PROCEEDINGS of the PACIFIC DIVISION of the

AMERICAN ASSOCIATION for the ADVANCEMENT of SCIENCE

and

NORTHWEST SCIENTIFIC ASSOCIATION

21-24 March, 2023

101st ANNUAL MEETING
PROGRAM WITH ABSTRACTS

(photo from the City of Bellingham. https://cob.org/)

Western Washington University
21-24 March, 2023

Reconnecting Regionally

AAAS | Pacific Division

NORTHWEST SCIENTIFIC ASSOCIATION

WESTERN WASHINGTON UNIVERSITY

NORTHWEST LICHENOLOGISTS

Meeting Program of the
Pacific Division of the
American Association for the Advancement of Science
and
The Northwest Scientific Association
Western Washington University
Bellingham, Washington
21-24 March, 2023

All talks/events/etc (except on Tuesday and a Lichens workshop) will be held in the Academic Instruction Center West (AW) at Western Washington University.

Parking in lot 12C, just south of AW (get the ParkMobile app). Free for government vehicles.

Symposia talks are 20 minutes (except 2,6, and 7).

Tuesday, 21 March

3:30-6:00 PM	NWSA Board Meeting	Bellingham Ferry Terminal
6:00-9:00	Registration opens and Social Icebreaker	Bellingham Ferry Terminal

Wednesday, 22 March

7:30 AM	Registration opens	AW, south entrance
8:30– 9:15	Welcome and Land Acknowledgement	AW 204

- *Brad Johnson*, Provost and Executive VP of Academic Affairs, WWU
- *Frank Lawrence III*: Welcome to the lands of the Lhag'Temish, the Lummi People. (Intro: Andy Ross)

9:15-10:15.	Plenary Speaker, *John Clague*, Simon Frasier Univ. (Intro: Dan Gavin)	204

- Giant ice age floods – an example from British Columbia.

10:15-10:30	Coffee Break.	AW
10:30 – 11:50	Symposia	

~~1. The science of making change: occupying the political space 203~~

~~A. *Sam Gutierrez*, along with *Senators Lovick, Kuderer, and Wellman* will host a discussion regarding data driven approaches at different levels of government.~~

2. Climate impacts and adaptations 1 (moderator: Upekala Wijayrante) 204
    A. *Jessica Halofsky*: Intro to fire and climate.
    B. *Brian Harvey*: Spatial patterns of burn severity in northwestern Cascadia: characteristics, drivers, and implications for post-fire landscapes.
    C. *Kris Jaeger*: Development of a streamflow data catalog and evaluation of the vulnerability of sensitive fish species to climate change across the Pacific Northwest.
    D. *Robert Mitchell*: Modeling 21st century peak flows in the Nooksack river using dynamically downscaled climate projections.
    E. *Eric Grossman*: Nature-based strategies assessment to inform resilience planning for higher sea level and stream runoff in the Pacific Northwest.
3. Animal Ecology (moderator: Srihari Yamanoor) 210
    A. *Harlow Huber*: Animal classification with machine learning.
    B. *Sarah Deshazer*: Investigation of small mammal diversity and abundance at the Eastern Washington University Prairie Restoration Site.
    C. *Nikhil Amin*: The reconstruction of maternal migration patterns of steelhead: a LA-ICP-MS otolith analysis.
    D. *Dietmar Schwartz*: Cascading adaptation to abiotic environmental variation across two trophic levels of parasites.

12:00-1:00 PM. Lunch AW

1:00-3:00 Symposia

4. Coding and Simulation (moderator: Calvin Deutschbein) 203
    A. *Juni DeYoung*: Aphrodite: security properties of RISC-V.
    B. *Lincoln Huber*: Visual knowledge discovery for machine learning.
    C. *Harlow Huber*: Monotone function visual analytic.s
    D. *Terrence Miles*: A practical, quantitative approach to crystal field theory using Mathematica.
    E. *Frank Jacobitz (via zoom)*: Simulation of the flow over a roughness element.
    F. *Ruhul Kuddus*: Application of Artificial Neural Network method and nonparametric statistical tools in analyzing the effects of the COVID-19 pandemic on heart and kidney transplantation in 30 countries.
5. Geology and Environmental Change (moderator: Richard Waitt) 205
    A. *Patrick Pringle* (zoom): Radiocarbon dating of subfossil trees in landslide-dammed lake crescent, Olympic Mountains, Washington.
    B. *Richard Waitt*: Large flows at Mount St. Helens 18 May 1980 timed by ashfall marker beds and eyewitnesses.
    C. *Gus Seixas*: Forest management history influences eight decades of shallow landsliding in northwest Washington State.
    D. *Cristina McKernan*: Inventory, assessment, and monitoring of fens in the Antelope Allotment, Oregon, USA.
    E. *Chantel Saban*: Inferences of Late Glacial through early Holocene environments using pollen from coprolites and sediments recovered from Paisley Caves, Oregon.
    F. *Jamila Baig*: Postglacial vegetation and fire history with a high-resolution analysis of tephra impacts, High Cascade Range, Oregon, USA.

1:00-2:00 Symposia

6. Climate impacts and adaptations 2 (moderator: Upekala Wijayrante) 204
    A. *Nicole DeCrappeo*: Advancing climate adaptation science and practice (introduce RAD).
    B. *Meade Krosby*: Co- production as a climate adaptation strategy.
    C. *Lindsay Thurman*: Persist in place or shift in space? Applying assessments of species adaptive capacity to inform climate adaptation planning.

D. *Kylie Avery*: Asserting tribal sovereignty through climate planning at the 2023 Southwest Tribal Climate Camp.

2:00-3:00 **Symposia**

7. Tribal Sovereignty and Climate Impacts (moderator: Stevan Harrel) 204
   A. *Cecelia Gobin*: Tribal treaty rights: a higher duty in the face of climate change and environmental justice.
   B. *Meade B. Krosby*: The Tribal Coastal Resilience Project: lessons in ethical and effective collaboration among tribal and academic partners.
   C. *George Swanaset Jr*: Nooksack core values and the struggle to preserve livelihoods in a time of climate change.

3:00-3:20 **Break**

3:20-4:20 **Plenary Speaker,** *Dr. Jozef Stec*, President, AAAS-PD (Intro: Bob Hickey) 204

- Ancient and modern infectious diseases: an overview of their impacts on global health, economy, and security.

4:30-6:30 **Poster Session and Social (All posters listed after schedule)** AW 3rd floor (400 level) skybridge

Thursday, 23 March

7:30 AM **Registration opens** AW

8:00-9:00 **Plenary Speaker.** *Dr. Nathan Kuwada*, Central Washington University (Intro: Bob Hickey) 204

- Dynamic mechanisms responsible for structure and organization in bacterial cells.

9:15-10:15. **Symposia**

8. Forests and Fires 1 (moderator: Skye Greenler) 204
   A. *William Nanavati*: Postglacial climate-vegetation-fire interactions along the western Cascades of southern Washington and Oregon.
   B. *James Johnston*: Exceptional variability in historical fire regimes of the west slope of the Oregon Cascades, USA.
   C. *Skye Greenler*: Too hot, too cold, or just right: can fire restore Pacific Northwest dry forests?
9. Psychology and Social Science (moderator: Gary Myers) 205
   A. *Gary Myers*: Harnessing intergroup contact theory in leadership development.
   B. Crystal Goldman (via zoom): Creation and validation of a survey instrument for succession planning in higher education.
   C. *Crystal Goldman (via zoom)*: Applying the motivation beliefs inventory (MBI) in academic libraries.
10. Applications of 3D printing in the classroom and lab (via zoom) (moderator: Joan Horvath) 203
   A. *Joan Horvath*: Making calculus accessible with 3D prints and Lego bricks.
   B. *Rich Cameron*: 3D printing and other maker tech for your classroom and lab.

9:15-10:15. **Workshop 1** 403

- Stereo Lichen Photographs and Lichen lightning talks (moderator: Fred Rhoades)

10:15-10:30 **Coffee break** AW

10:30-11:50 Symposia

11. Forests and Fires 2 (moderator: Jeffrey Kane) 204
    A. *Garrett Meigs*: Quantifying the work of wildfire: lessons from the 2021 and 2022 fires seasons across Washington.
    B. *Jeffrey Kane*: Douglas-fir encroachment and removal alter seasonal live and dead fuel moisture in a northwestern California oak woodland.
    C. *Jackson Carrasco*: Determining stand condition thresholds to limit fire severity in second-growth redwood forests following wildfire.
    D. *Jessie Thoreson*: Understanding Xánthiip (black oak, *Quercus kelloggii*) ecocultural revitalization in the western Klamath Mountains.
12. Historical and Philosophical Issues in Biology (moderator: Sarah Roe) 205
    A. *Aaron Chavez* (via zoom): Values and methods in classifying cancer.
    B. *Michael Brown*: I, organism: reflections on a particular history and philosophy of the organism concept.
    C. *Barbara Canavan*: Disease entanglements: human-animal-environment.
13. Lichens and Cacti (moderator: Xinhui Yu) 210
    A. *Xinhui Yu*: Geographic variation in the chemistry of Pacific Northwest endemic cyanolichens
    B. *Daphne Stone*: The proof is in the pudding – *Leptogium* and *Scytinium*.
    C. *Meaghan Petix*: Assessing nitrogen deposition in mountainous regions using epiphytic lichen communities.
    D. *Zarha Dillon-Zuppelli*: *Pediocactus nigrispinus* Demography and Habitat Associations.

11:50-1:30 PM Lunch. Pick up box lunches (by north doors) AW

- NWSA Business Lunch 204
- AAAS-PD Business lunch (get updates from both AAAS National and Pac. Div.) 210
- Everyone else, as the day before! AW

1:30-2:30 Plenary Speaker*: Dr. Michelle Koppes*, University of British Columbia (Intro: Dan Gavin) 204

- Braiding knowledges of braided rivers: embracing place-based, local and indigenous knowledges and lived experience in the science of landscapes.

2:30-3:30 Symposia

14. Historical and Philosophical Issues in Science Communication (moderator: Roberta Millstein) 205
    A. *C. Tyler DesRoches*: Climate change, civilization collapse, and climate ethics.
    B. *Melinda Fagan*: "Low effort" interdisciplinary explanations.
    C. *Natasha Haddal (via Zoom)*: A comparative analysis of pluralistic approaches and the tensions that arise in them.

3:30-4:30 Symposia

15. Bonus Talks (moderator: Bob Hickey/Brian Atwater) 205
    A. *Bill Trevarro*: Open autopoietic systems imitate life's processes.
    B. *Bill Trevarro*: Physical events leading to autopoietic chemical systems.
    ~~C. *Nicholas Kager*: The differing voices of ethnohistory.~~

2:30-4:30 Symposia

16. Forests and Fires 3 (moderator: Lucy Kerhoulas) 204
    A. *Lucy Kerhoulas*: Bigleaf maple within-crown seasonal physiology.
    B. *David Shaw*: The emerald ash borer has arrived in Oregon: what do we know about Oregon ash?
    C. *Susan Waters*: Prescribed fire increases resilience of plant-pollinator networks in western Washington prairie-oak savannah.
    D. *Daniel Donato*: Not fiery enough: why the modern era of large wildfires in eastern Oregon and Washington actually needs more fire.
    E. *Andrew Gray (via zoom)*: Forest carbon sequestration in west coast forests: myths and reality.
    F. *Eureka Joshi*: Nutrient leaching potential along a time series of forest water reclamation facilities in northern Idaho.
17. Birds and Drones (moderator: Graham Frank) 203
    A. *Andrew Merschel*: Time and Disturbance: Using Dendrochronology to Understand the Development History of Marbled Murrelet Nesting Habitat
    B. *Jake Verschuyl*: Are birds sensitive to changes in forest management intensity?
    C. *Graham Frank*: Does complexity matter for biodiversity in early seral forests? Responses of bird and carabid beetle communities to fire- and harvest-generated stands in southwest Oregon.
    D. *Gerry Gabrisch*: Drone-based photogrammetry to plan, document, and monitor salmon restoration projects (instream large woody debris) in the anadromous fish portions of the Nooksack River.
    E. ~~*Peter Keum*: Using drone for mitigation and monitoring program in the King County wastewater treatment division.~~
    F. *Carina Kusaka* (via zoom): Spatial analysis of trends in tufted puffin breeding habitat on the Oregon coast.

2:30-4:30 Workshop 2 210

- *Sarah Perrault and Veronica Galvan*: How to use low-stakes writing in science classes to promote scientific thinking
    - A one-hour workshop with the opportunity to continue for a second hour.

3:30-4:30. Workshop 3 IS 240/244

- All things lichen. (moderator: Daphne Stone)

4:30-6:30 Poster awards and final social AW 3rd floor (400 level) skybridge

Friday, 24 March

Meet and pick up box lunches at AW between 8:00 and 9:00AM

Time1: Field trip 1

Lichens and Bryophtyes: Leaves at 8:30

Time 2. Field Trip 2

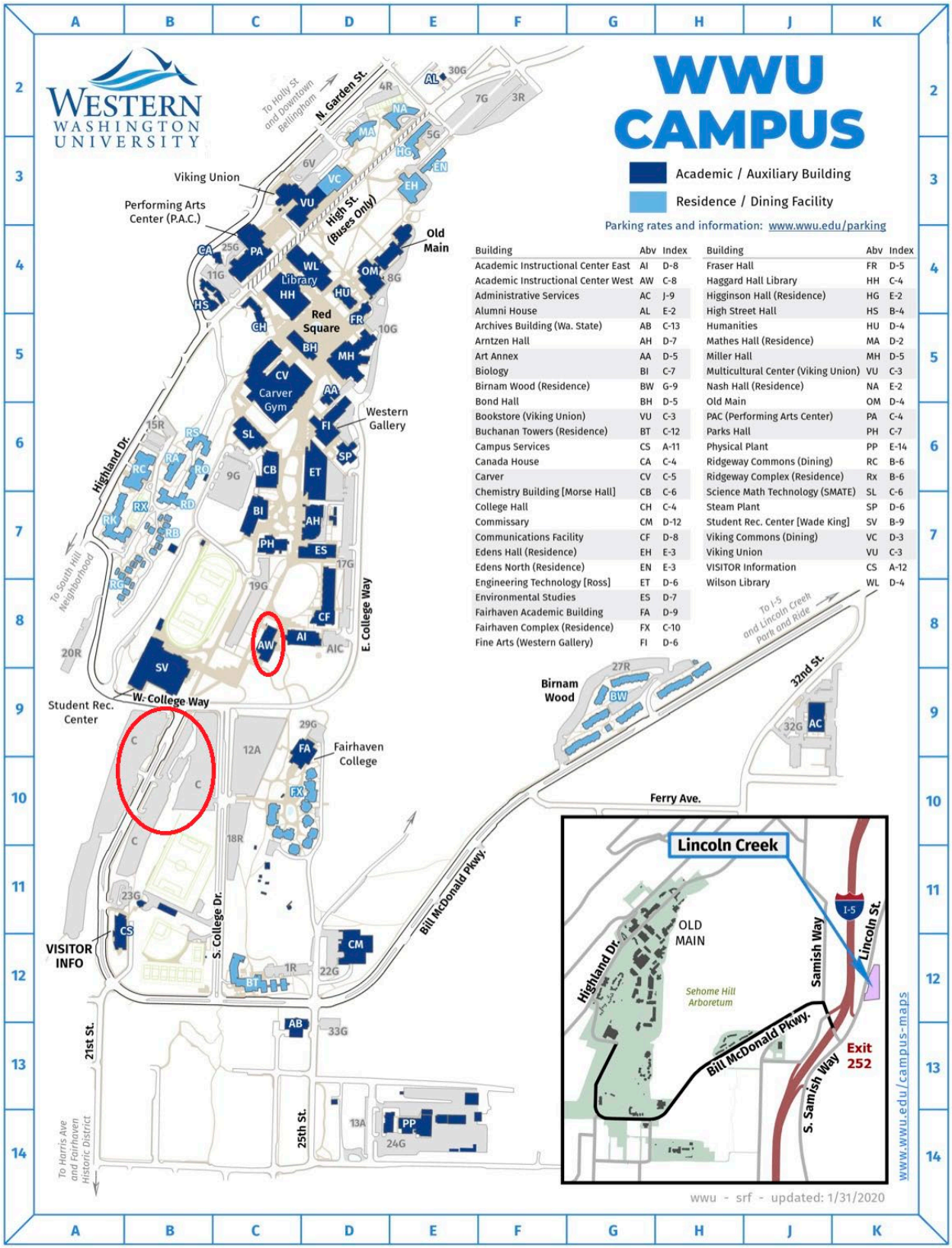
Padilla Bay National Estuarine Research Reserve and Skagit Bay: Leaves at 9:00 AM

Posters:

Posters should be hung on the 22nd by noon on the posterboards on the 3rd floor (400 level) skybridge next to your number. They should remain up for judging the afternoon of the 22nd through the afternoon social (and awards ceremony) on the 23rd. Hang your poster next to the assigned number.

1. **Berkey, Miles**: The Immensity of Minutiae: Utilizing Bryophytes to Detect an Ice Age Refugium in the North Cascades
2. **Morris, Claire**: The *punctelia subrudecta* (lichenized fungi: parmeliaceae) group in the pacific northwest
3. **Luehl, Thomas**: Effect of soil transplantation on ectomycorrhizal fungus communities during revegetation.
4. **Jacobson, Eleonore**: Exploring the *rhizocarpon geographicum* group (lichenized fungi) in western North America
5. **Sharrett, Stephen**: A comprehensive conservation assessment for the old growth specklebelly lichen, *pseudocyphellaria rainierensis*
6. **Schwarz, Elanor**: Exploring the *rhizocarpon geographicum* group (lichenized fungi) in western North America
7. **Taygan, Ruth**: *Cladonia*-moss associations in a Pacific Northwest conifer forest.
8. **Anderson, Jake**: Identification of *basidiomycete* yeasts in endangered reindeer lichens, *cladonia ciliata* and *cladonia portentosa* of Puget Sound prairies
9. **Weets, Marlee**: Prenatal Testosterone Exposure in Females Reduces Ovarian Function
10. **Li, Zihan**: Changes in cortical representation of mastication in the primate orofacial sensorimotor cortex following loss of sensation
11. **Tellinghusen, Blake**: Effects of long-term nicotine exposure on adult *drosophila*
12. **Luesink, Greg**: Investigating the effects of eight-week hangboard and handheld training methods on finger strength and endurance in intermediate and advanced rock climbers
13. **Frago, Jonah**: Strain variation in competency induction of the honey bee gut bacterium, *snodgressella alvi*
14. **Draayers, Bernadette**: Comparative genomic analysis of contig 57 on the *drosophila* Kikukawa Muller F element
15. **Miller, Isaac**: Isolation and characterization of a novel bacteriophage that efficiently kills a clinical strain of extended-spectrum beta-lactamase-producing *Klebsiella pneumoniae*
16. **Yamanoor, Srihari**: Lessons from low-cost prototype development for citizen science and DIY projects
17. **Callahan, Jocelyn**: The use of field philosophy in conserving the world's rarest ape, the Hainan gibbon (*nomascus hainanus*): a philosophical engagement with researchers and conservationists.
18. **Jantsch, Sydney**: A Characterization of Hyporheic and Streambed Temperatures with Applications for Salmon Habitat Restoration in a Warming River.
19. **Hickey, Robert**: Global Academic Clusters (if you believe academic ranking systems)
20. **Singh-Cundy, Anu**: North Cascades alpine meadows: flowering phenology and pollinators in the context of climate change

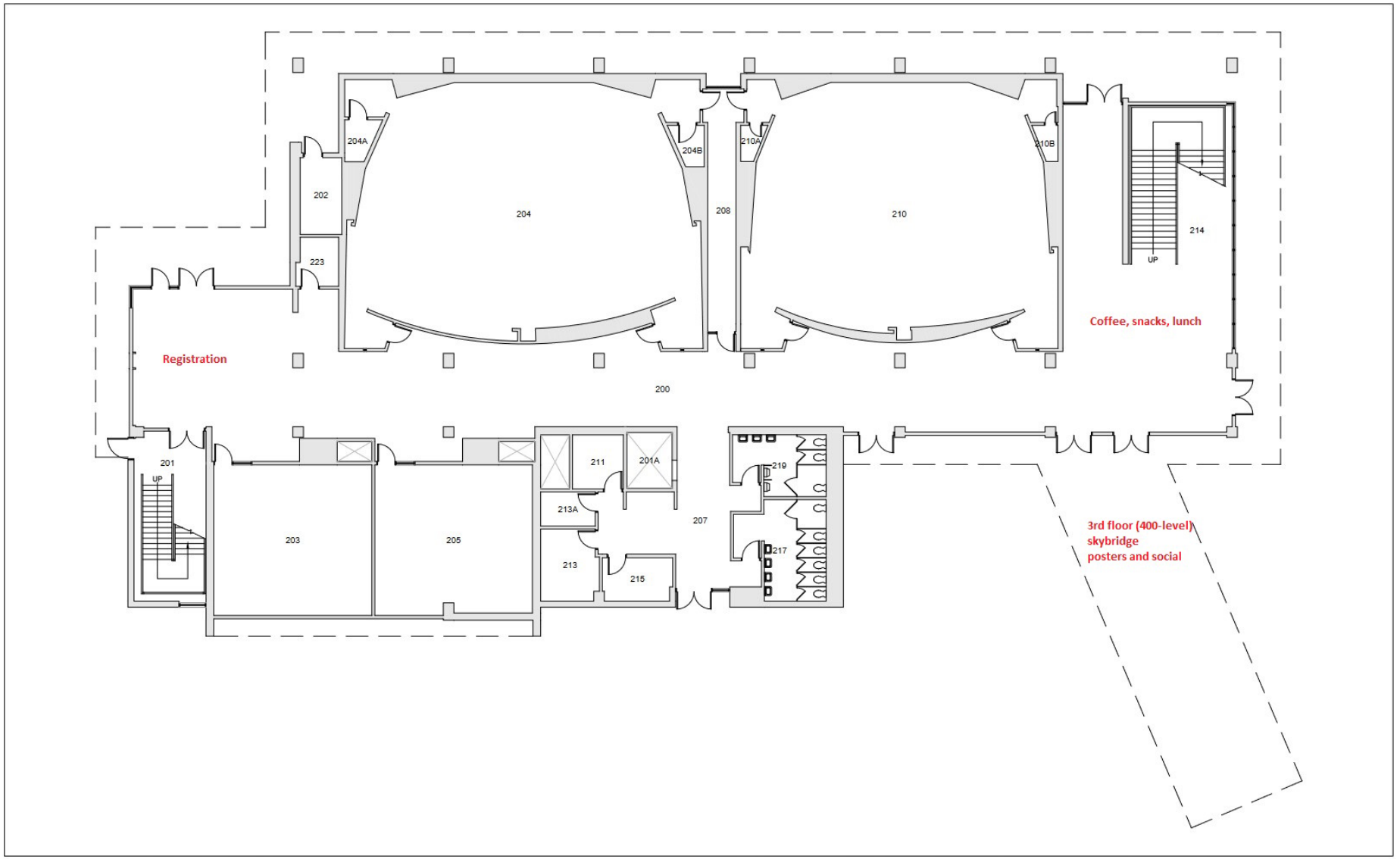
21. ~~**Carrasco, Jackson**: Post-fire regeneration in second growth redwood forests: modeling environmental, tree and stand factors contributing to basal sprout mass~~
22. **Rickard, Heather**: Basal fuels characterization for legacy hardwood trees in karuk aboriginal territory
23. ~~**Tershy, Astoria**: The impact of riparian buffers on n loading in the Nooksack River transboundary watershed~~
24. **Devine, Warren**: Adding a complex early-seral stage in production forestry
25. **Quick, Steven**: How is Soil Carbon affected by Old-Growth Forest Restoration Activities?
26. **Bjarvin, Christina**: Reuse, recycle, incinerate, or landfill? Lca-based environmental implications of end-of-life scenarios for mass timber building
27. **Tracy, Patrick**: Dynamics of a rotating cubic magnet levitating above a type-ii superconductor due to the Meissner-Ochsenfeld effect
28. **Klein, Nicholas**: Consequences of reducing symmetry in quantum systems
29. **Lowery, Seth**: Characterizing Uncertainty of Violin Mobility Measurements
30. **Danyluk, Liesl**: Transport Mechanisms of Nitrate on the Washington Shelf
31. **Smoot, Emily**: Investigating the impact of climate variability on summer stream temperatures in the Stillaguamish basin.
32. **Gavin, Daniel G**.: Carbon accumulation in Puget lowland peatlands over the Holocene: impact of disturbance and climate change
33. **Riedel, Jon**: Reconstruction of climate and ecology of Skagit Valley, Washington, from 27.7 to 19.8 ka based on plant and beetle macrofossils



