. Dunbeck, Matthew R. Dunkle, Christopher C. Caudill, Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID, 83844; rdunbeck675@gmail.com

Anadromous fish carcasses provide marine-derived nutrients to stream food-webs during a period of increased seasonal metabolic demand. We investigated the behavioral growth and movement response of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) to the presence of decomposing Pacific Lamprey (*Entosphenus tridentatus*) and rainbow trout (*Oncorhynchus mykiss*) carcasses in an artificial flow-through mesocosm system. Response variables included juvenile fish weight and length, periphyton biomass and chlorophyll *a* and invertebrate standing biomass at the conclusion of the study. We also monitored decomposition rate of carcasses. Trout carcasses decreased in mass significantly faster than lamprey carcasses, which gained wet mass for the first week of the experiment before declining. After one week, chlorophyll *a* was

significantly higher in light treatments for both carcass types and was also significantly higher on shaded tiles in trout treatments relative to control conditions. At the end of the experiment, only chlorophyll-a concentrations in trout tanks were significantly greater than that of control tanks. Mean macroinvertebrate biomass collected from the mesocosms at the end of the experiment were not significantly different across treatments. We observed greatest emigration under control conditions, moderate emigration with trout carcasses, and lowest with lamprey carcasses, suggesting lamprey and salmonid carcasses create patches perceived as higher quality by juvenile salmon than similar habitats without carcasses and that such patches may support a higher density of salmonids over the course of weeks during the growing season.

ORAL

SMALLMOUTH BASS DIET AND CHINOOK SALMON MORTALITY ALONG THE SNAKE RIVER CONTINUUM. John M. Erhardt, U.S. Fish and Wildlife Service, Idaho Fish and Wildlife Conservation Office, Orofino, ID 83544; Kenneth F. Tiffan, U.S. Geological Survey, Western Fisheries Research Center, Cook, WA 98605; john_erhardt@fws.gov

Predation by nonnative fishes has been identified as a contributing factor in the decline of juvenile salmonids in the Columbia River basin. Studies conducted in the Snake River during the 1990s found relatively low levels of smallmouth bass predation on Chinook salmon at a time when their populations were at low abundance. In 2012, we began research to re-evaluate smallmouth bass predation on juvenile fall Chinook salmon given their increase in abundance due to recovery measures. From 2012-2018, we examined 22,867 smallmouth bass stomachs from Hells Canyon to Lower Granite Reservoir. Chinook salmon were often the first- or second-most consumed fish species during the spring. Other predominate prey changed as the river transitioned into reservoir habitat. While bass abundance has not changed appreciably since the mid-1990s, bass consumption rate of subyearling Chinook salmon has increased 15-fold in some instances. Total mortality estimates of natural subyearlings in the 115 rkms of Hells Canyon that we studied ranged from 271,000 to 329,000 per year. Estimates of Chinook salmon mortality (hatchery and natural fish combined) ranged from 51,000 to 262,000 in 42 rkm of Lower Granite Reservoir. Fall Chinook salmon may be particularly vulnerable to predation due to their small size, extended reservoir rearing, and migrating at times when bass abundance and metabolic rates are high. Environmental variables and food web alterations likely have a significant impact on predation mortality of Chinook salmon by smallmouth bass.

ORAL

PRAIRIE RECONSTRUCTION ON THE PALOUSE. Brenda Erhardt, Latah Soil and Water Conservation District, 220 East 5th Street, Suite 208, Moscow, ID 83843; berhardt@latahswcd.org

The Palouse Prairie is a unique, forb-rich grassland in north Idaho that extends into portions of eastern Washington and northeastern Oregon. It is estimated that less than 1% of the native Palouse Prairie remains following conversion to agriculture in the late 1800s and early 1900s due to the rich deep soils. While protection of the existing Palouse Prairie remnants should remain a top priority, reconstructing the Palouse Prairie plant community to expand existing habitat and create wildlife and pollinator corridors is a critical component to enhance and protect this important ecosystem. Palouse Prairie reconstruction efforts have been building over the past decade, following expanded funding, technical expertise, and landowner interest. These factors

have opened markets to expand the production of locally-sourced native grass and forb seed, which are essential components of these projects. With these increased seed resources, more diverse seed mixes can be applied to Palouse Prairie reconstruction projects on a larger scale. Increased diversity in the seed mixes improves the resiliency, effectiveness, and success rates of these projects as well. The Latah Soil and Water Conservation District has partnered with numerous funding agencies and private landowners to convert over 200 acres of former agricultural land to native plant community. Site preparation, seeding, maintenance, weed control, and increasing plant diversity are all essential components of the prairie reconstruction process. This presentation will highlight the techniques and seed mixes used on multiple project sites to establish native plant communities on the Palouse as well as lessons learned along the way.

ORAL

THE INFLUENCE OF SPAWNING FISH ON RIVER PROFILES AND POTENTIAL SPECIATION OVER GEOLOGIC TIMESCALES. Alexander K. Fremier, School of the Environment, Washington State University, Pullman WA; Brian Yanites, Earth and Atmospheric Sciences, Indiana University, Bloomington, IN; Elowyn M. Yager, Center for Ecohydraulics Research, Department of Civil Engineering, University of Idaho, Boise, ID; alex.fremier@wsu.edu

While physically-based explanations of biological speciation are common (e.g. mountains separating a species can lead to speciation), less common is the inverse process examined; can a speciation event have significant influence on physical processes and patterns in a landscape? Here, we formalized the physical influence of salmon spawning on stream beds into a model of channel profile evolution by altering the critical shear stress required to move stream bed particles. We then asked, if spawning and an adaptive radiation event (similar to the one that occurred in Pacific salmon) could have an effect on channel erosion processes and stream profiles over geological time scales. We found that spawning can influence the longitudinal profiles of stream beds and thereby the evolution of entire watersheds. The radiation of five Pacific salmon from a common ancestor, additionally, could also cause significant geomorphic change by altering a wider section of the profile for a given distribution of grain sizes. This modeling study suggests that biological evolution can impact landscape evolution by increasing the sediment transport and erosion efficiency of mountain streams. Moreover, the physical effects of a species on its environment might be a complementary explanation for rapid radiation events in species, through the creation of new habitat types. This example provides an illustrative case for thinking about the long- and short-term coupling of biotic and abiotic systems.

OTOLITH ANALYSIS REVEALS VARIABLE JUVENILE GROWTH AND MIGRATION IN CHINOOK SALMON EXPERIENCING DIFFERENT ENVIRONMENTAL CONDITIONS.

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Understanding the conditions that produce diverse salmonid migration strategies is challenging in a large river network where life history trajectories arise from multiple biotic and abiotic factors. Because early growth is closely linked to migration initiation, identifying the growth conditions experienced by individual fish at a small time scale is crucial. Here, we paired a long-term otolith dataset with a detailed bioenergetic assessment of early growth opportunity in a population of Chinook salmon to identify how growth conditions related to migration initiation. In the Snake river population of fall Chinook salmon, juveniles historically migrated their first summer, but in recent years an overwintering migration strategy has emerged. Using otolith microchemistry and microstructure analysis, we determined that a significant proportion of fish from both the Clearwater and Snake rivers overwinter and migrate the following spring. Notably, Clearwater origin fish that migrated as yearlings performed a larger proportion of their freshwater growth in natal habitat than Snake origin fish. We also found higher growth and consumption during the early growth period for fish originating in the Snake river and downstream reservoir compared to the Clearwater river, by comparing relative growth and consumption using a daily time-step bioenergetics model. The combined bioenergetics and migration analysis demonstrates that while both Snake river and Clearwater origin fish express the overwintering strategy, their relative growth in natal habitats differ. These findings suggest that the yearling migration strategy may arise from different conditions throughout the population, though the net effect is the increasing prevalence of this strategy.

POSTER

LEAF AREA INDEX MEASUREMENTS DEPEND ON SITE PRODUCTIVITY AND THINNING IN THE INLAND NORTHWEST.

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Overstocked stands result in stressed trees due to competition for resources across the western United States. Stress due to overstocking can also be exacerbated by climate change, wildfires, disease, or insects. A common practice to improve stand value and alleviate stress caused by overstocking is the silvicultural technique of thinning. Thinning lessens competition for a site's resources. Light resources are improved by thinning, however thinning also decreases canopy light interception following thinning. The objective of this study is to determine how thinning practices effect the relationship between site productivity class and the forest canopy by measuring Leaf Area Index (LAI). The recovery of LAI is a strong indicator of thinning recovery. The study used 12 sites with 3 plots per site. The sites range in productivity based on height growth. The plots within each site include a control with no thinning, a 4.3 m thinning treatment and a 5.5 m treatment. The sites are located in northern Idaho and northern Washington and designed for long-term monitoring, so there is historical data and future

measurements are planned to compare to the results of this study. LAI measurements were taken with a LI-COR 2200C instrument in a dual wand configuration at each plot. LAI correlated most strongly with site productivity in the no-thin treatment. Thinning decreased LAI and disrupted the relationship with site productivity. LAI is expected to increase in thinned plots with future measurements.

ORAL

GENETIC DIVERSITY AND POPULATION STRUCTURE OF THE PYGMY RABBIT IN NORTHERN UTAH. Digpal S. Gour, Department of Fish and Wildlife Sciences, University of Idaho, 875 Perimeter Drive MS 1136, Moscow, ID 83844; Stephanie DeMay, Natural Resources Institute, Texas A&M, 578 John Kimbrough Blvd., College Station, TX 77843; Masako Wright, Uinta-Wasatch-Cache National Forest, United States Department of Agriculture, 507 25th Street, Ste.102, Ogden, UT 84401; Jennifer Adams, Department of Fish and Wildlife Sciences, University of Idaho, 875 Perimeter Drive MS 1136, Moscow, ID 83844; Lisette P. Waits, Department of Fish and Wildlife Sciences, University of Idaho, 875 Perimeter Drive MS 1136, Moscow, ID 83844; digpalsgour@uidaho.edu

The pygmy rabbit (*Brachylagus idahoensis*), the smallest rabbit in North America and a sagebrush obligate, is listed as a Bureau of Land Management sensitive species in Utah and as a Species of Concern by the Utah Division of Wildlife Resources. Threats to pygmy rabbits include habitat loss and fragmentation which can lead to population isolation and loss of genetic diversity. This study evaluated genetic diversity and connectivity between populations within and between Rich and Box Elder Counties in Utah. Non-invasive genetic sampling of fecal pellets and nuclear DNA microsatellite genotyping were used to detect 116 individuals across five sampling areas in Rich County and 38 individuals across three sampling areas in Box Elder County. Genetic diversity was assessed using observed and expected heterozygosity and allelic richness. Genetic structure and gene flow between sites in Rich and Box Elder counties were examined by calculating pairwise F_{ST} and G''_{ST} values, principal coordinates analysis (PCA) and Bayesian clustering analysis (STRUCTURE). Genetic diversity levels were variable across sampling areas with higher diversity observed in Box Elder County than Rich County. F_{ST} analyses indicated gene flow within counties and a restriction of gene flow between counties. These results were confirmed with PCA and STRUCTURE analyses that detected two main genetic groups that were divided by county. The genetic diversity and gene flow among pygmy rabbits within each county indicates there are no major barriers to dispersal and suggests these populations experience sufficient gene flow to prevent population subdivision and the loss of genetic diversity.

ORAL

RESOURCE PARTITIONING BETWEEN FORAGING BEARS AND TRIBAL HARVEST OF HUCKLEBERRIES ON THE FLATHEAD INDIAN RESERVATION. Celina Gray, Wildlife & Fisheries, Salish Kootenai College; Janene Lichtenberg & Antony Berthelote, Research Advisors, Salish Kootenai College, 58138 US-93, Pablo, MT 59855. celinagray@student.skcc.edu

Huckleberries (*Vaccinium* spp.) facilitate important ecological relationships for Native Americans within the Flathead Indian Reservation of Montana and throughout the Pacific Northwest. Huckleberries provide cultural resources such as traditional foods and customs, social

elements and economic products. Huckleberries are also an important food source for bears, another culturally important animal for the Confederated Salish and Kootenai Tribes (CSKT) along with many other Native American Tribes. Phenological data on huckleberries is extremely limited, the opportunity for traditional ecological knowledge (TEK) to be utilized in order to expand knowledge was a key focus for this project. To gain a better understanding of the role that huckleberries play in cultural and ecological networks, ecological characteristics of huckleberries across a range of habitats on the reservation were examined in addition to interviews with tribal elders about historic and modern use of huckleberries. Recorded phenology data at 10 sites at different elevations across the reservation were used to develop a baseline understanding of the time of flowering and berry production. We evaluated the relationship between site productivity of huckleberries and sugar content (measured in brix%) of berries at peak ripeness and compared those metrics with bear use, measured by the amount of bear sign at each site. Bear sign was most prevalent at the more remote locations with higher brix% ($R^2=0.82$, $p=0.012$) and plentiful berries. Finally, community interviews were conducted with adult tribal members about the importance of huckleberries for the tribal community and the people's understanding of the niche bears maintain concerning huckleberries; thus far the interviews support symbiosis between tribal harvesters and foraging bears. This research contributes to collaborative studies in Northwest Montana focusing on huckleberries as a food source for bears in the face of climate change, as well as supporting CSKT in asserting traditional food sovereignty.

ORAL

EVALUATING THE INFLUENCE OF PAST EXPERIENCE ON SWIMMING BEHAVIOR AND PASSAGE SUCCESS IN ADULT PACIFIC LAMPREY. Sarah Hanchett, Breanna Graves, Chuck Boggs, Timothy Blubaugh, Tami Clabough, and Christopher Caudill, Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID 83844-1136; sahanchett@uidaho.edu

During spawning migration, adult Pacific lampreys (*Entosphenus tridentatus*) navigate through fishways that have water velocities reaching ~2 m/s. As this exceeds critical swimming speed estimates (~0.86 m/s), lampreys can expend considerable amounts of energy as they approach anaerobic levels. Although several studies have examined the role a short-term or single passage challenge has on swimming ability and passage success, few studies have examined cumulative effects on endurance from overcoming multiple obstacles. The primary objective of this study was to evaluate Pacific lamprey endurance capacity in response to exhaustive exercise challenges in an experimental flume located in the adult fish facility (AFF) at Bonneville Dam. In the exhaustive exercise trials, passage success was measured according to ability to pass a 1.00 m vertical-slot weir in response to five treatment combinations of water velocity (0 m/s, 1.0 m/s & 1.4 m/s) and trial duration (0 min exercise, 20 min exercise only & 20 min exercise, then 10 min rest, then 20 min exercise). 36 fish were evaluated per treatment. Lamprey passage success was lowest (52.2%) during the high-velocity, long-duration treatment ($Z= 3.26$, $P= 0.001$). Lamprey size was not related to passage success. These results support the hypothesis that adult passage success at Columbia River dams is mediated in part by physiological limits of lampreys while they are in fishway sections containing vertical-slot weirs.

HOW WILL THE RANGE OF BLACK HUCKLEBERRY CHANGE IN THE FUTURE?

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Black huckleberry (*Vaccinium membranaceum*) is a widespread species with ecological, cultural, and recreational importance, thus, it is important to understand how the species might respond to future changes in climate. We used 2,834 observed locations of the species in western North America from publicly available databases to develop relationships between where the species occurs and specific climatic variables. We then used those relationships to predict future habitat suitability (range) for 2 time periods and 2 emission scenarios (RCP 4.5 - assumes lower emissions and RCP 8.5 - assumes business-as-usual). There were seven climate variables identified as significant by Maximum Entropy Modeling: four temperature variables, two moisture variables and one temperature-moisture variable. Based on our modeling, the range of black huckleberry will **shrink** at lower elevations and in drier portions of the range by midcentury (2045) in both emissions scenarios (greater reductions at higher emissions). On the other hand, the range will **increase** substantially to the north and east in Canada and generally in other locations at elevations above 10,000 feet. Modest range increases were predicted to occur by 2045 with both emission scenarios and much larger range increases in Canada by 2085 especially with the more pessimistic emissions scenario. This type of modeling may help in planning and prioritizing monitoring and management activities related to this important species. For example, priority for monitoring berry production or implementing management activities such as reducing overstory to enhance production could be given to traditional picking areas where the model predicts changes in habitat suitability.

