Expanding Science:

Diverse Perspectives for Effective Solutions in an Era of Rapid Change

Lupinus rivularis bloom two years following prescribed fire in the Bald Hills region, Redwood National Park, California. Photo by Jeff Kane

Program and Abstracts

92nd Annual Meeting of the Northwest Scientific Association

March 16-17, 2022

Cal Poly Humboldt, Arcata, California (Virtual)

Thanks to All Who Helped!

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

NWSA Local Planning Committee

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Lucy Kerhoulas, Local Program Committee, Cal Poly Humboldt
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Nick Kerhoulas
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Student Volunteers

Kelsey Fletterick
Jackson Carrasco
Janelle Chojnacki
Katie Terhaar

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NWSA — Linking Scientists throughout the Northwest

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

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

A Special THANK YOU is extended to our 2021-2022 Board of Directors

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LETTER FROM THE PRESIDENT OF THE ASSOCIATION

Welcome to the 2022 annual meeting of the Northwest Scientific Association. This is the 92nd annual meeting of the organization and the first to be held as a virtual annual meeting. Although we hope that we can resume in person meetings in the future, I hope some of the lessons we learned from putting on this meeting will allow us to improve our future programs to increase our ability to foster science in the Northwest.

Special thanks to the local program committee headed by Jeff Kane at Cal Poly Humboldt in Arcata, California (note the brand new name of the institution). Jeff, Lucy Kerhoulas, and Rosemary Sherriff of the local program committee (including our NWSA webmaster, Emily Wolfe) did an amazing job in organizing the meeting, including a major effort to switch to a virtual format when the number of Covid-19 cases increased to a level that made it untenable to plan for an in-person meeting.

One advantage to a virtual meeting is we can make the presentations available to a broader audience than would have happened with an in-person meeting. We were able to make registration free to all members and keep the registration cost low for non-members. If you are not a member, I hope you will consider joining (www.northwestscience.org).The organization sponsors an annual meeting, publishes a journal (Northwest Science), awards student grants, and participates in other activities (Facebook, Twitter, website). Last year we also sponsor several webinars. Our website and other social media activities feature photos from members (www.northwestscience.org/announcements) so please consider submitting some of your photos to share with the rest of us.

Our organizations By Laws require we hold an annual business meeting for our members and that has traditionally been held in conjunction with our scientific meeting. This year our business meeting will also be held virtually (during the lunch period on Thursday). Check the meeting program for the link and please join us. It is an opportunity to hear about activities of the organization and provide feedback on what you would like to see happen in the future.

Remember to check back to our meeting information page to be able to watch presentations that you missed. And our website now has a "Contact us" tab to make it easy to provide feedback. So, stay in touch . . .

Enjoy the meeting!

Constance Harrington
President NWSA

NWSA 92nd Annual Meeting — Program Overview

Cal Poly Humboldt, Arcata (Virtual)

Expanding Science: Diverse Perspectives for Effective Solutions in an Era of Rapid Change

Note: all posted times are Pacific Daylight Time

WEDNESDAY, MARCH 16

8:30-9:00am – Welcome

9:00am-12:00pm – Plenary Session

Paul Hessburg – Wildfire and climate change adaptation of western US Forests

Keith Parker – Traditional ecological knowledge in the Klamath River Basin: A salmon and lamprey case study

Faith Kearns – Getting to the heart of science communication

1:00-3:00pm – Oral Presentations

Special Session: Climate and Climate Change
Contributed Session: Wildlife
Contributed Session: Ecosystem Dynamics and Management

THURSDAY, MARCH 17

9:00am-12:00pm – Oral Presentations

Special Session: Fostering Fire Resilience in the Northwest
Contributed Session: Ecosystem Dynamics and Management
Contributed Session: Fisheries

12:00-1:00pm – Business Lunch, all welcome

1:00-3:00pm – Oral Presentations

Special Session: Fostering Fire Resilience in the Northwest
Special Session: Long-term Dynamics of Ecosystems of Northwestern North America

Biographies of Plenary Speakers

Paul Hessburg is a Senior Research Ecologist with the USDA-FS, Pacific Northwest Research Station, and Full Professor (Affiliate) at the UW-School of Environment and Forest Science, OSU-College of Forestry, and WSU – School of Environment. Paul is the incoming President of the International Association of Fire Ecology (AFE). His research explores wildfire and climate change effects on landscape dynamics, the structure and organization of historical, current, and future landscape resilience, decision support modeling for forestry applications, and the ecology of forest reburning. He holds a PhD from Oregon State University, a BS from the University of Minnesota, is married with grown kids, and he and his wife Mary enjoy many outdoor pastimes and delightful grandchildren. You can follow his research here: https://www.researchgate.net/profile/Paul-Hessburg

Keith Parker is a Senior Fisheries Biologist for the Yurok Tribe in northern California. Keith earned his M.S. degree in the Department of Fisheries Biology at Cal Poly Humboldt (formerly Humboldt State University). He was the recipient of the prestigious National Science Foundation Graduate Research Fellowship and the Switzer Foundation Environmental Fellowship. His research merges Traditional Ecological Knowledge and contemporary science approaches with a focus on fisheries biology, ecology, and conservation genetics.

Faith Kearns is a scientist and science communication practitioner who writes about water, wildfire, climate change, and people. In addition to her recent book, *Getting to the Heart of Science Communication* (Island Press), her work has been featured in the New Republic, On Being, Bay Nature, and more. She also co-hosts the podcast Water Talk. Kearns holds a BS in environmental science, geology, and political science from Northern Arizona University and a PhD from the Department of Environmental Science, Policy, and Management at the University of California, Berkeley. She has held previous positions at the Ecological Society of America, the U.S. Department of State as an AAAS Science and Technology Policy Fellow, UC Berkeley, and the Pew Charitable Trusts. She currently works with the UC California Institute for Water Resources.

Special Session:
Climate and Climate Change
Wednesday, 1-3 pm

Moderator: Rosemary Sherriff
Student volunteer: TBD

1:00, Michael Town – Air temperature and snow extent from iButton temperature measurements on the southern aspect of Mt. Baker, WA USA

1:20, Constance Harrington – Effect of June 2021 heat event on diameter growth of trees in western Washington and Oregon

1:40, Robert Andrus – Climate effects on western red cedar decline: evidence from tree rings

2:00, Daniel Gavin – Geological and historical evidence of a record flood in 1867 in western Washington

2:20, Matthew Reilly – Contemporary forest change in a diverse montane landscape: Lesson learned from the Russian Wilderness, northern California, USA

Special Session:

Fostering Fire Resilience in the Northwest

Thursday, 9-12 am & 1-3 pm

Morning
Moderator: Keala Hagmann
Student volunteer: Jackson Carrasco

9:00, Alan Tepley – Regional variation in the strength of fire-vegetation feedbacks and resistance to reburning across the North American boreal forest

9:20, Keala Hagmann – Contemporary wildfires further degrade resistance and resilience of fire-excluded forests in central and southcentral Oregon

9:40, Brian Harvey – Forest fires in western Cascadia: Drivers, characteristics, and indicators of post-fire resilience

10:00, Melissa Jaffe – Fate of early twentieth century high-severity fires: Fuels and forest structure of different fire histories

10:20, Andrew Merschel – Old-growth Douglas-fir (*Pseudotsuga menziesii*) forests developed with frequent mixed-severity fire in the southern western Cascades of Oregon, USA

10:40, James Johnston – New fires histories from the western Oregon Cascades

11:00, Graham Frank – Diversity and composition of early seral forest bird assemblages: Does disturbance type matter?