Building	Abv	Index
Academic Instructional Center East	AI	D-8
Academic Instructional Center West	AW	C-8
Administrative Services	AC	J-9
Alumni House	AL	E-2
Archives Building (Wa. State)	AB	C-13
Arntzen Hall	AH	D-7
Art Annex	AA	D-5
Biology	BI	C-7
Birnam Wood (Residence)	BW	G-9
Bond Hall	BH	D-5
Bookstore (Viking Union)	VU	C-3
Buchanan Towers (Residence)	BT	C-12
Campus Services	CS	A-11
Canada House	CA	C-4
Carver	CV	C-5
Chemistry Building [Morse Hall]	CB	C-6
College Hall	CH	C-4
Commissary	CM	D-12
Communications Facility	CF	D-8
Edens Hall (Residence)	EH	E-3
Edens North (Residence)	EN	E-3
Engineering Technology [Ross]	ET	D-6
Environmental Studies	ES	D-7
Fairhaven Academic Building	FA	D-9
Fairhaven Complex (Residence)	FX	C-10
Fine Arts (Western Gallery)	FI	D-6

Building	Abv	Index
Fraser Hall	FR	D-5
Haggard Hall Library	HH	C-4
Higginson Hall (Residence)	HG	E-2
High Street Hall	HS	B-4
Humanities	HU	D-4
Mathes Hall (Residence)	MA	D-2
Miller Hall	MH	D-5
Multicultural Center (Viking Union)	VU	C-3
Nash Hall (Residence)	NA	E-2
Old Main	OM	D-4
PAC (Performing Arts Center)	PA	C-4
Parks Hall	PH	C-7
Physical Plant	PP	E-14
Ridgeway Commons (Dining)	RC	B-6
Ridgeway Complex (Residence)	Rx	B-6
Science Math Technology (SMATE)	SL	C-6
Steam Plant	SP	D-6
Student Rec. Center [Wade King]	SV	B-9
Viking Commons (Dining)	VC	D-3
Viking Union	VU	C-3
VISITOR Information	CS	A-12
Wilson Library	WL	D-4

Circled locations are relevant! Park in lot C ($12/day). Conference in the Academic Instructional Center West (AW).



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TRUE NORTH

WESTERN WASHINGTON UNIVERSITY

ACADEMIC INSTRUCTIONAL CENTER WEST

SECOND LEVEL

Date Revised: 03/11/2016

Last Sync With FAMIS: 09/22/2015

AW

2

About Western Washington University

Western Washington University (WWU or Western) is a public university in Bellingham, Washington. The northernmost university in the contiguous United States, WWU was founded in 1893 as the state-funded New Whatcom Normal School, succeeding a private school of teaching for women founded in 1886.

Eventually the school moved to Bellingham (then "New Whatcom"), and through the efforts of William R. Moultray and George Judson (Phoebe's son). Governor John McGraw signed legislation establishing the New Whatcom Normal School on February 24, 1893. In November 1895, construction began on a permanent school building, now known as Old Main, the current administration building. Designed by prominent Seattle architects Warren Skillings & James Corner, it was completed by early 1897 but could not be opened to students until funds could be secured to install heating, lighting, and to do general grounds maintenance, which were not included in the original contract. The first official class entered in 1899, composed of 88 students.

The institution that is now Western Washington University underwent several name changes. In 1901, the school's name was changed to State Normal School at Whatcom to reflect New Whatcom's name change. In 1904, the name was changed to Washington State Normal School at Bellingham when the townships of Whatcom and Fairhaven joined, and again in 1937, to Western Washington College of Education when it became a four-year college. Twenty-four years later it became Western Washington State College and finally, in 1977, the institution gained university status and changed to its present name.

The 1960s was a period of especially rapid growth for Western, as its enrollment increased from 3,000 students to over 10,000 during the decade. Also during this time, the Fairhaven College of Interdisciplinary Studies was founded (1967), with non-traditional education methods that would serve as a model for The Evergreen State College in Olympia, Washington. Two years later, the Huxley College of the Environment, the nation's first dedicated environmental science college, was founded, continuing Western's trend toward "cluster" colleges. That same year, on a spring afternoon, students gained headlines by blocking Interstate 5 to protest the Vietnam War. Also in 1969, the College of Ethnic Studies was established; however, after being met with significant resistance, it was dismantled in 1975.[13]

Since this period, the College of Arts and Sciences was founded (1973) and divided into the College of Humanities & Social Sciences and the College of Science & Engineering (2003); the College of Fine and Performing Arts was formed from several art departments (1975); and the College of Business and Economics was established (1976).

Today, WWU has a student body that currently consists of over 16,000 students.

The campus is 215 acres (87 ha), including the 38-acre (15 ha) Sehome Arboretum, operated jointly with the city of Bellingham. Campus facilities include an electronic music studio, an air pollution lab, a motor vehicle research lab, a marine research lab, a wind tunnel, an electron microscope, and a neutron generator lab. Western's Vehicle Research Institute has led *Automobile Magazine* to describe Western as "very possibly the best school in the country for total car design." Western also has off-campus facilities at Shannon Point Marine Center in Anacortes, Washington; Lakewood, a 15-acre (6.1 ha) student-university facility at nearby Lake Whatcom; and Whatcom County property used for environmental and aquatic analyses.

Source:
https://en.wikipedia.org/wiki/Western_Washington_University

About Bellingham

Bellingham is the most populous city in, and county seat of Whatcom County in the U.S. state of Washington. It lies 21 miles (34 km) south of the U.S.–Canada border in between two major cities of the Pacific Northwest: Vancouver, British Columbia (located 52 miles (84 km) to the northwest) and Seattle (90 miles (140 km) to the south). The city had a population of 92,314 as of 2019.

The city takes its name from Bellingham Bay, named by George Vancouver in 1792, for Sir William Bellingham, the Controller of Storekeeper Accounts of the Royal Navy during the Vancouver Expedition.

Today, Bellingham is the northernmost city with a population of more than 90,000 people in the contiguous United States. It is a popular tourist destination known for its easy access to outdoor recreation in the San Juan Islands and North Cascades.

Bellingham is the homeland of the Coast Salish peoples of the Lummi (or Lhaq'temish) Nation and Nooksack Tribe. These groups continue to live in and around the lower Nooksack Valley and Bellingham Bay.

The first European immigrants reached the area about 1852 when Henry Roeder and Russel Peabody set up a lumber mill at Whatcom, now the northern part of Bellingham. Lumber cutting and milling continues to the present in Whatcom county. In 1858, the Fraser Canyon Gold Rush caused a short lived population growth that established the community.

Coal was mined in the Bellingham Bay area from the mid-19th to the mid-20th centuries starting when Henry Roeder's agents discovered coal south of Whatcom Creek. After a hundred years of extensive mining beneath present-day Bellingham, the last mine closed in 1955.

Bellingham was officially incorporated on December 28, 1903, as a result of the incremental consolidation of the four towns initially situated on the east of Bellingham Bay during the final decade of the 19th Century. Whatcom is today's "Old Town" area and was founded with Roeder's Mill in 1852. Sehome was an area of downtown founded with the Sehome Coal Mine in 1854. Bellingham was further south near Boulevard Park, founded in 1883 and purchased in 1890 by Fairhaven.

Named a “Best Place To Play Year Round,” “Adventure Town USA” and “Best Place to Retire and Live,” Bellingham is best known for its outdoor recreation and world-class brews.

Bellingham has an active waterfront port that supports fishing, charter cruises, leisure boating, boatbuilding, shipping and marina operations. It’s also big with paddlers and is rated “Best Paddling Destination in the US” (Outside Magazine).

Squalicum Harbor is the second largest in Puget Sound, with 1,900 pleasure and commercial boats moored. From Bellingham’s ports, passenger ferries leave for cruises around Bellingham and Chuckanut Bays to the San Juan Islands, either for whale watching or beer, wine, history and/or sunset cruises.

Bellingham’s downtown area offers a mix of restaurants, art galleries, theaters, and specialty shops. Bellingham challenges the status quo with locally sourced entertainment, food and experiences. Explore a variety of pubs, wine bars, cafes and restaurants to find out just how delicious locally grown and made food is.

Sources:
https://en.wikipedia.org/wiki/Bellingham,_Washington and
https://www.bellingham.org/bellingham

NWSA and AAAS-PD Conference Planning Committees

Primary Group

- Jon Riedel. NWSA Board, Skagit Quaternary Consulting and Western Washington University
- Leo Bodensteiner NWSA Board, Western Washington University
- Daniel Gavin. NWSA President and Professor (University of Oregon)
- Bob Hickey. AAAS-PD Executive Director and Professor (Central Washington University)
- Brian Atwater. Scientist emeritus, USGS and affiliate professor (University of Washington)
- Robin Lesher. NWSA Treasurer and USFS (ret.)
- Upekala Wijayratne. USFS

AAAS-PD Committee

- Bob Hickey. AAAS-PD Executive Director and Professor (Central Washington University)
- Jozef Stec. AAAS-PD President and Professor (Marshall B. Ketchum University)
- Veronica Galvan. Incoming AAAS-PD President and Professor (University of San Diego)
- Joan Horvath. AAAS-PD Executive Committee member and owner, Nonscriptum llc.
- Lisa Warner. Professor (Boise State University)

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NWSA

Daniel Gavin. President

Robyn Darbyshire. Secretary

Robin Lesher. Treasurer

David Shaw. Vice President

AAAS-PD

Jozef Stec. President

Veronica Galvan. Incoming President

Roger Christianson. Outgoing President

Robert Hickey. Executive Director

Thank You!

We would like to take this opportunity to thank the following people at Western Washington University and Bellingham in general for helping make this conference a success.

- Provost Brad Johnson
- Classroom scheduler: Troy Ragsdale
- Integrated Sciences Building S supervisor: Peter Thut
- Transport services supervisor: Daryl Larkin
- Tech supervisors: Robert Clark, Aspen Clark, Pete Sheldrup – and the students who helped at the conference!
- Parking services: Shelby Zimmerman
- Poster easels: Elizabeth Raymond (Chemistry)
- Environmental Sciences sponsor: Ruth Sofield, chair; Ridley Williams, office admin.
- Catering: Christina Chavez

Abstracts

Alphabetical by presenting author (bold)

Amin, Nikhil

THE RECONSTRUCTION OF MATERNAL MIGRATION PATTERNS OF STEELHEAD: A LA-ICP-MS OTOLITH ANALYSIS.

Leo Bodensteiner, Nikhil Amin, Nicole McGowan, Western Washington University, 516 High Street, Bellingham, WA 98225

The determination of life history patterns of rainbow trout/steelhead (*Oncorhynchus mykiss*) has become critical as populations experience long-term, ongoing declines, underscored by their Federal listing as Threatened. The study of the relation between maternity and anadromy has become of particular importance – is anadromy in offspring solely determined by maternal inheritance? This question is being addressed through microstructural analysis of otoliths from offspring to detect chemical signatures established during egg development in the parent. We explored this question in Skagit River fish using otoliths from fifty adult steelhead caught in the River from May-September in 2018. We sectioned and polished otolith to their cores, which reflect the chemistry of the female parent as they are established during egg development. We laser-ablated transects through the center-point in the core to the outer edge rim and used inductively coupled mass spectrometry to analyze a suite of elements. Presence and absence of high concentrations of strontium (Sr), normalized to calcium (Ca), in the center of the core, which corresponds to the earliest development of the otolith, distinguished female parents as having had a resident or anadromous life history. Our results indicated that 60% of the otoliths showed a Sr/Ca pattern corresponding to an anadromous life history and 40% had no Sr/Ca spike and thus appeared to have a female parent with a resident life history. Our findings suggest that anadromy in offspring is not solely determined by maternal inheritance, and further research should be done to identify what other factors influence this life habit.

Andersen, Jake

IDENTIFICATION OF BASIDIOMYCETE YEASTS IN ENDANGERED REINDEER LICHENS, CLADONIA CILIATA AND CLADONIA PORTENTOSA OF PUGET SOUND PRAIRIES

Jake R. Andersen, Levi Hamilton, Nathan Kent, Lalita M. Calabria, The Evergreen State College 2700 Evergreen Pkwy NW, Olympia, WA 98505, USA.

The discovery of basidiomycete yeast in the thalli of over 190 species of lichen by Spribille and co-workers (2016) has inspired new and exciting inquiries into the microbial and chemical diversity within lichens. One such inquiry is whether the presence and abundance of basidiomycete yeasts influences lichen chemotypes. The Puget Sound Prairies of Washington State host many rare and endemic plants, fungal, and animal species including State-listed, regionally rare reindeer lichen. Different chemical varieties of rare reindeer lichen species can be observed in Puget Sound prairies which either lack (*Cladonia ciliata* var. *ciliata*) or contain usnic acid and *Cladonia portentosa* ssp. *pacifica* (Smith et al. 2012, WNHP 2014, Calabria et al. 2015). The main goal of this project was to identify the potential basidiomycete yeasts in these regionally rare, State listed reindeer lichens. For the project we collected

fresh lichen thalli of *C. ciliata var. tenuis* and *C. portentosa* from Mima Mounds Natural Area Preserve and identified each specimen to species using dichotomous keys and chemical testing. We extracted DNA according to the DNAeasy kit and performed PCR using ascomycete (ITS-1F & ITS4) and basidiomycete (ITS_symrho_1 & LRO_symrho_R) primers from Spribille et al 2016. Phylogenetic analysis shows the presence of basidiomycete yeasts from *Microsporomycetaceae*, *Lichenozyma*, *Cystobasidium*, and *Chrysozyma* within the thalli of the rare reindeer lichen surveyed. The results from the analysis provide the groundwork for a larger scale study observing trends in ascomycete partners.

Avery, Kylie

ASSERTING TRIBAL SOVEREIGNTY THROUGH CLIMATE PLANNING AT THE 2023 SOUTHWEST TRIBAL CLIMATE CAMP

Kylie Avery, Affiliated Tribes of Northwest Indians, Portland, OR 97290

The Affiliated Tribes of Northwest Indians (ATNI), Navajo Technical University (NTU), and the Northwest, Southwest, and South Central Climate Adaptation Science Centers (CASCs) partnered to co-host the 2023 Southwest Tribal Climate Camp, a culturally appropriate, week-long training workshop for delegates from Tribal Nations to work on climate resilience planning. The Camp was designed to be an interactive experience with training done in classroom settings and field trips to local areas of Tribal and climate interest. As the week progressed, Tribal delegates worked with a facilitator to advance their unique Tribal climate priorities. The overall goal of the Camp was to build the capacity of Tribal leader teams to address climate change and associated economic, social, cultural, regulatory, and technological trends and impacts within their Tribes, between Tribes and between Tribes and other governments, through strategic alliances with partners across Indian Country and globally.

Baig, Jamila

POSTGLACIAL VEGETATION AND FIRE HISTORY WITH A HIGH-RESOLUTION ANALYSIS OF TEPHRA IMPACTS, HIGH CASCADE RANGE, OREGON, USA

Jamila Baig, Environmental Sciences, Studies, and Policy & Department of Geography, University of Oregon, Eugene, OR, 97403, USA; Daniel G. Gavin, Department of Geography, University of Oregon, Eugene, Oregon 97403, USA

The postglacial history of vegetation, wildfire, and climate in the Cascade Range (Oregon) is only partly understood. This study uses high-resolution macroscopic charcoal and pollen analysis from a 13-meter, 14,500 years sediment record from Gold Lake, located in a montane forest, to reconstruct forest vegetation and fire history. The occurrence of three tephra layers, including a 78-cm airfall Mazama tephra, as well as highly laminated segments, allows one to study tephra impacts on vegetation at a fine temporal resolution. From the Late Glacial through the Younger Dryas, pollen spectra vary little. The early Holocene is marked by a sudden increase in Pseudotsuga, indicating warmer conditions, while the late Holocene is marked by increasing Tsuga heterophylla and Tsuga mertensiana, indicating the onset of moist conditions in the region. High-resolution charcoal data show periods of large peaks during the Late Glacial, pre-, and post-Mazama eruption and since 4 ka (thousands of years before present). Low fire during the early Holocene is unexpected, given regional evidence of warmer and drier summers, but it may be the result of fuel limitation. After the Mazama tephra deposition (7.63 ka), the non-arboreal pollen composition was changed, with some taxa disappearing or reduced in abundance for 300 years.

Arboreal taxa were little affected by the tephra, showing only a 20% increase in Pinus pollen and no discernable impact on the pollen accumulation rate (PAR).

In contrast, the Mazama tephra was followed by ca. 70 years of very low charcoal input, followed by a large peak, consistent with the burial of surface fuels and decades of fuel accumulation. There was also increased fire frequency and peak magnitude at 1.5 ka, followed by very little fire after 0.4 ka, consistent with the current old-growth forest surrounding the lake. This detailed and high-resolution record adds significantly to understanding the impacts of climate change and the singular effect of the Mazama eruption, impacting watershed vegetation, and fire for centuries but with minimal impact on the regional forest composition.

Berkey, Miles

THE IMMENSITY OF MINUTIAE: UTILIZING BRYOPHYTES TO DETECT AN ICE AGE REFUGIUM IN THE NORTH CASCADES

Miles Berkey, Department of Biology, Western Washington University, 516 High Street, Bellingham WA 98225

Ice age refugia were ecologically stable areas that remained ice free during the Pleistocene glaciations. As a result, they offered a level of suitable conditions to host arctic and boreal species associated with the climate of that time. About 16,000 years ago the continental ice sheets in western North America began to recede, and these vestiges of the late Pleistocene became surrounded by the temperate ecosystems of today leaving disjunct and isolated species of a previous climate.

Efforts to locate ice age refugia relies on geological evidence to show an area was not impacted by continental glaciers. Given the supporting geological evidence, proportions of endemic and disjunct species of a suspected refugia can be compared to a non-refugial area. This has been a classic approach towards detecting ice age refugia. By identifying ice age refugia, knowledge gaps in the paleoecological history of species in north America can be solved, providing valuable insight towards understanding how species will respond in our warming climate.

Detection of these ice age refugia has largely relied on vascular plant and animal endemics and disjunct species. The restrictive niche selection, species specific dispersal limitations, and sensitivity to climatic change observed in bryophytes can help locate ice age refugia. By evaluating bryophyte floras we improve our confidence in ice age refugia testing while effectively serving conservation goals of discerning climate change refuges. This project builds on available herbaria and geological records to determine if the bryophyte flora of Barlow Pass, Washington supports an ice age refugium explanation.

Bjarvin, Christina

REUSE, RECYCLE, INCINERATE, OR LANDFILL? LCA-BASED ENVIRONMENTAL IMPLICATIONS OF END-OF-LIFE SCENARIOS FOR MASS TIMBER BUILDINGS.

Indroneil Ganguly, School of Environmental and Forest Sciences, University of Washington, Seattle, WA 98195; Tomás Méndez Echenagucia, Department of Architecture, University of Washington, Seattle, WA 98195; Francesca Pierobon, Pacific Northwest National Laboratory, Seattle, WA 98109

In the face of a warming planet, steps must be taken to reduce the greenhouse gas emissions associated with our building industry, which is a significant contributor to global greenhouse gas emissions. Large,

prefabricated wood elements such as mass timbers have great potential to achieve these reductions as they help displace high embodied carbon materials like steel and concrete. Furthermore, storing the wood carbon in buildings benefits the climate because it delays the eventual release of biogenic carbon into the atmosphere. While these climate impacts have been assessed for the construction phase of mass timber buildings, relatively few life cycle assessment (LCA) studies have evaluated the climate impacts for the buildings' end-of-life (EoL) phase.