POSTER

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

The Vegetation Zone (VZ) and Plant Association Group (PAG) Model is a representation of the potential natural vegetation of the State of Washington. This environmental gradient model is used to generate a map of both VZ and PAG, in grid format at a 90 x 90 meter pixel resolution. Both the VZ and PAG vegetation units represent a level of environmental similarity, such that a narrow range of environmental conditions occurs within each vegetation unit. It is a model of the landscape environmental conditions and the kind of potential vegetation which occurs for each defined environmental unit. This gradient model uses algorithms to predict the boundaries of the 13 VZs in Washington, where elevation is the principal dependent variable, and latitude and longitude are the other two geometrical/spatial variables—thus together are the x,y,z coordinates of geometric and geographic space. The independent variables in order of their importance in the VZ model are Precipitation at Sea Level (PSL) (by far the most predictive of the VZ variables)

which accounts for approximately 70% of the predictability of the lower boundary of the VZs, Topographic Moisture (TM), Fog Effect, Cold Air Drainage, Aspect, Short Wave Radiation, and Mean Annual Temperature at Sea Level. The Plant Association Group model uses a lookup table routine to assign a PAG unit to each gridcell based on the variables—VZ, PSL, TM, elevation and aspect. The result is potential vegetation maps (VZ and PAG) for Washington State representing a geographical space of over 21 million pixels.

ORAL

INTERTRIBAL TIMBER COUNCIL: TRIBAL RESEARCH NEEDS AND PRIORITIES ASSESSMENT. **Serra Hoagland**, USDA Forest Service, Rocky Mountain Research Station Fire Lab and Salish Kootenai College, 5775 US HWY 10 W Missoula MT 59808; serra.j.hoagland@usda.gov

In 2012 the Intertribal Timber Council (ITC) initiated a research needs assessment for tribal forest and natural resource managers. The findings of the 2012 survey was the first systematic effort to understanding research needs, priorities and interest of Native American tribe's forest resource managers and decision makers. The 2012 results indicated three themes: 1) tribes placed high value on non-timber products (such as water, wildlife, etc.), 2) collaboration and cooperation were priorities especially when incorporating traditional ecological knowledge and western science and 3) tribes wanted research to be adapted to meet local needs of their landscapes. More recently, the ITC Research Subcommittee received grant funding through the Washington Office of the US Forest Service to conduct an updated and more rigorous research needs and priorities assessment. This assessment will cover three main topics: tribes' interest in participating in primary research, tribes' access to primary literature and scientific publications, and topics of interest for additional research needs. This assessment will quantify tribal interests and needs to improve stewardship potential in Indian Country and has been led by native and non-native scientists. One of the topics within the new assessment is on first foods and integrated management plans that intend to incorporate holistic management goals to meet numerous objectives.

ORAL

VOLATILE ORGANIC COMPOUNDS AND OTHER AIR POLLUTANTS FROM WESTERN U.S. WILDFIRE SMOKE. **Lu Hu**, Department of Chemistry and Biochemistry, University of Montana, Missoula, MT 59812; lu.hu@mso.umt.edu

Wildfire smoke originating in the western U.S. impacts air quality, nutrient cycles, weather, and climate. The WE-CAN (Western wildfire Experiment for Cloud chemistry, Aerosol absorption and Nitrogen) project deployed the National Center for Atmospheric Research/National Science Foundation C-130 research aircraft in summer 2018 (22 July – 31 August) to sample wildfire smoke during its first day of atmospheric evolution. The flight plans and aircraft payload were designed to answer scientific questions related to fixed nitrogen, absorbing aerosols, cloud activation and chemistry in wildfire plumes. This talk will provide an overview of the particular wildfires that were characterized during this mission, and the spatial extent of the smoke that we sampled. I will highlight preliminary findings from this project with particular focuses on emissions and chemistry of various volatile organic compounds from wildfire smoke, and their impact on air quality downwind. More details on the project timeline and payload can be found here: https://www.eol.ucar.edu/field_projects/we-can.

ORAL

PALOUSE PRAIRE ESTABLISHMENT IN FIELD-TO-PRAIRE CONVERSATION AND POLLINATOR-FORB FIELD ENHANCEMENT. **Jacie W. Jensen**, partner, Thorn Creek Native Seed Farm, native seed production and prairie restoration services , 1461 Thorn Creek Rd., Genesee, ID 83832; jacie@nativeseedfarm.com

Although the majority of the Palouse Prairie has been converted to the human world of agriculture, there are remnants of the Palouse Prairie natural world that remain intact with diverse flora and fauna. These small, highly fragmented pockets provide valuable lessons in implementing practices to increase diversity in and around working lands.

Finding the sweet spot between the natural world and the human world is something users and producers of native seed struggle with all the time. Whether seeding a national forest, a Conservation Reserve Program (CRP) field or a crop field, we invite disasters when the industrial model is forced on the land. For any project, users of native seed want a seed product of specific quantity and consistent quality with particular genetic-traits, as well as successful plant establishment. However, the natural world works on a different timeline and with a variable controlled by Mother Nature.

Our attempt to bring together the natural and the human worlds started on a fourth generation Palouse no-till farm. While searching for native grass and forb seed for our own land restoration projects, we noticed a missing link to restoring and re-establishing the Palouse prairie. That link is the availability of native seed and the knowledge of best practices for successful plant establishment. This presentation will highlight the lessons learned in the establishment of Palouse native seed production fields, field-to-prairie conversions, CRP native fields and CRP pollinator strips.

ORAL

THE ENTIRE LANDSCAPE NEEDS RELIEF FROM FIRE-DEFICIT: PAST, PRESENT, AND FUTURE OF THE METOLIUS RESEARCH NATURAL AREA, OREGON. **Kayla Johnston**, College of Forestry, Oregon State University, Corvallis, Oregon 97331; kayla.johnston73@gmail.com

Organized fire suppression has led to over a century of fire-deficit for much of the western US. This fire-deficit is shown to cause a variety of forest stand alterations including shifts in density, structure, composition, and fuel loading that are detrimental to the resistance, resilience, and overall function of the stand. Most fire-deficit studies and efforts to mitigate fire-deficit effects are focused in forests and stands that were historically actively managed, leaving to question how designated conservation areas are dealing with fire-deficit and if managers should intervene for the health of the forest. This study used dendrochronology methods to examine historical fire frequency and compare historical to current stand conditions for a 4.5-hectare permanent research plot located within the Metolius Research Natural Area, located 29 km northwest of Sisters, Oregon. The current fuel loading, modeled fire behavior and mortality were compared to a representative, established fuel model. The future of the plot was explored by extrapolating population growth rates from 1981-2016 and modeling fire behavior and tree mortality. Fire historically returned to the plot on average every 9.5 years from 1613-1898, no fires were recorded since 1898, and stand characteristics have greatly deviated from estimated 1898 conditions. Further, considering the population growth rates from 1981-2016 and the modeled fire behavior and mortality, the stand may be in decline and at risk of high-severity disturbance

ORAL

VOLATILE ORGANIC COMPOUNDS AND PARTICULATE MATTER DURING THE 2017-2018 WILDFIRE SEASONS IN THE LEWIS-CLARK VALLEY. Nancy A. C.

Johnston, Damien T. Ketcherside, Brandi A. Bundy; Morganne A. Hamann, Laurel A. Nunez, Dorian L. Pittman, Phillip S. Scott, Division of Natural Sciences and Mathematics, Lewis-Clark State College, Lewiston, ID 83501; Brian K. Grimm, Jiahong Li, Departments of Environmental Engineering and Chemistry, Washington State University, Pullman, WA 99164 ; Melanie A. Manangquil, Anatek Labs Inc., Moscow, ID 83843 ; Reece P. Uhlorn, MGC Pure Chemicals America Inc., Mesa, Arizona 85212; John P. Andrew, Pacific Northwest University of Health Sciences, Yakima, WA 98901; najohnston@lsc.edu

The Lewis-Clark Valley (LCV) is located at the confluence of the Snake and Clearwater Rivers between North-Central Idaho and Southeastern Washington, with a surrounding population of over 50,000. Smoke from nearby and distant wildfires often settles into the LCV, lowering air quality significantly during the late summer. The composition of gases and particulate matter in this smoke is of importance to human health of the LCV residents. As part of a two-year study, long and short term air samples were taken daily to monthly in the LCV during 2017-2018 using sorbent tubes, then analyzed by thermal desorption gas chromatography-mass spectrometry (TD-GC-MS) for over 50 volatile organic compounds, hazardous air pollutants, and sulfides in ambient air. During this time, aged wildfire smoke was captured in the air samples and particulate matter measurements from the Idaho Department of Environmental Quality were obtained. The difference between smoky air and normal air were compared. Benzene and particulate matter were elevated in the wildfire smoke. The additional risk to human health was calculated.

ORAL

QUANTITATIVE FOOD WEB ANALYSIS TO DETANGLE DENSITY DEPENDENCE IN CO-LIMITED HABITATS. John Jorgensen, Alex Fremier, Marc Evans, Brad Luff,

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Quantifying and detangling carrying capacity and density dependence in lotic ecosystems is central to identifying limiting factors and prioritizing actions that increase or restore native anadromous salmonid populations. Identifying and prioritizing remedial actions is critical for restoration of co-limited streams (degraded physical habitat, reduced nutrients and competition from non-natives). Geomorphic and habitat-based monitoring metrics, models, and assessments (primarily abiotic) are available to evaluate ongoing physical limitations in stream reaches. Though needed and useful, their application has limited ability to resolve ongoing uncertainties of biological limitation. Additionally, such biological assessment tools involving static metrics (abundance, biomass and diversity) cannot directly quantify energetic limitations (food availability and trophic routing) and ultimately fail to adequately assess density dependence. To identify and quantify density dependent factors that inform the assessment of habitat carrying capacity, monitoring protocols and subsequent analytical procedures must capture food web processes that directly affect energetic routing.

To understand effects of density dependence in natal, lotic habitats we measured food web specific responses in a small co-limited stream, located in the Upper Columbia River Basin. We

used trophic basis of production and bioenergetic methods to identify and quantify co-limited drivers.

Here we present: 1) a brief overview of a quantitative food web approach and discuss associated advantages and disadvantages in the context of stream restoration, 2) initial project results using estimates of aquatic insect production to evaluate habitat restoration and potential impacts of non-native fish, and 3) a new quantitative analysis tool (R package) and its application in a broader management context.

POSTER

A GREENHOUSE STUDY ON EFFECT OF CLASS B RECLAIMED WATER ON GROWTH AND EXOENZYME ACTIVITY IN *POPULUS TRICHOCARPA*. Eureka Joshi, Department of Environmental Science, College of Natural Resources, University of Idaho, 875 Perimeter Dr, MS 1133, Moscow, ID 83843; josh8784@vandals.uidaho.edu

University of Idaho irrigates 482 acres of campus property with class B municipal reclaimed water. This study aimed to explore the irrigation effects of class B municipal reclaimed water from University of Idaho on biomass accumulation and exoenzyme activity in *Populus trichocarpa* under greenhouse conditions. Poplar cuttings were treated with Control, reclaimed water (20 ppm), fertilizer (20 ppm), fertilizer (commercial recommended amount) and 50:50 (v: v) recommended fertilizer and reclaimed water. Treatments were randomly assigned, such that there were five replicates of each treatment at each harvest. The first harvest within two days of planting, was to assess initial exoenzyme activity. For the following two harvests, poplar biomass and enzyme activity were measured. A strong effect of treatment on root biomass allocation was observed but overall, class B reclaimed water addition had an insignificant effect on biomass. Soil samples were stored on ice during transport to the lab for fluorometric exoenzyme assays of aminopeptidases [Alanine (AM) and Leucine (LAP)], cellulase (β -glucosidase (BG)), chitinase [N-acetyl- β -D-glucosaminidase (CH)], and phosphatase (PH). The results indicated strong effect of harvest on AM, LAP and BG. Exoenzyme assay response of BG, CH and PH were significantly higher compared to AM and LAP assays. Increased activities are indicative of increased amount of respective enzymes in soil. Application of nitrogen amendments positively influences exoenzyme activity indicating enhanced decomposition of organic matter and microbial activity.

ORAL

SCHITSU'UMSH CONTEMPORARY FOOD SOVEREIGNTY. Nicholas Kager, Deputy THPO, Coeur d' Alene Tribe, Hnkhwelkhwl Department, P.O. Box 408, Plummer, ID 83851; nkager@cdatribe-nsn.gov

With the natural sources of food destroyed, limited access to traditional sites and resource locations, and lack of time for traditional harvests and processing; gardening and control of the local food system is one contemporary expression of food sovereignty. The Schitsu'umsh have a community garden to provide fresh fruits and vegetables along with education. Tribal fish ponds provide access to traditional protein sources. Nurseries for culturally important plants will expand on the food system with materials for storage and cooking and traditional harvest methods. Language research is key to understanding the food system and the relationship between Schitsu'umsh and the foodshed.

EFFECTIVENESS OF GIRDLING TREATMENTS IN A CONIFER-ENCROACHED OREGON WHITE OAK WOODLAND. Jeffrey M. Kane, Department of Forestry and Wildland Resources, Humboldt State University, Arcata, CA 95521; Eamon A. Engber, John McClelland, Redwood National Park, Orick CA 95555.; jkane@humboldt.edu

The prolonged absence of fire in Oregon white oak (*Quercus garryana*) woodlands and savannas of the Pacific Northwest has resulted in substantial conifer encroachment over the past century. Use of low intensity prescribed burns often lacks sufficient intensity to kill encroached trees, requiring alternative approaches. In the Bald Hills region of Redwood National Park, managers have implemented girdling treatments to kill Douglas-fir (*Pseudotsuga menziesii*) to expand existing woodlands and aid the recovery of remnant oaks. We surveyed 259 girdled Douglas-fir to examine the effectiveness of girdling treatments to create snags and the impacts of girdling on tree regeneration and fuel recruitment over time. Girdling was successful in killing 91% of the treated Douglas-fir independent of the method used (axe or chainsaw). Larger trees with low girdle width-to-tree diameter ratios tended to survive girdling. Trees with a girdle width-to-tree diameter ratio ≥ 1 were most effective at killing trees. Snags generated through girdling decayed over time but did not significantly reduce their height over the time period examined and 19% had evidence of bird activity. Regeneration of Douglas-fir and oaks were highly variable and did not seem to be clearly linked to girdling activity. Fine woody fuel loading and fuelbed depths were potentially elevated 7 years after treatment but did not persist through the time period examined. Our results indicate that girdling is a highly effective treatment to kill Douglas-fir and aid restoration of Oregon oak woodlands with limited negative impacts on regeneration or fuel hazards.