11:20, Robert Van Pelt – Similarities and differences of post-fire response between coast redwood and giant sequoia using the August 2020 lighting siege as an example

11:40, Harold Zald – Long-term tree regeneration responses to thinning and prescribed burning in a Sierra Nevada mixed-conifer forest, California USA

Afternoon
Moderator: Jeff Kane
Student volunteer: Kelsey Fletterick)

1:00, Jill Beckmann – Did large-scale prescribed underburning treatments reduce fire severity at Whiskeytown NRA during the 2018 Carr Fire?

1:20, Heather Rickard – Factors contributing to legacy hardwood mortality following prescribed fire in Karuk Ancestral Territory

1:40, Kelsey Fletterick – The temporal window for post-fire sexual reproduction by conifers

2:00, Madeline Lopez – Investigating seed maturation and mortality: A mechanism for post-fire regeneration in non-serotinous conifers

2:20, Sean Lindley – Facultative serotiny: Predicting successful post-fire recruitment of non-serotinous conifer species as a function of masting behavior and the timing and severity of wildfire

Special Session:

Long-term Dynamics of Ecosystems of Northwestern North America

Thursday, 1-3 pm

Moderator: Dan Gavin
Student volunteer: TBD

1:00, Camille Giuliano – Holocene fire history and links to changes in forest composition and climate in south-coastal British Columbia, Canada

1:20, Katherine Hayes – Establishing baseline patterns of fire in old-growth coast redwood forests using soil carbon and charcoal

1:40, Clarke Knight – Land management explains major trends in forest structure and composition over the last millennium in California's Klamath Mountains

2:00, Patrick Pringle – Tree-ring dating of the electron mudflow, a large clay-rich lahar from Mount Rainier, to late 1507 CE

2:20, John Orcutt – Palaeogale and sexual dimporphism in the carnivoran fossil record

2:40, Jamilla Baig – Paleolimnological history of Gold Lake using geochemical signatures of organic matter, Willamette National Forest, Oregon, USA

Contributed Session:
Wildlife
Wednesday, 1-3 pm

Moderator: Nick Kerhoulas
Student volunteer: Janelle Chojnacki

1:00, Dana Coley – Investigating how bat ectoparasites influence the skin microbiome diversity and composition of Washington state bats

1:20, David Wright – Forest vegetation structure and snowshoe hare relative occupancy in young managed western larch stands in the Northern Rockies

1:40, Sky Button – Monitoring terrestrial salamanders in the Pacific Northwest using aquatic eDNA

2:00, Rachel Zitomer – Forest age and floral resource availability drive native bee abundance and diversity in intensively managed forests of the Oregon Coast Range

2:20, Nicholas Kerhoulas – Comparative biogeography of the southwestern Pacific Northwest

2:40, Janelle Chojnacki – Movement and resource use of an anthropogenically subsidized avian predator and implications for a threatened shorebird

Contributed Session:
Ecosystem Dynamics and Management
Wednesday, 1-3 pm| Thursday 9-12 am

Wednesday (Moderator: Lucy Kerhoulas)

1:00, Andrew Gray – What are the ecological benefits of Wilderness on the west coast?

1:20, Mara Gans – Geotagging the wilderness: exploring the relationship between social media geotags and wilderness visitation in the Alpine Lakes Wilderness, WA

1:40, Richards Pätsch – Bedrock Meadows – Species assembly and functional patterns of a distinct and overlooked vegetation type in the North American Interior Northwest

2:00, Victoria Wagner – Non-native invasions in native prairie grasslands of Alberta, Canada

2:20, Rachelle Lugar – Long term effects of forb-selective herbicides on grassland communities

2:40, Gabriel Roletti – Diversity of conifer responses to drought across habitat and competitive gradients in northern California

Thursday (Moderator: Lucy Kerhoulas)

9:00, Lucy Kerhoulas – Physiological responses to conifer encroachment and removal in a northern California oak woodland

9:20, Jill Beckmann – Douglas-fir encroachment reduces drought resistance in Oregeon white oak of northern California

9:40, Andrew Stubblefield – Monitoring impacts of timber harvest and landslides, Railroad Gulch, Elk River, California

10:00, Yianna Bekris – Impacts of variable-density thinning on understory diversity and non-native plants over 17 years in Olympic Peninsula forests

10:20, Stephen Quick – How is carbon affected by active forest management for old-growth forest conditions?

10:40, Wallis Robinson – Effects of long-term drought on conifers Cross northern California

11:00, Sophia Lemmo – Tree mortality and regeneration trends in northern California

Contributed Session:
Fisheries
Thursday 9-12 am

Moderator: Jose Marin Jarrin
Student volunteer: TBD

9:00, Emily Cooper-Hertel – Assessing Trinity River restoration of juvenile Chinook Salmon habitat with a physical capacity model and considerations for incorporating bioenergetic components

9:20, Z Zenobia – Status of night smelt *Spirinchus starksi* populations in Humboldt and Del Norte Counties

9:40, Katie Terhaar – A characterization of the northern California sandy beach surf zone fish and macroinvertebrate community and the effect of marine protected areas

10:00, Matthew Campbell – The origin and purity of *Oncorhynchus mykiss* in Wood River Basin of central Idaho

10:20, Deon Roche – Post-mortem changes of egg viability in hatchery-raised Rainbow trout (*Oncorhynchus mykiss*)

ABSTRACTS

NWSA ORAL PRESENTATIONS

(*Arranged alphabetically by first author last name*)

CLIMATE EFFECTS ON WESTERN RED CEDAR DECLINE: EVIDENCE FROM TREE RINGS. Andrus, RA, HD Adams, D Henry, AJH Meddens, LR Peach, School of the Environment, Washington State University, Pullman, WA 99164; KB Moffet, School of the Environment, Washington State University, Vancouver, WA 98686; A Holz, Department of Geography, Portland State University, Portland, OR 97201; A Ramirez, Department of Biology, Reed College, Portland, OR 97202. robert.andrus@wsu.edu

Tree mortality and partial tree canopy dieback events are increasing in forested regions across the earth. Events are often associated with warming and drying conditions, but few events have been observed in the Pacific Northwest, USA. In the last five years, western red cedar (*Thuja plicata*) has experienced anomalous canopy dieback and mortality (collectively, WRC decline) in Washington and Oregon, with mortality rates well above background rates. WRC is a culturally, economically, and ecologically important tree species in moist mixed conifer forests in the Pacific Northwest. Warmer and drier annual and growing season climate conditions are hypothesized as potential causes of recent WRC decline. We investigated climate effects on WRC decline using field surveys and tree ring methods in the Washington, Oregon, and Idaho. West of the Cascade Mountains, tree mortality, as indicated by the last tree ring, primarily occurred from 2017-18 in five sites separated by ~400km. The mortality period corresponded to multiple years of drought during the growing season. By comparing radial growth rates of coexisting healthy, partial canopy dieback, and dead trees, we found additional evidence for when radial growth rates of dead and canopy dieback trees diverged from healthy trees. These findings suggest the recent WRC decline is associated with hotter drought conditions that have affected PNW ecosystems and are likely to increase with continued anthropogenic climate change.