This research assesses the climate impacts of four EoL scenarios for mass timber panels: reusing as mass timber, recycling into particleboard, incinerating, and landfilling. We calculated the embodied carbon and carbon storage benefits associated with the construction, deconstruction, and EoL processing of hybrid mass timber buildings in the U.S. Pacific Northwest. These impacts were integrated into a novel dynamic LCA model over a 160-year time horizon. Of the four selected EoL scenarios, the reuse and recycle scenarios had the lowest global warming impact, and emerged as climate-preferred scenarios. The lower impact associated with the reuse and recycle scenarios is due to the low fossil carbon emissions during EoL processing and extensive biogenic carbon storage benefits. These results highlight the importance of efficient wood use through reusing and recycling.

Brown, Michael

I, ORGANISM: REFLECTIONS ON A PARTICULAR HISTORY AND PHILOSOPHY OF THE ORGANISM CONCEPT.

Michael Brown, History and Philosophy of Science Program, University of Notre Dame, 1019 De Maude Ave., South Bend, IN 46616

In this paper, I argue that recent models of organismic unity present both a development and recapitulation of a long running organism/anti-organism dialectic. I first offer a historical survey of certain “organismic” philosophies that emphasize some robust principle that accounts for the individuating unity of discrete organisms. Opposed to this, I introduce a loose grouping of “anti-organismic” philosophies that resist the metaphysics of discrete substances and emphasize flows and relations over boundaries and individuals. I suggest that this dialectic is alive and well in contemporary philosophy of biology. I then examine several proposals for what might be called the organismic self or subject, namely, the autopoietic model of Maturana and Varela, the “Free Energy Principle” approach developed by Karl Friston and others, and some attempts to determine an immunological self. I contend that these aim to circumvent problems with past organismic views, dismissing empirically dubious homunculi and souls, while also aiming to properly account for both the genesis of such organisms and the permeability of their boundaries. I believe it is historically important that these new models of the organism hang not on some essential nature or substantial form, but precisely on organisms’ *active* role in sustaining their own organization and functioning within an environment. While an organism anti-organism dialectic continues, these most recent contributions reveal an important change in the dialectical landscape.

Callahan, Jocelyn

THE USE OF FIELD PHILOSOPHY IN CONSERVING THE WORLD'S RAREST APE, THE HAINAN GIBBON (NOMASCUS HAINANUS): A PHILOSOPHICAL ENGAGMENT WITH RESEARCHERS AND CONSERVATIONISTS.

Jocelyn Callahan, Department of Primate Behavior and Ecology, Central Washington University, 400 E University Way, Ellensburg, WA 98926

This study considered the world's rarest ape, the Hainan gibbon (*Nomascus hainanus*), from a new perspective – field philosophy (i.e., philosophy carried out in the field with non-philosophers), by exploring how researchers and conservationists understand the Hainan gibbon based on their lived experiences, particularly focusing on the topics of conservation, extinction/loss, and agency. I conducted semi-structured interviews with eight participants drawing from the phenomenological approach to qualitative research. Additional information was collected through a systematic literature review, as well as an analysis of creative works by participants. The results revealed a story of hope and loss, which related to agency and extinction respectively, and how lived experiences in scientific fields shape perceptions of the Hainan gibbon and their conservation. Additionally, I considered local communities' perspectives of the Hainan gibbon from a historical and ethnoprimatological angle. Lastly, this study found that participants were generally receptive to the idea of field philosophy because it could offer critical reflection and new perspectives on Hainan gibbon conservation. Overall, this philosophical endeavor created a space to consider the Hainan gibbons beyond biology and ecology, taking seriously their agency and loss which will work to bridge empathy across species boundaries.

Cameron, Rich

3D PRINTING AND OTHER MAKER TECH FOR YOUR CLASSROOM AND LAB

Rich Cameron, Joan Horvath, Nonscriptum LLC, 155 N. Lake Ave. Suite 800, Pasadena, CA 91101

The first wave of innovation in 3D printing was largely in hardware; then in new materials; and now in generative design and artificial intelligence. What might your lab or classroom be able to build with the intersection of these technologies? At the low end, the price of consumer-level 3D printers has fallen to a few hundred dollars. At the other extreme (and higher price points), specialized printers are able to work at very small scales to create microfluidic devices, and to print scaffolds with living cells to create organoids. 3D printing ceramic and metal parts to be sintered later are becoming commonplace as well. There are even printers that can start with sawdust and a binder and lay up wood-like parts, and printers that can create glass pieces. This one-hour workshop will start off with a beginner's introduction to 3D printing and what it takes to get started, including a survey of free, open source resources. Then we will move on to more-sophisticated materials and printers and what the limitations are, and select applications. Participant questions about use cases are highly encouraged.

Canavan, Barbara

DISEASE ENTANGLEMENTS: HUMAN-ANIMAL-ENVIRONMENT.

Barbara Canavan, Independent Scholar

Disease ecology, a highly interdisciplinary field, includes microbes, human and non-human animals, and landscape-scale disease effects. The links between shared natural environments and infectious diseases

are complex and occur over long time scales that can obscure these interconnections. Researchers identifying environmental drivers of disease emergence have challenges with the complexity, scale, and natural variability of the systems involved. However, perspectives from the history of science and medicine, environmental science, animal science, disease ecology, politics, and anthropology provide a frame of reference for assessing patterns of human-animal-environment entanglement. This presentation briefly discusses collaborative models that integrate the study of diseases and natural environments, such as:

- Historical perspectives on plague history include genomics and ecology.
- Collaborations on the health impacts of accelerating global climate change shed light on how climate warming creates opportunities for pathogens to jump from wild animals to other species.
- The historical ecology of the Tibetan Plateau sheds light on rapid climate changes throughout history.
- Historical perspectives of bat-borne diseases clarify the complexities of how biology, science, society, and culture intersect.
- The origin of the HIV-AIDS virus illuminates the interplay of ecological, virological, and social aspects of emerging diseases.
- Ecological changes in the Caribbean led to historical epidemics of yellow fever and malaria.
- An avian flu case study reveals the human-animal-environment interconnections of zoonotic diseases. As a result, disease ecologists have urged research into migratory birds and the impacts of climate change.
- Contemporary industrial food production produces unintentional biological fallouts.

Carrasco, Jackson

DETERMINING STAND CONDITION THRESHOLDS TO LIMIT FIRE SEVERITY IN SECOND-GROWTH REDWOOD FORESTS FOLLOWING WILDFIRE

Jackson Carrasco, Jeffrey M. Kane, California State Polytechnic, Humboldt, Arcata, CA 95521

Over a century of fire exclusion and climate change-induced warming have brought a dramatic increase in forest fire activity in the last few decades. Consequently, there is a strong need to understand how stand conditions interact with other factors to affect fire severity and tree mortality to better inform forest management. Large wildfires in 2020 along the coast of California including the Walbridge, CZU Lightning Complex, and Dolan fires provided a unique opportunity to observe the relative importance of contributing factors that affect fire severity in Coast Redwood (Sequoia sempervirens) forests. In the Summer of 2021, we collected data on stand conditions from 125 plots across these three fire mosaics to determine potential stand density thresholds that may limit fire severity across a range of topographic and climatic conditions. Average stand mortality was low with less than 15% mortality in redwood and less than 25% across all species. Lower tree mortality was associated with lower-intensity fire, lower stand density, higher crown base heights, and higher proportion of redwoods. Our results will inform decisions of land managers and assist in identifying stand conditions that are most effective at limiting fire severity under a wide range of fire conditions and aid in prioritizing areas for potential treatment

Chavez, Aaron

VALUES AND METHODS IN CLASSIFYING CANCER.

Aaron Chavez, Department of Philosophy, 1 Shields Ave, University of California, Davis, Davis, CA, 95616

Values are entrenched in scientific practice and their effects are felt in the classificatory practices one adopts. I show how both epistemic and non-epistemic values constrain classification and how this ultimately affects methodology. I preface this by clarifying what is meant by the term *classification*. In effect, I take classification to be a systematic organization of concepts and conceptualizations into distinct categories. Additionally, I take there to be a normative component in our construction of classificatory systems. The aim of this project is to explore ways in which values help to shape the very objects under study. I use Plutynski's (2018) focus on the pathophysiology of cancer to highlight the interplay between both non-epistemic or social values on the one hand (e.g. resource allocation for research projects) and epistemic values on the other (e.g. theoretical generality, simplicity, replicability, etc.). Plutynski notes that some cancers are classified by their locus of origin, that is, classified by tumorigenesis rather than by development, or metastasis. Pathophysiology then becomes an important tool for assessing the proper course of action for treatment. But cancer, as a phenomenon, is not unified. Rather, it is a set of processes which require further categorization into different types, subtypes, and stages. The TNM classification system, for example, is used in cancer staging for the purpose of prognosis and treatment. However, these staging systems are not universal and consideration of what counts as a specific type of cancer will determine the appropriate system to use.

Clague, John

GIANT ICE AGE FLOODS – AN EXAMPLE FROM BRITISH COLUMBIA

John J. Clague, Department of Earth Sciences, Simon Fraser University, Burnaby, B.C., Canada, V5A 1S6

At the end of the Pleistocene, a glacier-dammed lake in central British Columbia suddenly drained, causing a megaflood along the Fraser River valley. Floodwater travelled 330 km down the valley to Hope, British Columbia, and from there to the west into the Salish Sea near Vancouver. The flood was caused by the failure of a glacier dam that blocked the Fraser Valley on the British Columbia Interior Plateau, impounding a lake that was over 250 m deep at the dam and contained about 500 km^3 of water. The rapid escape of this water through the breach deeply incised a thick Pleistocene sediment fill in the Fraser Valley to the south and transported much of this sediment into the Salish Sea west of Vancouver and Bellingham. Sediments deposited in the lake basin were subsequently and rapidly incised, leaving paraglacial gravel terraces up to 100 m above the present channel of Fraser River. Terrestrial cosmogenic nuclide and radiocarbon ages indicate that the megaflood happened about 11,500 years ago, at the Pleistocene-Holocene transition.

Evidence for the floods includes boulder-strewn bars and streamlined 'whaleback' ridges, gravel dune fields, terraces sloping opposite present-day stream channels, sheets of massive to poorly sorted gravel containing large boulders and rip-up clasts, and backwater flood sediments. I provide examples of these landforms and sediments from my own work and that of others who have documented even larger megafloods from glacial Lake Missoula and a lake in the Russian Altai Mountains.

Danyluk, Liesl

TRANSPORT MECHANISMS OF NITRATE ON THE WASHINGTON SHELF

Liesl Danyluk, Erika McPhee-Shaw, Sean Crosby, Sam Kastner, College of the Environment, Western Washington University, 516 High Street, Bellingham, WA 98225

While there have been extensive studies of nutrient transport and productivity on the Pacific Northwestern coast of the US (Davis et al., 2014, Siedlecki et al., 2015, Ware and Thomson, 2005, Banas et al., 2009), there is renewed interest in understanding these transport processes as dissolved oxygen (DO) decreases with climate change, leading to persistent hypoxia (Siedlecki et al., 2015, Hickey and Banas, 2003). This study aims to describe and quantify the across and along-shelf transport mechanisms of nitrate on the WA shelf and identify the dominant processes bringing deep, dense, nutrient rich water to coastal surface waters, focusing on internal waves and upwelling. Data was sourced from a mooring array at 100 m depth on the Washington shelf. Transport by canyon-enhanced upwelling and internal waves are estimated from spectral variance as well as a classification scheme I developed to parse out baroclinic events. While wind driven up and downwelling dominated summer variability (34%), internal-wave-driven variance was significant (28% - 13%). Sets of internal waves inundated the shelf on approximately 12-hour timescales, increasing the nitrate concentration by approximately 7 umol/L during periods of internal wave influence (26.5% increase) with a mean nitrate flux increase of 3.7 $\bullet mol \bullet mvL^{-1} \bullet s^{-1}$(18-fold increase). Wind driven upwelling increased surface nitrate concentration by approximately 8 umol/L (30.3% increase) with a mean nitrate flux increase of 4.5 $\bullet mol \bullet m \bullet L^{-1} \bullet s^{-1}$(22-fold increase). Despite weaker upwelling during the study period enhancing the relative impact by internal waves, internal waves are likely a significant contributor to nitrate transport on the WA shelf and should be studied further.

DeCrappeo, Nicole

ADVANCING CLIMATE ADAPTATION SCIENCE AND PRACTICE BY CENTERING PARTNERS' CHALLENGES AND NEEDS

Nicole M. DeCrappeo, USGS Northwest Climate Adaptation Science Center, 777 NW 9th Street, Corvallis, OR 97330

Climate adaptation science is a young discipline that focuses on understanding ways to decrease vulnerability or increase resilience to climate change. Incorporating climate adaptation into natural and cultural resource management is challenging for two primary reasons: 1) scientists rarely understand the decision-making context that resource managers face and 2) resource managers are rarely able to access and use the latest scientific information and tools. The talks in this session will highlight activities that attempt to overcome these challenges by centering on developing communities of practice, building capacity, and engaging in participatory science to advance both the science and practice of climate adaptation.

Deshazer, Sarah

INVESTIGATION OF SMALL MAMMAL DIVERSITY AND ABUNDANCE AT THE EASTERN WASHINGTON UNIVERSITY PRAIRIE RESTORATION SITE

Sarah E. Deshazer, Krisztian Magori, Paul Spruell, Department of Biology, Eastern Washington University, Cheney, WA 99004

Small mammals are an ecologically important component of every landscape on Earth. They are a food source for higher trophic level animals, disperse plant seed and mycorrhizal fungi spore, engineer the landscape through burrowing and foraging activities, and alter plant community composition through selective predation of seed and grain. Small mammals have been found to help facilitate the transition between successive stages in prairie restoration. Eastern Washington University has dedicated 120 acres of campus land to restoration of native prairie habitat. We conducted a baseline survey of resident small mammals on and around the Eastern Washington University Prairie Restoration Project site. Small mammals were live trapped over a 16-week period during Spring and Fall of 2022 at ten sites within a 4 km radius of the restoration site in areas of agricultural wheatfield and natural vegetation. Animals were tagged with individually unique ear tags for mark-recapture analysis. Trapping success was highest at sites located within the restoration site, where ground cover was the highest. The overall most common and abundant species collected was *Peromyscus maniculatus*, both on and off the restoration site. *Mus musculus* and *Microtus spp.* were collected only at sites located within the restoration area. *Sorex vagrans* was collected at one site, within an agricultural area near a drainage ditch. Buccal epithelial cheek swabs were also collected for ongoing genetic analysis of population structure for *Peromyscus maniculatus* to analyze connectivity on and around the restoration site.

DesRoches, C. Tyler

CLIMATE CHANGE, CIVILIZATION COLLAPSE, AND CLIMATE ETHICS.

C. Tyler DesRoches, School of Sustainability, Arizona State University, PO Box 877904, Tempe, AZ 85287-7904; Daniel Steel, Department of Philosophy, University of British Columbia; Kian Mintz-Woo, Department of Philosophy, University College Cork

In this article, we consider the implications of anthropogenic climate change driven civilization collapse ("climate collapse") for climate ethics. We suggest that a society collapses when its social development is reduced to a level where it is no longer able to implement, even as an approximation, any scheme of distributive or procedural justice. Climate collapse is a real possibility: many experts believe that 4°C could lead to collapse, and the Intergovernmental Panel on Climate Change's latest assessment report's high-emission socioeconomic pathways include that level of warming in their very likely (66-100%) range by 2100. In this article, we argue that taking the risk of climate collapse seriously challenges two longstanding assumptions in the field of climate ethics: *stable governance* and *minimal current benefit*. Stable governance presumes that the long-term persistence of governments possessing the wherewithal to promote climate justice, such as wealthier nations able to compensate poorer nations for climate loss and damage. Minimal current benefits states that due to inertia in the climate system, net benefits of climate change mitigation for current generations would be minimal at best. Both assumptions should be rejected.

Devine, Warren

ADDING A COMPLEX EARLY-SERAL STAGE IN PRODUCTION FORESTRY

Warren Devine, Daniel Donato, and Teodora Minkova, Washington State Department of Natural Resources, 1111 Washington St. SE, Olympia, WA 98504

Early-seral, or pre-forest, habitat is the successional stage between a stand-replacing disturbance and subsequent tree canopy closure. Structurally complex early seral (CES) is distinct from plantations in that it comprises a complex mix of shrubs, herbs, naturally regenerating trees, and disturbance legacies such as snags, down wood, and surviving trees. CES habitat is important for wildlife, such as birds and pollinators, but it is currently the rarest forest habitat on Pacific Northwest forestlands. Public land managers are beginning to actively create early-seral habitats, but for lands managed for timber production, the tradeoffs of promoting a CES stage are not well understood. We are implementing a management experiment to quantify the tradeoffs—ecological, silvicultural, and economic—of a prescription designed to produce CES habitat at the scale of harvest units 5-20 hectares in size. We will explore the practicality of promoting a CES stage while keeping forest stands on a production trajectory. The CES prescription is designed to emulate conditions after a severe wind storm, the most common stand-replacing natural disturbance in the area, by leaving scattered residual trees, increased large and small woody debris across the site, and natural regeneration without vegetation control. This block-design study, with a control treatment consisting of conventional harvest and reforestation, is part of the T3 Watershed Experiment in the Olympic Experimental State Forest on the western Olympic Peninsula. Monitoring includes: vegetation structure and composition, woody debris, bird response sampled through acoustic monitoring, stand regeneration, and operational costs combined with stand growth and yield projections.

DeYoung, Juni

APHRODITE: SECURITY PROPERTIES OF RISC-V

Hardware specification mining is a relatively new line of research that aims to develop a set of validation properties for use during the design validation phase of the hardware life-cycle. Prior work in this field has targeted open-source RISC architectures and relies on access to the register transfer level design including developers' repositories, bugtracker databases, and email archives. We develop Aphrodite, a tool for specification mining generalized at the instruction set architecture (ISA) level. We use a full-system emulator with a lightweight extension to generate trace data over arbitrary assembly code or existing suites, such as Linux boot, and generate hardware properties which include both functional and security properties. Using the motivating example of the established GPR0 security property (for "General Purpose Register 0", it is the property that the zeroth general purpose register must always be set to 0 for correct calculation of security-relevant operations), we show that Aphrodite may extract security-relevant, as well as functional, properties of the design. Our analysis provides insight into those properties that are guaranteed by the ISA and those that are required of the operating system.

Dillon-Zuppelli, Zarha

PEDIOCACTUS NIGRISPINUS DEMOGRAPHY AND HABITAT ASSOCIATIONS

Zarha Dillon-Zuppelli, Mary Poulson, Eric Graham, Department of Biology, Central Washington University, Ellensburg, WA 98926

Cacti are iconic contributors to arid ecosystems, stabilizing the soil and providing essential food and habitat to wildlife. Pediocactus nigrispinus is a species of cactus endemic to the Pacific Northwest and has been listed by the Department of Natural Resources as a sensitive species of Washington State. Some threats to this cactus include habitat fragmentation, poaching and a changing climate. Best-practice conservation methods for this species are poorly understood, due in part to a limited understanding of its demography and associations that may help define its occurrence.

A demography study at the Wild Horse Wind Farm was initiated in 2016. Five years of size, fecundity, and survival data were recorded, and a life table response experiment was built. A stochastic demographic projection was built to test population survival probabilities for different climatic variables. Biotic and abiotic associations were assessed in 16 plots throughout Washington and Oregon using both GIS analysis of soil and climatic variables as well as a ground-truth assessment of vegetation and ground cover associations. These variables were then compared with population density and overall size of measured individuals at each plot to assess population health. The demography study found no juvenile recruitment and that the population was declining over all four census years, regardless of climatic variables such as temperature and precipitation. The association analysis determined that the most important variables to define occurrence were temperature, precipitation, and soil type.

Donato, Daniel

NOT FIERY ENOUGH: WHY THE MODERN ERA OF LARGE WILDFIRES IN EASTERN OREGON AND WASHINGTON ACTUALLY NEEDS MORE FIRE

Daniel C. Donato; Joshua S. Halofsky; Derek J. Churchill; Annie Smith, Washington State Department of Natural Resources, 1111 Washington St SE, Box 47014, Olympia WA 98504; Ryan D. Haugo, Bryce Kellogg; The Nature Conservancy, 821 SE 14th Ave, Portland OR 97214; C. Alina Cansler, University of Montana, 32 Campus Drive, Missoula MT 59812; Brian J. Harvey, University of Washington, School of Environmental & Forest Sciences, Seattle WA 98195.

Wildfires and fire seasons are commonly cast as good or bad based largely on the simple metric of area burned (more acres = bad). A seemingly paradoxical narrative frames large fire seasons as a symptom of a forest health problem (too much fire), while simultaneously stating that fire-dependent forests lack sufficient fire to maintain system resilience (too little fire). One key to resolving this paradox is placing contemporary fire years in the context of historical fire regimes, considering not only total fire area but also burn severity distributions. Historical regimes can also inform forest restoration efforts by illuminating how much fire area historically maintained (i.e., 'treated') fire-resilient landscapes. Here, we compare modern wildfire years in eastern Oregon and Washington to historical rates of burning (prior to widespread Euro-American arrival). Contrary to the common narrative of unprecedented or too-much fire in our dry forest landscapes today, modern fire years are only burning a small fraction of a typical historical year, when hundreds of thousands of acres burned annually on average. With current forest restoration efforts also occurring at a fraction of historical fire 'treatment' rates, these findings highlight the potential need for managed fire to contribute if restoration and maintenance are to

ultimately succeed. As such, 'good' fire years may be those not with less, but rather more, area burned – with characteristic severity and patch distributions, minimal clearly-negative impacts (e.g. loss of life and property), and contribution to forest restoration and maintenance objectives.

Draayers, Bernadette

COMPARATIVE GENOMIC ANALYSIS OF CONTIG 57 ON THE DROSOPHILA KIKKAWAI MULLER F ELEMENT.