INSECT HERBIVORY DRIVES COMMUNITY STRUCTURE AND PRIMARY SUCCESSION ON MOUNT SAINT HELENS. Helen Kesting, School of Environmental and Forest Sciences, University of Washington, Seattle, WA 98195; John Bishop, Rebecca Evans, School of Biological Sciences, Washington State University, Vancouver, WA 98686; bishopj@wsu.edu

On May 18, 1980, Mount Saint Helens erupted, creating a 60-kilometer area of primary succession. As species recolonize the disturbance zone, insect herbivores have a profound impact on the spread and growth of plants. Several specialist species consume Sitka willow (*Salix sitchensis*) which provides vertical habitat structure and supports soil formation. To assess the effects of specialist willow stemborers on community structure, we applied insecticide annually, beginning in 2009, to exclude the native moth *Paranthrene robiniae* and the nonnative weevil *Cryptorhynchus lapathi* from two 20-meter by 10-meter plots on the Pumice Plain. Here, we report results from year 10. We used the Welch's t-test for unequal variance to analyze data collected on willow basal area and vegetation percent cover. We also collected data on stem damage to assess the extent of recent herbivory. We found that plots sprayed with insecticide contained 6 to 9 times more *S. sitchensis* by basal area, corresponding to 17.3% canopy cover, as well as significantly more cover of grass (*Agrostis pallens* and *A. scabra*) and moss (*Polytrichum juniperinum* and *Racomitrium canescens*). In control plots, 24.8 percent of willow stems were damaged by *C. lapathi* and 4.4 percent by *P. robiniae*. Surveys of transects across the Pumice Plain indicated damage rates of 35.0 to 45.9 percent by *C. lapathi* and 2.4 to 13.4 percent by *P.*

robiniae. We conclude that insect herbivory prevents dominance by *S. sitchensis* and hence inhibits the formation of 3 dimensional habitat structure and soil development in uplands on the Pumice Plain.

ORAL

DRONE-MOUNTED DIGITAL CAMERAS PROVIDE UNBIASED ESTIMATES OF NEST SURVIVAL FOR COLONIAL NESTING WATERBIRDS. Deo Lachman, Kerri Vierling, Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID 83844; Courtney Conway, U.S. Geological Survey-Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, ID 83844; Ty Matthews, Minidoka National Wildlife Refuge, Rupert, ID 83350; lach2475@vandals.uidaho.edu

Western Grebes (*Aechmophorus occidentalis*) are colonial nesting waterbird that have experienced a dramatic population decline. Our objective was to explore a non-invasive technique for estimating nest survival and to identify the factors that influence nest survival. We conducted our study at Cascade Reservoir in Cascade, Idaho, home to the largest grebe breeding colony in Idaho. We used an unmanned aerial system (drone) to map and monitor the grebe colony during the breeding period. We conducted six flights between June 10 – July 11, 2018 and used the photographs from each flight to create an orthomosaic image that we then digitized and georeferenced. We created nest histories and estimated nest fate for 709 grebe nests. We collected data on the following covariates to assess whether any of them affected nest survival: distance of the nest to the center of the colony; distance of the nest to the edge of the colony; distance of the nest to deep water habitat; water depth at the nest; nearest neighbor distance, and an aggregation index that is the mean of the five nearest neighbor distances. We used program MARK to estimate daily survival probabilities for each nest and AIC to select among 45 candidate nest survival models. Of the 709 grebe nests, 49.4% were successful. The daily survival probability of grebe nests was positively correlated with water depth at the nest and the aggregation index. Daily survival probabilities were negatively correlated with distance between the nest and the colony center and distance to deep water habitat.

ORAL

ICE-RAFTED ERRATICS FROM AN ICEBERG FEATURE AT THE COYOTE CANYON MAMMOTH SITE, KENNEWICK, WASHINGTON. George V. Last, Mid-Columbia Basin Old Natural Education Sciences (MCBONES) Research Center Foundation, Kennewick, WA 99338; Anne E. Maughan, Mid-Columbia Basin Old Natural Education Sciences (MCBONES) Research Center Foundation, Kennewick, WA 99338 and Geology Department, Brigham Young University-Idaho, Rexburg, ID 83460; Curtis J. Austin, Mid-Columbia Basin Old Natural Education Sciences (MCBONES) Research Center Foundation, Kennewick, WA 99338; Bax R. Barton, Burke Museum of Natural History and Culture and Quaternary Research Center, University of Washington, Seattle, WA 98195-1360; gvlast@charter.net

Numerous pebble-size ice-rafted erratics were found clustered together where a small iceberg came to rest adjacent to the remains of a Columbian mammoth (*Mammuthus columbi*). The erratic clasts and mammoth remains are entrained within a sequence of Ice Age flood rhythmites and dated at 17,449+/-168 calBP. The 39 pebble-size clasts examined from this single iceberg feature all exhibited rock compositions different from the indigenous basalt bedrock. We

grouped these clasts into three main lithologic groups and seven subgroups. The majority (~54%) were light-colored carbonate-rich rocks that included limestone, limestone interbedded with siltite, and marble. The next most abundant lithology (~31%) consisted of light colored granitoid and altered (metamorphosed) granitoid rocks. The third most common rock types (~15%) were metasedimentary rocks (quartzite and siltite). These lithologies were mostly consistent with documented accounts of boulder-size ice-rafted erratics found throughout eastern Washington and northern Oregon, in areas impacted by Pleistocene outburst floods. The main exception was the large number of carbonate-rich (e.g. limestone) erratic pebbles found, while only one other limestone erratic has been documented. Eleven of the 39 pebbles were of sufficient quality to be tentatively associated with the Lakeview Limestone, Cretaceous granitoids (tonalite, granodiorite and quartz diorite), and Belt Supergroup rocks in the Lake Pend Oreille, Idaho area. While there is some uncertainty about the potential provenance of some carbonate-rich pebbles, the bulk of our research suggests that this single iceberg feature likely originated from the breakup of a Glacial Lake Missoula ice dam, that occurred approximately 17,450 years ago.

POSTER

PRIORITIZING ROAD TREATMENTS FOLLOWING WILDFIRE. Matthew Lesiecki, Erin Brooks, Department of Soil and Water Systems, University of Idaho, 875 Perimeter Drive, MS 2060, Moscow, ID 83844; Pete Robichaud, Rocky Mountain Research Station, 1221 South Main Street, Moscow, ID 83843; mlesiecki92@gmail.com

High and moderate severity wildfires in forests of the western US create a disturbance regime where the burned areas may be vulnerable to elevated runoff and erosion. After wildfires, Burned Area Emergency Response (BAER) Teams identify and assess the magnitude of potential watershed responses, as well as document values at risk. After large wildfires, BAER Teams often generate a list of high risk values, such as road infrastructure, due to increased stream flows, debris flows and surface erosion. The number of vulnerable stream crossings can exceed the available funds, time, and equipment to treat them all. Given these limitations, managers must identify and prioritize treatments. In 2017, over 250,000 acres burned on the Lolo National Forest, Montana. Forest managers requested nearly \$4M for culvert upgrades/replacements, but were approved for less than half of that. With the given limitations, we proposed to investigate how to prioritize post-fire road treatments and determine their effectiveness. Using available peak flow models with on-site field measurements, we propose to develop a decision making process that will allow forest managers to identify the highest risk stream crossings and to determine attributes that improve treatment success. During this effort, we have installed instrumentation to monitor rainfall and streamflow, measured channel attributes and are monitoring mineral soil exposure as model inputs over this disturbed area. These measurements should give us the best opportunity to detail the inputs needed to prioritize stream crossings.

ORAL

NON-TRADITIONAL (BIOLOGICAL) APPLICATIONS FOR GEOLOGIC MAPS. Reed S. Lewis, Idaho Geological Survey, University of Idaho, 875 Perimeter Drive MS 3014, Moscow, ID 83844-3014; reedl@uidaho.edu

Geologic maps that depict the distribution of rock types at the earth's surface have been constructed for over 200 years. Traditional applications include mineral exploration, landslide

hazard evaluations, and, more broadly, use as a tool to understand the geologic history of the earth. In conjunction with age information from the fossil record, radiometric dating techniques, and geochemistry, geologic maps provide the basic “lay of the land” when it comes to understanding the geology of a given region. An arguably underutilized application is that of geologic controls on biological processes. Examples of uses in the biological realm include work by the UI Intermountain Forestry Cooperative to develop “site type” classifications for forested lands. Site types capture the interaction of topography, soil parent material, and climate on vegetation communities and are thus dependent on rock types and their properties. As work by UI fish ecologists has shown, underlying geology and geologic complexity are also reflected in the chemistry of otoliths (concretions in the internal ear of fish), which in turn provides clues to migration patterns during the fish’s lifetime. Other biological applications include the distribution of certain species of lichen and land snails. The primary strength of geologic maps is their predictive capability over large areas, in contrast to site-specific data. They are also easily combined with other GIS datasets. Inherent disadvantages include the fact that geologic map units are not always homogeneous, and that detailed geologic mapping of Idaho is available for only about 40 percent of the state.

ORAL

GENOMIC AND GEOLOGIC PATTERNS OF ORNAMENTATION IN *OREOHELIX*. T. **Mason Linscott**, Christine E Paren, Department of Biological Sciences, University of Idaho, Moscow, ID 83843; mason.linscott@gmail.com

Few biological forms have held the focus of the human mind for as long as the land snail shell and remain an enigma. Despite widely documented instances of intraspecific variation and convergent evolution of land snail ornamentation between species, there are few ecological factors known to be associated with the evolution of ornamentation. Perhaps as a result of this mostly null-finding, it has been proposed by others that the convergence of land snail ornamentation across multiple species assemblages is the result of sexual selection or from relaxed selection and genetic drift. To understand the possible processes governing shell ornamentation evolution, we conducted a series of land surveys and population genetic analyses on a diverse assemblage of ornamented large land snails (*Oreohelix*). We identify calcareous rock formations as being associated with ornamented species occurrence and that variably ornamented species form a continuum of ornamentation from ‘weak’ to ‘strong’ based on proximity to calcareous geologic units. High levels of admixture between ornamented and unornamented forms were detected, indicating that ornamentation persists even with high levels of gene flow. We propose that ecological sources of selection cannot be ruled out, and measuring the available calcium at ornamented species sites may be key to understanding the wide convergence of ornamented forms in other land snail groups.

ORAL

THE LAST OCCURRENCE OF THE COLUMBIAN MAMMOTH IN NORTH AMERICA: WAS THE EXTINCTION HUMAN CAUSED OR RELATED TO CLIMATE CHANGE? **Renee L. Love**, Department of Geological Sciences, 875 Perimeter Drive MS 3022, Moscow, ID 93944-3022; rlove@uidaho.edu

Eighty percent of a mammoth skeleton was excavated from Soda Springs, Idaho. Mammoths lived during major environmental and anthropogenic stresses during the Pleistocene ice age (1.5

million to 10,000 years ago) before their demise. Our research goals are to: 1) Determine the age of the mammoth and whether the mammoth lived at a glacial maxima or minima, 2) Use isotopes analysis of the tusks and teeth for climate and diet assessment. Pit marks and scratches on the teeth can also help determine diet, 3) Determine if the mammoth died by hunting of early humans, disease, or severe injury by analyzing marks on bones. Post-mortem scavenger marks will also be examined, 4) Perform a detailed analysis of the excavation site will indicate whether the bones were deposited in place or were moved by humans, scavengers, or a river after death, 5) Perform protein, lipid, and mtDNA analysis. This will help us determine if the mammoth was healthy during its life, was it stressed, and did it interbreed with Wooley mammoths due to environmental challenges?, 6) Determine the gender, age, estimated weight, and height of the mammoth using precise measurements of the teeth, bones, tusks, and pelvis, and 7) image the bones using CT scanning equipment to further assess the cause of death by the recognition of fractures, evidence of hunting, or scavenger marks. Preliminary results show that this is a Columbian mammoth that lived near the final extinction event and were stressed due to a combination of climatic and human-caused events.

ORAL

THE INFLUENCE OF ENSO ANOMALIES ON STREAM FLOW METRICS ACROSS THE CONTIGUOUS UNITED STATES. **Bradley T. Luff**, Alexander K. Fremier, School of Environment, Washington State University, Pullman, WA 99164; Von P. Walden, Civil and Environmental Engineering, Washington State University, Pullman, WA 99164; bradley.luff@wsu.edu

The El Nino Southern Oscillation (ENSO) is known to cause episodic changes in seasonal temperature and precipitation patterns across a large portion of the globe. ENSO climatological patterns are well described, but the associated changes in stream discharge are not. By combining the temperature and precipitation trends, it is possible to derive four classifications for geographic areas where either an El Nino or La Nina event has consistent climate anomalies. By using these classifications associated with location, it is then possible to group stream gages with consistent anomalous effects into the same four classifications. We asked: (1) do ENSO anomalies cause observable differences in stream flow metrics, and (2) what is the spatial pattern of these differences across the contiguous United States? To answer these questions, we analyzed the Livneh dataset of meteorological variables, specifically daily temperature and precipitation means, to classify ENSO anomalies across the study areas based on the Oceanic Nino Index (ONI). We then selected all stream gages with consistent ENSO patterns to statistically compare average to anomalous years of stream discharges in four different ENSO classifications (warm/wet; warm/dry; cool/wet; cool/dry). Using these classified ENSO patterns, we analyzed stream flow metrics over the entire water year, including total discharge, average discharge, peak flow, minimum flow, and a variation of the peak and minimum flows using multiple day time periods. Our spatial classification of ENSO effects on stream discharge give us a better understanding of the episodic patterns of river hydrology.

DISEASE ECOLOGY OF DERMACENTOR TICKS AT TURNBULL NATIONAL WILDLIFE REFUGE. Krisztian Magori, Luis Matos, Justin Donahue, Robert Shadix, Heather Forrest Fruscalzo, Hattie Johnson, Nicholas Vanderholm, Department of Biology, Eastern Washington University, 258 Science Building, Cheney WA 99004; kmagori@ewu.edu

Ticks are ectoparasites capable of transmitting a wide variety of pathogens to wildlife, livestock, pets and people. In the Inland Northwest, two common tick species are the Rocky Mountain Wood Tick (*Dermacentor andersoni*) and the American Dog Tick (*Dermacentor variabilis*). Students in my lab at Eastern Washington University have been investigating the ecology of these two ticks at Turnbull National Wildlife Refuge for the last 5 years, in collaboration with US Fish and Wildlife and the Washington Department of Health Zoonotic Disease Program. We found that these ticks have high density along trails, and in areas with abundant shrub and/or grass vegetation. We are in the process of developing a statistical model to predict their density at a fine scale based on their habitat preferences. In collaboration with the Matos lab at EWU, we also detected *Rickettsia rickettsii*, the causative agent of Rocky Mountain spotted fever, in these ticks, in multiple years, albeit at small numbers. Finally, we developed a statistical method to differentiate these two tick species from each other based on morphological differences. In the future, we aim to extend our studies beyond Turnbull, and predict the density of these ticks across Eastern Washington, in order to reduce the risk of encounter with and infection by these parasites.

LONG-TERM EFFECTIVENESS OF FUEL REDUCTION TREATMENTS IN OAK AND CHAPARRAL STANDS OF NORTHERN CALIFORNIA. Caroline Martorano, Jeffrey Kane, Department of Natural Resources, Humboldt State University, Arcata, CA 95521; Eamon Engber, National Park Service, Orick, CA 95555; Jennifer Gibson, National Park Service, Whiskeytown, CA 96095; cam68@humboldt.edu

Fuel reduction treatments are broadly implemented to reduce the risk of extreme wildfire. Yet, research on the long-term effectiveness among these treatments is lacking. In this study, we examined short- and long-term changes in fuels and understory vegetation after treatment in oak-chaparral stands of Whiskeytown National Recreation Area. Treatments included mastication and spring burning, spring burning only, mastication only, and hand thinning. Preliminary results showed that all treatments promoted persistent reductions in fine woody surface fuel (1- and 10-hr) compared to the control ($p < 0.028$), with the hand thinning treatment having the lowest loading 15 years after treatment. Shrub density ($F = 3.9$, $p = 0.008$) and standing dead shrub fuel load ($X^2 = 26.4$, $p = 0.001$) also differed among treatments. The mastication and spring burn treatment had up to 2.8 times higher shrub density than other treatments. The spring burn only treatment had 8.4 % greater standing dead shrub fuel load than the control and the other treatments contained little to no standing dead shrub fuel. Except for the spring burn treatment ($t = -0.81$, $p = 0.42$), species richness increased by 21.4 to 54.8% in all treatments relative to the control ($t > 2.0$, $p < 0.05$) and the mastication and spring burn treatment increased the most ($t = 4.35$, $p < 0.001$). The effects of fuel treatments on fuels and understory vegetation were highly varied but all had some level of effectiveness. However, spring burning alone was the least effective treatment from a fuels and vegetation perspective, indicating the need to consider subsequent treatment.