PALEOLIMNOLOGICAL HISTORY OF GOLD LAKE USING GEOCHEMICAL SIGNATURES OF ORGANIC MATTER, WILLAMETTE NATIONAL FOREST, OREGON, USA. Baig, J, DG Gavin, PF McDowell, Department of Geography, University of Oregon, Eugene, OR 97403. jbaig@uoregon.edu

Lake-sediment organic matter is affected by terrestrial vegetation present within the lake catchment, aquatic productivity, and the lake's hydrological conditions. A 13-meter-long lake sediment core was collected from Gold Lake, Willamette National Forest, Oregon. Lake productivity was determined for the last 14,700 years by using a total of 171 samples analyzed for total organic carbon (TOC), total nitrogen (TN), $\delta^{13}C_{org}$, and $\delta^{15}N$ at every 10-cm pre-Mazama and at every 5-cm post-Mazama tephra.

The base of the core (14,700-14,000 cal yr BP) following deglaciation is marked by low C:N (<10), high $\delta^{15}N$ (> 1.5‰), and high $\delta^{13}C$ (> -26‰) consistent with little terrestrial input and high aquatic productivity promoted by nitrogen subsidies from the final melting of watershed glaciers. This is supported by the strong correlation between $\delta^{13}C$ and inorganic mass accumulation, which is most likely from diatom production. Following forest establishment in the watershed (10,700 cal yr BP), $\delta^{15}N$ decreases to -0.5 ‰, consistent with high input from cyanobacteria that fix nitrogen from the atmosphere. For most of the core, C:N is negatively correlated with $\delta^{13}C$, as expected if high aquatic productivity enriches dissolved $^{13}CO_2$ and lowers C:N. This correlation is especially evident during the post-Mazama period when the sedimentation rate is very high. The thick Mazama tephra (78 cm) provided abundant silica for high diatom production for several centuries. For the remainder of the Holocene, diatom productivity has a significant role in depressing TOC. After a period of low productivity ($\delta^{13}C$ < -30‰, C: N>12), the late Holocene returned to a high aquatic productivity similar to the post-Mazama period and greater than during the early Holocene. Late Holocene also shows increased inorganic mass accumulation, but it never reaches to the level of core base. This increase in productivity may be due to increased forest fire and increased amount of runoff nutrients into the lake. This detailed record of aquatic productivity adds significantly to understanding of climate change and ecosystem changes in the Oregon High Cascades.

DID LARGE-SCALE PRESCRIBED UNDERBURNING TREATMENTS REDUCE FIRE SEVERITY AT WHISKEYTOWN NRA DURING THE 2018 CARR FIRE? Beckmann, J, MW Wright, P van Mantgem, U.S. Geological Survey, Western Ecological Research Center, Arcata, CA 95521; E Engbar, National Park Service, Redwood National Park, Orick, CA 95555. jjb646@nau.edu

Severe fire weather is on the rise throughout the Western United States. These changing conditions demand a better understanding of how prescribed fire treatments perform under diverse conditions, including the effects of vegetation, topography, and time since treatment under extreme burning conditions. The Carr Fire of July 2018 was one of the most destructive wildfires in California history and burned the entire land area of Whiskeytown National Recreation Area (NRA). Prior to the Carr fire and since 1997, staff at Whiskeytown NRA treated 23% of the 15,756-ha NRA using large-scale prescribed fire treatments (underburns) ranging in size from 40 to 400 hectares. We used simultaneous autoregressive models to describe the effects of these landscape-scale fuels treatments on wildfire severity under extreme burning conditions and across diverse vegetation and topographic settings at Whiskeytown NRA. We found that the most important factor related to 2018 Carr fire severity was time since treatment of underburn treatments, but that treatment effectiveness dissipated rapidly, showing notable effectiveness within 5 years of underburning but virtually no effectiveness beyond 10 years post-treatment. Our models indicated that several additional factors related to severity including vegetation structure, topographic position index, aspect, slope, temperature, and gust speed. However, these effects were relatively minor and models were comparable regardless of the source of vegetation structure data. Our results show that large-scale underburning treatments do reduce wildfire severity even under extreme fire weather conditions but suggest that frequent maintenance intervals are required to maintain treatment effectiveness ahead of severe wildfire events.

DOUGLAS-FIR ENCROACHMENT REDUCES DROUGHT RESISTANCE IN OREGON WHITE OAK OF NORTHERN CALIFORNIA. Beckmann, J, R Sherriff, L Kerhoulas, J Kane, Cal Poly Humboldt, CA 95521. jjb646@nau.edu

Oregon white oak (*Quercus garryana*) is experiencing increasing competition from Douglas-fir (*Pseudotsuga menziesii*) across much of its range, while climate variability and the frequency of extreme droughts are also increasing. An improved understanding of the combined effects of competition, climate, and drought is therefore needed to inform management of oak woodlands. Across a gradient of encroachment in an oak woodland in northwestern California, we used linear mixed effects models to evaluate the effects of competition and climate on Oregon white oak and Douglas-fir tree growth (2002-2016) and drought response (2013-2015). We found that while both species responded negatively to drought, Oregon white oak growth was more resistant to prolonged drought than Douglas-fir growth; and after the first year of drought, drought resistance increased in oaks and decreased in Douglas-firs. In both species, drought resistance declined with increasing Douglas-fir competition and growth was more strongly limited by Douglas-fir competition than climate. For oaks, intraspecific competition decreased growth but increased drought resistance. There were notable differences in the seasonal climate factors related to growth for each species; Douglas-fir competition interacted with late spring temperature, summer precipitation, and previous year climatic water deficit to affect oak growth. We conclude that Oregon white oak may be better suited to future climate conditions than Douglas-fir, although Douglas-fir encroachment will likely continue to reduce Oregon white oak resistance to future drought. Addressing Douglas-fir encroachment in Oregon white oak woodlands will have the benefit of increasing drought resistance and preserving biodiversity under climate change.