Bernadette H. G. Draayers, James E. J. Bedard, Department of Biology, University of the Fraser Valley, 33844 King Rd, Abbotsford, BC V2S 7M7

The Muller F element in *Drosophila* genomes has mostly heterochromatic properties while still retaining transcriptional activity. The investigation of properties unique to this domain as well as the DNA annotation of different F elements across *Drosophila* species can provide insight into this unique chromosome. The purpose of this study was to use the techniques of comparative genomics to create functional gene models for contig 57 of the *Drosophila kikkawai* F element. The fully annotated genome of *Drosophila melanogaster* was used as a reference to compare the DNA of contig 57 to and resulted in six regions of significant Blastx similarity. After further investigation with various bioinformatics tools, five of the six regions were determined to be gene coding regions and orthologous to those seen in *D. melanogaster* (CG32017, Kif3C, pho, CG33521, and PIP4K). The percent similarity of the genes between the two species ranged from 64.4%-98.0% with the highest similarity in translated sequence being from the gene PIP4K which is involved in the positive regulation of biological and cellular processes. With the data gathered, gene models for contig 57 on the F element of *D. kikkawai* were generated. Evolutionary history can be better understood by studying the changes in size and position of genes over time. This information may help understand the rate of genome change in *Drosophila* species and the factors contributing to genome expansion within the genus.

Fagan, Melinda

"LOW EFFORT" INTERDISCIPLINARY EXPLANATIONS.

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Explanations in scientific practice are often highly technical and specialized. Entering a scientific field – a specialized scientific community - is largely a matter of learning its explanatory models and accepting the epistemic values that underpin them. This talk considers explanation and understanding from a social perspective. On this view, scientific understanding, conveyed by an explanatory model, is in the first instance localized a particular scientific community. The obvious question then is how can scientific understanding cross its originating community boundary?

Studies of interdisciplinary research suggest that, often, it doesn't. Interdisciplinary research is challenging and demanding, and despite many top-down inducements its track-record and conditions for success remain murky. But sometimes interdisciplinary projects succeed. This paper proposes a conceptual framework for analyzing and evaluating "interdisciplinary explanations" (IDE). Although only one aspect of interdisciplinarity, IDE has broader implications for science-society interactions as well as views on explanation and understanding.

The IDE framework has three parts. The first is very general. Any IDE project can be located with respect to two continuous axes: stage when different fields interact (early or late), and degree of connection involved (low or high). Late-stage low-degree connections between explanatory models are a promising approach for many IDE projects. The second and third parts of the IDE framework clarify these connections. Briefly: explanatory models can be connected directly or indirectly, in virtue of similarity or difference. For disparate fields, direct connections are unlikely. The third part of the IDE framework proposes norms for indirect connections between different explanatory models.

Frago, Jonah

STRAIN VARIATION IN COMPETENCY INDUCTION OF THE HONEY BEE GUT BACTERIUM, SNODGRESSELLA ALVI

Jonah Frago, Macee Mitchell, Jenifer Walke, Department of Biology, Eastern Washington University, 526 5th St, Cheney, WA 99004.

Many diseases afflict western honey bees, *Apis mellifera*, which are important pollinators in agriculture and ecosystems. A potential way to combat disease is the implementation of genes which produce pro-immune response metabolites into bacteria native to the honey bee gut. One core bacterium in the microbial community of the honey bee gut is *Snodgrassella alvi*. Although there is some research working with engineered *S. alvi*, transformation was done through conjugation and thus no published papers show an established method for inducing competency in this core bacterium. Through protocols for taxonomically similar microbes, I aimed to induce competency in several *S. alvi* strains, allowing the introduction of exogenous DNA, and tested for any difference in competency induction across strains. Successfully induced competency of *S. alvi* cells were indicated based on growth on selective kanamycin plates after transformation with a kanamycin resistance gene. We isolated 46 *S. alvi* strains from honey bee guts and sequenced their 16S rRNA gene. All strains had >99% 16S rRNA sequence similarity, but may vary in other aspects of their genome, which may influence competency induction. We obtained successful growth of *S. alvi* cells on unselective TSA media and the transformation of the kanamycin resistance gene into competent DH5a Escherichia coli. The development of reliable competency protocols for *S. alvi* will give researchers a necessary tool to further study potential solutions to honey bee disease through symbiotic microbial genetic engineering.

Frank, Graham

DOES COMPLEXITY MATTER FOR BIODIVERSITY IN EARLY SERAL FORESTS? RESPONSES OF BIRD AND CARABID BEETLE COMMUNITIES TO FIRE- AND HARVEST-GENERATED STANDS IN SOUTHWEST OREGON.

Graham Frank, Matt Betts, Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR 97331; AJ Kroll, Weyerhaeuser Company, Springfield, OR 97478; James W. Rivers, Department of Forest Engineering, Resources & Management, Oregon State University, Corvallis, OR 97331; Mark E. Swanson, School of the Environment, Washington State University, Pullman, WA 99163; Meg Krawchuk, Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR 97331

Understanding the degree to which intensive forestry supports biodiversity can inform whether practices promoting complex habitat structure and composition are necessary to improve conservation outcomes of timber production. The early seral stage of forest succession immediately following stand-replacing

disturbance can support high species richness and distinct species assemblages compared to closed-canopy forests. However, limited structural retention in industrial clearcuts, repeated herbicide applications, and evenly spaced conifer plantings alter the characteristics and dynamics of wildlife habitat compared to early seral generated by natural disturbances. We conducted a large-scale mensurative experiment across a chronosequence of early stand development (2-20 years) in southwest Oregon to compare the biodiversity of early seral forests generated by industrial clearcutting, stand-replacing wildfire, and post-fire salvage logging. Bird species richness in recently harvested, intensively managed stands was lower than in post-fire stands of the same age, especially for leaf-gleaning insectivores and cavity-nesting species. Similarly, carabid beetle richness was also higher after recent fire than in recently harvested stands, and post-fire beetle communities were characterized by a distinct suite of disturbance adapted traits. For both taxa, species richness and community composition converged in older early seral stands. However, temporal patterns in bird and carabid beetle communities inferred from our chronosequence were distinctly different from one another. These differences likely reflect the direct effect of fire on carabid beetles, and contrasts in relevant habitat variables for either group, underscoring the importance of multi-taxa approaches to quantifying biodiversity.

Gabrisch, Gerry

DRONE-BASED PHOTOGRAMMETRY TO PLAN, DOCUMENT, AND MONITOR SALMON RESTORATION PROJECTS (INSTREAM LARGE WOODY DEBRIS) IN THE ANADROMOUS FISH PORTIONS OF THE NOOKSACK RIVER.

Gerry Gabrisch, Lummi Nation GIS Division, 2616 Kwina Road, Bellingham, WA 98226

Since 2017 the Lummi Nation has been utilizing drone-based photogrammetry to plan, document, and monitor salmon habitat restoration projects (instream large woody debris (LWD)) in the forks of the Nooksack River. Pre-construction orthomosaic imagery and surface models are used for hydrologic modeling and LWD placements, imagery and surface model generation are used to document as-built construction, and post-construction flights are used to monitor changes in the restoration zone.

In this presentation I will discuss the tools, software, and techniques used to generate drone-based photogrammetry products. Furthermore, I will discuss the challenges of remote drone operations in forested and high-relief environments.

Gavin, Daniel

CARBON ACCUMULATION IN PUGET LOWLAND PEATLANDS OVER THE HOLOCENE: IMPACT OF DISTURBANCE AND CLIMATE CHANGE

Daniel G. Gavin, Department of Geography, University of Oregon, Eugene, OR 97403; Joe Rocchio, Department of Natural Resources, Olympia, WA 98504; John Hribljan, Department of Biology, University of Nebraska Omaha, Omaha, NE 68182; Jeremy Shaw, David J. Cooper, Department of Forest and Rangeland Stewardship, Colorado State University, Fort Collins, CO 80523

Peatlands, wetlands with an accumulating organic matter substrate, occur in isolated topographic depressions across the Puget Lowlands. Lowland peatlands are increasingly rare south of the Puget Lowlands, suggesting they occur near their climatic limit. We reconstructed peat accumulation using continuous peat cores and measurements of peat bulk density, loss-on-ignition, and 74 AMS radiocarbon

ages from eight sites. We identified abrupt changes in the peat profiles using a breakpoint analysis on bulk density. Age-depth relationships were constructed with potential hiatuses at the depths of bulk-density breakpoints. Peat depth ranged from 311 to 756 cm, though glacial silt was not reached at all sites. We found 2 to 4 breakpoints per site, which often corresponded to a hiatus in the age-depth model. The mean accumulation rate was about 0.5 m/1000 yr, often with higher rates in the late Holocene. The long-term rate of organic matter accumulation was very similar among sites (ca. 500 $g/m^2/yr$) over the late Holocene, but much lower (200 $g/m^2/yr$) over the early Holocene and correlated with a regional rainfall reconstruction. Hiatuses, not synchronous among sites, ranged up to 1200 yr. The age-depth relationships suggest that local hydrological factors or fires burning the peat surface account for the late Holocene hiatuses via the consumption of previously accumulated peat, rather than extended periods of low peat accumulation. Overall, the sensitivity of peat accumulation to Holocene rainfall, and the hiatuses denoting significant peat loss events, confirms the sensitivity of these biologically and hydrologically significant sites.

Gobin, Cecilia

TRIBAL TREATY RIGHTS: A HIGHER DUTY IN THE FACE OF CLIMATE CHANGE AND ENVIRONMENTAL JUSTICE

The purpose of this session is to provide an introduction and overview of tribal treaty rights in western Washington, their history and origin, and legal importance in the protection of tribal rights and resources, and tribal sovereignty overall. Discussion will center on understanding the foundations of treaty law and federal Indian law, the trust relationship between the U.S. federal government and tribes, and the distinction between treaty rights as a legal obligation and environmental justice as a broader moral obligation and the differences in meeting each. Finally, discussion will briefly introduce how tribal rights and treaty protected resources are at further risk as a result of climate change; its direct impact to treaty rights, as well as repercussions for tribal economies and cultural lifeways.

Goldman, Crystal

APPLYING THE MOTIVATION BELIEFS INVENTORY (MBI) IN ACADEMIC LIBRARIES

Crystal Goldman, Geisel Library, University of California - San Diego, 9500 Gilman Drive, La Jolla, CA, 92093-0175

Much can be learned from examining what leaders and followers believe motivates their work and the work of their colleagues. Research indicates a person's actions are inseparable from their beliefs and, given the many workplace decisions made on a daily basis, studying the motivational beliefs that underlie those decisions could reveal a great deal about workplace dynamics. The Motivation Beliefs Inventory (MBI) is a validated survey instrument designed to measure motivation beliefs along four theoretical lines, including reinforcement theory, expectancy-valence theory, achievement motivation theory, and self-determination theory. While this instrument has been used to measure motivation beliefs in such disparate industries as global consulting and the U.S. military, it has never been used in an academic or library setting. Thus, this presentation will discuss the results of a study which investigated the motivation beliefs of Association of Research Libraries (ARL) academic librarians in the United States. This study utilized a cross-sectional survey design with a stratified random sample of academic librarians employed by the 102 U.S. ARL member libraries (n=409). The findings indicate that ARL librarians' gender identity, race/ethnicity, faculty status, manager/non-manager job duties, educational

attainment, and years of experience in academic libraries impact the motivation theories with which their beliefs align.

Goldman, Crystal

CREATION AND VALIDATION OF A SURVEY INSTRUMENT FOR SUCCESSION PLANNING IN HIGHER EDUCATION.

Crystal Goldman, Geisel Library, UC San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0175

In the last few decades, there have been multiple academic publications that suggest higher education institutions do not establish appropriate succession plans, nor do they develop the required leadership capacity in their faculty. This article discusses the development and of a survey instrument to measure the frequency with which succession planning activities take place as well as the results of a survey study which was used to validate the instrument. The initial implementation of this instrument assessed succession planning practices in the academic libraries of research universities in the United States, specifically members of the Association of Research Libraries (ARL). This study utilized a cross-sectional design with a stratified random sample (n=353) of academic librarians and administrators employed by ARL libraries. After data analysis, validity and reliability analyses revealed the survey instrument demonstrates acceptable psychometric properties and produced a strong alpha coefficient of .91. Findings also suggest that a number of factors impact respondents' knowledge of and/or participation in succession planning activities, including their sexual orientation, primary job duties, layers of management in their institutional hierarchy, and whether or not administrators identify and prepare interims for critical positions in their organization.

Gray, Andrew

FOREST CARBON SEQUESTRATION IN WEST COAST FORESTS: MYTHS AND REALITY .

Andrew N. Gray, USDA Forest Service PNW Research Station, 3200 SW Jefferson Way, Corvallis, OR

Confusion about the processes controlling forest carbon is common in public and scientific discussions, due in part to sloppy use of terminology and simplistic conclusions from narrow studies. This work summarizes current status and trends in forest carbon on the west coast, quantifies the impacts of disturbance and logging, and examines how within-stand processes of growth and mortality determine long-term carbon storage. Analyses are based on repeated on-the-ground measurements of strategic forest monitoring plots in all forest types of California, Oregon, and Washington over the last 20 years.

Forests in the Pacific Coast states accumulated 60.4 ± 5.3 Tg CO_2 e/yr between 2001-2019 (mean ± standard error). Carbon in harvested wood products and landfills (HWP) increased by 19.5 Tg CO_2 e/yr, for a total forest sector sequestration rate of 87.1 Tg CO_2 e/yr. Most of the increase occurred on federal lands outside of reserved areas (e.g., Wilderness and National Parks), but substantial increases were seen on private non-industrial lands in all states and industry lands in California. Mortality varied greatly by year due to wildfire or drought, and exceeded net primary production of wood (NPPw) in 2015 and 2016 in California (121 and 218 vs. 71 Tg CO_2 e/yr), and in 2002 in Oregon (168 vs 90 Tg CO_2 e/yr). Analyses of dynamics of undisturbed stands indicate that forests do not "slow down" as they age—mortality increases to approach the rate of growth, and that big trees do not grow more than little trees—when they're assessed on a unit area basis.

Greenler, Skye

TOO HOT, TOO COLD, OR JUST RIGHT: CAN FIRE RESTORE PACIFIC NORTHWEST DRY FORESTS?.

Skye M. Greenler Oregon State University, College of Forestry; Chris J. Dunn Oregon State University, College of Forestry; John D. Bailey Oregon State University, College of Forestry, 346 Peavy Forest Science Center, Corvallis, OR 97331

Managed wildfire and landscape-scale prescribed burns are increasingly considered key tools to restore ecosystem function and reduce wildfire hazard in dry forests of the western United States. However, these fires burn with mixed effects and may not achieve desired outcomes where fire severity is too high or too low. To explore the potential for fire to restore dry forests, we developed a novel modeling framework to predict the fire severity range most likely to restore historical forest basal area, density, and species composition in forests across eastern Oregon. We first developed a set of probabilistic tree mortality models for 24 species based on fire severity (RdNBR) and tree characteristics from burned forest inventory plots. Next, we applied these estimates to unburned stands in four National Forests to predict post-fire stand conditions across the range of observed fire severities. We then compared these results to historical reconstructions to assess what fire severity range had the highest restoration potential. Generally, basal area and tree density targets could be achieved by a relatively narrow range of moderate-severity fire. However, single fire events did not restore species composition in forests that were historically maintained by frequent, low-severity fire. Our results suggest historical forest conditions cannot be easily restored by single fires and help identify areas of opportunity where active post-fire management, such as silvicultural manipulations or repeated burning, can leverage wildfire effects to restore forest resilience and increase resistance to future disturbance and climate.

Grossman, Eric

NATURE-BASED STRATEGIES ASSESSMENT TO INFORM RESILIENCE PLANNING FOR HIGHER SEA LEVEL AND STREAM RUNOFF IN THE PACIFIC NORTHWEST

Eric E. Grossman, USGS Pacific Coastal and Marine Science Center; Kees Nederhoff, Deltares, USA; Kai Parker, USGS Pacific Coastal and Marine Science Center

Projections of higher sea level and winter stream flooding are expected to challenge coastal flood management. We explore the growing flood hazards across the lower Nooksack and Nisqually rivers in response to projected sea level rise and stream runoff into the 2080s by applying a new computationally efficient compound flood model. We also assess the individual and cumulative effects of nature-based mitigation strategies and resulting changes in estuary sedimentation that affect flow conveyance. The models account for stream flow, historical re-analysis and future projections of tide and storm surge resolved by the USGS Coastal Storm Modeling System (CoSMoS), improved elevation data of the USGS 1-
meter topobathymetric digital elevation model (TBDEM) for Puget Sound, and spatially varying roughness. The results indicate that recently observed moderate flood events like a 10-yr recurrence flood will become more severe (e.g. 50-yr event) in response to the combination of more intense lowland rainfall, runoff and sea level rise as early as the 2040s, depending on society's carbon emissions. Conversely, historical extreme events will become more frequent. Modeled nature-based strategies aimed to improve salmon floodplain habitat show potential to reduce flood hazards to vulnerable communities, valued ecosystems, and important industries. The model also helps inform the sensitivity and expected increase in longer-term estuary sedimentation that affects flow conveyance and

flood risk due to greater fluvial sediment delivery by higher stream runoff, the trapping effects of tidal backwatering, and rerouting of flow by the restoration strategies themselves.

Findings: Coastal flood exposure is expected to increase rapidly in response to the combined effects of higher sea level and stream runoff in the Pacific Northwest. Salmon habitat restoration strategies can reduce projected flood exposure, but effects of sedimentation and groundwater are complex and require further study.

Haddal, Natasha

A COMPARATIVE ANALYSIS OF PLURALISTIC APPROACHES AND THE TENSIONS THAT ARISE IN THEM.

Natasha Haddal, Department of Philosophy, 1 Shields Ave, University of California, Davis, Davis, CA, 95616

The term “pluralism” has served a broadly useful role as a term of art in its short history. Being aware and sensitive to diverse elements in our analysis of a concept, method, or theory has yielded fruitful insights that make sense of the complicated interweaving of data, practice, and practitioners.

However, there are dialectical reasons for wanting to engage in better distinctions when flagging a pluralistic approach. If one is motivated to understand the employment of “pluralism” as a monolith, this can lead to misunderstanding of the work on offer and even miss some importance nuance that may be useful and fruitful for dialectical engagement. Highlighting that there are complex analytical challenges associated with complex contexts, especially biological, doesn’t provide robust frameworks for dialectical engagement. Researchers can be unclear about the sense in which they are a pluralist. Appealing broadly to pluralism does not capture what many different pluralists think the complexities are ultimately targeting. These differences in pluralism matter both philosophically and empirically because depending on the type of pluralisms that have been employed, as researchers one may approach the dialectic in relevantly different ways.

I motivate these reasons by case study. I broadly motivate a sex pluralism, and then I compare and contrast how a variety of pluralistic approaches will have normatively different consequences that are important not just for scientific discourse, but also public uptake.

Halofsky, Jessica

CHANGING CLIMATE AND FIRE IN THE PACIFIC NORTHWEST.

Jessica E. Halofsky and David L. Peterson, U.S. Forest Service, Pacific Northwest Research Station, 3625 93rd Ave. SW, Olympia, WA 98512

Wildfires in the Pacific Northwest (Washington, Oregon, Idaho, and western Montana, USA) have been immense in recent years, capturing the attention of resource managers, fire scientists, and the general public. Large and severe fires in the Pacific Northwest are associated with warm and dry conditions, and such conditions will likely occur with increasing frequency in a warming climate. According to projections based on historical records, current trends, and simulation modeling, protracted warmer and drier conditions will drive lower fuel moisture and longer fire seasons in the future, likely increasing the frequency and extent of fires compared to the twentieth century. Interactions between fire and other disturbances, such as drought and insect outbreaks, are likely to be the primary drivers of ecosystem

change in a warming climate. Reburns are also likely to occur more frequently with warming and drought, with potential effects on tree regeneration and species composition. Hotter, drier sites may be particularly at risk for regeneration failures. Resource managers will likely be unable to affect the total area burned by fire, as this trend is driven strongly by climate. However, fuel treatments, when implemented in a spatially strategic manner, can help to decrease fire intensity and severity and improve forest resilience to fire, insects, and drought. Where fuel treatments are less effective (wetter, high-elevation, and coastal forests), managers may consider implementing fuel breaks around high-value resources.

Harvey, Brian

SPATIAL PATTERNS OF BURN SEVERITY IN NORTHWESTERN CASCADIA: CHARACTERISTICS, DRIVERS, AND IMPLICATIONS FOR POST-FIRE LANDSCAPES.

Brian J. Harvey, School of Environmental and Forest Sciences, University of Washington, Seattle WA 98195; Michele S. Buonanduci, School of Environmental and Forest Sciences, University of Washington and Quantitative Ecology and Resource Management, University of Washington, Seattle WA 98195; Daniel C. Donato, Washington Department of Natural Resources, Olympia WA 98504; Joshua S. Halofsky, Washington Department of Natural Resources, Olympia WA 98504; Matthew J. Reilly, USDA Forest Service Pacific Northwest Research Station, Corvallis OR 97333.

Spatial patterns of burn severity determine landscape arrangement of key dimensions of forests (e.g., patterns of tree regeneration, early-seral plant communities, carbon). Insights on characteristics and drivers of burn severity patterns are particularly lacking in forests shaped by infrequent and severe fires. In this study, we developed regional maps of burn severity for forests west of the Cascade Crest in Washington and northern Oregon, USA ('northwestern Cascadia') for all fires from 1984 to 2020 using a network of field plots and field-calibrated satellite burn severity maps. We characterized patterns and drivers of high-severity (stand-replacing) fire, to build understanding of the spatial signature of the northwestern Cascadia fire regime. Further, we asked if large, east-wind driven fires had qualitatively different burn severity patch configurations than other fires in the past 3.5 decades. For all fires between 1984 and 2020 in the northwestern Cascades, the percentage of area burning as stand-replacing was variable for smaller fires (ranging from <20 to >75%), but was consistently >50% for fires >10,000 ha in extent. Across all fires, >50% of stand-replacing patches were <1 ha, though collectively accounted for <1% of total stand-replacing fire. Conversely, 12 individual patches of stand-replacing fire from the six largest (and east-wind driven) fires, were >1,000 ha in size and accounted for >70% of total stand-replacing burned area regionwide. Our findings address an important knowledge gap in understanding burn severity patterns characteristic of northwestern Cascadia, and provide insight into how mechanisms of resilience to fire are spatially distributed in post-fire landscapes.