ORAL

LET THE OLD ONES SPEAK: FORGOTTEN NATIVE FRESHWATER MUSSELS CONTRIBUTING TO STREAM BENTHIC COMMUNITIES. **Sammy L. Matsaw**, Water Resources Department, University of Idaho, 875 Perimeter Drive MS 3002, Moscow, ID 83844-3002; matssamm@isu.edu

Although, the scientific legacy of the Corps of Discovery has led us down many perceived positive paths, there have been many forgotten important aspects of science not included the dominant narrative. Since Lewis and Clark much of Indigenous Knowledge has been truncated as myth, legend and less than. Today I will present another perspective of ecology from an Indigenous Scientist's perspective and how we view nature and our connections to land. I'm asking questions to the role of native freshwater mussels in the Salmon River drainage through their connections to benthic algae and invertebrates. As filter-feeding organisms and the largest invertebrates in freshwater streams they are largely overlooked, and unknown. A longer view, through Traditional Ecological Knowledge (TEK), is to continue this thread of connections to salmon, salmon-eaters, and the cultures that have been informed by these more-than-human relatives. I will share preliminary data comparing living mussels with sham mussels (shells filled with sand), and controls with no mussels before and after salmon spawning. This mesocosm experiment was conducted in Bear Valley Creek, a headwater tributary stream, of the Middle Fork Salmon River. The stream is home to a natural-origin Chinook salmon population managed by the Shoshone-Bannock Tribes.

ORAL

MORE-THAN-HUMAN RELATIVES: HOW THE NATURAL WORLD TEACHES AND INFORMS OUR EPISTEMOLOGIES OF LAND-BASED KNOWING. **Sammy L. Matsaw**, Water Resources Department, University of Idaho, 875 Perimeter Dr. MS 3002, Moscow, ID 83844-3002; matssamm@isu.edu

There has been an on-going interruption of the natural environment since the Corps of Discovery separating Indigenous peoples from their knowledge. Connections to land is where the premise of Indigenous Knowing comes from and where we continue to engage as did our ancestors. Through our ceremonies honoring the more-than-human kinds who die so that we may go on, we have also learned a great deal from them as teachers. They are a direct connection to our place, our homelands, and why we consider them so sacred. What tribal managers need is more context of this lost link as they are inundated with the onslaught against nature from a dominant society. Much of our labor and effort is directed at something we have had little power to change or make any real progress towards protecting our treaty resources.

ORAL

RESTORATION STRATEGIES FOR CAMASSIA QUAMASH ON THE WEIPPE PRAIRIE: A CASE STUDY IN PROGRESS. **Kathryn Matthews**, College of Natural Resources, University of Idaho; Natural Resources, Nez Perce National Historical Park, 39063 US Hwy 95, Lapwai, ID, 83843; Kathryn_Matthews@nps.gov

Camas (*Camassia quamash* (Pursh) Greene) is a facultative wetland hydrophyte that is culturally important to the Nez Perce and other Native American tribes of the Columbia Plateau. An

important, traditional Nez Perce harvest site for camas is Weippe Prairie, located in central Idaho. Like many wetland prairies across the United States, much of Weippe Prairie was converted for agricultural use in the 19th century. Rehabilitation of camas prairies will serve in both repairing the functionality of these ecosystems as well as restoring lands that are culturally significant. After three years of research identifying the specific habitat criteria required by camas and evaluating different restoration techniques such as seeding and outplanting, this study will aid in the development of a restoration protocol for camas that can be applied to camas meadows across the plants' North American habitat.

ORAL

QUANTIFYING ABOVE-GROUND BIOMASS CONSUMPTION AND DEMONSTRATING LANDSCAPE-SCALE LINKAGE BETWEEN FUEL CONSUMPTION AND ENERGY RELEASE: A CASE STUDY OF THE POLE CREEK FIRE IN OREGON. T. Ryan McCarley, Aaron M. Sparks, Luigi Boschetti, Arjan J. Meddens, College of Natural Resources, University of Idaho, Moscow, ID 83844; Andrew T. Hudak, Rocky Mountain Research Station, United States Forest Service, Moscow, ID 83843; tmccarley@uidaho.edu

Accurate estimation of fuels consumed by wildfire is important for measuring smoke production, carbon emissions, and understanding burn patterns across a landscape. Furthermore, increases in wildfire size and duration of the wildfire season driven by global climate change and accumulation of fuels provide further impetus to characterize fuel consumption and understand these processes over time. The 2012 Pole Creek fire in central Oregon provided a unique opportunity to quantify change in above-ground biomass (AGB) for an entire fire using pre- and post-fire airborne LiDAR and field data. Additionally, multiple MODIS observations allowed us to compare fire radiative energy (FRE) to changes in AGB, thus establishing a method of estimating change in AGB at much larger scales. Using Random Forest regression, AGB was predicted from various LiDAR height and density metrics ($R^2=0.65$) and applied to the pre- and post-fire landscape to quantify change across the fire. A linear regression between change in AGB and MODIS FRE indicated a combustion factor of 0.297, which is consistent with other studies. This study demonstrates the potential for quantifying fuel consumption using pre- and post-fire LiDAR and establishes linkage between structural changes caused by fire and energy release observed by MODIS. These results have application for accurate fine-scale measurement of fuel consumption using LiDAR and large-scale estimates using MODIS.

POSTER

THE WILD WILD (NORTH)WEST: ASSESSING FUTURE LAND USE AND CLIMATE CHANGE IN WILDERNESS AREAS OF THE NORTHWESTERN U.S. T. Ryan McCarley, Jocelyn L. Aycrigg, Fish and Wildlife Sciences, College of Natural Resources, University of Idaho, Moscow, ID 83844; R. Travis Belote, The Wilderness Society, Bozeman, MT 59715; Sebastian Martinuzzi, SILVIS Lab, Department of Forest and Wildlife Ecology, University of Wisconsin, Madison, WI 53706; tmccarley@uidaho.edu

The Wilderness Act of 1964 established the National Wilderness Preservation System and since then 91 wilderness areas have been designated in the Northwest (Idaho, Oregon, and Washington). These wilderness area designations are intended to preserve natural condition; however, these areas are and will continue to be influenced by land-use land-cover (LULC)

conversion and climate change. We assessed the impact of LULC and climate change through 2050 under low (RCP45) and high (RCP85) emission scenarios to identify vulnerable wilderness areas. Both natural and anthropogenic LULC changes were summarized for 10km buffers surrounding wilderness areas, while climate change indicators such as changes in frequency of extreme weather events were summarized for wilderness areas plus the 10 km buffer. Changes were assessed as departure from 2006 conditions to 2050 regardless of direction. Wilderness areas along the cascade crest between Mount Rainer and the Three Sisters and the Washington and Oregon coasts were predicted to experience the most change in LULC, while wilderness areas in arid regions, such as southwestern Idaho, eastern Oregon, and the Columbia basin were predicted to experience the most change in climate conditions, for both the low and high emission scenarios. These results may be useful for managers and lawmakers looking to identify wilderness areas where the preservation of natural condition may be threatened by future LULC, climate change, or both.

ORAL

A PROBABILISTIC INTERACTIVE KEY FOR *HYPOGYMNA* IN NORTH AMERICA.

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Online interactive keying for species identification has been developing for decades, but the promise of these methods has so far exceeded their actual utility. We identified two problems with many interactive keys by comparing how online keys work with how experts think about identification. We then attempted to design a method to remedy these problems. First, in the underlying data, character states are often treated as if a species does or does not have a particular character state. In reality, a species is variable: most character states are not completely consistent within a species. Second, experts often ask where a specimen came from. Using *Hypogymnia* as a test case, we addressed the first problem by treating character states as probabilistic rather than strictly yes/no. Each character state is specified for each species with a probability for a specimen in hand. To address the second problem, we adopted a Bayesian classifier, setting prior probabilities for each species for each geographic region. Given a user's choice of characters to specify, we then calculate the probability of a specimen belonging to each species, combining the prior probabilities and the character probabilities. The species with the highest probabilities are suggested as possible answers, along with statistics to express support for each of those species based on the observations. Early testing suggests that the method can provide efficient, accurate identification. Still, the method requires effort and skill by the users, because they need to learn the underlying terminology and develop experience with interpreting character states.

POSTER

VULNERABILITY OF ROTIFER AND COPEPOD NAUPLII PREY TO COPEPOD PREDATION IN FLATHEAD LAKE (MT).

Michael F. Meyer, Bradley T. Luff, School of the Environment, Washington State University, Pullman, WA 99164; michael.f.meyer@wsu.edu

As lakes warm worldwide, increasing temperatures may alter plankton community structure and abundance via shifting trophic interactions. In particular, cryophilic zooplankton may experience changing predation pressures, especially as warming temperatures may create opportunity for cosmopolitan plankton species to function both as new prey items and predators, thereby

distributing predation pressure across a wider suite of prey. Flathead Lake (MT) presents opportunity to study trophic dynamics of historically cryophilic plankton communities in the context of a warming climate. To understand cosmopolitan plankton predation pressures, we studied predator-prey relationships of a copepod predator (*Diacyclops thomasi*) with three prey types: two rotifer species (*Gastropus stylifer* and *Keratella cochlearis*) and copepod nauplii. We hypothesized that the more evasive copepod nauplii would be less vulnerable to predation than the rotifer species. We exposed a starved predator to each of the prey types and noted encounters, captures, attacks, ingestions, and escapes. Contrary to our hypothesis, *Gastropus stylifer* and *Keratella cochlearis* were attacked at lower rates than nauplii, although rotifer escapes per encounter were significantly lower than nauplii. Naupliar high rates of attacks and escapes per encounter suggest that although nauplii are more frequently attacked by predators, their large size buffers from ingestion. Together, these results suggest that rotifers may be able to withstand copepod predation, especially as cosmopolitan nauplii become more abundant in a warming Flathead.

POSTER

HOW DO YOU ACCURATELY MEASURE BEDDING IN A MONOTONOUS PILE OF BASALT LAVA FLOW ROCKS? INSIGHTS IN EXCITING APPLICATIONS OF MATHEMATICS. Heather A. Moon, Mathematics Program, Lewis-Clark State College; Keegan Schmidt, Earth Science Program, Lewis-Clark State College; hamoon@lcsc.edu

One of the important issues in planetary science is the ability to remotely measure the planar orientation bedding in sedimentary or volcanic strata. Basalt lava flow rocks in the Columbia River Basin provide a useful analog for refining methods used to acquire bedding measurements. Traditional methods use least squares regression analysis to calculate planar orientations, by fitting planes to points acquired from bedding surface exposures. Issues that arise with this approach when acquired points can only be chosen roughly along one direction. We compared the results from least squares regression with other promising data analysis techniques such as Singular Value Decomposition (a method to find the n most prominent directions in a data set) and other Least Deviation methods (methods similar to least squares, but are not amplified by a few data points) that are better equipped to deal with outliers. Using each of these techniques we also calculated best fit lines along two neighboring bedding surface exposures, fitting them to a plane. We also explored the option of semi-automating these calculations with user intervention minimal. Typical image analysis techniques such as image segmentation and/or data clustering can be applied to determine data points along an exposed section. These points will then be used to determine bedding orientation.

ORAL

HUCKLEBERRY RESTORATION AFTER WILDFIRE ON THE COLVILLE RESERVATION, 2016-18. Pendleton Moses, Nikanot Sylvia Tatshama Peasley, Traditional Cultural Plants Project, History/Archaeology Program, Confederated Tribes of the Colville Reservation, Nespelem, WA 99155; Rebecca Peone, Colville Confederated Tribes/Bureau of Indian Affairs Burned Area Emergency Response Team, Nespelem, WA 99155; Kathleen Robson, Traditional Cultural Plants Project, History/Archaeology Program, Confederated Tribes of the Colville Reservation, Nespelem, WA 99155; Trisha Johnson, History/Archaeology Program GIS, Confederated Tribes of the Colville Reservation, Nespelem, WA 99155; pendleton.moses.hsy@colvilletribes.com

In 2015 the North Star Fire burned thousands of acres, including large populations of big huckleberry (*Vaccinium membranaceum*) that had been favorite gathering areas for some tribal families. During the summer of 2016 Rebecca Peone of the BAER Team organized the purchase of 1,800 young, greenhouse-grown huckleberry shrubs and a crew of youth workers to plant them on two sites. Later in the summer, the same youth crew gathered huckleberries to be used for seed. The Cultural Plants Team marked a sample of plants from each site; mortality was high. In 2018, a crew of forestry tree planters set out another group of young shrubs close to one of the 2016 plantings. The second planting may have been more successful due to earlier timing, experienced planters and rocky soils. In the third year post-fire, more of the original huckleberries re-sprouted, especially those near boulders. Monitoring transplanted and regenerated shrubs continues.

POSTER

QUANTIFYING THE ACCURACY OF LANDSAT DERIVED SURFACE WATER INDICES FOR ESTIMATING SMALL RESERVOIR WATER SURFACE AREA IN THE VOLTA RIVER BASIN (WEST AFRICA). Lambert Ngenzi, Alex Fremier, School of the Environment, Washington State University; lambert.ngenzi@wsu.edu

Surface water is a crucial resource for food production in semi-arid regions of the world, such as parts of West Africa. Thus, the understanding of the dynamics of water storage plays a critical role in human well-being. Increasingly satellite data is being used to estimate water surface area, yet the precision of satellite surface water indices in West Africa is particularly poor. In this research, we calculated multiple water indices from Landsat (7 and 8) imagery to quantify the spatial and temporal dynamics of water storage in ~1200 small reservoirs in the Volta Basin. We validated estimates using aerial images, when available (2000-2016). After the accuracy assessment, we quantified other surface factors that influence accuracy, such as soil color, latitude and reservoir size. Although Landsat images tend to overestimate and/or underestimate water surface areas in the small reservoirs. Overall, Landsat images do a better job in estimating water surface indices (R square equals to .86), particularly with Normalized Difference Vegetation Index (NDVI) values greater than zero. A detailed accuracy assessment using water index will improve our ability to estimate changes in storage across semi-arid regions of the world to inform water resources management. In addition, we hope to detect changes in water quantity by assessing the impact of the local communities and their activities in these small reservoirs in the Volta Basin.

ORAL

RAPID INVASION BY THE ANNUAL GRASS *VENTENATA DUBIA* INTO PROTECTED-AREA LOW-ELEVATION SAGEBRUSH STEPPE. Melissa M. Nicolli, Tom J. Rodhouse, Devin S. Stucki, National Park Service, Upper Columbia Basin I&M, 497 SW Century Dr Ste 105, Bend, OR 97702; Matthew Shinderman, Oregon State University- Cascades, Human & Ecosystem Resilience & Sustainability Lab, 497 SW Century Dr Ste 105, Bend, OR 97702; melissa_nicolli@nps.gov

Protected-area managers are confronted by rapidly-evolving ecological novelty from forces beyond their control. In protected-area sagebrush steppe, novelty arises from interactions among historic and recent land use, climatic change, altered fire regimes, and biological invasions.