IMPACTS OF VARIABLE-DENSITY THINNING ON UNDERSTORY DIVERSITY AND NON-NATIVE PLANTS OVER 17 YEARS IN OLYMPIC PENINSULA FORESTS. Bekris, Y, Department of Geography, Portland State University, Portland, OR 97201; USDA Forest Service Pacific Northwest Research Station Olympia Forestry Sciences Laboratory, Olympia, WA 98512; JS Prevy, USGS Fort Collins Science Center, Fort Collins, CO 80526; USDA Forest Service Pacific Northwest Research Station Olympia Forestry Sciences Laboratory, Olympia, WA 98512; LC Brodie, CA Harrington, USDA Forest Service Pacific Northwest Research Station Olympia Forestry Sciences Laboratory, Olympia, WA 98512. ybekris@pdx.edu

In the Pacific Northwest, management practices have extensively transformed old-growth forests into second-growth stands lacking the structural heterogeneity, plant diversity, and species richness critical to wildlife habitat. The Olympic Habitat Development Study on Washington State's Olympic Peninsula was designed to address this issue by accelerating the development of specific old-growth features in second-growth stands using variable-density thinning. A potential concern is the introduction of non-native plants, which can have negative ecological and economic impacts. We examined how variable-density thinning influences desirable forest characteristics, such as increased plant species richness, versus the less desirable effects of non-native plant species introduction. We tested two hypotheses regarding plant invasions. First, thinning would promote establishment of non-native species, but their

abundance would eventually decline. Second, thinning would initially promote understory richness of all species, although richness would decline over time with canopy closure and increased tree seedling and shrub cover. We found that richness and cover of non-native species initially increased after thinning, peaking at 16 species in thinned treatments in year three. By year 17, however, only 11 species remained throughout the seven 6.5-ha treatment plots sampled, and cover was negligible. As predicted, species richness increased following thinning, but contrary to our hypothesis, native species richness remained elevated through year 17. Native species diversity also increased following thinning and remained higher in thinned treatments than controls through year 17. Our results show that enhancement of native understory richness and diversity persists while increased non-native richness and cover is temporary following variable-density thinning.

MONITORING TERRESTRIAL SALAMANDERS IN THE PACIFIC NORTHWEST USING AQUATIC DNA. Button, S, J Piovia-Scott, School of Biological Science, Washington State University Vancouver, Vancouver, WA 98686; C Goldberg, School of the Environment, Washington State University, Pullman, WA 99163. sky.button@wsu.edu

Environmental DNA (eDNA) is a critical tool in conservation science due to its ability to detect rare and secretive species that would be infeasible to study otherwise. However, aquatic eDNA has rarely been used to study terrestrial amphibians, and has never been tested for terrestrial salamanders. We assessed aquatic eDNA as a tool for studying terrestrial Coeur d'Alene salamanders (*Plethodon idahoensis*) and Van Dyke's salamanders (*Plethodon vandykei*) at sites with known populations in the Northern Rockies and Cascades. These species rarely enter watercourses but inhabit moist soil at the edges of seeps and headwater streams. For each species, we collected 2-3 eDNA samples on each of 3-5 visits made to six occupied sites. For *P. idahoensis*, aquatic eDNA-based detection reached 83% in May and October, was more efficient than daytime visual encounter surveys, and had similar efficacy to night-time visual encounter surveys for detecting this species. For *P. vandykei*, eDNA yielded higher detection rates (67%) than day or night-time visual encounter surveys (33%) at seeps and first order streams (n = 3) during and one month after peak snowmelt, but failed to detect this species later in the year and at larger streams. Our results suggest that aquatic eDNA is useful for detecting our study species when used complimentary to visual encounter surveys, despite habitat and timing-specific caveats. We plan to expand eDNA sampling for *P. vandykei* to 40 historically occupied sites in 2022 to better understand how current occupancy and eDNA-based detection relate to land use and habitat types.

THE ORIGIN AND PURITY OF *ONCORHYNCHUS MYKISS* IN THE WOOD RIVER BASIN OF CENTRAL IDAHO. Campbell, M, Idaho Department of Fish and Game, Eagle, ID 83616; T Delomas, USDA ARS National Cold Water Marine Aquaculture Center, Kingston, RI 02881; M Peterson, Idaho Department of Fish and Game, Magic Valley Region, Jerome, ID 83338; K Meyer, Idaho Department of Fish and Game, Nampa Research Office, Nampa, ID 83686. matthew.campbell@idfg.idaho.gov

The origin and taxonomic identification of trout within the Wood River basin of central Idaho has been in question for more than 120 years. The earliest surveys described specimens from the Wood River as cutthroat trout *Oncorhynchus clarkii* (Gilbert and Evermann 1894). Later surveys described them as rainbow trout *O. mykiss* and based on meristic examination of a single museum specimen, it was suggested they were a relict form of redband trout (Behnke 1979). Genetic investigations conducted over the last 30 years, using a variety of genetic markers, suggested they were Columbia River redband trout *O. m. gairdneri*, but had been extensively introgressed or replaced with coastal hatchery rainbow trout *O. m. irideus*. In an attempt to disentangle the various hypotheses of native contemporary, native relict, non-native, or some admixture between native and non-native forms, we greatly expanded the sampling and genetic screening that had been completed in previous studies. Our results suggest that *O. mykiss* are native to the Wood River Basin, have been isolated for a long period of time, and represent a unique, previously undescribed lineage of *O. mykiss*. Surprisingly, despite extensive hatchery stocking throughout the basin, introgression from non-native hatchery rainbow trout of coastal origin appears limited. We discuss management and conservation implications for current populations within the basin.

MOVEMENT AND RESOURCE USE OF AN ANTHROPOGENICALLY SUBSIDIZED AVIAN PREDATOR AND IMPLICATIONS FOR A THREATENED SHOREBIRD. Chojnacki, J, Department of Wildlife, Cal Poly Humboldt, Arcata, CA 95521. jc726@humboldt.edu

Common ravens (*Corvus corax*) are intelligent, synanthropic predators heavily subsidized by human activity throughout their range. Because of their attraction to human food resources, raven populations are increasing in North America, which has intensified predation risk for many protected species, including a federally threatened shorebird; the Western snowy plover (WSP, *Charadrius nivosus nivosus*). The breeding population of WSP in northwestern California has continued to fall below recovery goals and ongoing monitoring consistently reveals raven nest predation to be the highest direct cause of WSP reproductive failure. The correlation between human food subsidies and raven use of WSP breeding areas has never before been quantified, so this project is using GPS units to track the movement and habitat use of individual ravens captured from WSP nesting beaches in Humboldt County to evaluate raven use of human food resources and to better understand the factors influencing high raven abundance. Preliminary results from the first year of data collection indicate that surrounding landcover features as well as point sources of human food subsidies have strong influences on raven foraging activity and raven densities and these preliminary results strongly suggest that mitigating raven predation through site-specific strategies that incorporate surrounding landcover features as well as raven ecology will be the most effective for promoting higher WSP reproductive success in the future.