Hickey, Robert

GLOBAL ACADEMIC CLUSTERS (IF YOU BELIEVE ACADEMIC RANKING SYSTEMS)

Robert Hickey and Allison Coleman. Department of Geography, Central Washington University. Ellensburg, WA 98926

The goal of this project is to examine the global distribution of highly ranked universities. This was done using the QS and Shanghai ranking systems from 2005 and 2020. The universities were then mapped based on their individual scores, clusters (25 km radius), cumulative scores within each country, and

per-capita cumulative scores within each country. While every continent (except Antarctica) is represented by a top-200 university, they most common in North America, Europe, China, Japan, and Australia. Based on the QS data, the top 10 clusters generally shifted toward the US and Asia, with Australia and Europe losing top positions. Based on the Shanghai data, the US dominated the top tier, but lost one position from 2005-2020. Europe and China picked up single positions, while Japan lost one. When considering the cumulative scores within individual countries, the QS top 10 didn't change much overall. A few positions shifted slightly, while South Korea made an entrance onto the list in 2020 and the Netherlands dropped off. As might be expected, the per-capita analysis was dominated by smaller population countries. From 2005-2020, Austria dropped off the list while Norway was added. Overall, the results show a general increase in both the number and status of Chinese top-200 universities. This is supported by a shift in the weighted mean centers toward China – especially for the science-focused Shanghai ranking.

Horvath, Joan

MAKING CALCULUS ACCESSIBLE WITH 3D PRINTS AND LEGO BRICKS

Joan Horvath, Rich Cameron, Nonscriptum LLC, 155 N. Lake Ave. Suite 800, Pasadena CA 91101

Calculus is about how things move and change. It is usually buried in a lot of algebra, but Newton did not lay it out that way, and we do not have to teach it that way today. In this interactive workshop we will demonstrate hands-on, open source mathematical models from our book, *Make:Calculus* . We will start with a LEGO brick exposition of the Fundamental Theorem of Calculus. Next, we will use 3D prints and household items to explore the intuitive meanings of derivatives, integrals, limits and the Lotka-Volterra equations. We will also give a brief tutorial on OpenSCAD, the open source CAD program used to create our models. We will discuss how we designed our math models to optimize learning and, at the same time, make them as simple as possible to create. We want our models to embody universal design, which is the premise that making something useful for someone with different abilities often makes it better for everyone. We will describe our experiences (and barriers we encountered) trying to make our models as accessible as possible, in all senses of the word. If you teach calculus, join us and we will value your feedback. If you took it and wish you had understood it better, see if an hour of playing with models can get you closer! Bring a laptop if you would like to follow along with the OpenSCAD demonstrations and download models from our Github repositories.

Huber, Lincoln

VISUAL KNOWLEDGE DISCOVERY FOR MACHINE LEARNING

Lincoln Huber, Boris Kovalerchuck, Department of Computer Science, Central Washington University, 400 E University Way, Ellensburg, WA 98926

While many powerful Machine Learning (ML) methods already exist, these methods are often unexplainable or perform poorly on non-linearly separable data. This paper proposes modifications to the General Line Coordinates Linear (GLC-L) algorithm to provide explainable and interactive visualization methods capable of separating non-linear data, explaining ML models by rules, and visualizing these data, models, and rules. To ensure the rules created for a model are accurate, additional modifications to the GLC-L algorithm produce interactive visualizations for finding worst-case validation splits. Experiments across multiple datasets shows that this visualization method can compete with other visual and analytic machine learning algorithms.

Huber, Harlow

MONOTONE FUNCTION VISUAL ANALYTICS

Harlow Huber, Boris Kovalerchuk, Department of Computer Science, Central Washington University, 400 E University Way, Ellensburg, WA 98926

Visual analytics is a field which presents more easily understandable interpretations of machine learning models. This talk will present the expert data mining algorithm, its scope of applications, and visualizing the algorithm output on case studies data. A common problem is when an expert of a field can classify some data into two categories, but there is no system to determine the class quickly or on unknown cases. With expert data mining, the field expert can answer a series of questions to derive a function that classifies their data. The proposed method works on Boolean and *k*-valued data. A *k*-value is the total number of different values that an attribute has. The brute-force technique is asking an exponential number of questions, but the proposed method significantly reduces that number. The Monotone Function Visual Analytics method visualizes the outputted function on a series of "disks." A disk contains vectors with the same sum of the values (norm). Vector are ordered in each disk and between disks based on their monotonic relation. Using both of these methods, it was possible to derive a function that determines whether a tumor is malignant or benign. When visualized, there was a clear separation of data between malignant and benign cases as well as outliers.

Huber, Harlow

ANIMAL CLASSIFICATION WITH MACHINE LEARNING

Harlow Huber, Lincoln Huber Depart of Computer Science, Central Washington University, 400 E University Way, WA 98926

To lessen incidents where animals and people are harmed or killed by trying to cross roads, the Washington State Department of Transportation (WSDOT) has built wildlife crossings, a project called the I-90 corridor campaign. The idea is that animals will learn to use their own designated bridges and underpasses instead of directly crossing highways, which is more dangerous for both the animals and the drivers on the road. However, in order to quantify the results, WSDOT needs to track the animals that use these wildlife crossings. Tracking the number of animals and the types is an arduous task for a manned system, especially considering the fact that one will need to sort through photos that are automatically taken when movement occurs. Thousands of photos can be taken a day, many of which are simply environmental photos with no animals in them. To alleviate this issue, a machine learning model was proposed to automatically determine if a photo is of an animal or of the environment. If the photo is of an animal, the species is determined as well. The experimentation process consisted of testing several different deep neural network models, such as VGG-16 and VGG-19, by adapting the training process with different image resolutions, and training with augmented data to fight data unbalancing and overfitting. It was determined that InceptionResNet was the best model with a 78% accuracy when no data augmentation was considered. Finally, our data augmentation yielded the best results with an overall of 90.36% accuracy in recognizing the animals.

Jacobitz, Frank

SIMULATION OF THE FLOW OVER A ROUGHNESS ELEMENT

Frank Jacobitz, Ian Sysyn, Jacob Ryan, Jack Comfort, Dylan Poole, Department of Mechanical Engineering, Shiley-Marcos School of Engineering, University of San Diego, 5998 Alcala Park, San Diego, CA 92110, USA; Jonathan Lemarechal, Marco Costantini, Institut für Aerodynamik und Strömungstechnik, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Bunsenstraße 10, 37073 Göttingen, Deutschland

Simulations using Ansys Fluent are performed in order to study the interaction of a Blasius boundary layer developing on a flat surface with a cylindrical roughness element of small aspect ratio and a height smaller than the local boundary layer thickness. The goal of the simulations is a comparison with experiments performed in a laminar water channel by means of temperature-sensitive paint (TSP) (J. Lemarechal et al., 2018). Two cases are considered: First, the development of a Blasius boundary layer developing over a heated flat plate. Second, the interaction of the boundary layer with a roughness element. For the first case, the simulation results for the downstream development of the surface temperature agree with those obtained from the experiments. For the second case, the flow develops a horseshoe-shaped vortical structure around the roughness element as well as a recirculation zone directly downstream of the roughness element. Again, the flow structure observed in the simulation agrees qualitatively and quantitatively with the thermal footprint of the flow structure determined experimentally using TSP.

Jacobson, Eleonore

EXPLORING THE RHIZOCARPON GEOGRAPHICUM GROUP (LICHENIZED FUNGI) IN WESTERN NORTH AMERICA.

Mike Haldeman, Eleonore Jacobson, Bruce McCune, Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331, U.S.A; Einar Timdal, Mika Bendiksby, Natural History Museum, University of Oslo, P.O. Box 1172 Blindern, NO-0318 Oslo, Norway; Steve Leavitt, Department of Biology & Life Science Museum, 1115 MLBM, Provo, UT 84602, U.S.A.

The bright yellow species of *Rhizocarpon* are one of the most eye-catching groups of crustose lichens on rock in temperate to Arctic climates. These have widely been used in lichenometric studies in cold climates. The core of these, the *geographicum* group, has been troublesome for taxonomists worldwide. As part of an effort to clarify the species in this group, we have intensively sampled from Alaska to northern California and inland to Montana and Wyoming. For each specimen we have studied morphology, anatomy, major secondary metabolites, and the nrITS barcoding locus for as many as possible. Combining our data with GenBank and a smaller dataset from Northern Europe, we currently have 208 specimens in the *geographicum* group. A maximum likelihood phylogenetic reconstruction shows strong internal structure that will result in numerous taxonomic changes. These include new taxa, some apparently endemic to the Pacific Northwest of North America. Some species names within this group, as applied in the literature, are polyphyletic. Most well supported major clades are distinguishable by a combination of morphology and secondary metabolites, while others present ongoing puzzles in either morphology or metabolites or both.

Jaeger, Kristin

CHARACTERIZING IN-CHANNEL CONDITIONS FOR RIVER NETWORKS OF THE PACIFIC NORTHWEST, U.S. BASED ON MODELED STREAMFLOW PERMANENCE AND WATER TEMPERATURES

Theodore Barnhart[2], Joe Benjamin[3], Mike Brown[4], Jonathan Burnett[5], Jason Dunham[3], Sherri Johnson[5], Scott Lightcap[4], Meryl Mims[6], Chloe Moore[6], Roy Sando[2], Steve Wondzell[5]

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Integrating model outputs of different environmental variables improves application of modeling tools for land and water resource management. For stream dwelling organisms, water temperature and the presence/absence of surface flow are critical for habitat conditions. We align August water temperature estimates from the NorWeST model (Isaak et al., 2017) and annual perennial/non-perennial flow classifications from the PROSPER model (Jaeger, Sando, et al., 2019) to evaluate in-stream habitat conditions. Flowlines from the National Hydrography Dataset Medium Resolution for the HUC17 Northwest (NW) Region were classified perennial or non-perennial, based on PROSPER estimates, and warm or cold, based on NorWeST estimates above or below 16°C, the maximum temperature for core summer salmonid habitat. Four broad thermal-hydrologic categories (THC) result: cold-perennial, cold-non-perennial, warm-perennial, and warm-non-perennial. The percent of total stream length in each category was summarized by eight-digit watersheds annually from 2004 – 2015. Categories were also summarized by land cover and ownership. For the NW, cold water streams account for 78% of flowlines; with a greater percent of cold-non-perennial streams compared to cold-perennial streams (42% versus 36%). Of the remaining 22% of flowlines, 17% are warm-non-perennial. Cold-perennial and -non-perennial streams mainly are within forest, shrub and grassland landcover and U.S. Forest Service ownership; most warm-non-perennial streams are within shrub, grassland, and cropland landcover and Bureau of Land Management or private ownership. These results that combine different model outputs to characterize complex environmental phenomena across large regions can help direct regional land management activities such as timber harvest and grazing intensities and restoration projects.

Jantsch, Sydney

A CHARACTERIZATION OF HYPORHEIC AND STREAMBED TEMPERATURES WITH APPLICATIONS FOR SALMON HABITAT RESTORATION IN A WARMING RIVER

Sydney Jantsch, Western Washington University

This project is part of an ongoing study assessing the effectiveness of a potentially innovative habitat restoration strategy for Chinook salmon in the lower South Fork Nooksack River. This strategy uses engineered log jams (ELJs) to create pockets of cool water refuge by forming deep scour pools and promoting localized upwellings of shallow subsurface (i.e., hyporheic) water. This project seeks to characterize the relationship between hyporheic temperature and overlying surface temperature, and to elucidate the extent to which hyporheic upwellings can deliver cool water to ELJ-formed pools. The long-term goals of this work are to guide future habitat restoration efforts and promote climate

adaptation for salmon populations in thermally impaired rivers. Preliminary results indicate that it is possible for ELJ construction to promote upwellings of relatively cool hyporheic flow, but patterns of hyporheic temperature are variable over relatively small spatial scales.

Johnston, James

EXCEPTIONAL VARIABILITY IN HISTORICAL FIRE REGIMES OF THE WEST SLOPE OF THE OREGON CASCADES, USA

James Johnston, Andrew Merschel, College of Forestry, Oregon State University, 140 Peavy Hall, 3100 SW Jefferson Way, Corvallis, OR 97333

Dendroecologists have created extensive annually resolved records of fire occurrence over hundreds of years BP in seasonally dry forests, but no comparable records exist for the temperate rainforests of the Pacific Northwest, USA, which are some of the most productive forest ecosystems on earth. We describe methods to reconstruct historical (1500 CE to 1900 CE) fire across a range of forest types present in a ~15,000-ha coastal Douglas-fir dominated study area in the western Oregon Cascades. There was little synchrony in fire occurrence or tree cohort initiation between 16 sites separated by ~4km, suggesting that large wind drive fires that result in significant stand-replacing patches of the sort that occurred in the western Cascades in 2020 were not an important feature of historical forest successional and disturbance dynamics in our study area. We reconstructed more frequent fire in highly productive coastal Douglas-fir dominated forests than predicted by standard forest succession theory. Stands seral to western hemlock (Tsuga heterophylla), which are ubiquitous in western Oregon and western Washington, historically experienced fire every 21 to 45 years in our study area. We reconstructed very short fire (<10 year) return intervals in stands seral to Douglas-fir. Historical fire in stands seral to Douglas-fir was strongly associated with antecedent moisture and less strongly associated with drought in the year of fire. We interpret the extraordinary tempo of fire we observed at stands seral to Douglas-fir and the unique climate pattern that predicts fires in these stands to be indicative of Indigenous fire stewardship.

Joshi, Eureka

NUTRIENT LEACHING POTENTIAL ALONG A TIME SERIES OF FOREST WATER RECLAMATION FACILITIES IN NORTHERN IDAHO.

Eureka Joshi, Environmental Science Program, College of Natural Resources, University of Idaho; Mark D. Coleman, Department of Forest, Rangeland and Fire Sciences, College of Natural Resources, University of Idaho, 875 Perimeter Drive MS 1133, Moscow, ID 83843

Forest water reclamation is a decades-old practice of repurposing reclaimed water using land-application on forests. Widely accepted as a safe disposal alternative, it has economic, environmental, and social benefits, particularly in areas sensitive to nutrient additions. Long-term land application of reclaimed water may lead to nutrient saturation and subsequent leaching causing irreversible impairment of environmental quality. The goal of this study was to investigate the long-term effects of reclaimed water application on nutrient leaching potential at a time series of forest water reclamation facilities in northern Idaho. Our approach included installation of drain gauges and porous cup tension lysimeters, and a suite of microplate-based colorimetric assays to quantify drainage and soil water nutrient

concentrations to determine net leaching losses of nitrogen and phosphorus species. Analysis of variance and covariance showed a significant effect of treatment, season, and establishment date across the facilities, with a pronounced increase in drainage during the wet-season in reclaimed water amended plots at the long-established facilities. While differences in soil water ammonium, phosphate and dissolved organic nitrogen concentrations between control and effluent treatments in lysimeter samples weren't significant, nitrate concentration were notably higher in effluent treated lysimeter samples. Nutrient concentrations in drain gauge samples were significantly higher than lysimeter samples, indicating occurrence of nutrient losses predominantly through preferential flow paths. Nitrate was found to be most vulnerable to leaching via both matrix and preferential flow paths during the wet season, particularly at long-established facilities that have been in operation for over three decades.

Kane, Jeffrey

DOUGLAS-FIR ENCROACHMENT AND REMOVAL ALTER SEASONAL LIVE AND DEAD FUEL MOISTURE IN A NORTHWESTERN CALIFORNIA OAK WOODLAND.

Jeffrey M. Kane, Lucy P. Kerhoulas, Gabriel S. Goff, Department of Forestry, Fire, and Rangeland Management, California State Polytechinc University, Humboldt, One Harpst Street, Arcata, California 95521

The role of stand conditions on dead fuel moisture and foliar moisture content is poorly understood and the limited research available is inconsistent across studies. This study examined the effects of different stand conditions on seasonal variation of dead surface fuel moisture and live foliar moisture content within Oregon white oak (*Quercus garryana*) woodlands and forests of northern California. Stand conditions included intact oak-dominated stands without Douglas-fir (Pse*udotsuga menziesii*), oak stands that have been invaded by Douglas-fir (encroached), and thinned stands with Douglas-fir removed. Stand condition had a strong effect on microclimate and fuel moisture over time with thinned stands consistently having warmer and drier conditions with lower fuel moisture than encroached stands in dead and live fuel components. Observed dead fuel moisture values did not correlate well with estimates from remotely automated weather stations or process-based calculations, especially when observed fuel moisture values exceeded 20%. Dead fuel moisture differences among stand conditions were most pronounced in the late spring and early fall. Higher foliar moisture content in encroached stands also had higher midday leaf water potential compared with lower density stands. Collectively, these findings provide strong evidence that stand conditions can influence dead surface fuel moisture and foliar moisture content within Oregon white oak ecosystems of northern California. Better understanding of the role of stand conditions on dead and live fuel moisture dynamics may contribute to improved modeling of fire behavior and effects.

Kerhoulas, Lucy

BIGLEAF MAPLE WITHIN-CROWN SEASONAL PHYSIOLOGY.

Lucy P. Kerhoulas, Department of Forestry, Fire, and Rangeland Management, Cal Poly Humboldt, Arcata, CA 95521; David T. Hammons, Bureau of Land Management, Arcata, CA 95521; Nicholas J. Kerhoulas, Department of Wildlife, Cal Poly Humboldt, Arcata, CA 95521.

We investigated the influences of height, light availability, leaf structure, and season on bigleaf maple (*Acer macrophyllum*) leaf physiology in northern California to improve our understanding of productivity and carbon sequestration in western forests. Using hydrated cuttings and lab-based

measurements, we found that leaf mass-to-area ratio and maximum photosynthetic capacity increased with height and distance from the bole. In situ, we measured leaf physiology throughout tree crowns from June through September and found that predawn water potential was remarkably constant, indicating sustained access to water. We also found that midday water potential generally decreased with height and distance from the bole, noticeably decreased at the end of the growing season, and did not fall below –2 MPa, suggesting ample access to water and/or stomatal regulation to maintain hydrated water status. At midday, light availability and stomatal conductance of water vapor generally increased with height and distance from the bole. Stomatal conductance peaked in the treetop in June, in the mid-crown in July and August, and in the low-crown in September, demonstrating temporal and spatial optimization of crown resources in response to changing light quality, climatic conditions, and water status across the season to maximize carbon uptake at the tree-level. Together, our water potential and light measurements suggest that light availability is a stronger determinant of leaf morphology and physiology than hydraulic limitation in this species. These findings provide information on seasonal physiology in a widespread deciduous hardwood species, thereby strengthening our understanding of forest productivity in a predominantly coniferous region.

Klein, Nicholas

CONSEQUENCES OF REDUCING SYMMETRY IN QUANTUM SYSTEMS.

Nicholas Klein, Dr. Benjamin White, Department of Physics, Central Washington University, 400 E University Way, Ellensburg, WA 98926

Symmetry is a fundamental characteristic of any physical system and it plays a clear role in biology, chemistry, classical physics, mathematics, and other disciplines. The role of symmetry in quantum mechanics is more abstract, and this research project constituted an investigation of how the symmetry of a quantum system governs the possible energies of the system's states. A triangular arrangement of three spin-1/2 particles was used as a test system. The energies and states of a triangular arrangement with high-symmetry (equal magnetic exchange interactions between the particles) were calculated and compared to the energies and states of a triangular arrangement with low-symmetry (one of the exchange interactions was different than the other two). The states of the Hamiltonian of each arrangement were calculated and expressed in terms of the states of the spin-squared and z-component of spin operators, and the energies were calculated by applying the Hamiltonian of each arrangement to those eigenstates. The high-symmetry arrangement had a significant number of different states with the same energy (significant degeneracy), while the low-symmetry arrangement had less degeneracy. Both the high-symmetry and low-symmetry arrangements contained time-invariance symmetry, which can be broken by applying a magnetic field. The consequences for the energies of the two arrangements when a magnetic field is applied were calculated and a reduction in degeneracy was observed for both arrangements. The results of these calculations show that, in general, reduction of symmetry in quantum systems leads to degeneracy in energy levels being lifted.

Koppes, Michele

BRAIDING KNOWLEDGES OF BRAIDED RIVERS: EMBRACING PLACE-BASED, LOCAL AND INDIGENOUS KNOWLEDGES AND LIVED EXPREINCE IN THE SCIENCE OF LANDSCAPES

Michele Koppes, Department of Geography, University of British Columbia, Vancouver, BC, Canada V6T 1Z4

The societal and environmental crises of today require a holistic, critical and systems understanding of our relationship to and with the Earth. We now live in an era where all components of the Earth surface, from glaciers to rivers to forests to oceans to hillsides, are responding to the cascading effects of anthropogenic climate change. The climate emergency is defined, on the one hand, by state failures, pandemics, increasingly widespread wildfires, catastrophic floods and other critical natural hazards. On the other, it is simply an intensification of ongoing, inequitable environmental change imposed on Indigenous peoples by colonialism. We hence need to be more critical of how our observations and predictions of climate and landscape change, derived using data collected from sensors in the sky or probes in the ground, exclude the lived experiences, perspectives and histories of the people inhabiting these landscapes. We need to examine how using a singular, objective standpoint in the scientific process privileges determinism over other ways of seeing and being.

To reorient the geosciences towards a more ethical and societally-relevant role, the scientific community in particular needs to embrace indigenous, local and place-based knowledges of the land and our role in shaping it, particularly as the communities most affected by the climate crisis are the least involved in guiding our scientific efforts and outcomes. I invite the community to imagine how we might revisit how we understand landscapes from more than one perspective for achieving more holistic and just approaches to climate adaptation.

Krosby, Meade

BUILDING AN ENGAGED SCIENCE WORKFORCE TO SUPPORT SOCIETAL RESPONSES TO CLIMATE CHANGE

As the impacts of climate change accelerate so does the need for actionable science to inform decisions aimed at reducing climate risks. Actionable science – that is, science that is useful to and used by decision-makers to address real world challenges – is most reliably generated through co-production, the collaborative co-creation of knowledge by scientists and decision-makers with the intention of making that knowledge useable in practice. And yet, most science training does not provide the kinds of collaborative research skills required to work effectively with decision-makers. We will share lessons learned from the Northwest Climate Adaptation Science Center's efforts to build the capacity of scientists to co-produce actionable science with Northwest resource managers as they respond to climate risks, and suggest transformations in how scientists are trained and supported by universities to help mobilize the engaged science workforce the climate crisis demands.