State-transition models used to map expected pathways for ecological change in sagebrush steppe describe cheatgrass invasion (*Bromus tectorum* L.) as a terminal state but not recent ecological surprises such as cheatgrass die-off and succession to other novel conditions. One new invader, ventenata grass (*Ventenata dubia* [Leers] Coss.), has only recently been reported in low-elevation sagebrush steppe. We first encountered ventenata in 2014 in the John Day Fossil Beds National Monument, a low-elevation steppe protected area in Central Oregon. This discovery was incidental to formal vegetation monitoring. In 2016 we encountered ventenata in monitoring plots and documented rapid spread in 2017 and 2018. Ventenata increased ~650% over three years, from 21 ha to 138 ha (95% CI 31-265 ha), within our 4674 ha monitored area. This is likely a conservative estimate that will quickly be surpassed. In our study, ventenata exhibited broad ecological amplitude, occurring across all surveyed elevations, and on all but steep southern slopes. Invaded sites were in well-drained clay soils in association with other invasive annual grasses. Our study reveals that ventenata threatens a wider range of North American dryland ecosystems than previously understood and illustrates the kinds of ecological novelties confronting protected areas. It also exemplifies the value of geographically-extensive surveillance and monitoring that can quickly inform protected-area managers about these emerging novelties.

ORAL

THE BONNEVILLE LANDSLIDE AND BRIDGE OF THE GODS—FOLKLORE, FORESTS, AND FLOODS. Jim E. O'Connor, U.S. Geological Survey, 2130 SW Fifth Ave., Portland, OR 97201; occonnor@usgs.gov

In the Columbia River Gorge, where the Columbia River breaks through the Cascade Range, an 1800-foot-long steel bridge spans the Columbia River at a narrow spot near the town of Cascade Locks. This bridge is known as the Bridge of the Gods. But this modern name derives from a much larger Bridge of the Gods that crossed the Columbia River in about 1450 AD. This earlier "bridge" was not really a bridge, but a blockage from a huge landslide, the Bonneville Landslide. This immense landslide headed on Table Mountain north of the river and cascaded downward, filling the Columbia River valley with 15 square kilometers of debris more than 100 meters thick. The Bonneville Landslide almost certainly gave rise to Indigenous accounts of the Bridge of the Gods spanning the valley bottom. After blockage by the landslide, the Columbia River ponded behind the debris dam, also noted by Indigenous descriptions of the river attaining "great heights" upstream. The rising lake drowned riparian forests, their snags later recorded by first explorers. After rising ~85 m, the lake spilled over and the Columbia River cut—catastrophically—through and around the southern edge of the landslide mass, flooding the downstream estuary. But downcutting was not complete, and large rocky debris too big to be carried away by the river remained as a long set of foaming rapids, first mapped by Lewis and Clark as "The Great Shoot." Later known as Cascade Rapids, they are now stilled under the pool behind Bonneville Dam.

ESTABLISHING NATIVE FORBS IN EXISTING CRP USING NO-TILL TECHNIQUES IN NORTHERN IDAHO: COMPARISON OF DRILLS AND SEEDBED

PREPARATIONS. Pamela Pavek, USDA Natural Resources Conservation Service, 1848 S. Mountain View Rd, Moscow, ID; Jacie Jensen, Thorn Creek Native Seed Farm, 1461 Thorn Creek Rd, Genesee, ID 83832; Wayne Jensen, JenCrops, 1461 Thorn Creek Rd, Genesee, ID 83832; pamela.pavек@id.usda.gov

Habitat for pollinators, upland birds and other wildlife can be improved by diversification of existing Conservation Reserve Program (CRP) fields. Additional conservation benefits can be achieved if diverse plant species are established without tillage, particularly on the steep slopes in the Palouse region of northern Idaho. A study was conducted to determine if native forbs can be established with no-till techniques and if there are differences in drill type and seedbed preparation methods. The study was planted on three herbicide-treated CRP field sites in Latah County, Idaho, including one 20-year-old stand of intermediate wheatgrass [*Thinopyrum intermedium* (Host) Barkworth & D.R. Dewey] and two 7-year-old stands of native bunch grasses dominated by bluebunch wheatgrass [*Pseudoroegneria spicata* (Pursh) Á. Löve] and Idaho fescue (*Festuca idahoensis* Elmer). Sixteen species of native Palouse Prairie forbs were seeded at the three sites in October 2010 with two no-till drills (a Cross Slot® and a Great Plains® double disk) and two seedbed preparations (mowed and not mowed) in a split-plot design. Forb density increased in all plots at all sites from Year 1 to Year 3 and all plots met CRP requirements by Year 3. Forbs established more rapidly in the 20-year-old intermediate wheatgrass stand than in the 7-year-old native grass stands. There were no consistent differences among drill types used, and no overall effect of mowing as a seedbed preparation method. The results suggest no-till techniques may be used to establish native forbs, and three or more years may be required before determining stand success.

CONDUCTING THE FIRST NON-VASCULAR SURVEYS IN MUSSELLSHELL

COUNTY, MONTANA. Andrea Pipp, Montana Natural Heritage Program, 1515 East Sixth Avenue, Helena, MT 59601; apipp@mt.gov

The Montana Natural Heritage Program (MTNHP) is the central database for Montana plant and animal species. The first documented non-vascular surveys for Mussellsell County was conducted by Northwest Lichenologists at a private livestock ranch, September 13-15, 2016. Across 15,000 acres of rolling grasslands bisected by rock outcrops and pine stands, 8 specialists surveyed 10 sites located on State, BLM, and privately-owned parcels. Approximately 97 moss observations representing 29 species were databased; 86 specimens verified by Dr. Joe Elliott were deposited at the University of Montana (MONTU) herbarium. Noteworthy species included the first Montana records of *Didymodon tectorum* and *Gemmabryum kunzei*, the rare *Pseudocrossidium obtusulum*, and a Species of Concern *Syntrichia papillosissima*. Approximately 395 lichen observations representing about 118 species are being databased and will be deposited at MONTU. Preliminary reporting found at least five lichen species new to Montana. Approximately four cyanobacteria and no liverwort species were found. An exploratory study using the Ground Layer for Rangelands (GLIR) was implemented. This method applies non-destructive sampling to assess functional groups (not species) and estimates their biomass, carbon and nitrogen content at plot and landscape scales. On five plots representing different habitats, 12 functional groups of lichens, mosses, and cyanobacteria were

found. Biomass, carbon and nitrogen content, functional groups, timing and stocking rates of cattle grazing will be presented. The MTNHP has posted a moss checklist with County distributions and a lichen checklist (<http://mtnhp.org/>). The “History, Biogeography, and Species of Montana Mosses (1880-2018)” will be published in *Evansia* (June 2019).

ORAL

RESEARCH UPDATE ON THE USE OF RADIOCARBON DATING AND TREE-RING ANALYSIS ON SUBFOSSIL FORESTS KILLED BY LAHARS OR VOLCANIC ERUPTIONS FROM MOUNT RAINIER, WASHINGTON STATE, USA. Patrick T.

Pringle, Science Dept., Centralia College, Centralia, WA 98531; Ariel Quinn Moran, Science Dept., Centralia College, Centralia, WA 98531; Beverly Luke, Dept. of Horticulture, Oregon State University, Corvallis, OR 97331-7304; patrick.pringle@centralia.edu

We used radiocarbon dating and dendrochronology to better constrain the ages of past eruptions and lahars from Mount Rainier within the past 1600 years, focusing on trees buried near Kent, Washington (~518–550 CE), at Fife and Auburn (~900 CE), and in the Puyallup River valley (~1490–1510 CE). Samples were obtained with borers and saws and were mounted, polished, and scanned at 0.01mm resolution. We used ImageJ software for tree-ring measurements and programs Cofecha and Arstan for analysis as well as visual examination and cross-dating methods. At Kent we correlated five of eleven trees, eight of which were Douglas-fir (*Pseudotsuga menziesii*); three displayed minor earlywood beneath bark, suggesting tree death in spring. The Fife subfossil trees include many sub-horizontal logs at ~3-4 m depth and one standing Western redcedar (*Thuja plicata*) rooted at a depth of ~5 m. Trees at Auburn of the same age were buried by an eruption-triggered lahar that appears correlative with deposits at the Port of Seattle and those in Fife. The radiocarbon ages of the trees in Fife and Auburn are similar to dates on trees killed by the Seattle Fault (Atwater, 1999) and Tacoma Fault (Sherrod and others, 2004). Trees we sampled in the Puyallup valley were killed by the Electron Mudflow and include 28 Douglas-firs recovered near Orting and from Lake Kapowsin, which was dammed by the Electron Mudflow. Oral stories of the indigenous people appear to describe the lahar events at ~900 CE and the Electron Mudflow (Kearns and Pringle, 2015).

POSTER

LONG-TERM EVALUATION OF FITNESS AND DEMOGRAPHIC EFFECTS OF A CHINOOK SALMON SUPPLEMENTATION PROGRAM. Ilana Janowitz-Koch; Maureen A. Hess; Shawn R. Narum, Columbia River Inter-Tribal Fish Commission, Hagerman, ID, 83332; Craig Rabe; Ryan Kinzer; Doug Nelson, Nez Perce Tribe Department of Fisheries Resources Management, McCall Field Office, McCall, ID 83638; craigr@nezperce.org

While the goal of supplementation programs is to provide positive, population-level effects for species of conservation concern, these programs can also present an inherent fitness risk when captive-born individuals are fully integrated into the natural population. In order to evaluate the long-term effects of a supplementation program and estimate the demographic and phenotypic factors influencing the fitness of a threatened population of Chinook Salmon (*Oncorhynchus tshawytscha*), we genotyped tissue samples spanning a 19-year period (1998–2016) to generate pedigrees from adult fish returning to Johnson Creek, Idaho, USA. We expanded upon previous estimates of relative reproductive success (RRS) to include grandparentage analyses and used

generalized linear models to determine whether origin (hatchery or natural) or phenotypic traits (timing of arrival to spawning grounds, body length, and age) significantly predicted reproductive success (RS) across multiple years. Our results provide evidence that this supplementation program with 100% natural-origin broodstock provided a long-term demographic boost to the population (mean of 4.56 times in the first generation and mean of 2.52 times in the second generation). Overall, when spawning in nature, hatchery-origin fish demonstrated a trend toward lower RS compared to natural-origin fish ($p < 0.05$). However, when hatchery-origin fish successfully spawned with natural-origin fish, they had similar RS compared to natural by natural crosses (first-generation mean hatchery by natural cross RRS = 1.11 females, 1.13 males; second-generation mean hatchery by natural cross RRS = 1.03 females, 1.08 males). While origin, return year, and body length were significant predictors of fitness for both males and females ($p < 0.05$), return day was significant for males but not females ($p < 0.05$). These results indicate that supplementation programs that reduce the potential for genetic adaptation to captivity can be effective at increasing population abundance while limiting long-term fitness effects on wild populations.

ORAL

THE ROLE OF HISTORICAL AND CONTEMPORARY PROCESSES ON GENETIC DIVERSITY IN *ANGUISPIRA* SNAILS OF THE NORTHERN ROCKY MOUNTAINS.

Andrew M. Rankin, Jack Sullivan, Department of Biological Sciences, University of Idaho, Moscow, ID 83844; Frank Anderson, Department of Zoology, Southern Illinois University, Carbondale, IL, 62901; rank3288@vandals.uidaho.edu

The northern Rocky Mountains have been an important place for gastropod diversification. Here, dispersal and vicariance events, coupled with a complex physiography and periods of climate change have deeply affected the biogeography of the region. We present a comparative phylogeographic study of two congeneric snails, *Anguispira kochi* and *A. nimapuna*, from the northern Rockies. These two species are partially co-distributed and are separated from eastern North American *Anguispira* species by the Great Plains, where no related forms occur. In addition, *A. kochi* has a widespread distribution, whereas *A. nimapuna* is a narrowly distributed species endemic to only a few watersheds in Idaho. Our goals are to determine their phylogenetic position with respect to Eastern North American *Anguispira*, and to infer biogeographic events and factors that can explain differences in population genetic structure and range size between the two species.

ORAL

DEVELOPMENT AND UTILIZATION OF A RIPARIAN ECOLOGICAL TYPE CLASSIFICATION FOR MONITORING LONG-TERM LIVESTOCK GRAZING EFFECTS IN CENTRAL OREGON. **Gregg M. Riegel**, USDA Forest Service, 63095 Deschutes Market Rd, Bend, OR 97701; Cristina McKernan, USDA Forest Service, 10237 Highway 12, Naches, WA 98937; griegel@fs.fed.us

A classification of riparian ecological types was developed for Central Oregon utilizing over 670 permanent plots established in dry to wet meadows, shrub and conifer dominated streambanks, as well as disturbance conditions that represented low to high livestock grazing use. Cluster analyses were used in the classification process to identify *ecological types* that are defined by

combinations of plant communities, soil types, and landform, which differ in their ability to produce vegetation, and their response to natural disturbances and management. Within each ecological type, physical attributes and dominant plant species were ordinated and interpreted as seral and disturbance gradients used to define *ecological status*, a term used to evaluate ecosystem function and defined as the degree of similarity between existing vegetation and soil conditions on a site compared to the Potential Natural Community (PNC). We examined annual livestock grazing use metrics and found no relationship with long-term monitoring metrics measured over 20 years at the pasture level. Water is the limiting resource in these environments. Since we have no direct measurements of water table or nearby stream gauges, annual precipitation served as a proxy hydrologic attribute for our interpretations. Precipitation patterns evaluated from seven nearby NRCS SNOTEL stations over the last 18 years (2000 to 2017) show a declining trend in annual precipitation compared with the 30-year average from 1981 to 2010. Drier meadow ecological types are showing the greatest change over time shifting to plants that indicate even drier conditions or lower ecological status suggesting that climate is the greater stressor in these grazed systems.

POSTER

INVESTIGATING THE POSSIBILITY OF SPECIATION IN *STEREOCAULON SPATHULIFERUM*. Bailey Rodgers, Bruce McCune, Department of Botany and Plant Pathology, Oregon State University, 2701 SW Campus Way, Corvallis OR 97331; bruce.mccune@science.oregonstate.edu

Stereocaulon spathuliferum is a rare, high elevation species of lichen with a circumboreal range. Small populations are found from Alaska down to the west side of the Cascades in Oregon. Previous genetic analysis and morphological observations of *Stereocaulon spathuliferum* in Alaska suggested the possibility of a new species of Stereocaulon. This new species is tentatively being called *Stereocaulon sphaerosoralium*. Our goal was to further investigate the possibility of speciation in Alaska, as well as identify if speciation was occurring in Oregon. Using a combination of morphological features along with sequence data from ITS and LSU loci we found that while *Stereocaulon sphaerosoralium* fits an artificial species definition, the genetic analysis did not produce phylogenetic trees with strong enough bootstrap values to confirm speciation. The low bootstrap values were most likely influenced by high agreement of the LSU locus in *Stereocaulon spathuliferum*. However, our trees did clearly group the artificially named *Stereocaulon sphaerosoralium* which continues to suggest the possibility of speciation in *Stereocaulon spathuliferum*. Future research using the addition of a third locus such as GPDH or RPB1 to the analysis could be useful in reaching a more definitive conclusion.

ORAL

BIOCRUST SPECIES AND TRAITS MOST SUITABLE FOR RESTORATION PROJECTS. Roger Rosentreter, Ann M. DeBolt, 2032 S. Crystal Way, Boise, ID 83706; roger.rosentreter0@gmail.com

Reintroducing biocrusts to areas slated for restoration or rehabilitation may prove integral to project success, by filling the biocrust component of arid ecosystems. In doing so, it is important to select appropriate species, genetic source material, and to ameliorate environmental conditions so that biocrusts can establish. Some biocrust species are early pioneers and are well-suited for restoration projects. Information on the specific biological and ecological traits are helpful when

attempting to restore plant communities. Traits such as high sexual and asexual reproductive rates, rapid establishment rates, and larger asexual reproductive propagules are helpful for restoration. The large number of spores produced by some mosses are beneficial in arid environments. Biocrust species that are wide ranging both geographically and ecologically are recommended over narrower geographically and edaphic biocrusts that occur only in specific habitats, such as on calcareous soils. Associated native vascular plants are recommended over exotic plants. Resting the site from human, mechanical, and livestock disturbances will also increase the chance of successful restoration.