INVESTIGATING HOW BAT ECTOPARASITES INFLUENCE THE SKIN MICROBIOME DIVERSITY AND COMPOSITION OF WASHINGTON STATE BATS. Colley, D, Department of Biology, Eastern Washington University, Cheney, WA 99004. dcolley3@ewu.edu

White-Nose Syndrome (WNS), caused by the psychrophilic pathogenic fungus *Pseudogymnoascus destructans* (Pd), has killed millions of bats in the eastern United States since its initial introduction in 2006 and recent expansion into the western United States. Understanding the factors that contribute to the spread of Pd and risk of infection is crucial for management of WNS as it becomes more pervasive throughout the United States. Bat ectoparasites, such as bat mites and bat flies, are omnipresent in bat populations, yet the relationship between these ectoparasites and bat health is still unknown. We examined the relationship between bat ectoparasites and the skin microbiome in relation to WNS infection risk in Washington state bats. We hypothesized that bats with ectoparasites would have a decreased skin microbiome diversity thus increasing their susceptibility to Pd infection. We collaborated with the Washington Department of Fish and Wildlife during their annual WNS surveillance in Spring 2021, sampling 147 bats representing five different species across 10 bat roosts in Washington state. Preliminary data indicate that certain bat species are more likely to be infested with ectoparasites than others, especially *Eptesicus fuscus* and *Myotis volans*. Currently, we are determining whether ectoparasites decrease the skin microbiome diversity of these bats using next-gen sequencing techniques. Using culturing methods, we are also isolating culturable bacteria from the skin of these bats for comparison to the sequenced microbiome to understand the culturable bacterial community. This information may be valuable for the development of probiotic therapies to treat WNS in the future.

ASSESSING TRINITY RIVER RESTORATION OF JUVENILE CHINOOK SALMON HABITAT WITH A PHYSICAL CAPACITY MODEL AND CONSIDERATIONS FOR INCORPORATING BIOENERGETIC COMPONENTS. Cooper-Hertel, E, D Gaeuman, K De Julio, A Martin, Yurok Tribe Fisheries Department, Klamath, CA 95548; J Boyce, D Goodman, N Som, US Fish and Wildlife Service, Arcata, CA 95521; J Alvarez, Hoopa Valley Tribal Fisheries Department, Hoopa, CA 95546. ecooper@yuroktribe.nsn.us

The Trinity River Restoration program is tasked with recovering salmonid populations through mechanical restoration and flow management targeted in the 64-km reach below Lewiston Dam, known as the restoration reach. Restoration strategies are intended to evolve through adaptive management regarding habitat assessment, restoration action, and rehabilitation effectiveness monitoring. Rearing habitat is hypothesized to be most limiting to juvenile salmonid production in the Trinity River. We used a spatially-explicit, flow specific Capacity model defined by depth, velocity, and in-water escape cover to compare habitat between specified areas and differential flow durations for juvenile Chinook Salmon (*Oncorhynchus tshawytscha*). Under current management, winter baseflow limits Capacity during 70% of the rearing period, especially for the fry life stage, and we found that fry Capacity tends to be limited over a wider and more frequent range of flows in downstream reaches. Generally, the relationship between Capacity and flow reflects greater Capacity values at lower flows, followed by a negative relationship up to around 2,000 cfs before becoming positive. Regarding implications for restoration and flow management, this suggests that low-flow habitat is superior to mid-range flow habitat for rearing juveniles. However, other studies show profitable feeding locations for drift foraging fish can be lacking during lower streamflows, and therefore incorporating this dynamic into habitat assessment can better predict juvenile

salmonid densities. Further research with recently approved funding will go beyond decades-long approaches to habitat assessment by incorporating bioenergetic variables to physical models that will refine salmonid habitat valuation and implications for management.

THE TEMPORATL WINDOW FOR POST-FIRE SEXUAL REPRODUCTION BY CONIFERS. Fletterick, K, D Greene, J Kane, Department of Forestry and Wildland Resources, Cal Poly Humboldt, Arcata, CA 95521. david.greene@humboldt.edu

While the majority of recent severe fires in the West have been poorly recruited, nonetheless even those burns are typically well-stocked near the edges where seed dispersal is less constrained. Given the shade of the growing recruits and reinvasion by granivores, at what time after fire does the paucity of light and the increased granivory preclude subsequent germination? We examined white spruce (Picea glauca) in dense stands at the edge of two fires in British Columbia 16 or 18 years after the last burn, as well as Douglas fir (*Pseudotsuga menziesii*) regeneration at a 14-year-old fire edge in California. For all three fires we also had estimates of annual cone production since the last burn which we could translate into viable seed production. At each fire we sampled about 100 stems, examining their basal rings. Recruit densities at the time of sampling were high: 2 to 5 stems per m^2. Light at the ground surface averaged only 2% of the radiation in the open. At all three fires, the cumulative number of recruits had reached 87% by the fifth year since fire and 98% by the 8th despite the occurrence of substantial subsequent seed crops. As expected, the estimated cumulative survivorship (from seed to censused recruit) as a function of time since fire declined rapidly from a high of about 0.01 for early arriving cohorts to essentially 0 by the 9th year following fire. In summary, where recruitment is dense, such as with serotinous species or near burn edges for non-serotinous species, the window for invasion is about five years. It is not clear that increasing shade is the only driver of this temporal trend in survivorship; reinvasion by granivorous mammals may also pose a non-trivial constraint.

DIVERSITY AND COMPOSITION OF EARLY SERAL FOREST BIRD ASSEMBLAGES: DOES DISTURBANCE TYPE MATTER? Frank, GS, MA Krawchuk, Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR 97331. graham.frank@oregonstate.edu

Early seral forests generated by stand-replacing disturbances can be the most biologically diverse stage of forest development in the Pacific Northwest. Some early seral associated taxa are supported by timber harvesting, including intensive forest management regimes on private industrial timberlands and post-fire salvage logging. However, management alters the structure, composition, and temporal characteristics of the early seral period and it is unclear to what degree anthropogenic forms of early seral support the biodiversity associated with their closest natural counterpart in the Pacific Northwest, high severity wildfire. As part of a multi-taxa study of early seral biodiversity on private and public lands in southwest Oregon, we conducted avian point counts during the spring breeding season across a 220-year chronosequence of young forest development following high severity fire or intensively managed clearcutting, and 6-8 years after post-fire salvage logging. Preliminary results from a multispecies occupancy model suggest that intensively managed clearcuts initially support

fewer species than recent burns. However, richness increased with post-harvest stand development, and older clearcut stands may support as many or more species than older burns. We found similar trends for richness of leaf-gleaning insectivores, a guild of conservation concern, likely tracking differences in vegetation development. Overall, differences in community composition between disturbances were greatest for the most recently disturbed stands but diminished with stand age, reinforcing the idea that management alters the temporal characteristics of early seral wildlife assemblages. Understanding variability in early seral forest habitat will inform coarse-scale conservation planning, and tradeoffs between conservation and production.