Kuddus, Ruhul

APPLICATION OF ARTIFICIAL NEURAL NETWORK METHOD AND NONPARAMETRIC STATISTICAL TOOLS IN ANALYZING THE EFFECTS OF THE COVID-19 PANDEMIC ON HEART AND KIDNEY TRANSPLANTATION IN 30 COUNTRIES

Ruhul Kuddus and Bryson Edwards, Department of Biology; Mohammed Islam, Department of Mathematics, Utah Valley University, Orem UT USA 84058

Background: We investigated if COVID-19 incidence and mortality and economic conditions of 2020 affected the transplantation of cadaveric and live-donor kidneys and hearts in 30 countries.

Methods: Data was obtained from GODT, WTP, WHO, and IMF databases. The expected transplants in 2020 were calculated based on 2015-2019 data by the ANN method. The effect size and statistical

significance were obtained by the Hodges-Lemann estimate and Wilcoxon Signed Rank test, respectively. The epidemic effect was examined by the Jonckheere-Tersptra test. The association of transplantation and economic variables, COVID-19 incidence, and COVID-19 mortality was tested using Kendall's rank correlation.

Results: The countries hierarchically clustered into Group 1 (Australia, Denmark, Norway, Sweden, Switzerland, and the United States); Group 2 (Belgium, Finland, France, Germany, Hong Kong, Israel, Italy, Japan, Kuwait, Slovenia, South Korea, and the United Kingdom); and Group 3 (Argentina, Belarus, Brazil, Bulgaria, China, Croatia, Iran, Mexico, Pakistan, Romania, Russia, and Turkey). There was a decline in transplants in all countries, but it was insignificant in Group 1. Group 2 had a significant decline in heart and deceased kidney transplantation. Group 3 had a significant decline in kidney but not heart transplants. Overall, the countries with low GDP were disproportionally affected. The inflation rate had a negative impact but none of the economic variables examined had a statistically significant impact.

Conclusions: The 2020 epidemic disproportionately affected transplantation of hearts and kidneys in less developed countries, but COVID-19 incidence and mortality, and the four economic parameters we analyzed had no significant effect on transplantation.

Kusaka, Carina

SPATIAL ANALYSIS OF TRENDS IN TUFTED PUFFIN BREEDING HABITAT ON THE OREGON COAST

Carina Kusaka, Melanie Davis, James T. Peterson, Department of Fisheries, Wildlife, and Conservation Science, Oregon State University, 06 Nash Hall, Corvallis, OR 97331; Shawn Stephensen United States Fish and Wildlife Service, Oregon Coast National Wildlife Refuge Complex, 2127 SE Marine Science Drive, Newport, OR 97365

Tufted puffins (*Fratercula cirrhata*) are an iconic species in the Pacific Northwest that provide a wide range of ecological, economic, and historically important services such as ecotourism for local communities- and bringing marine derived nutrients to terrestrial habitats. Further, tufted puffins are sensitive to changes in prey availability and as such, are good indicators of overfishing and ecosystem disturbance. Tufted puffin populations on the Oregon Coast have declined dramatically over the past 30 years from over 5,000 birds in 1989 to only 550 birds in 2021. In 2018, the tufted puffin Species Status Assessment (SSA) determined that factors related to breeding site conditions are one of the most probable causes of puffin decline; however, little is known about the specific characteristics of nesting habitat along the Oregon Coast, or how it relates to their population demographics. To address this knowledge gap, we conducted a spatial analysis to examine the distribution of suitable breeding habitat for tufted puffins on the Oregon Islands National Wildlife Refuge, OR, USA. Specifically, we compared the percent cover of vegetation at tufted puffin breeding sites from 1979 to 2021 using a combination of ground truth data, aerial photos of the islands, and data from the National Agriculture Imagery Program (NAIP). Preliminary results suggest a decrease in the percent cover of live vegetation at critical breeding habitat. Assessing how suitable puffin breeding habitat characteristics have changed over time will provide necessary information to guide refuge managers in habitat restoration and support adaptive management decisions.

Kuwada, Nathan

DYNAMIC MECHANISMS RESPONSIBLE FOR STRUCTURE AND ORGANIZATION IN BACTERIAL CELLS.

Nathan J. Kuwada, Central Washington University

Complex, dynamic structure and organization are essential hallmarks of biological systems. Although long thought to be a 'mixed-bag' of randomly distributed proteins and DNA with little to no structure, recent observations show even the tiny single-celled bacterium dis- plays a high level of cellular-scale organization. But, despite their relative biological simplicity, many details of the physical mechanisms responsible for sub-cellular organization in bacteria remain elusive. Here we will discuss some of the challenges in studying live bacterial cells and describe recent biophysical approaches to uncover the mechanisms that allow bacteria to measure cellular-scale lengths using a molecular-scale toolkit.

Lawrence III, Frank

WELCOME TO THE LANDS OF THE LHAG'TEMISH, THE LUMMI PEOPLE

Frank Lawrence III, Deputy Director Natural Resources II, Lummi Nation, Bellingham, WA 98226

Fishing and gathering is our Schelangen "Lummi Way of Life" and it is no riddle that salmon need to endure difficult and life-threatening times in the Nooksack River on their way home to spawn. Fish habitat is degraded, and water temperature is increasing to lethal levels. Fishing is as important as the air we breathe, and we need to pay attention to the life surrounding us. Why are fish die offs becoming more common and floods happening more often? Animals are evolving to bravery. Is this due to human population taking over their habitat? If we take a close look at how we must live today, our future is kind of hard to imagine.

Li, Zihan

CHANGES IN CORTICAL REPRESENTATION OF MASTICATION IN THE PRIMATE OROFACIAL SENSORIMOTOR CORTEX FOLLOWING LOSS OF SENSATION

Zihan Li, Fritzie Arce-Mcshane

Vital and complex behaviors, such as eating, require precise positioning and coordination of tongue and jaw to move food inside the mouth. Indeed, swallowing and masticatory dysfunctions have devastating effects to the quality of life. The orofacial sensorimotor cortex (oSM) has been implicated in the control of feeding, yet little is known about how chewing different food types on either left or right side of the mouth is represented in oSM. Here, we evaluated the cortical representation of chew-side and food-type in the orofacial primary motor cortex (oM1) and primary somatosensory cortex (oS1) and how this was affected by the absence of tactile inputs to the oral cavity. We used demixed principal components analysis1 to decompose the dependencies of the population activity into a task-independent parameter of time (for activity related to the progression through the trial), and task-dependent parameters of chew-side and food-type, and the interaction between them. Latent activity in M1 and S1 exhibited similar tuning to chew-side and food-type, as these task parameters accounted for 6-11% and 4-13% of the variance, respectively. While the variance accounted for by chew-side or food-type was modest, the latent activity related to each parameter was well-separated at different epochs around minimal gape. In the absence of tactile inputs, activity related to both chew-side and food-type decreased in M1 but

increased in S1. Overall, the contrasting adaptive changes in tuning properties in M1 and S1 suggest different cortical involvement to compensate for the absence of oral tactile inputs.

Lowery, Seth

CHARACTERIZING UNCERTAINTY OF VIOLIN MOBILITY MEASUREMENTS

Seth Lowery, Department of Physics, Central Washington University, Ellensburg, WA 98926

Knowledge of measurement uncertainty is crucial to any experiment that tests a causal relationship among two or more variables. We have developed a method for quantifying the expected range of deviation among repeated measurements of the impulse response of violins. We measure this quantity by tapping the bridge of a violin with a small force hammer and recording the vibration of the top plate in several places using a laser Doppler vibrometer; the acoustics are measured in an anechoic chamber with microphones. Both quantities are functions of frequency, derived from digital Fourier transforms of sampled time-varying signals. The variance of the response at each frequency is calculated for N measurement trials, each of which consists of the average of multiple taps. These are averaged over specific frequency ranges of interest and scaled to the largest value within the range. We investigate how the number of taps included in the average for each trial affects the size of the uncertainty values. We also compare the response of individual measurements to the average. Changes in response due to string tension creep are compared to the base deviation measurements to observe the effect of string tension on the response of the violin. The procedure for finding the uncertainty of violin measurements will be used in future research to better determine the effects of playing a violin over time, a process known to violin players as "playing in" the instrument.

Luehl, Thomas

EFFECT OF SOIL TRANSPLANTATION ON ECTOMYCORRHIZAL FUNGUS COMMUNITIES DURING REVEGETATION.

Thomas Luehl, Dr. Jim Johnson, Dr. Mary Poulson, Department of Biological Sciences, Central Washington University, 400 E. University Way Ellensburg, WA 98926.

Ectomycorrhizal fungi are integral parts of the natural ecological systems where they form symbiotic relationships with plants that provide access to nutrients that would otherwise be unavailable. These relationships are known to improve plant growth rate, increase resistance to stressors, and increase survival. Current restoration practices ignore this relationship between fungi and plants. During the revegetation of the I90 Keechelus Lake wildlife overcrossing we collected soil from forest sites adjacent to the restoration area and inoculated a set of experimental plots and established a set of control plots were which were left uninoculated. Each plot was centered around a known ectomycorrhizal associated plant species. We assessed the establishment of ectomycorrhizal communities in the treated and control plots by comparing 125 soil fungal DNA samples to the adjacent forested areas using Illumina MiSeq amplicon sequencing of the internal transcribed spacer 1 region. We then compared communities in the crossing structure post revegetation to a previous study examining the nursery and the crossing structure before revegetation. We monitored plant growth, general health, and survival within the control and experimental plots over the two-year period after revegetation. Ectomycorrhizal composition found in pre- and post-inoculation (control and experimental) sites were notably different, as were those found in the nurseries and post-inoculation soils. We found that total fungal diversity and abundance was greater in the post-inoculation sites than in the pre-inoculation and nursery samples. Despite higher diversity

and abundances of ectomycorrhizal fungi being present post-inoculation, we found that plant survival was not significantly impacted.

Luesink, Greg

INVESTIGATING THE EFFECTS OF EIGHT WEEK HANGBOARD AND HANDHELD TRAINING METHODS ON FINGER STRENGTH AND ENDURANCE IN INTERMEDIATE AND ADVANCED ROCK CLIMBERS.

Gregory D. Luesink, Cynthia J. Thomson, School of Kinesiology, University of the Fraser Valley, 45190 Caen Ave, Chilliwack, BC, V2R 0N3

Purpose: This study aimed to compare the effectiveness of handheld training devices (Pinch Block [PB], and Crimp Block [CB]) to conventional Hangboard (HB) training and climbing as usual (control group [CG]) in rock climbers. Participants: 22 intermediate to advanced level climbers were randomly assigned to groups (HB, n = 6; PB, n = 5; CB, n = 6; CG, n = 5), of which there were 15 males and 7 females. Methods: All participants completed baseline tests for strength and endurance in all three training modalities. CG continued with regular climbing, while HB, PB, and CB followed an adapted intermittent hang/grip program from Lopez & Gonzales-Badillo (2012) for 8 weeks. Results: All four groups improved significantly in both strength and endurance for hangboard, pinch block, and crimp block ($p < .05$). Deadhang endurance has been shown to be a significant predictor of performance (measured as HB endurance). While every group significantly improved over time for HB endurance ($p < .05$), there were no significant differences between the groups ($p > .05$). Discussion: Overall, training with hangboard, pinch block, crimp block, and regular climbing all resulted in improvements in strength and endurance with no overall differences between groups. We did observe training specific improvements in pinch endurance for PB over CB ($p < .05$). The results of this study inform training for intermediate to advanced climbers.

McKernan, Cristina

INVENTORY, ASSESSMENT, AND MONITORING OF FENS IN THE ANTELOPE ALLOTMENT, OREGON, USA

Cristina McKernan, Gregg Riegel, United State Forest Service, 63095 Deschutes Market Road, Bend Oregon 97703; David Cooper, Colorado State University, Fort Collins, CO 80523; Dave Weixelman, United States Forest Service (retired), Nevada City, CA 95959

Fens are peat-forming wetlands that are created and maintained by their distinctive ground water driven hydrologic regime. Peat accumulation occurs when high groundwater tables create anoxic conditions that slow the decomposition of organic matter. Fens occupy a small proportion of mountain landscapes yet they are disproportionately important in the ecosystem services they provide such as forage for wildlife, nutrient cycling, flood attenuation, regional biodiversity enhancement, and are a major sink for atmospheric carbon. Fens in the Antelope Grazing Allotment of the Fremont-Winema National Forest formed after the eruption of Mount Mazama (approximately 7700 years ago) and support several regionally rare taxa including the federally listed Oregon Spotted Frog. Our project is located within the Antelope Grazing Allotment and focuses on 1) identifying the location of fens on the landscape (fens were previously mis-identified), 2) characterizing current fen conditions, and 3) establishing a monitoring protocol that centers on the relationship between vegetation and hydrologic regimes to develop criteria that will trigger the need for adaptive management.

Meigs, Garrett

QUANTIFYING THE WORK OF WILDFIRE: LESSONS FROM THE 2021 AND 2022 FIRES SEASONS ACROSS WASHINGTON.

Garrett Meigs; Ana Barros; Derek Churchill; Chuck Hersey; Annie Smith, Washington State Department of Natural Resources, Olympia, WA 98504

Throughout the western US, wildfire presents perennial challenges and opportunities for communities, land managers, and policy makers. In recent years, wildfires have burned millions of acres in Washington State, inducing a wide range of effects across environmental gradients and forest types. In 2017, the Washington State Department of Natural Resources (DNR) launched the 20-Year Forest Health Strategic Plan to accelerate landscape-scale wildfire risk reduction, ecosystem restoration, and climate adaptation across all lands in eastern Washington. DNR scientists and planners have collaborated with many partners to prioritize planning areas and treatment needs, implement treatments, and monitor changes in landscape conditions and treatment effectiveness. To better understand the widespread impacts of the 2021 fire season, we piloted a rapid assessment to evaluate the work of wildfire – i.e., the degree to which fire effects were consistent with the landscape resilience and wildfire risk reduction objectives of the 20-Year Plan. Here, we present results from the 2021 and 2022 fires across eastern and western Washington. We highlight how wildfires have both positive and negative effects, depending on location, forest type, and landowner objectives. Using examples from the 2021 Schneider Springs Fire (eastside) and 2022 Bolt Creek Fire (westside), we demonstrate approaches for mapping and monitoring fire effects, evaluating forest health treatment effectiveness, and engaging with wildfire managers to understand how they utilize treatments. Given recent trends and climate projections, understanding and harnessing the work of wildfire will be increasingly important for forest health and landscape resilience.

Merschel, Andrew

TIME AND DISTURBANCE: USING DENDROCHRONOLOGY TO UNDERSTAND THE DEVELOPMENT HISTORY OF MARBLED MURRELET NESTING HABITAT

Andrew G. Merschel, Western Wildland Threat Assessment Center, United States Forest Service, Corvallis, OR 97333; Jennifer Bailey Guerrero, Cassidy Ruge, College of Forestry, Oregon State University, Corvallis, Oregon 97333

The Marbled Murrelet *Brachyramphus marmoratus*, hereafter murrelet, is a dove-sized seabird native to the Pacific Coast from central California to southern Alaska. In Oregon, the murrelet was recently reclassified from threatened to endangered in 2021. Murrelets are a species of two worlds; foraging on schooling fish and invertebrates at sea and nesting in mature to old-growth forests up to 80 km inland. They lay a single egg on moss covered branches > 10 cm in diameter in forests with canopy layering and cover that may lower nest predation by corvids and raptors. Conventional wisdom suggests that forests that provide nest and habitat develop simply as a function of time. However, robust tree-ring records of forest development and disturbance histories are absent in Coastal forests in Oregon.

We use two dendrochronological datasets from the Oregon Coast Range to describe the age structure of murrelet nest trees, and the development history of nest stands. The first is a systematic reconstruction of fire and forest development history from the Elliot State Forest (ESF) a well-documented hotspot for murrelets. The second is a reconstruction of tree ages and development history in 29 murrelet nest

stands. Contrary to the hypothesized infrequent, high-severity fire regime, we reconstructed a moderately-frequent, mixed-severity fire regime on the ESF. Mature and old forests developed diverse canopy and age structure with non-stand-replacing fires. Murrelet nest tree ages range from 120-520 years old. Nest stands include multiple Douglas-fir cohorts that are consistent with a history of recurrent low- to moderate-severity disturbance.

Miles, Terrence

A PRACTICAL, QUANTITATIVE APPROACH TO CRYSTAL FIELD THEORY USING MATHEMATICA

Terrence D. Miles, Department of Chemistry, Citrus Community College, 1000 W. Foothill Blvd., Glendora, CA 91741

The use of crystal field theory as a simple substitute for more complex theories on the electronic structure of transition metals (TMs) in crystals and in complex ions is well documented. Due to its intuitive nature, this electrostatic model has allowed for better understanding of the properties of TM ions in various media as well as providing a semi-empirical approach to electronic structure calculations. Specifically, the ability to construct crystal field energy diagrams has proven useful in the understanding of spin crossover, the nephelauxetic effect, and some photochemical processes involving TMs.

Although the literature is rife with sources of static electronic energy level diagrams and

tables of useful ligand field parameters, it is often useful to have the ability to adjust these parameters. Further, the ability to display electronic distributions in TMs subjected to external fields is also instructive and can be useful in obtaining a better qualitative understanding of such systems. In this work, MATHEMATICA has been used to create tables of reduced electronic energies, coupled wavefunctions, and three-dimensional surface and slice contour plots for TMs subjected to an octahedral field of point charges. The facility of the use of MATHEMATICA affords the user the ability to accomplish the above tasks in a single computational environment without the need for a strong background in computer science.

Miller, Isaac

ISOLATION AND CHARACTERIZATION OF A NOVEL BACTERIOPHAGE THAT EFFICIENTLY KILLS A CLINICAL STRAIN OF EXTENDED-SPECTRUM BETA-LACTAMASE-PRODUCING KLEBSIELLA PNEUMONIAE

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Background: *Klebsiella pneumoniae*'s drug resistance rate has approached 70% and *K. pneumoniae* infection-related fatalities have reached 40-70%. Bacteriophage therapy (BPT) presents a hopeful alternative to antibiotic-resistant bacterial infections. Here we report the isolation and partial characterization of a bacteriophage that potentially can be used in treating *K. pneumoniae* infections. Methods: *K. pneumoniae* strain 700603, an extended-spectrum beta-lactamase (ESBL) producing clinical isolate was obtained from ATCC. Filtered wastewater from Orem Water Treatment Facility was exposed to *K. pneumoniae*, with viruses being plaque-purified through five rounds of reinfection. Purified phage DNA was sequenced with Oxford Nanopore MinION chip v10.4.1 using Rapid DNA sequencing kit for 20 h. The FASTQ files were assembled into contigs using FLYE. The genome was

annotated with Pharokka v1.2.0. Results: We isolated a novel bacteriophage related to Klebsiella phage KM18, sharing 86.36% nucleotide identity, that aggressively infects *K. pneumoniae*. Overnight infection produces a virus titer of $>10^{10}$/mL. The virus remains infectious after freezing (-82°C) and thawing (4°C) in a dimethyl sulfoxide and glycerol-containing medium. The virus has a 51,251 bp linear dsDNA genome containing 121 predicted open reading frames. We are currently in pursuit of determining the minimum inhibitory concentration, minimum bactericidal concentration, decimal reduction time, and other pharmacological aspects of the bacteriophage as a therapeutic agent. Conclusions: We have isolated and partially characterized a novel bacteriophage that aggressively infects and kills an ESBL-producing clinical strain of *K. pneumoniae*. Further studies on this bacteriophage's potential as a BPT agent in managing *K. pneumoniae* infections are underway.

Mitchell, Robert

MODELING 21ST CENTURY PEAK FLOWS IN THE NOOKSACK RIVER USING DYNAMICALLY DOWNSCALED CLIMATE PROJECTIONS

Robert Mitchell, Evan Paul, Department of Geology, Western Washington University, 516 High Street, Bellingham, WA 98225

The Nooksack River in northwest Washington State provides freshwater for agriculture and industrial use and serves as a vital habitat for endangered salmon, a resource that is of cultural and economic importance to the Nooksack Indian Tribe. Global climate models (GCMs) project an increase in air temperatures and more intense winter rainfall that will increase peak flows and sediment delivery to streams resulting in salmon habitat degradation and increased flood risk in the lowlands. To quantify the timing and magnitude of projected peak flows, we use a calibrated Distributed Hydrology Soil Vegetation Model and gridded meteorological data from an ensemble of 12 high-emission GCMs dynamically downscaled using the Weather Research and Forecasting model. Due to the variability of climate scenarios depicted by GCMs, a range of streamflow and snowpack magnitude changes in the Nooksack River basin are projected by the hydrology simulations. By the end of the 21st century, results indicate a decrease in annual peak snow-water equivalent (-70% to -80%) and an increase in winter flows (+30% to +55%). Peak flow magnitudes are projected to increase by 35-60% across all flow durations and return periods that were analyzed, with the largest changes occurring in the high relief basins. The frequency of high magnitude, flood-inducing peak flows will also increase into the future, lengthening the flood season by approximately three months. By late century, the dominate mechanism for peak flow generation is high-intensity rainfall as rain-on-snow events become less common.

Morris, Claire

THE PUNCTELIA SUBRUDECTA (LICHENIZED FUNGI: PARMELIACEAE) GROUP IN THE PACIFIC NORTHWEST.

Claire Morris, Bruce McCune, Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97333

Taxonomy of the *Punctelia subrudecta* group in western North America has lurched around among several names, including *P. subrudecta, P. perreticulata, P. jeckeri*, and *P. caseana*, but on the basis of almost no evidence from the western States and Provinces. We still have no clear idea of how many species in this group occur here, how they can be separated, and what they should be named. Over the past few years we have gradually approached this problem by accumulating collections and DNA

sequences from the Pacific Northwest. Specimens collected since 2019 display a wide variety of morphological characteristics, but they all occur at low elevations at urban, suburban, and valley-fringe sites. We combined our DNA sequences (nrITS) of 17 specimens with all other North American sequences for this group from GenBank, then constructed maximum likelihood phylogenetic trees. These show several supported clades that include material from our region, but not all of our specimens fall neatly into existing clades. We also found an indication of a distinct clade, sister to *P. caseana*, a species from east of the Rocky Mountains.