POSTER

PASSIVE METAL REMOVAL SYSTEM UTILIZING ZEOLITE FOR INITIAL TREATMENT OF SEASONAL ACID ROCK DRAINAGE- NEW TECHNOLOGY FOR ENHANCING PASSIVE TREATMENT SYSTEMS. Wes R. Sandlin, Jeff B. Langman, Department of Geological Sciences; J. G. Moberly, Department of Chemical and Materials Engineering, 875 Perimeter Dr., Moscow, ID 83844; sand2086@vandals.uidaho.edu

Efficacy of passive treatment systems for remediation of acid rock drainage (ARD) can be limited by the seasonal flux of discharge and metal concentrations that may not have been considered during treatment design. Drainage and metal variability can lead to surface passivation and flow bypass, thereby reducing the efficacy and life of a treatment system. In cases of highly variable ARD, complimentary treatment systems may assist in reducing metal concentrations and acidity to lessen the variability of hydrochemical conditions for downstream primary treatment systems. For this study, three silicate substrates—bare silica fiber, functionalized silica fiber, and zeolite—were compared for their ability to remove Fe from an acidic solution representative of ARD conditions. Initially, each substrate was placed in nylon strainers, suspended in acidic Fe solutions, placed on an orbital shaker, and the solution monitored periodically for reductions in Fe(II) and total Fe concentrations. Results of these batch sorption experiments indicated a sorption efficacy order of zeolite > functionalized silica fiber > bare silica fiber with the zeolite capable of removing approximately 50% of the Fe in solution. Following these experiments, the substrates were evaluated for their ability to sorb Fe under dynamic flow conditions. Each substrate was packed into a 5-cm diameter PVC pipe with sufficient permeability to allow for continuous introduction of 0.2 L/s of the acidic Fe solution. Zeolite again removed greater quantities of Fe from solution and was selected as the sorbing substrate for development of a new passive and modular ARD treatment system.

POSTER

MACHINE LEARNING MODELS OF MONARCH BUTTERFLIES BREEDING IN PALOUSE PRAIRIE. Rodney D. Saylor, Erim Gomez, School of the Environment, Washington State University, Pullman, WA 99164-2812; rdsaylor@wsu.edu

Monarch butterfly populations have been declining dramatically in North America, especially in the western U.S. where wintering populations have recently dropped by 86% to historic low levels. From 2016-18 we studied Monarch butterflies breeding in Palouse Prairie habitats and described environmental factors associated with the use of native milkweed plants by egg-laying females. Our working hypothesis was that egg-laying females would select milkweed patches and individual plants with features potentially associated with higher survival of caterpillars. We surveyed 3,025 plants in 40 milkweed patches to determine the occurrence of herbivory by

monarch caterpillars and describe ecological factors related to plant use. We measured 21 variables related to size, growth, phenology, and landscape context of 722 individual milkweed plants of which 72 plants had evidence of caterpillar herbivory. We used machine-learning statistical techniques (e.g., bootstrap forest; boosted tree; neural networks) to model relationships among environmental variables predicting the presence or absence of monarch caterpillar herbivory on individual milkweed plants. Egg-laying females appeared to select host plants based on a combination of patch and landscape features, as well as location and quality of individual plants within milkweed patches. Probability of caterpillar herbivory was higher in clusters of smaller milkweed patches with higher stem densities and on robustly-growing plants in cultivated landscapes. Unfortunately, the combination of butterfly migration patterns and our models of regional milkweed ecology suggests that Palouse Prairie is not high quality habitat for breeding Monarch butterflies.

POSTER

SPATIAL AND TEMPORAL OVERVIEW OF HIGH POTASSIUM INTRUSIONS IN IDAHO. D. Kate Schalck, Division of Natural Sciences and Mathematics, Lewis-Clark State College, 700 8th Avenue, Lewiston, ID 83501; dkshalck@lsc.edu

Potassic intrusions in Idaho form spatial and temporal arrays of small-volume, syenitic plutons. High potassium magmas intruded continental crust during the Eocene, Cretaceous, Ordovician to Cambrian and Neoproterozoic. The stocks are zoned and produce a wide variety of rock types including pyroxenite, monzonite, syenite, and quartz alkali feldspar syenite plus others depending on the local geologic setting. The magmas are distinctly enriched in potassium, but not sodium. High potassium magmatism in Idaho seems to be coincident with major calc-alkaline magmatic events. The Eocene Sorrel Spring syenitic complex is located in the central part of the state south of Challis and forms a sill-like pluton that intruded Devonian dolostone and limestones and Eocene sedimentary and volcanic rocks. In the southeast corner of the state, the Eocene Caribou Mountain shonkinite intrudes Cretaceous sedimentary rocks in the eastern Idaho thrust belt. Cretaceous syenite and related rocks occur in the northern Idaho panhandle from the Canadian border to the Clearwater River and intruded Mesoproterozoic Belt Supergroup rocks. The Cretaceous group includes the Gem Stocks in the Coeur d'Alene mining district and Gold Hill near Potlatch. In east-central Idaho, Ordovician to Cambrian syenite stocks intruded Belt basin (Lemhi subbasin) metasedimentary rocks. West of Salmon there is a northeast-trending alignment of three Paleozoic stocks, Yellowjacket, Deep Creek and Arnett Creek. In the Beaverhead Mountains east of Leadore, Paleozoic syenitic intrusions occur within thrust plates in the thrust belt. Northeast of McCall, three Neoproterozoic syenite and diorite stocks align in a northwest trend along Big Creek.

POSTER

HOW DO YOU ACCURATELY MEASURE BEDDING IN A MONOTONOUS PILE OF BASALT LAVA FLOW ROCKS? INSIGHTS FROM THE MIOCENE COLUMBIA RIVER BASALT GROUP. Keegan Schmidt, Heather A. Moon, Division of Natural Science and Mathematics, Lewis-Clark State College, 500 8th Ave, Lewiston, ID 83501; klschmidt@lsc.edu

A fundamental issue in understanding the subsurface structure of terrestrial planets is the ability to measure the orientation of bedded rock units that are exposed at planetary surfaces. The thick

sequences of flood basalt lava flow rocks of the Miocene Columbia River Basalt Group (CRB) in the Pacific Northwest provide an excellent analog for the lava flows found on other planets. A major issue with measuring bedding in CRB rocks is that bedding is typically massive, and the few bedding features that do occur are highly irregular such as surfaces bounding flow-top breccias. When viewed from a distance, outcrop traces that are developed on the topography by variation in erosional resistance in the exposed basalt strata are useful for estimating bedding because irregularities are smoothed and bedding horizons are well defined. Remote sensing techniques provide a robust method to acquire points on bedding traces to calculate best-fit solutions of bedding planes (the classic “3-point problem”). However, issues commonly arise for this method because the points that are acquired must be from: (1) the same bedding horizon; (2) a large enough area to minimize total error; and (3) a relatively equant area to give good 3D control in the plane calculation. A solution to these issues is to acquire points along individual outcrop traces to calculate best-fit lines on bedding horizons that are then fit to a plane. This method assumes that the strata across the area of the measurement are homoclinal, which can be tested using a subdomain sampling technique.

ORAL

POORMAN-BALM MINE COMPLEX RECLAMATION-A MULTIDISCIPLINARY VENTURE. Denine Schmitz, Katherine Coddington, BLM Vale District, Baker Field Office, 3100 H St., Baker City, OR 97814; dlschmit@blm.gov

The Poorman-Balm Mine Complex reclamation posed an suite of conundrums. Complexity from minerals, hydrology, fish habitat, and cultural resources required collaboration among BLM specialists, a tribe, and several consulting agencies. After 15 years of working through obstacles, the project is complete and results indicate that “it worked”. The main elements of reclamation (tailings removal, shaft stabilization, water treatment, constructed stream channel and wetland, onsite repository) aimed to reduce the hazard of tailings rich in zinc, copper, and manganese through isolation and removal. Cultural resources on site were managed through consultation, and a combination of preservation, data recovery, and mitigation. Water quality results analyzed through nonparametric techniques indicate that the repository is functioning properly by retaining heavy metals. Surface water results 4 years after reclamation indicate that the exceedances in copper arise from sources upstream from the site and no heavy metal inputs occur from the reclaimed mine.

POSTER

CONTACT METAMORPHISM, MINERALIZATION, AND DETRIAL ZIRCON INTERPRETATION FROM SILVER HILL SPOKANE WASHINGTON. Jeremy J. Shaw, Eastern Washington University, 117 Science Building Cheney WA 99004-2439 USA, Chad J. Pritchard, Department of Geology, Eastern Washington University, 100 Science Building Cheney WA 99004-2439 USA; jaremy.shaw@eagles.ewu.edu

Silver Hill, in Spokane County, Washington, hosts an abandoned tin-tungsten mine from the early 1900’s. Detrital zircon analysis yielded unexpectedly young detrital zircon (DZ) ages in the host rock. Twenty-seven of 113 zircon grains were about 48 million-years-old from a rock mapped as Mezoproterozoic metasedimentary rocks, or approximately 1.45 billion years old Belt Super group. Why and how did these young zircon crystals form? There are a few possible reasons why very young zircons are present in the quartzite, but one key factor is that the

proximal and sometimes cross-cutting (intruding) granite is also about 48 million years old (Stephens et al., 2017). Possible hypotheses for these young DZ ages: 1) Zircon grains were deposited with ash fallout, buried, and then tectonically ex-hummed within the error (2%) of age determination (about a million years); 2) Young zircon grains were from contamination during sample preparation; 3) Zircon grains crystallized during contact metamorphism from the granite. Younger zircons in the quartzite were small, 20 micron and equant, suggesting that they were not eroded or transported. Burial, lithification, uplift and high temperature (600 to 900 degrees Celsius) would suggest re-crystallization by contact metamorphism. Obliterated small and equant zircons crystal associated in an ash deposit. Contamination was discluded because small grains of zircon were observed in micro-probe analyses which was done at WSU to analyze the samples of granite and quartzite. This data yielded the different types of feldspar's within the rock and examined the grains that were in contact with one another to analyze using two-feldspar temperature and pressure ratios. This was to determine where in the thermal gradient the young zircon crystals grew and to show it was not deep enough for complete melt of the rock. Silver Hill is the roof pendant of this intrusion. The similarities of age of the granite and the younger zircon grains suggest contact metamorphism. The presence ore: sheelite, wolframite (Tungsten ore) and Cassidertie (tin ore) also suggest shallow hydro-thermal enrichment associated with intrusions and contact metamorphism. Therefore, this study concludes that the host rock is Neoproterozoic, the granite is Eocene, and that the ore enrichment was likely coeval with the intrusion.

POSTER

ORGANIC NITROGEN TURNOVER AS AN INDICATOR OF FOREST

PRODUCTIVITY. Brianna M. Slothower, Mark D. Coleman, Department of Forest, Rangeland and Fire Sciences, University of Idaho, Moscow, ID 83844; mcoleman@uidaho.edu

Nitrogen (N) is an essential nutrient for determining forest productivity. N is often the limiting nutrient in forests, and therefore is critical in determining the growth and resilience of a stand. Soil microbes and plants acquire nitrogen from the soil solution as amino acids and amino sugars. Microbes also increase supply of small organic molecules in solution by excreting enzymes that decompose proteins and chitin into amino acids and amino sugars. Rapid flux to or from the soil solution can lead to high turnover rates. By using microplate methods to measure enzyme flux and soil solution concentrations, turnover can be quickly assessed. The objective of this study is to compare the importance of organic N turnover as it relates to productivity. Using spectrofluorometric microplate assays, fluxes of alanine aminopeptidase (AM), leucine aminopeptidase (LAP), and chitinase (CH) were quantified. The total amino acid pools were measured by using o-phthaldialdehyde methanol (OPAME) microplate method. CH was found to have considerably larger enzyme flux rates when compared to AM and LAP. Turnover rates were also compared to treatment type and stand measurements. Although no significant relationships were found, turnover increased with increasing tree spacing. Greater precision in turnover may be achieved by considering soil solution concentrations of individual organic molecules produced by measured soil enzymes rather than total amino concentration.

GLOBAL BIOMASS OF GROUND-DWELLING LICHENS AND MOSSES. Robert J. Smith, Department of Botany and Plant Pathology, Oregon State University, 2082 Cordley Hall, Corvallis, OR, 97331-2902, USA.; smithr2@oregonstate.edu

The global signatures of climate, productivity and disturbances are evident in the local abundances of terrestrial primary producers. Ground-dwelling lichens and mosses (“ground layers”) are uniquely positioned to reveal how changing conditions may impact biomass accumulation at the soil–atmosphere interface. Through quantitative meta-analysis (1076 observations from 249 sources), I estimated how ground layer biomass is constrained by, and is sensitive to, several biophysical predictors (climate, soils, productivity, and disturbance legacies). I also evaluated geographic and socioeconomic equitability of observations. Worldwide, half of all ground layers exceeded 1260 kg ha⁻¹ biomass (range: 1–13,450 kg ha⁻¹), roughly equivalent to 554 kg C ha⁻¹ of carbon storage. However, observations were inequitably distributed: they over-represented the northern hemisphere, mid-latitudes, low elevations, and countries ranked highly on the UN Human Development Index. Nonlinear quantile regression revealed that ground layer biomass (and by extension, carbon storage) was constrained at relatively high net primary productivity (NPP) of vascular plants, high potential evapotranspiration, and extreme temperatures, with greatest sensitivity to changes in NPP and climatic moisture predictors. Large-scale changes in these conditions could alter the accumulation of biomass and persistent storage of carbon in ground layers. Forecasting such responses will require expanded sampling among tropical and subtropical locations that afford partnership opportunities with stakeholders in developing countries.

CONSERVATION OF THE ENDANGERED PALOUSE PRAIRIE: FRAGMENTS AND FRACTIONS. Angela C. Sondena, Nez Perce Tribe, PO Box 365, Lapwai, ID 83540; angelas@nezperce.org

The Nimiipuu people have a long and intimate relationship with the rich prairie ecosystems within their homeland, but this relationship has been significantly impacted by settlement and modern agricultural practices. An assessment of 500,000 acres within the current 1863 Nez Perce reservation boundary identified approximately 2,163 acres of potential prairie remnant scattered in 537 individual polygons (<0.5% of the area evaluated). Remnants ranged in size from 0.014 – 120 acres with an average size of 4 acres. A Kernel Density spatial analysis showed that prairie remnants are not randomly spaced on the landscape but are rather clustered which may help prioritize where future conservation and restoration work should occur. Ecological assessments of high priority remnants show that they harbor high biodiversity of native plants (>230 native species so far) and significant populations of 12 rare plant species including the federally Threatened Spalding’s catchfly (*Silene spaldingii*). Challenges to conservation of this ecosystem are many including high rates of private ownership, ubiquitous noxious weeds, pollinator declines, and the lack of a comprehensive conservation strategy.

ORAL

MAPPING LEGAL AUTHORITY TO CONSERVE RIPARIAN CORRIDORS FOR CLEAN WATER, FISH, AND WILDLIFE.