GEOTAGGING THE WILDERNESS: EXPLORING THE RELATIONSHIP BETWEEN SOCIAL MEDIA GEOTAGS AND WILDERNESS VISITATION IN THE ALPINE LAKES WILDERNESS, WA. Gans, MA, Cultural and Environmental Resource Management, Central Washington University, Ellensburg, WA. mara.gans@cwu.edu

Many have raised concerns about the impact of geotagged social media images on public lands. They claim that geotags increase recreational visitation which subsequently contributes to negative recreational impacts including crowding, trampled vegetation, erosion, and litter. Others, however, claim that geotagging on social media has made the outdoors more accessible to less privileged communities and raise concerns that restricting geotags will perpetuate the exclusion of certain groups from nature. This debate is particularly relevant to federally designated wilderness. Wilderness is legally defined as "untrammeled by man," and this problematic construction has helped justify indigenous land dispossession and restricted access for other marginalized populations in wilderness areas. This paper will present the results of research that explores the relationship between geotags, visitation, and the perception of recreational impacts within the Alpine Lakes Wilderness in Washington. It uses a GIS kernel density analysis to determine which locations are most frequently geotagged on Flickr and Instagram and then surveys visitors at these sites to ascertain if geotags played a role in individuals' decisions to visit. It also explores whether recreational impacts negatively affect visitor experience at these sites and explores visitors' expectations for wilderness. The findings of this study suggest that social media does play a role in some visitors travel decisions, however few visitors consider geotags specifically when making their decisions. Furthermore, this research suggests that, despite individuals' concerns that geotags are "ruining nature," the majority of visitors' expectations are still being met within frequently geotagged sites in the Alpine Lakes Wilderness.

GEOLOGICAL AND HISTORICAL EVIDENCE OF A RECORD FLOOD IN 1867 IN WESTERN WASHINGTON. Gavin, DG, PJ Bartlein, Department of Geography, University of Oregon, Eugene, OR 97403; FS Hu, Department of Earth and Planetary Sciences, Washington University, St. Louis MO 63130; CJ Mock, Department of Geography, University of South Carolina, Columbia SC 29208; WT Struble, Department of Geosciences, University of Arizona, Tucson, AZ 85721. dgavin@uoregon.edu

Flood hazards along alluvial rivers are dynamic due to changing intense precipitation as well as changing channel capacity. In western Washington, where atmospheric river (AR) events cause the majority of floods in the Puget Lowland, rivers are also dynamically adjusting to a legacy of Pleistocene glaciation and carry abundant sediment onto alluvial fans and floodplains. In some locations channels are incised into Holocene fans, such that it is unclear whether the fans are relicts from periods of rapid geomorphic change following deglaciation or were active more recently. We used an annually laminated sediment record from a lake bordering an alluvial fan where floods onto the fan carry silt into the lake. The only flood at our site in the last 1000 years is dated by varves and 210Pb close to a historic AR event in December 1867. Precipitation data from historic forts in western Washington, compared to modern weather stations, show the 1867 AR event was the greatest or second-greatest four-day precipitation. Reanalysis data are consistent with a strong AR event with snowmelt. A hydraulic model shows that channel capacity would need to be reduced at least 60% for the largest floods to overtop the bank. Thus, while 1867 may have been the largest historical flood, flooding the fan surface still requires reduced channel capacity. Abundant landslides upstream have surface roughness age estimates of a few centuries; such landsliding could rapidly aggrade the channel. We infer that landsliding and large AR events can greatly increase flood hazard on inactive fans in western Washington.

HOLOCENE FIRE HISTORY AND LINKS TO CHANGES IN FOREST COMPOSITION AND CLIMATE IN SOUTH-COASTAL BRITISH COLUMBIA, CANADA. Giuliano, C, T Lacourse, Department of Biology and Centre for Forest Biology, University of Victoria, BC, Canada V8P 5C2. cams0405@live.ca

In recent years, forests in western North America have been burning more frequently and over larger areas. Understanding the dynamics among fire regimes, forest composition, and climate is becoming increasingly important as climate continues to trend towards warmer and drier summer conditions. We performed contiguous charcoal analyses on a 9 m long lake sediment core from Roe Lake on Pender Island in southern British Columbia, Canada to reconstruct fire history over the last 10,000 years. CharAnalysis was used to interpolate the dataset to a median sample resolution of 13 years and to calculate charcoal accumulation rates for identifying fire events and estimating return intervals. Over the last 10,000 years, the mean fire return interval (mFRI) was 142 ± 28 years with a total of 71 identified fire episodes. Fire was more frequent before about 7200 cal yr BP with high charcoal accumulation rates, frequent low severity fire, and a mFRI of 100 ± 29 years. This period of more frequent fire coincides with warmer, drier summers in the early Holocene. After 7200 cal yr BP, charcoal accumulation rates decreased and the mFRI lengthened to 167 ± 43 years. Pollen analyses on the same sediments show that forests have been mostly dominated by Douglas-fir for much of the Holocene with a gradual closing of the canopy over time, giving more weight to climate as the main driver of change in fire regimes rather than large shifts in forest composition.

WHAT ARE THE ECOLOGICAL BENEFITS OF WILDERNESS ON THE WEST COAST? AN Gray, USDA Forest Service Pacific Northwest Research Station, Corvallis, OR 97331; RJ Smith, Washington State University, Pullman, WA 99164; BNI Eskelson, University of British Columbia, Vancouver,

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Federally designated wilderness areas are intended to fulfill a range of social and ecological goals. While long-term monitoring is key to this mandate, it is seldom consistent within and across agencies. Consistent, granular information can enable coordinated interagency responses to boundary-crossing challenges like pollution, wildfire, plant invasions, and climate change. We compiled literature and data to assess the utility of a strategic forest inventory for meeting wilderness management objectives, and present results focused on the West Coast (California, Oregon, and Washington). The national forest inventory (NFI) in the U.S. can help stakeholders comply with wilderness policy, reduce risks to public safety, define economic opportunities, guide conservation efforts and forecast key ecological processes. The NFI has identified hot spots for long-distance air-pollution in the Sierra and in the Cascades. Monitoring has determined that recent mortality of whitebark pine (*Pinus albicaulis*) is greater in the North Cascades (48%) than in the Sierra Nevada (9%) and coincides with damage from blister rust (*Cronartium ribicola*). While 49% of wilderness in the west coast is forested, subalpine forest types are better represented than dry types. Live tree carbon stocks have been high and slowly increasing in wetter, western wilderness areas (0.39 Mg ha^{-1} yr^{-1}), but have been declining in drier areas (-0.40 Mg ha^{-1} yr^{-1}), primarily due to high-severity wildfires in recent decades. Long-term NFI monitoring contributes to assessing wilderness status, trends, and causes of change. Improvements could consist of expanded measurement of nonforest ecosystems and linking wildlife monitoring to the NFI framework.