Myers, Gary

HARNESSING INTERGROUP CONTACT THEORY IN LEADERSHIP DEVELOPMENT.

Gary Myers, Olivia Zavala, Jessica Williamson, Belle Williams, Department of Sociology, Central Washington University, 400 E. University Way, Ellensburg, WA 98926

Leadership studies have begun to emphasize the importance of cultivating unique ways to both facilitate leadership self-efficacy and to simultaneously deepen the connection between leader and follower. Intergroup contact theory suggests that social contexts which mitigate (or eliminate) status differentials can facilitate stronger relationships and minimize bias in interactions. In order to determine the differences in perception of measurement of leadership dimensions between a face-to-face leadership camp and an anonymous virtual platform leadership project, 82 undergraduate students (from 2 different university campuses) and 91 undergraduate students (from 9 different university campuses) were surveyed throughout their respective curriculums. All participants were asked to rate the leaders of their respective exercises on four dimensions: *Preparation*, *Support*, *Friendliness*, and *Patience*. A *t*-test was performed to compare the means of all four dimensions between the participants of the face-to-face leadership camp and the participants of the virtual platform leadership project. Results indicated there were significant differences between how participants in the face-to-face leadership camp rated their leaders and how the participants in the virtual leadership project rated their leaders. Furthermore, virtual platform participants were more likely to rate their leaders higher in all dimensions.

Nanavati, William

POSTGLACIAL CLIMATE-VEGETATION-FIRE INTERACTIONS ALONG THE WESTERN CASCADES OF SOUTHERN WASHINGTON AND OREGON

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Pollen and charcoal records from the western Cascades of southern Washington and Oregon were evaluated to constrain regional trends in postglacial environmental history. Data from paleoecological sites were composited into syntheses of vegetation change and fire activity to describe regional climate-vegetation-fire interactions. Before 11 ka, regional pollen data suggest that *Picea-Pinus-Abies-Tsuga mertensiana* subalpine parkland transitioned into *Pinus-Pseudotsuga* forest, as postglacial climate conditions warmed. The regional charcoal composite suggests low levels of fire activity at this time , likely resulting from the colder temperatures and low levels of biomass. *Pseudotsuga-Alnus* forest with fern understory expanded throughout the region until 10 ka, when *Pseudotsuga* and ferns declined as fire activity continued to increase until 8 ka. This period of high fire activity aligns with climate conditions that were warm and dry along the western Cascades from 9 to 7 ka. Between 8 and 4 ka, *T. heterophylla* and Cupressaceae expanded as fire activity decreased to present levels throughout the region, suggesting

cooler, effectively wetter conditions than before. Pollen assemblages reached similar-to-present levels throughout the region by 3 ka, but the abundance of important forest taxa varied locally with disturbance and increased interannual climate variability (e.g., El Niño-Southern Oscillation) through present, suggesting non-stationarity in ecological composition and structure. Regional fire activity increased between 3 and 1.5 ka and then decreased after 1.5 ka. These results suggest that Native American genocide and later fire suppression may have amplified a longer trend of decreasing fire activity, resulting in the recent centuries of low fire activity.

Petix, Meaghan

ASSESSING NITROGEN DEPOSITION IN MOUNTAINOUS REGIONS USING EPIPHYTIC LICHEN COMMUNITIES.

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Anthropogenic nitrogen (N) deposition (N_{dep}) disrupts nutrient and carbon cycling, ecosystem function, biodiversity, and community composition across the globe. Ecosystems located in mountainous regions are potentially sensitive to nutrient enrichment from anthropogenic N_{dep} as they are often nutrient-limited and receive high amounts of precipitation. Epiphytic lichen community composition can indicate atmospheric N_{dep} because certain species are more sensitive to N than others. Increasing N inputs can cause the loss of oligotrophic N-sensitive lichens, along with an increase of eutrophic N-tolerant species. Lichen community-based airscores are a metric for estimating N_{dep} that reflects the proportion of eutrophic versus oligotrophic species. The goals of this study were to determine what is driving epiphytic lichen diversity and community composition in two mountainous regions in the Pacific Northwest, USA – North Cascades National Park and Olympic National Park – and to determine if lichen communities in these regions are being affected by N_{dep}. Our approach was to survey epiphytic lichen communities across these regions, analyze patterns of lichen α- and β-diversity, and calculate lichen community-based airscores. Climate and deposition variables accounted for 46% of observed variation in lichen communities based on variation partitioning. Community-based airscores indicate that these regions had fairly low, background levels of N_{dep}. This study suggests that epiphytic lichen communities can be useful indicators to assess N_{dep} in mountainous regions.

Pringle, Patrick

RADIOCARBON DATING OF SUBFOSSIL TREES IN LANDSLIDE-DAMMED LAKE CRESCENT, OLYMPIC MOUNTAINS, WASHINGTON

Patrick T. Pringle, Centralia College, 600 Centralia College Blvd., Centralia WA 98531, Karl W. Wegmann and Elana L. Leithold, North Carolina State University; Department of Marine, Earth, and Atmospheric Sciences, 2800 Faucette Drive, Raleigh, NC 27695; Dan Pontbriand and William Westlake Walker, National Park Service (retired).

We report new radiocarbon ages on submerged trees from Lake Crescent. NPS divers sampled the Fairholme, Log Cabin, Bovee's Meadow, and Saratoga Point trees. The 4,404–4,268 cal yr BP (σ3) age of the Fairholme tree, rooted at ~24 m depth, is potentially consistent (considering probable eroded outer rings) with a ~4 ka megaturbidite deposit, likely correlative with one landslide in a complex that

separates Lakes Crescent from Sutherland, which today is ~24 m lower than Lake Crescent. That landslide diverted drainage from Lake Crescent north into the Strait of Juan de Fuca via the Lyre River (Tabor, 1975). The timing of lake separation is important for biologists studying the genetics of isolated aquatic populations.

The 3,185–2,998 cal yr BP (σ3) Log Cabin tree, rooted at 15–18 m depth, is consistent with a ~3 ka megaturbidite that was contemporaneous with the Sledgehammer Point landslide. Both landslides into the lake were likely triggered by earthquakes on the North Olympic fault zones at about 4 and 3 ka, respectively. Video taken during sampling by the NPS divers may reveal more about the provenance of the trees.

Three of four younger radiocarbon ages on submerged trees cluster at ~300 yr BP. The Saratoga Point log radiocarbon dated by Logan and Schuster (1991) cross dates via dendrochronology with Olympic Peninsula and Vancouver Island master tree-ring chronologies, revealing an outermost complete annual ring of 1704 CE and partial 1705 ring. Thus, it was not directly killed by the 1700 CE Great Cascadia earthquake.

Quick, Steven

HOW IS SOIL CARBON AFFECTED BY OLD-GROWTH FOREST RESTORATION ACTIVITIES?

Steven A. Quick, Dylan G. Fischer, Department of Ecology, The Evergreen State College, 2700 Evergreen Pkwy NW, Olympia, WA 98505; Michael Case, The Nature Conservancy, 74 Wall St, Seattle, WA 98121

Changes in forest carbon (C) associated with ecological restoration activities in temperate rainforests are poorly understood. Management practices restoring late-seral forest conditions in southwest Washington represent an opportunity to examine how active management can interface with forest C dynamics. Forest thinning can accelerate development of structural complexity toward old-growth conditions, but could paradoxically reduce C storage in forests. Here, we model 100 years of change in forest C using the Forest Vegetation Simulator (FVS) in combination with fourteen-year repeat measurements of aboveground forest conditions, and soil organic matter (OM) at the Ellsworth Creek Preserve in Washington State. We hypothesized that 1) aboveground carbon storage would remain depressed under active management; 2) soil OM C would decrease in managed plots, driven by the removal of forest litter inputs; and 3) the magnitude of soil OM losses would be greater in younger stands, due to the C losses from soil respiration being greater than C uptake from regrowth. Results show reduced C pool aboveground in most active management scenarios, and reduced soil OM C response to thinning operations in the short term. However, treatment groups converged in the long-term, and stands under active management likely contain structural features more approximative of old-growth conditions due to thinning and generation of larger diameter trees. Our results highlight the trade-offs of ecological restoration practices and elucidate stand conditions that favor preservation of soil OM C in western temperate rainforest systems.

Reidel, Jon

RECONSTRUCTION OF CLIMATE AND ECOLOGY OF SKAGIT VALLEY, WASHINGTON, FROM 27.7 TO 19.8 ka BASED ON PLANT AND BEETLE MACROFOSSILS

Jon Riedel, Skagit Quaternary, 1605 24th Place, Anacortes, WA 98221; Alice Telka, Paleotech; Andy Bunn, Department of Environmental Sciences, Western Washington University; John Clague, Department of Earth Sciences, Simon Fraser University

Glacial lake sediments exposed at two sites in Skagit Valley, Washington, encase abundant macrofossils dating from 27.7 to 19.8 cal ka BP. At the Last Glacial Maximum (LGM) most of the valley floor was part of a regionally extensive arid boreal (subalpine) forest that periodically included montane and temperate trees and open boreal species such as dwarf birch, northern spikemoss, and heath. We used the modern distribution and climate of 14 species in 12 macrofossil assemblages and a probability density function approach to reconstruct the LGM climate. Median annual precipitation (MAP) at glacial Lake Concrete (GLC) was ~50% lower than today. In comparison, MAP at glacial Lake Skymo (GLS) was only ~10% lower, which eliminated the steep climate gradient observed today. Median January air temperature at GLC was up to 10.8°C lower than today at 23.5 cal ka BP and 8.7°C lower at GLS at 25.1 cal ka BP. Median July air temperature declines were smaller at GLC (3.4–5.0°C) and GLS (4.2–6.3°C). Warmer winters (+2–4°C) and increases in MAP (+200 mm) occurred at 27.7, 25.9, 24.4, and 21.2–20.7 cal ka BP. These changes accord with other regional proxies and Dansgaard–Oeschger interstadials in the North Atlantic.

Rickard, Heather

BASAL FUELS CHARACTERIZATION FOR LEGACY HARDWOOD TREES IN KARUK ABORIGINAL TERRITORY.

Heather D. Rickard, Jeffrey M. Kane, Cal Poly Humboldt 1 Harpst St, Arcata, CA 95521

Interruption of Indigenous stewardship has resulted in hardwood decline along the middle Klamath River in Northern California causing adverse effects to Tribal food sovereignty and community wellbeing. A century of fire exclusion has resulted in unprecedented fuel loading possibly contributing to post-fire tree mortality. We quantified fuels around the base of legacy tanoak (*Notholithocarpus densiflorus*), California black oak (*Quercus kelloggii*), and madrone (*Arbutus menziesii*). Samples accounted for distance from tree (0-3 m), direction (up, down, left, right facing upslope), competition and site conditions. We sampled 166 hardwoods ranging in size from 25 to 176 cm diameter at breast height (dbh) with a median of 51 cm, across six sites in Karuk Aboriginal Territory. Depth was positively correlated with litter ($P = 0.0254$) and duff load ($P < 0.00001$). Using linear mixed effects models, distance and direction best explained fuel depth for litter ($P = 0.0001$) and duff depth ($P < 0.00001$), with a less strong but significant variation between species for litter ($P = 0.0007$) and duff depth ($P < 0.00001$). Fuels under the canopy were greater than in canopy gaps for both litter ($P < 0.00001$) and duff depth ($P < 0.0001$). Tree-level litter and duff depth were negatively related with Douglas-fir (*Pseudotsuga menziesii*) competition and tree dbh ($P< 0.00001$) Preliminary results suggest basal accumulations of fuels vary spatially with tree and site level conditions in the region, and may warrant remediation prior to prescribed fire to prevent tree damage.

Saban, Chantel

INFERENCES OF LATE GLACIAL THROUGH EARLY HOLOCENE ENVIRONMENTS USING POLLEN FROM COPROLITES AND SEDIMENTS RECOVERED FROM PAISLEY CAVES, OREGON

Chantel V. Saban, Erin M. Herring, Dennis L. Jenkins, Daniel G. Gavin, Department of Geography, University of Oregon, Eugene, OR 97403

Materials collected during excavations at the Paisley Caves of south-central Oregon were used to compare pollen from coprolites to pollen from chronologically associative sediments for the purpose of measuring the range of dissimilarity between two contemporaneous pollen sinks from the terminal Pleistocene through the Early Holocene. By contrasting the degree of changes between adjacent pollen sample types, we found that the dissimilarity of pollen assemblages between coprolites and associated sediments was greater than the serial dissimilarity between stratigraphically adjacent samples within either group. However, serial dissimilarity within types was not greater for coprolites than sediments. The coprolites showed localized pollen assemblages related to carnivorous or omnivorous mammalian survival strategies within 1-2 day periods showing less taxonomic variability over time than decadal scale sedimentary pollen.

Schwarz, Dietmar

CASCADING ADAPTATION TO ABIOTIC ENVIRONMENTAL VARIATION ACROSS TWO TROPHIC LEVELS OF PARASITES

Nathan Roueche, Washington State Department of Agriculture, 1111 Washington St SE, Olympia, WA 98504; Amanda Jackson, Department of Biology, Western Washington University, 516 High St., Bellingham, WA 98225; Jeffrey L. Feder, Department of Biological Sciences, University of Notre Dame, Notre Dame, IN 46556; Galvin Life Sciences Building, Dietmar Schwarz, Department of Biology, Western Washington University, 516 High St., Bellingham, WA 98225

Specialist parasites are intimately adapted to the biotic environment created by their hosts. However, many parasites also have free-living life stages that are exposed to the abiotic conditions outside their host organism. As host and parasite co-occur in the same habitat they are exposed to the same abiotic stressors. In order to track the their host across climatic gradients in space parasites must be able to adapt to abiotic environmental variation. The environment experienced by the host may therefore lead to "cascading" adaptations in specialist parasites that may extend across multiple trophic levels. Snowberries are an ubiquitous plant in the Pacific Northwest and occur an both humid coastal areas and arid rain shadows. Its berries are parasitized by the larvae of the snowberry maggot fly, *Rhagoletis zephyria*, that is in turn host to larval braconid parasitoids. We collected R. *zephyria* larvae from >40 geographic locations spanning several climatic gradients in the Pacific Northwest and exposed both un-parasitized and parasitized larvae to desiccation treatment in the lab, targeting the vulnerable stage between leaving the host fruit and pupariation in the soil in late summer. We found that climatic factors explained >57% of variation in fly desiccation resistance with flies from more arid locations showing greater drought resistance. Fly desiccation resistance was a strong predictor of parasitoid desiccation resistance (r^2 >71%). These phenotypic data are consistent with the abiotic variation across the geographic range driving cascading adaptation to drought across two trophic levels of snowberry parasites.

Seixas, Gus

FOREST MANAGEMENT HISTORY INFLUENCES EIGHT DECADES OF SHALLOW LANDSLIDING IN NORTHWEST WASHINGTON STATE

Gus Seixas, Skagit River System Cooperative; Curt Veldhuisen, Skagit River System Cooperative

Reducing forestry-related landslide impacts to streams has been a principal component of forestry regulation in Washington State since the 1990s. This contribution highlights ongoing landslide inventory work conducted by tribal staff scientists to understand how past and current land use practices may impact treaty-protected aquatic resources. We compiled shallow landslide inventories starting in the 1940s from nine small watersheds in the northwest Cascade Mountains, USA, and updated the mapping through 2019. We stratified the landscape into three management strata (industrial and federal ownerships and forests with no history of management) and compared landslide volume generation rates against time series representing regional climate, storm history, harvest rate, and predictions of the topography model SHALSTAB. Results demonstrate a bell-shaped trend in composite landsliding driven by peaks in managed forests in the 1970s and 1980s. The signal from unmanaged forests correlates with a regional climate proxy at the multi-decadal scale, but we found mixed quantitative support for storm hydrology in explaining the landslide trends. Landsliding in federal managed forests was greatly reduced following cessation of clearcut logging in the mid-1990s; in contrast, topographic modeling using SHALSTAB suggests the industrial forest signal is consistent with a favorable outcome from greater regulation of logging operations, not changes to logging rate, with a declining density of recent clearcuts on highly unstable landscape elements after the 1980s. These results suggest declining sediment supply may be reducing forestry impacts to salmon productivity, although the legacy of simplified habitat remains in many rivers and streams.

Sharrett, Stephen

A COMPREHENSIVE CONSERVATION ASSESSMENT FOR THE OLD GROWTH SPECKLEBELLY LICHEN, PSEUDOCYPHELLARIA RAINIERENSIS

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Conservation assessments for rare or narrowly endemic lichen species are often hindered by knowledge gaps, limited long-term monitoring, and an incomplete understanding of the threats to those species. *Pseudocyphellaria rainierensis* is a rare epiphytic macrolichen endemic to old-growth forests in northwestern North America that is currently under assessment by the International Union of the Conservation of Nature to determine its global conservation status. The objective of this project was to address data gaps in the conservation knowledge of *P. rainierensis* populations in Washington. The current status of populations and distribution of the species in Washington was assessed through revisits to historic collection sites. *P. rainierensis* was present at 35 of the 53 sites revisited (66%) suggesting there may be significant declines within some parts of the species range in Washington. To characterize the genetic structure and genetic diversity within and among populations of *P. rainierensis* a reference genome was assembled using long read data and RAD-seq data were generated for 96 individuals. The total length of the genome assembly is 131 MBp assembled into 19 contigs (N50 = 7.15 MBp, L50 = 8).

97.4% of the BUSCO genes were recovered as complete, 2.5% of which were duplicates. A substantial proportion of the genome is comprised of interspersed repeats (68.8%). The complete genome was recovered. This study is the first to investigate the population genetic structure of *P. rainierensis* , or any rare old-growth associated lichen in the Pacific Northwest bioregion.

Shaw, David

THE EMERALD ASH BORER HAS ARRIVED IN OREGON: WHAT DO WE KNOW ABOUT OREGON ASH?

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The emerald ash borer (EAB) (*Agrilus plenipennis*) (Coleoptera: Burprestidae) was detected in Oregon in July of 2022 in Forest Grove, SW of Portland. Current surveys, coordinated by Oregon Department of Agriculture (ODA), have EAB limited to the city and nearby surrounding area. However, the insect is thought to have been present for at least 3-5 years previous to official discovery and may be well-established. There is now a significant threat to native Oregon ash (*Fraxinus latifolia*). What do we know about the ecology of Oregon ash? Or the insects and pathogens of Oregon ash? We actually know very little, however, with new interest in the species and management implications of the losses, we documented known insect and pathogen (fungi) on Oregon ash, and note one study of Oregon ash plant communities in the Willamette Valley. The most common pathogens known for Oregon ash include foliage diseases (leaf spots and ash anthracnose), while several forest defoliators are documented in Oregon ash, and a seed weevil, bark beetle and a wood borer have been described. Other insects and fungi are poorly known. Sean Prive has published a thesis at Oregon State University that investigated the plant communities and forest structure of 11 wetlands dominated by Oregon ash. A total of 216 plant species were identified in these wetlands (147 were in forest plots), indicating the importance of the community type for biodiversity in the region.

Singh-Cundy, Anu

NORTH CASCADES ALPINE MEADOWS: FLOWERING PHENOLOGY AND POLLINATORS IN THE CONTEXT OF CLIMATE CHANGE.

James R. Davis, Shuksan Conservancy, Bellingham, WA 98225; Abe Lloyd, College of the Environment, Western Washington University, Bellingham, WA 98225; Anu Singh-Cundy, Biology Department, Western Washington University, Bellingham, WA 98225

We studied flower and pollinator phenology, and bumblebee foraging behavior, in Heather Meadows in the North Cascades in Washington State. We recorded 78 species of eudicot forbs and shrubs on seven transects at elevations ranging from 1,260 meters to 1,582 meters. We observed continuity of floral resources within each transect, and across the elevation gradient, over the growing season. Black huckleberry began blooming even when 98% of the transect area was under snow cover. This *Vaccinium* species was a critically important forage resource for post-diapause queens as they began to establish nests in spring. Transects with the highest tree island cover had the largest number of foraging spring queens. There was no evidence of colony establishment at the highest transect, which is however an important floral resource for workers from colonies established at lower elevations. The exceptionally early spring of 2015 made that year a good analog of climate change predicted for this region toward the end of the century. In 2015, bloom onset was two to eight weeks early for a majority of species,

compared to a more typical year. Bloom duration increased for a few species, and decreased drastically for some. There was significant phenological reassembly, and novel co-flowering patterns were seen. These findings preview the potential impacts of climate change on the biota of montane meadows in the Pacific Northwest and could guide effective mitigation and conservation strategies.

Smoot, Emily

INVESTIGATING THE IMPACT OF CLIMATE VARIABILITY ON SUMMER STREAM TEMPERATURES IN THE STILLAGUAMISH BASIN.

Emily E. Smoot, Robert J. Mitchell, Geology Department, Western Washington University, 516 High ST, Bellingham, WA, 98225; John R. Yearsley, Civil and Environmental Engineering Department, University of Washington, 1410 NE Campus Parkway, Seattle, WA, 98195

The Stillaguamish River is the fifth largest river in the Puget Sound basin and contains over 1400 km of salmonid habitat. Climate warming is reducing the snowpack and sequential snowmelt in the basin, which is important for sustaining spring and summer streamflow and buffering stream temperatures. Because the river is currently subject to a temperature total maximum daily load, it is important to understand how projected climate change will affect hydrology, and stream temperatures to assess the effects on salmon habitat. To assess climate change impacts, we used historical meteorological data to calibrate the Distributed Hydrology Soil Vegetation Model and the River Basin Model stream temperature model and then applied 12 dynamically downscaled global climate scenarios to project basin responses through 2099. Our projected modeling has shown that by late century snowpack will decrease by about seventy-five percent with peak snow accumulation occurring roughly a month earlier than historical averages. Smaller snowpacks and warmer drier summers cause lower streamflows and increased stream temperatures in all tributaries in the basin. Projections of July and August streamflow suggest a decrease of roughly fifty percent by the 2080s across the primary and subbasin outlets. Stream temperatures show monthly average increases ranging from 1.6 degrees Celsius to 4.7 degrees Celsius during the summer by the end of the century.