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Despite significant political and economic barriers to building and maintaining habitat corridors for wildlife conservation, habitat connectivity models do not yet explicitly and quantitatively incorporate legal drivers of change. We formulated a method to evaluate the spatial arrangement of legal authority for streamside (riparian) area conservation across a fragmented landscape between the Cascade Range and the Rocky Mountains in Okanogan County, Washington. We focused on streamside lands as a network of potential corridors because they represent a nexus of conservation goals (ecosystem services and wildlife movement corridors) and require multi-dimensional coordination. We developed a method for mapping multiple sources of spatially-explicit legal authority for streamside conservation and applied it to Okanogan County. We then intersected this countywide authority map with a map of national-scale ecological corridor value to consider the local legal-ecological landscape within the broader regional context of enhancing habitat connectivity. The results show that incorporating the legal landscape with respect to multiple conservation goals into a connectivity model identifies different priority areas for rebuilding habitat connectivity than a model based on ecological conditions alone. The map products highlight areas of opportunity for promoting coordination across scales and goals, prioritizing areas for riparian restoration, or effecting policy change to enhance connectivity. This type of cross-scale, legal-ecological categorization scheme is a step toward strategic corridor planning to address both social and ecological barriers to landscape connectivity and could be tailored to fit an array of other management scenarios.

ORAL

PRE-LATE WISCONSIN VALLEY-GLACIER ERRATICS BETWEEN LEAVENWORTH AND PESHASTIN, WENATCHEE VALLEY, WASHINGTON.

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The late Wisconsin Icicle Creek alpine glacier transported tonalite boulders from the Mount Stuart batholith to prominent end moraines in Icicle valley and Wenatchee valley near Leavenworth. Downvalley between Leavenworth and Peshastin, Mount Stuart boulders lie above the valley floor at altitudes 352-490 m. Boulders near the valley floor seem not embedded within silt but only draped by silt. Some previous workers considered these minimally weathered boulders as having been ice rafted into a late Wisconsin landslide-dammed lake. But there is no candidate landslide or other feature along lower Wenatchee valley that could physically pond the valley to such high levels. Flood-bar or landslide deposits in Columbia valley apparently did not pond water to above about 275 m. The boulders more likely lie within of pre-late Wisconsin drift correlative to lateral moraines on Boundary Butte. The silt—a younger deposit that covers some boulders—postdates the pre-and early Wisconsin boulders. The silt derives not from a physically ponded lake but apparently from brief Missoula backfloods up the valley.

WOOD DECAY FUNGI COMMUNITIES ASSOCIATED WITH WOODPECKER CAVITIES IN PONDEROSA PINE SNAGS OF THE EASTERN CASCADES. Jessica Stitt, Dept. of Fish and Wildlife Sciences, University of Idaho, Moscow Idaho; jstitt@uidaho.edu

Woodpeckers that excavate cavities in standing dead trees have been shown to select for trees with softer wood, and softer wood is primarily linked to the wood decay fungi present in a given tree. We explored the wood decay fungal community present in ponderosa pine standing dead trees (known as snags) in the eastern Cascades of Washington state and asked two main questions: 1) whether the fungal communities differ between excavated and unexcavated snags; and 2) whether the fungal communities found within excavated snags differ across species of woodpecker excavating the cavity. Using next-generation sequencing of fungal DNA samples collected from each snag, we analyzed the fungal communities from 27 woodpecker cavities (over four species of woodpecker) in ponderosa pine snags, compared to 27 communities from unexcavated snags with similar characteristics, and discovered significant differences in the community composition and richness of fungal taxa. There was also support for differences in fungal communities between the four species of woodpecker, but sample sizes for certain species were too small to be conclusive.

POSTER

PALOUSE PRAIRIE-FOREST ECOTONE: THEN, NOW, AND IN THE FUTURE.

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The Palouse prairie-forest ecotone in southeastern Washington and west-central Idaho has been shaped by fire and is greatly changed by land use. The historical fire occurrence is largely unknown. We used General Land Office Survey field notes from pre-EuroAmerican settlement (1872-1879) about bearing tree species, or lack thereof, to indicate historical forest, pine savanna, and prairie. We then contrasted the historical data with LANDFIRE existing vegetation classes to estimate long-term land cover transitions. Historically extensive prairie and open ponderosa pine forests are now mostly replaced by dryland agriculture, residential development, conservation reserve program (CRP) lands, and closed canopy forest with less pine and more fir. Fires occurred every 5 to 8 years in the forests on the edge of the Palouse prairie based on our reconstruction of historical fire occurrence (1650-1900) from fire-scarred stumps at eight sites at the prairie-forest edge. In contrast, there are few fires documented in recent times (1992-2015) despite long dry summers with some lightning. Lightning and people may ignite fires that spread

readily in the future as conservation and restoration and other land use changes result in more continuous vegetation fuel for fires. Fire was ecologically important historically, whether ignited by lightning or people, and may increase in importance again as climate becomes warmer and dryer. Understanding the past and potential future role of fire in the Palouse bioregion may help us live with fire while conserving ecological values here and in similar prairie-forest landscapes into the future.

ORAL

CHALLENGES AND STRATEGIES FOR ENVIRONMENTAL DNA SAMPLING IN STREAMS. Katherine Strickler, Caren Goldberg, Alexander Fremier, School of the Environment, 1228 Webster Hall, Washington State University, Pullman, WA 99164; k.strickler@wsu.edu

Environmental DNA (eDNA) technology is undergoing rapid transition from research to application by practitioners seeking to incorporate eDNA detection into management of aquatic systems. However, we have much to learn about how to optimally incorporate it into monitoring programs. As with any sampling tool, the reliability of occupancy estimates based on eDNA is dependent on understanding the factors that affect detection probabilities. Understanding factors that affect eDNA detection in stream systems is particularly challenging. Transport of eDNA away from source organisms complicates detection and inference and is difficult to predict in natural, hydrologically complex streams. We present 1) an overview of the current state of knowledge of eDNA transport in stream systems, 2) results of several studies in which we examined factors affecting bull trout (*Salvelinus confluentus*) eDNA detection, and 3) key considerations for incorporating eDNA sampling into monitoring programs for stream biota. We close with a brief discussion of research needs for better understanding transport and detection of eDNA in streams.

ORAL

INDIAN CARROTS (*PERIDERIDIA GAIRDNERI*) AND THE EFFECTS OF FIRE ON THE COLVILLE RESERVATION, 2016-18. Nikanot Sylvia Tatshama Peasley, Pendleton Moses, Traditional Cultural Plants Project, History/Archaeology Program, Confederated Tribes of the Colville Reservation, Nespelem, WA 99155; Rebecca Peone, Colville Confederated Tribes/Bureau of Indian Affairs Burned Area Emergency Response Team, Nespelem, WA 99155; Trisha Johnson, History/Archaeology Program GIS, Confederated Tribes of the Colville Reservation, Nespelem, WA 99155; Kathleen Robson, Traditional Cultural Plants Project, History/Archaeology Program, Confederated Tribes of the Colville Reservation, Nespelem, WA 99155; sylvia.peasley.hsy@colvilletribes.com

Indian carrot or yampah (*Perideridia gairdneri*) is a favorite traditional food of many Northwestern tribes. This graceful member of the carrot and celery family occurs in a range of habitats, from open woods and mountain meadows at mid elevations to moist swales in sagebrush-steppe. In 2015, the North Star Fire burned through stands of ponderosa pine with carrots and other species in the understory. In 2016 the Cultural Plant Team set up two 25 m transects in neighboring populations of carrots, blooming vigorously after the fire. We collected data on carrots, non-living variables and associated plants from ten randomly-selected 1 m plots along these transects for three years. Though we have no pre-fire data, the carrots seemed to be thriving the first year after fire and were more numerous the second, but decreased in year three,

possibly from competition with other native plants. Experiments with controlled burning would provide clarification.

POSTER

QUANTIFYING HABITAT STRUCTURE IN WESTERN GREBE COLONIES. Madi Thurston, Courtney J Conway, U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, ID 83843; Kerri T. Vierling, Department of Fish and Wildlife Science, University of Idaho, Moscow, ID 83843; Deo Lachman, Fish and wildlife services, University of Idaho, Moscow, ID 83843; thur8631@vandals.uidaho.edu

The Western Grebe (*Aechmophorus occidentalis*) is a piscivorous bird that relies on water for foraging, nesting, and courtship rituals. These birds commonly build their nests in marshy areas characterized by emergent vegetation. These nesting habitats are often subjected to water drawdowns from agricultural use. Changes in water level can affect nest survival and cause grebe colonies to abandon or change sites in the future. The objective of my investigation was to quantify factors hypothesized to influence grebe colony site selection: mean water depth, and vegetation cover. I conducted my research at Cascade Reservoir in Cascade, Idaho which is home to the largest breeding colony of Western Grebes in Idaho. The water level at Cascade Reservoir can fall ~60cm during the grebe breeding period. I sampled three previous grebe colony sites as well as the current colony site during the 2018 breeding period. I sampled 60 bathymetry points at each of the four sites during peak water level. I also used a UAS (drone) to collect aerial imagery of each site to estimate vegetation cover. I categorized vegetation cover into three categories: open water; sparse vegetation; or full vegetation. The mean water depth at the current site was 57.84cm while the other sites varied significantly at 36.2cm, 66.9cm, and 87.5cm. The vegetation structure also varied significantly among sites. The current colony site had 90% sparse vegetation and only 0.7% open water, while the other sites were primarily open water with 47%, 58%, and 88%. The grebe colony also had one of the lowest percentages of full vegetation cover at 9.3%. The differences in mean water depth between the sites suggests that water depth may influence colony site selection. Also, there may be a preferred range of water depth that is neither too shallow nor too deep. The low percentage of open water at the colony may inform the colony's susceptibility to water drawdowns, however, further research is required. These results demonstrate that the Western Grebe requires a specific combination of water depth and vegetation cover. Cascade Reservoir is a highly managed environment and the areas that contain the proper mix of water depth and sparse vegetation may change from year to year. This information can be valuable in informing water use policies as well as predicting future colony sites.

ORAL

RECENT ADDITIONS TO THE FOOD WEB OF LOWER GRANITE RESERVOIR: WELCOMED GUESTS OR UNWANTED PARTY CRASHERS? Ken Tiffan, U.S. Geological Survey, Western Fisheries Research Center, 5501A Cook-Underwood Rd., Cook, WA 98605; ktiffan@usgs.gov

The food web in Lower Granite Reservoir has changed in recent years with the addition of both native and nonnative species. However, their effects on fishes of interest, such as ESA-listed salmonids, remains largely unknown. Three recent additions will be discussed: the nonnative Siberian prawn (*Palaemon modestus*), nonnative opossum shrimp (*Neomysis mercedis*), and the

endemic sand roller (*Percopsis transmontana*). Siberian prawns were first found in the Snake River in 1998 and their population has increased dramatically. This benthic invertebrate is relatively large (~70 mm total length), reproduces in late summer, feeds omnivorously on other invertebrates and detritus, but its use as prey by other species is poorly understood. *Neomysis* has become very abundant since the mid-1990s and is preyed upon heavily by many littoral fish species when they move into shoreline habitats in the spring to spawn. In this respect they provide a benefit to many fishes particularly since they likely transport energy from offshore to nearshore habitats. However, they do have the potential to compete with subyearling fall Chinook salmon for zooplankton in late summer when low velocities allow them to ascend into the water column to forage. Finally, sand rollers, long absent from the reservoir, are now abundant and may provide a predation buffer for juvenile salmonids. The cause for their population resurgence is unknown but is encouraging when so many native species are in decline. Changes to reservoir food webs are often under-appreciated in the context of species recovery.

POSTER

PRESENCE OF NORTHERN IDAHO GROUND SQUIRRELS *UROCITELLUS BRUNNEUS* INFLUENCES BY OTHER SMALL MAMMALS SPECIES AND ENVIRONMENTAL FACTORS. Cassandra C. Townsend, Fish and Wildlife Sciences, University of Idaho; Courtney J Conway, U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit; Kerri T. Vierling, Department of Fish and Wildlife Science, University of Idaho; Austin Allison, Fish and Wildlife Science, University of Idaho; Deo Lachman, Department of Fish and Wildlife, University of Idaho, Moscow, ID 83843; town6566@vandals.uidaho.edu

The Northern Idaho ground squirrel is endemic to Adams and Valley Counties in west-central Idaho and are one of the rarest North American mammals. Their populations have decreased due to fire suppression and encroaching forest on their meadow habitat. Due to this they are classified as a Species of Special Concern by the Idaho Department of Fish and Game, USDA Forest Service Sensitive Species, and listed as federally threatened under the Endangered Species Act. This study compared two different sites in Adams county for the presence of the Northern Idaho ground squirrels. The goal of this study was to quantify variables hypothesized to influence Northern Idaho ground squirrel presence. Habitat use will allow us to understand if the Northern Idaho ground squirrel's habitat range has increased based on various factors. We quantified presence of each small mammal species at two sites, Steve's Creek Rd and YCC, both are used by a collaborative recovery project by the U.S Fish and Wildlife Service, Idaho Department of Fish and Game, Payette National Forest, Boise National Forest, and Albertsons College. Each site contains forest and meadow habitat, cameras were placed at each site to detect presence and identity of any small mammal that entered the study site. Our results will allow future management and trapping efforts understand the different variables that can influence Northern Idaho ground squirrel presence. This study can also identify different environmental factors that may affect the habitat expansion or constraints of the Northern Idaho ground squirrels.

A FIELD GUIDE TO GRASSES AND GRASS-LIKE PLANTS OF IDAHO. Justin J. Trujillo, Eva K. Strand, Department of Forest, Rangeland, and Fire Sciences, University of Idaho, 875 Perimeter Drive MS 1135, Moscow, ID 83844-1135.; evas@uidaho.edu

Within its grasslands, shrublands, meadows and open forests, over 50% of Idaho and up to 70% of land within adjacent states, is covered by grasses and grass-like plants. These plants are the mainstay in diets of wild and domestic hooved mammals, provide habitat for ground-nesting birds and other species, mitigate soil erosion, and play an essential role in wildland and range management. Grasses and grass-like plants are not easily identified. We therefore developed a user-friendly field guide, an off-line smartphone app, and a 9th-12th-grade educational curriculum for the state of Idaho, specifically designed to meet the needs of those with limited background to advanced botany skills. The field guide and smartphone app for iPhones and Android devices features 89 grasses and grass-like plants, intended for K-16 educators and students, ranchers, land managers, field technicians, recreationists, and nature enthusiasts, with accompanying K-12 educational materials that follow the Next Generation Science Standards and the Common Core State Standards. The guide and app include nearly 400 colorful images, which provide a unique visual experience, showing detailed vegetative and reproductive features of each plant. The guide and app include easy-to-use dichotomous keys and a filtering system, and information about each plant's forage value, importance for wildlife cover, erosion control, and revegetation value. Comparisons to similar species, synonyms, flowering periods, distribution maps, and black-and-white illustrations are included to aid in identification. The field guide, smartphone app, and educational curriculum provide rich photographs and detailed drawings that set a new standard for visually engaging plant identification.

ORAL

LINGUISTIC EVIDENCE OF DIETARY TRANSITION: THE CASE OF THE SCHITSU'UMSH. Jill Maria Wagner, Tribal Historic Preservation Officer, Hnkhwelkwhln Dept, Coeur d'Alene Tribe, P.O. Box 408/ 805 A Street, Plummer, Idaho 83851; jwagner@cdatribe-nsn.gov

Colonization dramatically changed Schitsu'umsh foodways. Access to traditional hunting and gathering areas, the time and manpower to harvest and process in traditional ways were lost. Gardening and orcharding were introduced. The earliest iterations are found at the Coeur d'Alenes Old Mission at Cataldo, Idaho and are evidenced in the language. Terms for foods grown at the Mission are largely borrowed from French. Those terms and additional research on the remnant orchards, documents, and purchasing records informs the history of domesticated food production among the Schitsu'umsh.