CONTEMPORARY WILDFIRES FURTHER DEGRADE RESISTANCE AND RESILIENCE OF FIRE-EXCLUDED FORESTS IN CENTRAL AND SOUTHCENTRAL OREGON. Hagmann, RK, Kiilehua Forestry and University of Washington, School of Environmental and Forest Sciences, Seattle, WA 98177; PF Hessburg, RB Salter, USDA-FS, Pacific Northwest Research Station, Wenatchee, WA 98801; AG Merschel, Oregon State University, College of Forestry, Corvallis, OR 97331; MJ Reilly, USDA-FS, Pacific Northwest Research Station, Western Wildland Environmental Threat Assessment Center, Corvallis, OR 97331. hokulea@uw.edu

In fire-dependent forest landscapes, frequent low- to moderate-severity fire historically maintained vegetation patterns that limited the severity of droughts and wildfires. After more than a century of fire exclusion, today, much denser forests and highly connected fuel loads leave ecosystems in these landscapes vulnerable to drought and fire, especially under a rapidly warming climate. To quantify the departure of contemporary conditions from those that existed prior to fire exclusion, we used multiple independent records of historical conditions, including timber inventories, cover type maps, aerial photographs, and tree-ring records. In the early 20th century, extensive high-severity fire effects were relatively common in cold and mesic forest types, but rare in drier forest types. In recent wildfires, however, extensive high-severity fire occurred across all forest types, creating more abundant and larger patches of nonforest cover than existed in early 20th century records for similar forest types across the Pacific Northwest. In the early 20th century following centuries of frequent fire, medium and large trees were widely distributed across all forested areas. Following recent fires, medium and large trees were absent or less abundant compared to recently unburned landscapes and

early 20th century records. Additionally, in the early 20th century, stand density index values were generally well below the threshold currently recognized as the lower limit of full site occupancy and vulnerability to density-dependent competition. In these fire-excluded landscapes, peak-season wildfires compounded the legacy of past management and further reduced options for conserving or restoring cultural, social, and ecological functions of multi-aged forests.

EFFECT OF JUNE 2021 HEAT EVENT ON DIAMETER GROWTH OF TREES IN WESTERN WASHINGTON AND OREGON. Harrington, CA, Pacific Northwest Research Station, Olympia, WA 98512; R Cronn, Pacific Northwest Research Station, Corvallis, OR, 97331. constance.harrington@usda.gov

Record setting maximum air temperatures were recorded across the Pacific Northwest June 26-28, 2021. Did the high temperatures impact tree growth rates? We measured tree diameter shortly after the heat event and again at the end of the growing season at 6 locations in western Oregon and Washington. Four of the locations (near Medford, OR, Grants Pass, OR, Chehalis, WA and Raymond, WA) were in the Douglas-fir Seed-Source Movement Trial so we were able to measure 15-year old trees of the same three seed sources across the four locations. The other two locations near Olympia, WA allowed comparisons between Douglas-fir, western hemlock and western redcedar at one site and between Douglas-fir, Oregon white oak and western redcedar at the second site. The sites each experienced 1 to 3 days of maximum air temperature above 40 ℃. None of these trees had significant levels of foliage scorch. Diameter growth was limited after the heat event at most locations and for most species. The seed source from the Washington coast grew least on the hot dry OR sites but had the same or better growth than the other 2 sources on the WA sites. On the 2 sites with 3-species comparison, Douglas-fir had the best growth on one site but the poorest growth on the other site, indicating that both local site conditions as well as species composition influenced results. Additional detailed measurements with electronic dendrometers indicated there were differences between trees in short- and longer-term diurnal growth rates.

FOREST FIRES IN WESTERN CASCADIA: DRIVERS, CHARACTERISTICS, AND INDICATORS OF POST-FIRE RESILIENCE. Harvey, BJ, University of Washington; DC Donato, Washington Department of Natural Resources; JS Halofsky, Washington Department of Natural Resources; MS Buonanduci, University of Washington; MM Laughlin, University of Washington; LK Rangel-Parra, University of Washington; JE Morris, University of Washington. bjharvey@uw.edu

Understanding the mechanisms that underpin forest resilience to fires is of high importance as the climate warms and fire activity increases worldwide. This knowledge gap is particularly wide in forests characterized by infrequent and severe fires, since opportunities to study fire events are inherently rare. In a series of associated projects, we characterize factors associated with, and indicators of forest resilience to fire west of the Cascade Crest in Washington and northern Oregon, USA (western Cascadia). Using satellite burn severity mapping and landscape ecological analyses, we characterize patterns and drivers of stand-replacing fire from 1984 to 2020, building an understanding of the spatial signature of the

western Cascadia fire regime. In a network of intensively measured permanent field plots distributed across forests burned between 2015 and 2020, we measure how pre-fire forest structure, burn severity, and topoclimate relate to several key post-fire indicators of resilience. Specifically, data on post-fire tree regeneration, early-seral vegetation communities, woody carbon, and fuel profiles are critical early indicators of resilience and potential long-term post-fire trajectories. Collectively, findings provide valuable insights into the role that fire plays in shaping western Cascadia, and provide the foundation for understanding resilience to fire now and in the future.

ESTABLISHING BASELINE PATTERNS OF FIRE IN OLD-GROWTH COAST REDWOOD FORESTS USING SOIL CARBON AND CHARCOAL. Hayes, K, University of Colorado, Denver CO 80218; D Gavin, University of Oregon, OR 97403. katherine.hayes@ucdenver.edu

Fire regimes are an important ecological feature in temperate forests, often best described and informed by long-term records. Yet determining past fire regimes may be difficult in ecosystems with limited available fire proxies or histories, complicating our ability to contextualize modern shifts in fire against a historic or prehistoric baseline range of variability. Here, we establish long-term records of fire in coast redwood forests, an important temperate forest ecosystem with limited information on past fire regimes. We use radiocarbon dating and quantification of both soil macro-charcoal and soil and pyrogenic carbon in an old growth redwood stand to examine fire events in redwood forests. We sampled charcoal fragments, soil carbon and soil pyrogenic carbon in the Headwaters Forest Reserve, a protected fragment of old growth redwood in Humboldt County, California to investigate whether prehistoric fire events were detectable in soil archives and to inform historic ranges of variability. Radiocarbon dates from macro-charcoal indicate fire events occurring a maximum of 6,840 calibrated years BP, predating existing records. Composite 14C dates show increased fire activity within the last 1,000 years in synchrony with existing dendrochronological records. Soil C averaged 928 g m^2, of which a high proportion was pyrogenic C (15-30%). Abundant soil pyrogenic carbon and charcoal indicates that fire was a frequent feature of prehistoric coast redwood fire regimes. Information from this multi-proxy reconstruction clarifies our understanding of the nature of coast redwood fires, contributing to ongoing discussions of both past and present coast redwood fire regimes.