Stec, Jozef

ANCIENT AND MODERN INFECTIOUS DISEASES: AN OVERVIEW OF THEIR IMPACTS ON GLOBAL HEALTH, ECONOMY, AND SECURITY

Jozef Stec, Department of Pharmaceutical Sciences, College of Pharmacy, Marshall B. Ketchum University, 2575 Yorba Linda Blvd., Fullerton, CA 92831

Bacteria, parasites, viruses, and fungi represent the four major and distinctive infective agents that plagued humankind for millennia leading to high morbidity and mortality rates. Although infectious disease outbreaks are rather rare nowadays and mostly limited to endemic countries, they still pose serious global health threat due to disease transmission as well as rapidly developing drug resistance. The medications used currently to treat various infectious diseases were often developed as early as the 1950s during the so-called “golden era of antibiotics.” Additionally, it is often required that multiple agents are administered concurrently (i.e. combination therapy) for improved treatment outcomes and many of the medications are accompanied with severe adverse effects, which in turn limits their use. Accordingly, the discovery and development of new, safe, and effective agents to not only control and limit but ideally eradicate infectious diseases globally is of high priority. During this presentation, a broader overview of various types of infectious diseases along with their socioeconomic and national

security impacts will be provided as well as recent developments in the treatment of infectious diseases will be discussed.

Stone, Daphne

THE PROOF IS IN THE PUDDING – LEPTOGIUM and SCYTINIUM

Daphne Fisher Stone, Department of Botany and Plant Pathology, 2701 SW Campus Way, Oregon State University, Corvallis, OR 97331

The genus *Leptogium* is a confusing and poorly studied group. Splitting it into new genera, which in some cases helps people understand other genera, may seem to make *Leptogium* more confusing. However *Scytinium*, a recently proposed genus composed of the small species without tomentum on the lower surface, is fairly clear-cut. The problem of distinguishing individual species remains. What characters are actually useful? How consistent are they? After sequencing about 225 specimens of *Scytinium*, grouping them genetically and morphologically, we have a few clues. Characters that are helpful include wrinkles, isidia and shape of hyphal cells in the medulla and their placement. Using detailed observations of these and other characters, we realize that the PNW holds a treasure trove of new species.

Swanaset, George

NOOKSACK CORE VALUES AND THE STRUGGLE TO PRESERVE LIVELIHOODS IN A TIME OF CLIMATE CHANGE

George Swanaset, Jr. Nooksack Tribe

What I will be discussing is on the core values of the Nooksack people, as it relates to our presence in the region from time immemorial to present. The relationship between our people to the land from the glaciers to the mouth of the Nooksack River. As well as the many tributaries. (Nooksack territory). What we have lost, and our struggles to hang onto what little we have left. I will also touch on the collaborative efforts between different outside agencies in protecting our resources. The struggles our people face when the resources are not available. What we have lost when we lost our villages. What we are doing in order to continue as a people.

Taygan, Ruth

CLADONIA-MOSS ASSOCIATIONS IN A PACIFIC NORTHWEST CONIFER FOREST

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What factors influence the distribution of species? In forests and woodlands *Cladonia* species can often be found growing directly on mosses on woody substrates. Despite substrate being a known factor of importance for bryophytes and lichens, there is very little known about these potential associations. The lichen *Cladonia* is often found associated with bryophytes, but few studies have tested the occurrence of positive (or negative) interactions between these taxa. This study explores the relationship between common moss genera and Cladonia species within a mature *Pseudotsuga mensziesii* dominant forest. We recorded a total of 163 observations of moss genera (*Kindbergia*, *Neckera*, *Isothecium*, *Hypnum*, *Dicranum*, *Claopodium*) growing on woody substrates (*Pseudotsuga menziesii*, *Alnus rubra*, *Thuja*

plicata, *Acer macrophyllum*, stumps and logs) and noted *Cladonia* presence (n=73) or absence (n=88) for each observation. The highest proportion of our *Cladonia* observations were found on stumps and *Pseudotsuga mensziesii*. Positive or negative pairwise species associations were tested using contingency table analysis. We found a significant positive relationship between *Cladonia* and two moss species, *Hypnum* (p=0.0001) and *Isothecium* (p=0.05). We found a negative relationship between *Cladonia* and *Claopodium* (p=0.05). These data contribute to a better understanding of the role of bryophytes in structuring lichen communities in pacific northwest forests and could help to shape future forest management.

Tellinghusen, Blake

EFFECTS OF LONG-TERM NICOTINE EXPOSURE ON ADULT DROSOPHILA

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The tobacco epidemic continues to threaten lives despite ample research warning of its dangers, killing over 8 million people annually from direct use and 1.2 million from secondhand smoke. Nicotine, the highly addictive active ingredient in tobacco, is a plant-derived alkaloid that leads to increased tolerance and reliance on the compound. Our lab has used *Drosophila melanogaster* to identify genes and mechanisms that control drug abuse and has shown that developmental nicotine exposure results in decreased survival and sensitivity, and we're now working to characterize the effects of long-term nicotine exposure in adult flies of the strain w1118. We performed a survival assay with nicotine concentrations ranging from 0.0-1.3mg/mL, and found that increased nicotine led to higher mortality. We also ran a negative-geotaxis and olfactory choice assay and found that female *Drosophila* display increased negative-geotaxis behavior, while no significant differences were observed in olfactory behavior. Lastly, we found patterns of nicotine-use escalation in adult *Drosophila* when performing a CAFE nicotine consumption assay. These results potentially highlight sex differences in long-term nicotine behavioral response and addiction. Overall, this research is important for determining the genetic, cellular, and molecular mechanisms that mediate nicotine addiction in order to develop effective strategies for prevention and treatment of nicotine addiction in humans.

Thoreson, Jessie

UNDERSTANDING XÁNTHIIP (BLACK OAK, QUERCUS KELLOGGII) ECOCULTURAL REVITALIZATION IN THE WESTERN KLAMATH MOUNTAINS.

Jessie Thoreson, Meg Krawchuk, Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR 97330; Colleen Rossier, Karuk Department of Natural Resources, Orleans, CA 95556; Arielle Halpern, Department of Biology, Southern Oregon University, Ashland, OR 97520; Kathy McCovey, Karuk Tribal member, cultural practitioner, archaeologist, and anthropologist, Happy Camp, CA 96039

Black oak plays an important role in both ecological function and Traditional Indigenous Lifeways across its range including with the Karuk people in present-day northern California. The Karuk have tended black oaks using traditional ecological practices, such as cultural fire, to promote large, full-crowned, acorn producing individuals since time immemorial. These legacy trees, compared to younger individuals, facilitate a disproportionate amount of cultural and ecosystem services including wildlife

habitat, acorn production, and fire adaptive stand structure. However, the cessation of frequent, low-intensity Indigenous burning and other Indigenous stewardship practices over the last 100 years of Euro-American colonialism has led to a substantial decrease in the vigor, quantity, and quality of cultural resources including legacy black oaks. These trees are now at a higher risk of mortality from conifer encroachment, moisture stress, and high severity wildfire.

Restoration of black oak groves is a priority of The Karuk Department of Natural Resources (K-DNR). This research, co-developed by K-DNR, Pikyav Review Committee, and Oregon State University, use qualitative social science research methods to determine what the cultural and ecological priorities are of Karuk cultural practitioners when it comes to the revitalization of black oak stewardship practices.

Research findings illuminate a constellation of values held by Karuk cultural practitioners that, when intact, represent a robust ecocultural system of oak grove stewardship. This research also identifies current barriers to stewardship as seen by Karuk practitioners. The intention of this qualitative synthesis is to inform Karuk-directed black oak revitalization efforts within these historically stewarded oak groves.

Thurman, Lindsey

PERSIST IN PLACE OR SHIFT IN SPACE? APPLYING ASSESSMENTS OF SPECIES ADAPTIVE CAPACITY TO INFORM CLIMATE ADAPTATION PLANNING

Julian Olden, School of Aquatic and Fisheries Sciences, University of Washington, Seattle, WA 98195; Joshua Lawler, Department of Environmental and Forest Sciences, University of Washington, Seattle, WA 98195; Erik Beever, Northern Rocky Mountain Science Center, U.S. Geological Survey, Bozeman, MT, 59715

Adaptive capacity (AC) is the intrinsic ability of a species to cope with or adjust to changing climate conditions. Research and outreach to the broader practitioner community has revealed a fundamental, yet heretofore unmet, need for guidance on how to assess AC and incorporate that information into conservation planning and decision-making. In response, a large, international working group was formed with the task of improving the application of AC information in natural-resource management. From this working group, we developed a framework for evaluating species' AC based on a suite of attributes (or traits) that can be applied to any taxon (e.g., plants, animals, invertebrates, etc.). In partnership with state fish & wildlife agencies in Oregon, Washington, and Idaho, we conducted a regional evaluation of AC for priority species and report on those results and opportunities for identifying AC-informed conservation actions.

Tracy, Patrick

DYNAMICS OF A ROTATING CUBIC MAGNET LEVITATING ABOVE A TYPE-II SUPERCONDUCTOR DUE TO THE MEISSNER-OCHSENFELD EFFECT

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A superconductor is a material that experiences no electrical resistivity at temperatures below a material-specific critical temperature. Additionally, magnetic field lines within a material are expelled as it transitions from its normal state into its superconducting state due to the Meissner-Ochsenfeld effect. A type-II superconductor allows limited magnetic field lines to remain inside it in quantized amounts

called vortices. Vortices can snag on defects within the material as the source of the magnetic field moves, which is called pinning. In this study, we investigated the strength of vortex-pinning by measuring its impact on the rotational dynamics of a cubic magnet levitating above a superconducting $YBa_2Cu_3O_7$ pellet. A torque was briefly applied to the levitating magnet, causing it to rotate about the direction of its magnetic moment. Vortex pinning applied a counter torque that opposed the magnet's rotation as field lines moved through the superconductor, which caused the magnet to gradually stop spinning. A Canon Rebel T5I with a 60-fps frame rate was used to track the rotational motion, and video analysis methods were used to measure the angular velocity of the rotating magnet as a function of time; these measurements were used to calculate the vortex-pinning torque. This experiment was repeated for three different angles between the magnetic moment axis and the surface of the superconductor. A greater vortex-pinning torque was applied to the cubic magnet as the angle between the magnetic moment axis and the surface of the superconductor increased.

Trevarrow, Bill

OPEN AUTOPOIETIC SYSTEMS IMITATE LIFE'S PROCESSES

Bill Trevarrow, retired in Eugene, OR

Many important aspects of "living things" can be imitated by self-sustaining autopoietic chemical systems. A chemical systems approach provides an overview of how complex molecular machines work, and how they could be assembled from molecules up.

Luisi (2016) described (paraphrased) life as "a self-sufficient autopoietic chemical system, able to make its own way in its environment, using environmental resources". Open autopoietic chemical systems are able to use energy and higher-level structure to forestall the effects of entropy (Schrödinger, 1944). This results in increased individual system persistence. If an autopoietic system makes more replacement parts than are needed, excess parts not needed for replacement, go to growth in size. Adding the ability to successfully divide leads to reproduction and ultimately competition.

The natural chemical systems (natural multimolecular units) discussed here are defined by their membrane envelopment. The contained space plus the enveloping molecules define the system's components. The membrane is a thermodynamic barrier to diffusional losses.

The earliest autopoietic chemical systems were simple assemblies of chemicals, able to make more of all their constituent molecular parts (not obtainable from their environment). The origination of such early chemical systems would have been greatly aided by extraordinarily beneficial nursery environments.

Gánti identified metabolism, isolation, and inheritance as important parts of a self-sustaining chemical system in the 1970s. These different subsystems are composed of specific molecules.

Although the first assembled systems are expected to be as simple as possible, additional components could add functions, if they mesh with the pre-existing components.

Trevarrow, Bill

PHYSICAL EVENTS LEADING TO AUTOPOIETIC CHEMICAL SYSTEMS

Bill Trevarrow, retired, Eugene, OR 97402

Terrestrial life probably emerged in a series of thermodynamically driven transitions, each more closely approaching the autopoietic systems that we perceive as life today.

Early in Earth's history, geochemical serpentinization reactions involving liquid water and newly formed rocks generated CO2 and H2, and other chemicals. This started the complexification of earthly organic chemistry. Mineral catalysts and structural geochemical conditions enabled the further synthesis of 150-250 small organic molecules, in situ, from this starting material. Among these were many core metabolic chemicals. Amphiphilic lipid (membrane) molecules and some amino acids are only one or two reactions removed from the core metabolism.

High enough concentrations of membrane molecules could lead to the emergence of membranes and vesicles. A vesicle envelopes a set of aqueous molecules in its thermodynamically distinct lipophilic region. This provides a metabolic cost-free barrier to losses from molecular diffusion.

These vesicle enclosed spaces are natural chemical units. Each of these units are potentially an autopoietic chemical system, as well as a molecularly distinct selectable individual, and a potential platform for hosting cybernetic molecular controls.

An ideal origin site would support the formation of potentially autopoietic systems with a constant supply of molecules for organic syntheses and chemical energy to drive reactions. It must also provide waste removal services. This would ease early steps in the assembly of these complex systems by reducing what they are required to do.

LUCA was vastly more sophisticated than these minimally autopoietic or reproductive systems.

Verschuyl, Jake

ARE BIRDS SENSITIVE TO CHANGES IN FOREST MANAGEMENT INTENSITY?

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Intensively managed tree plantations can supply wood products to an expanding human population while reducing pressure on natural forests. Herbicides are used to accelerate growth of crop trees by suppressing competing vegetation but early-seral avian communities may be negatively affected by simplification of the plant community following herbicide application. To better understand this, we used a large-scale randomized complete block experiment to investigate avian responses to variation in stand management intensity post-harvest in the Pacific Northwest, USA, 2011-2020. We evaluated how abundance and species richness changed for 54 species in response to three levels of plant cover reduction (Light, Moderate, and Intensive herbicide applications) in relation to a control without herbicide. By year 5 of stand growth, we found no evidence of differences in abundance of non-leaf-gleaning species on the Moderate or Intensive treatments compared to the control. By year 6 all treatments had similar numbers of species present. By year 8, there was no evidence of on-going reductions in abundance for leaf-gleaning species in Moderate or Intensive treated stands. Substantial block-specific variation suggests that other factors may mediate treatment effects for individual stands.

Breeding populations of the 54 species occurred on all treatments, abundance differences between treatment and control stands for leaf-gleaning species were minor in the last three years of study. We emphasize that demographic information is required to compare relative contributions of treatment and control stands to stands originating from natural disturbance, and to determine how all stand types contribute to maintaining regional bird populations.

Waitt, Richard

LARGE FLOWS AT MOUNT ST. HELENS 18 MAY 1980 TIMED BY ASHFALL MARKER BEDS AND EYEWITNESSES.

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1980s and later field research refines timing of large flow deposits during the first minutes of Mount St. Helens' cataclysmic 18 May 1980 eruption. Eyewitness accounts and photos partly time deposits of the lithic pyroclastic surge layers A1 and A2, ashfall-silt layer A3, pumiceous central-column fall unit B, and ignimbritic ashcloud unit C. Such identifiable "marker beds" interbed with deposits of giant debris avalanches, a catastrophic water wave, and lahars. The pyroclastic surge leveled a coniferous forest across 600 km 2 in four minutes, depositing layers A1 and A2 [08:35–08:39]. The surge carried (saltating?) coarse forest wood and rocks 1–2 m and more above ground, trapped there by some vehicles. A convective column rose 25 km and spread into a mushroom cloud from which layer A3 fell widely [08:50–10:00]. Three great landslides fragmented into enormous debris avalanches. On proximal ridges the fast avalanches slung off a marginal veneer. Upvalley avalanche margins came to rest during A1, downvalley ones during A2, distal ones after A2. The avalanche(s) catastrophically displaced Spirit Lake water to as high as 265 m above old lake level after A1 and during A2. This water and logs flooded back to the now-filled-in lake basin during and after A2 and before A3. The hot surge melted snow on the upper volcano flanks to form slushy lahars after A2 but before A3. The North Fork Toutle lahar formed as water poured from the avalanches before, during, and after A3 fell—starting thus hours before first seen from search helicopters.

Waters, Susan

PRESCRIBED FIRE INCREASES RESILIENCE OF PLANT-POLLINATOR NETWORKS IN WESTERN WASHINGTON PRAIRIE-OAK SAVANNAH.

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Restoration efforts often attempt to alter the composition and structure of invaded plant communities, with the hope that restored communities will be more resilient to future stressors. However, the impact of restoration activities such as prescribed fire on plant-pollinator interaction network structure and robustness is poorly understood. We examined the effects of restoration-focused prescribed fire and native forb replanting on plant-pollinator network structure in a restoration chronosequence in western Washington prairies. We then simulated the effects of three plant species loss/removal scenarios on secondary extinction cascades in the networks: removal of an abundant exotic forb, removal of an abundant forb designated a noxious weed, and loss of the rarest native forb. We compared these to control scenarios.

Pyrodiversity, proportion of area recently burned, and cumulative replanting effort (plugging and seeding) over the prior 10 years increased (1) increased the abundance and diversity of floral resources, (2) increased the frequency and diversity of pollinator visits, (3) decreased network connectance and nestedness. Pyrodiversity also buffered networks against secondary extinction cascades. Rare forbs contributed disproportionately to network robustness in less restored prairies, while removal of typical "problem" plants like exotic and noxious species had relatively small impacts, particularly in prairies with a long history of restoration activities. Restoration actions aimed mainly at improving the diversity and abundance of pollinator-provisioning plants may also produce plant-pollinator networks with increased resilience to plant species losses.

Weets, Marlee

PRENATAL TESTOSTERONE EXPOSURE IN FEMALES REDUCES OVARIAN FUNCTION

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Polycystic ovarian syndrome (PCOS) is an endocrine disease that impacts 7-15% of females worldwide and is the leading cause of infertility among women of reproductive age. Symptoms of PCOS include high testosterone levels, irregular menstrual cycles, infertility, and cystic ovaries. Previous research has shown that prenatal exposure to dihydrotestosterone (DHT) in females causes changes in the estrous cycle and to ovarian morphology suggesting anovulation or reduced ovulation. To examine ovarian function and morphology, we used a PCOS mouse model that uses prenatal exposure of DHT. We also included flutamide (an androgen antagonist) to examine mechanism of action. Dams were treated on gestational days 16.5, 17.5, and 18.5 with vehicle control, 250 mg DHT, 3 mg Flutamide or a combination of DHT+Flutamide. Superovulation was induced following standard procedures before puberty (aged 7 weeks) or as adults (aged 4.5 months) and ovulated oocytes were counted. Ovaries were also collected, fixed in formalin, and sectioned to assess ovarian morphology. Preliminary data has shown that the prepubertal DHT treated females have reduced numbers of oocytes ovulated ($p<0.05$) compared to controls. By adulthood, there are no significant differences in oocytes ovulated, suggesting that prenatal treatment with DHT does affect early ovarian function. Breeding studies are currently being set up to examine *in vivo* fertility rates.

Yamanoor, Srihari

LESSONS FROM LOW-COST PROTOTYPE DEVELOPMENT FOR CITIZEN SCIENCE AND DIY PROJECTS

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Citizen scientists acting as groups and individuals are increasingly exploring avenues for contributing to the progress of science by designing, implementing, participating and/or commenting on research work conducted by formally trained scientists in various fields across climate change, environmental and ecological studies, public health, shelters and living spaces, among others. Citizen Science endeavors especially improve awareness and acceptance of science, as well as the research work that is helping society develop an understanding of large- and small-scale problems, while also developing solutions to such problems. In a similar vein, recent incidents such as the pandemic have demonstrated the need for responsive, low-cost solutions to population health, alongside similar requirements for widely prevalent

chronic health conditions such as diabetes and hypertension. Certain projects require already accessible tools such as smartphones, reducing the barriers to entry, retention and participation scaling. Projects requiring hardware can be limited, at any scale, owing to costs, ease of assembly and others. The authors will demonstrate examples of Minimum Viable Products (MVP) and prototypes, designed with low-cost, high-fidelity as the aim. Initial costs of prototypes tend to be high, but with volume, these costs can be lowered. Demonstrated are, the use of Linux-based Single Board Computers (SBCs), microcontrollers, low-cost Printed Circuit Board Assemblies (PCBAs), and low-cost electromechanical components to construct the prototypes. Examples include step counters for physical activity monitoring, non-contact and contact thermometers, air quality monitors and smart devices. The design philosophy emphasizes open-designs with all codes and component data publicly available for consumption and expansion.

Yu, Xinhui

GEOGRAPHIC VARIATION IN THE CHEMISTRY OF PACIFIC NORTHWEST ENDEMIC CYANOLICHENS

Xinhui Yu, Kerry McPhail, Oregon State University, Dept Pharmaceutical Sciences, Corvallis, OR, 97331; Eleonore Clara Jacob, Zane T.Walker, Bruce McCune, Oregon State University, Dept Botany and Plant Pathology, Corvallis, OR, 97331.

Lichens, comprising a symbiosis of fungi and photosynthetic partners (algae and/or cyanobacteria), are a diverse and abundant group in the Pacific Northwest. Lichen are increasingly recognized as sensitive sentinels of environmental change. Our ongoing study uses liquid chromatography and high-resolution tandem mass spectrometry (LCMS/MS) to investigate the effect of geography, and ultimately environmental changes, on the production of specialized metabolites in cyanolichens of the Peltigeraceae family. The potential biological activity of complex chemical extracts from these cyanolichens is also under-investigation. Chemical extracts and their ‘first tier’ chromatographic fractions were tested in parallel against a panel of BSL2 human bacterial pathogens. Preliminary test results indicated that coastal individuals from Oregon produced more antibacterial secondary metabolites compared to their inland counterparts. Cheminformatic analyses of LC-MS/MS and antibacterial assay data were utilized to assign putative antibacterial compounds to chemical structure classes. These findings suggest that geography plays a crucial role in the selectivity and production of lichen secondary metabolites.