ERRATICS AND SILT DEPOSITS AS EVIDENCE OF LATE WISCONSIN MISSOULA OUTBURST FLOODS IN LOWER WENATCHEE AND COLUMBIA VALLEYS,

WASHINGTON. Richard B. Waitt, U.S. Geological Survey, 1300 SE Cardinal Ct., Ste. 100, Vancouver, WA 98683; William A. Long, Cashmere, WA (deceased); Kelsay Stanton, Department of Earth and Space Science, University of Washington, Seattle, WA 98195; waitt@usgs.gov

The Pleistocene Missoula floods through eastern and central Washington are by peak flow rate the greatest freshwater cataclysms known on Earth. Newly explored features along the Wenatchee reach of Columbia valley give new evidence and revise earlier interpretations of size, frequency, and routing of megafloods.

Crystalline-rock erratics derived from far northeast lie scattered about the sandstone hills of lower Wenatchee valley and adjacent Columbia valley up to 495 m altitude, 320 m above Columbia River. Evidence of physically ponded water lies only much lower in the valley, below 275 m. The high erratics can only have been ice-rafted by flood(s) running down the Columbia. Before the late Wisconsin Okanogan lobe of Cordilleran ice blocked the Columbia, at least one monstrous iceberg-carrying Missoula flood poured down the valley past Wenatchee and backflooded Wenatchee valley.

Rhythmically bedded sandy silt in Columbia valley between Trinidad and Wenatchee records repeated silt-rich backfloods up the Columbia from Quincy basin—after Okanogan-lobe ice had blocked the Columbia upvalley. Such rhythmically graded silt beds in Wenatchee valley at Dryden containing Columbia-derived dropstones record ten Missoula backfloods up the valley. Thick but poorly exposed silt farther up Wenatchee valley between Peshastin and Leavenworth had been thought deposits of a long-lived lake, dammed supposedly by the Malaga landslide. But the heights and distribution of provable lake beds now make Moses Coulee bar the only viable dam—and only up to altitude 275 m. The silt above Dryden lying at 315–385 m altitude must also have been laid by Missoula backfloods.

POSTER

BURN SEASON AND INTERVAL EFFECT PONDEROSA PINE GROWTH AND WESTERN PINE BEETLE MORTALITY IN THE BLUE MOUNTAINS OF OREGON.

Douglas J. Westlind and Becky K. Kerns, USDA Forest Service, Pacific Northwest Research Station, Forestry Sciences Laboratory, 3200 SW Jefferson Way, Corvallis, OR 97331; dwestlind@usda.gov

Thinning ponderosa pine forests followed by repeated prescribed burning may return fire to its historical role and develop resiliency to wildfire. However, the impacts on tree growth and mortality are not well understood. We investigated growth and mortality after repeated spring or fall prescribed burns in the Blue Mountains of Oregon. Six thinned pine stands were divided into five areas assigned as an unburned control, or a burn season by interval treatment: spring 5 yr, fall 5 yr, spring 15 yr, and fall 15 yr. Growth was measured for 15 yr, and mortality monitored for 20 yr following initial burns. Pine height growth did not differ between treatments, but diameters in fall burns were 18 to 25 % greater than spring burns, and 12 to 19 % above the unburned controls. Mortality for the first five yr was largely attributed to damage from the initial fires. Subsequent mortality was rarely attributable to re-burning, but primarily to insects and disease with the fall having 38 to 45 % the mortality of the spring treatments. During

our study, all stands experienced widespread defoliation from a pine butterfly outbreak, followed by an eruption of western pine beetle. Pine butterfly mortality was lowest in the two fall treatments, but not statistically different from spring or controls. Western pine beetle mortality in fall burn treatments was only 27 % to 54 % of the spring or controls. These results suggest fall burning positively impacts long-term ponderosa pine forest health while spring burning provides little benefit.

POSTER

GLOBAL OBSERVATION RESEARCH INITIATIVE IN ALPINE ENVIRONMENTS (GLORIA): FIRST YEAR DATA FROM THE WALLOWA MOUNTAINS OF OREGON.

Upekala Wijayratne, Michael Jennings, Nathan Poage, U.S. Forest Service Region 6 Ecology Program; Rachel Brunner, Institute for Natural Resources, Portland State University; Daniel Luoma, Department of Forest Ecosystems and Society, Oregon State University; Elizabeth Martin, Lewis-Clark State College; ucwijayratne@fs.fed.us

The Global Observation Research Initiative in Alpine Environments (GLORIA) is a worldwide network of long-term research sites established to monitor contemporary changes in plant species composition and the rate of change in native alpine plant communities. Many alpine plant species are being affected by habitat loss due to climate change. This study summarizes the first year field plot data collected at three sites in the Wallowa Mountains of Northeastern Oregon. This is the only GLORIA installation in the Pacific Northwest. Three permanent field plots were installed on three summits at elevations ranging from 2588-2791 meters. On each summit, habitat characteristics, species composition, species cover, and frequency counts are recorded in sixteen 1m x 1m quadrats. Additional surveys of surface type and species cover in eight larger plots extending to 10m below the summit focus on detecting changes in species richness and species migrations. Sites were analyzed both independently and as a group to explore similarities and differences in species composition and correlations with abiotic factors such as substrate, elevation, aspect and climate. Over 80 different species were identified across all sites. The summits exhibited heterogeneous plant communities in which most species were infrequent and vegetative cover ranged from less than 1% to 40%. Elevation, aspect, and substrate all influenced plant community composition. Resampling over time will allow us to discern trends in species diversity and climate, and assess and predict losses in biodiversity and other threats to these fragile alpine ecosystems.

ORAL

VARIATION IN BEHAVIOURAL TRAITS WITHIN AND BETWEEN WILD AND CAPTIVE-BORN VANCOUVER ISLAND MARMOTS (*MARMOTA*

***VANCOUVERENSIS*). Megan Wilkins, 22 Torikko Crescent, Nanaimo, BC V9X 1C1. Jamie Gorrell, Vancouver Island University, 900 Fifth Street, Nanaimo, BC V9R 5S5.; mmkwilkins@gmail.com**

Reintroduction and captive breeding programs have made the difference between survival and extinction for many species such as the Vancouver Island marmot (*Marmota vancouverensis*). The Vancouver Island marmot is Canada's most endangered mammal and in the early 2000s a captive-breeding and reintroduction program was initiated to prevent the species from going extinct and to restore wild populations. A major impediment limiting the success of the reintroduction program is the predation of reintroduced marmots. Previous studies have shown

that captive-bred marmots suffer higher mortality rates due to predation than their wild-born counterparts. I tested for differences in risk-adverse behaviour within and between wild-born and captive-bred marmots on Mount Washington (Vancouver Island, B.C.) to detect any behavioural deficiencies that may prove to be disadvantageous in the wild. I found no evidence that captive-bred marmots were less responsive to a potential predator than their wild-born counterparts ($U=29, n_{\text{captive}}=7, n_{\text{wild}}=9, p>0.83$). However, this may be due to habituation to human presence on Mount Washington, an alpine resort where human traffic is concentrated. Captive-bred males displayed larger exploratory ranges than captive-bred females ($\bar{x}_{\text{females}}= 5,144 \text{ m}^2 \pm 1,751 \text{ m}^2$, $\bar{x}_{\text{males}}= 193,657 \text{ m}^2 \pm 221,768 \text{ m}^2$), though these differences were not statistically significant ($U=0, n_{\text{females}}=2, n_{\text{males}}=3, p>0.20$). Large exploratory movements may place released animals at a greater risk of being predated upon thus future reintroductions could be improved by determining factors that may increase site fidelity.

ORAL

VARIATION OF RESOURCE SELECTION DUE TO SEASONALLY INDUCED INTER-COHORT COMPETITION IN STEELHEAD (*ONCORHYNCHUS MYKISS*).

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To maximize energetic gain per unit of effort, fish are expected to select larger prey as they grow; however, seasonally-induced intraspecific competition due to climate change could hinder optimal foraging behavior. Changes in diet due to greater competition could result in lower growth and survival of fish populations. To determine the relative role of inter-cohort competition and seasonality on resource selection within a threatened population of steelhead (*Oncorhynchus mykiss*), invertebrate food availability and stomach contents of subyearling and yearling fish were sampled in summer and fall. Taxonomy of samples for availability and diet contents were identified to order. For these samples, prey abundance and dry-mass were measured. Levin's standardized niche breadth was calculated to determine differences in niche width under varying yearling densities. To determine dissimilarities in prey preference under varying yearling densities, Chesson's α was calculated and resource selection was modeled for yearling and subyearling fish. In yearling fish, niche width expanded, and greater selection of fish and less energetically efficient invertebrate prey were observed at greater yearling densities and warmer temperatures. In subyearling fish, there was little change in niche width and greater selection of energetically poor prey was observed at sites with greater yearling densities. These findings support that changes in resource selection can occur at low population densities due to seasonally induced inter-cohort competition for resources and could lead to energetic deficiencies in the future.

PALOUSE PRAIRIE CONSERVATION AND RESTORATION: LEVELS OF INFESTATION, SEED CONSUMPTION, AND THE EFFECT OF ENVIRONMENTAL SITE CONDITIONS ON TWO INSECT BIOLOGICAL CONTROLS FOR YELLOW STARHISTLE (*CENTAUREA SOLSTITIALIS*). Steven E. Woodley and Benjamin A. Zamora, School of the Environment, Washington State University, Pullman, WA 99164; Todd Coffey, Department of Research and Biostatistics, Idaho College of Osteopathic Medicine, Meridian, ID 83642; steven.woodley@wsu.edu

Two separate 2-yr field studies (2014-2015) quantified (1) the effect of environmental factors on the overwintered hairy weevil (*Eustenopus villosus*) and flower weevil (*Larinus curtus*) adults in relation to the different phenophases of yellow starthistle (*Centaurea solstitialis*) and (2) determined the species levels of infestation and seed consumption. Levels of infestation and seed consumption were compared to similar studies that occurred in Mediterranean climates to assess the efficacy of the southeastern Washington populations. Studies were conducted within the Kramer Prairie Natural Area, a remnant Palouse Prairie plant community, south of Pullman, Washington. Findings suggest that the appearance of the both insect species is most associated with warming temperatures, however, the appearance flower weevil was also found to be associated with the flowering stage of yellow starthistle. Species decline in frequency was likely a function of the species completing their life cycle coupled along with the loss of breeding and forage sites with the phenological advancement of yellow starthistle. Levels of infestation by the hairy weevil were similar between years, 40% in 2014 and 39.5% in 2015, and the flower weevil increased from 16.7% in 2014 to 23.3% in 2015. A percentage of flowerheads was also infested by both species both years (5.8% in 2014 and 9.9% in 2015). Hairy weevil and flower weevil consumed the same proportion of seeds (76.1% 75.4% respectively). Infestation and seed consumption were lowest in southeastern Washington suggesting that the efficacy of the species may be less in more continental macroclimates than in Mediterranean influenced climates.

LONG-TERM SUCCESS OF SEEDLINGS ESTABLISHING IN SUBALPINE MEADOWS, OLYMPIC NATIONAL PARK. Andrea Woodward, USGS Forest & Rangeland Ecosystem Science Center, 6505 NE 65th Street, Seattle, WA 98115; Jonathan Soll, Portland Metro Regional Government, 600 NE Grand Avenue, Portland, OR 97232; awoodward@usgs.gov

Establishment of trees in subalpine meadows has been studied as a potential example of ecological effects of climate change. Tree establishment is a multi-year process including cone and seed production, germination, seedling establishment, and growth with each step possibly sensitive to different climate limitations. While most studies have focused on one or a few steps, this study follows a cohort of individually marked seedlings for 28 years beginning as seeds in two subalpine meadows on Hurricane Ridge, Olympic National Park. Results show that seedling success varies with host plant community and by developmental stage. Seedling germination and establishment are sensitive to high air and soil temperatures and drought, while mortality of established seedlings is related to seedling size and to climate indirectly through effects of growth. Growth is enhanced by longer growing season and warmer minimum temperatures; mortality due to poor growth is often a multi-year process. Most seedling survival occurred in lichen (primarily *Lepraria neglecta*) and *Vaccinium deliciosum* plant communities. It is also

apparent that while microsite is important in determining seedling success, the landscape position of meadows relative to regional climate exerts a higher-level control over whether a subalpine meadow is likely to disappear with warming climate.

ORAL

EXPLORING A MULTI-DISCIPLINARY APPROACH TO INCORPORATING TRADITIONAL KNOWLEDGE INTO FUELS TREATMENTS. **Monique D. Wynecoop**, USFS Colville National Forest, 765 South Main Street, Colville, WA, 99114; Penelope Morgan, Eva Strand, University of Idaho, Department of Forest, Rangeland, and Fire Sciences, 975 Perimeter Drive MS 1133, Moscow, Idaho 83844; Fernando Sánchez Trigueros, University of Arizona, School of Geography and Development, 1064 E. Lowell Street, Tucson, Arizona 85721; crum7709@vandals.uidaho.edu

Evaluating fuel treatment effectiveness is challenging when managing a landscape for diverse ecological, social, and economic values. We used Participatory Geographic Information System (PGIS) to understand Confederated Colville Tribal (CCT) member views regarding the location and effectiveness of fuel treatments within their ancestral territory within the Colville National Forest (CNF) boundary. The 2015 North Star Fire burned 88 221 ha (218 000 acres) of the CCT ancestral territory.

ORAL

TRIBAL PERSPECTIVES, RECOMMENDATIONS, AND RESEARCH NEEDS FOR PROMOTING TRIBAL FOOD SOVEREIGNTY AND RESPONSIBLE MANAGEMENT OF TRADITIONAL FOODS AND PLACES. Panel moderated by **Monique Wynecoop**, Pit River/Maidu, Fire Ecologist, Colville National Forest, 765 S. Main Street, Colville, WA, 99114, moniquedwynecoop@fs.fed.us. Panel members: **Nicholas Kager**, Deputy Tribal Historic Preservation Officer, Coeur d'Alene Tribe; **Jill Wagner**, Tribal Historic Preservation Officer, Coeur d'Alene Tribe; **Serra Hoagland**, Liaison Officer (Biologist), USFS Rocky Mountain Research Station Fire, Fuels, & Smoke Program; **Celina Gray**, Undergrad Student of Biology, Salish Kootenai College; **Sammy Matsaw**, Shoshone/Bannock & Oglala Lakota, Ph.D Student, University of Idaho; **Pendleton Moses**, Cultural Plants Specialist, Confederated Colville Tribes; **Sylvia Peasley**, Cultural Plants Specialist, Confederated Colville Tribes; **Josiah Pinkham**, Hanford Cultural Program, Nez Perce Tribe; and members from other area tribes may participate.

The special session on Northwest Native Foods: Plants, Animals and Fish will include both specific presentations on a wide range of topics including: Schistu'umsh Contemporary Food Sovereignty; Linguistic Evidence of Dietary Transition: The Case of the Schistu'umsh; Intertribal Timber Council Research Needs Assessment Findings; Huckleberry/Bear Interactions; Indigenous "Alter-Native" Science: First Foods Ecology; Fire Effects on Cultural Plants of the Confederated Colville Tribes and other topics. Following the formal presentations will be a panel to discuss some broader issues on tribal perspectives and information needs in relation to native foods and related topics. When discussing the future and management of tribal foods and places, it is important to do so within the cultural context of tribal communities that provide and depend on the knowledge. Attendees will hear the perspective and management recommendations and have the opportunity to ask questions of area tribal community members,

resource managers, and researchers; leaders in their communities that have a cultural stake in promoting responsible management of traditional foods and places.

ORAL

EASTERN WASHINGTON'S GREATEST HITS..GEOLOGICALLY. Nick Zentner,
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Unique land forms—in the rain shadow of the majestic Cascades—are on display in the deserts of Eastern Washington. Drone footage and various video clips of key Inland Northwest geologic features will be featured. Flood basalts, spatter at fissures, loess hills, Ice Age Floods-carved coulees, Ice Age slackwater deposits, thick ash fall deposits from the Yellowstone Hot Spot, etc....it's all here to studied and enjoyed.