PLENARY

WILDFIRE AND CLIMATE CHANGE ADAPTATION OF WESTERN US FORESTS. Hessburg, P, PNW Research Station, USDA Forest Service; School of Environment and Forest Resources, University of Washington. phessburg@fs.fed.us

Forest landscapes across western North America (wNA) have experienced extensive changes over the last two centuries, while climatic warming has become a rapidly expanding global reality over the last four decades. Resulting interactions between historical increases in forested area and density and recent rapid warming, increasing insect mortality, and wildfire burned areas, are now leading to substantial abrupt landscape alterations. These outcomes are forcing forest planners and managers to identify strategies that can modify future outcomes

that are ecologically and/or socially undesirable. Past forest management, including widespread harvest of fire- and climate-tolerant large old trees and old forests, fire exclusion (both Indigenous and lightning ignitions), and highly effective wildfire suppression have contributed to the current state of wNA forests. These practices were successful at meeting short-term demands, but they match poorly to modern realities. I will concisely relate the findings in a recent trilogy of invited review articles. First, I will summarize a century of research reviewed in Hagmann et al. (2021) that details widespread changes in forested landscapes and wildfire regimes since the influx of European colonists. Next, I will recap research by Prichard et al. (2021) that addressed 10 common questions surrounding application and relevance of management practices historically applied by Indigenous tribes and currently applied by some managers to intentionally manage forests for climate adapted-resilient conditions. I will close by recapping recommendations for intentional adaptive management made in a third paper by Hessburg et al. (2021). To do so, I will discuss progress paralysis that can occur with strict adherence to the *precautionary principle*; offer insights for dealing with the problem of irreducible uncertainty; provide suggestions for reframing management and policy direction; and identify key knowledge gaps and research needs.

FATE OF EARLY TWENTIETH CENTURY HIGH-SEVERITY FIRES: FUELS AND FOREST STRUCTURE OF DIFFERENT FIRE HISTORIES. Jaffe, MR, Department of Forest Management; WA Franke, College of Forestry and Conservation, University of Montana, Missoula, MT 59812; SA Parks, U.S. Forest Service Aldo Leopold Wilderness Research Institute, Missoula, Montana 59801; AJ Larson, Department of Forest Management, WA Franke College of Forestry and Conservation, University of Montana, Missoula, MT 59812. melissa.jaffe@umconnect.umt.edu

High-severity fires create lasting effects on landscape vegetation mosaics. Recent increases in fire activity and severity highlight the need to understand the long-term effects of high-severity fire, including interactions with subsequent fires. In the northern US Rocky Mountains, including Selway-Bitterroot Wilderness (SBW), the early 20th century saw several years marked by large, high-severity fires. We investigated the influence of fire frequency (once, twice, and thrice burned from 1910-2017) on forest structure, conifer regeneration, and fuel loading in areas that initially burned at high severity in the SBW in 1910 and 1934. We found that 129,682 hectares of mixed-conifer forest burned during regional fire years between 1910-1934. Of that area, 38,014 hectares reburned once and 3,999 hectares reburned twice between 1985 and 2017. Conifer tree regeneration was abundant across all three burn histories and 99% of sample sites were <200 m from the nearest seed source. Douglas-fir seedling density was higher in areas that burned two or three times; grand fir seedlings was more abundant in once-burned areas. Snags and coarse woody material were less affected by fire frequency and more impacted by having a recent (since 1985), second or third fire. High shrub biomass only occurred on steep southwest aspects with low overstory tree basal area. Live tree composition and density differ across forests that initiated from early 20th century high-severity fire with contrasting recent fire history, but even thrice-burned sites are largely regenerating to forest communities.

NEW FIRE HISTORIES FROM THE WESTERN OREGON CASCADES. Johnston, JD, Department of Forest Ecosystems and Society, Oregon State University, OR 97333. james.johnston@oregonstate.edu

Douglas-fir dominated forests of the west slope of the Cascades are among the moistest and most productive forests in North America. Many of these forests receive more than 2,000mm of precipitation a year, lightning ignitions are relatively rare, and older stands in this region accumulate more biomass than any other terrestrial system. The standard model of stand development attributes the phenomenal complexity of older western Cascades forests to stand replacing fire that resets succession at coarse spatial scales followed by a long fire-free period with stand development driven primarily by competition and fine scale disease and windthrow disturbance. An extraordinary period of fire activity in northwestern Oregon in the summer 2020, when three-quarters of the total area burned in the region in the last 70 years burned in just 72 hours, seemed to confirm the importance of infrequent stand-replacing fire in productive Douglas-fir forests. But an accumulating body of evidence suggests that natural fire regimes of the western Cascades are far more complex than suggested by theory or recent experience. This study describes the pattern of fire occurrence over 400 years within a large study area in the southern Willamette Valley in the heart of the western Oregon Cascades. Non-stand replacing fires were reconstructed at most sites, and some sites recorded extremely frequent fire (mean fire return interval <5 years) for hundreds of years prior to the late 19th century. Future forest management of the western Oregon Cascades will require recognition of huge variability in the natural fire regime.

PLENARY

GETTING TO THE HEART OF SCIENCE COMMUNICATION. Kearns, F, California Institute for Water Resources. faith.kearns@ucop.edu

From droughts to fires to climate change, many issues that scientists and science communicators work on are highly emotional, often contentious, and sometimes traumatizing, with high stakes for practitioners -- who are often in precarious positions -- and communities alike. Relating, listening, working with conflict, and understanding trauma, all with an eye toward justice, are key tools in the 21st century science communication toolkit. Using examples from her own and other's work, Dr. Kearns will also share tips on navigating sometimes difficult discussions.

COMPARATIVE BIOGEOGRAPHY OF THE SOUTHWESTERN PACIFIC NORTHWEST. Kerhoulas, N, Department of Wildlife, Cal Poly Humboldt, Arcata, CA 95521. nk17@humboldt.edu

While the distribution of plants and animals in the Pacific Northwest is generally well known, the geographic distribution of genetic variation and shared patterns of isolation among taxa remain less resolved. I will use existing data and a comparative biogeography approach to explore previously proposed biogeographic patterns in the southwestern Pacific Northwest. I will review some of the overarching biogeography trends of the southwestern Pacific Northwest and then present a synthesis of the current animal literature to highlight regions of

historic isolation and shared species' distributions. I will also summarize the current and historic distribution of the recently-described Humboldt's flying squirrel (*Glaucomys oregonensis*) using molecular data and niche modeling, as results suggest that northern California and southern Oregon (the Klamath Mountain region) likely served as a refugium for this species. Overall, although several similar patterns of distribution and shared molecular variation emerge among taxa within this region, the mechanism that drove these patterns remains enigmatic.

PHYSIOLOGICAL RESPONSES TO CONIFER ENCROACHMENT AND REMOVAL IN A NORTHERN CALIFORNIA OAK WOODLAND. Kerhoulas, L, G Goff, Department of Forestry & Wildland Resources, Cal Poly Humboldt,Arcata, CA 95521; N Kerhoulas, Department of Wildlife, Cal Poly Humboldt, Arcata, CA 95521; J Beckmann, School of Forestry, Northern Arizona University, Flagstaff, AZ 86011; J Kane, R Sherriff, Department of Forestry & Wildland Resources, Cal Poly Humboldt, Arcata, CA 95521. lucy.kerhoulas@humboldt.edu

In northern California, conifer encroachment following a century of fire suppression threatens the perpetuation of oak woodlands. Widespread management treatments therefore strive to retain oaks and remove conifers. Using a *Quercus garryana* woodland in northwestern California, we investigated physiological responses to conifer encroachment in open, moderately encroached, and heavily encroached stands before (2017) and after (2018 and 2019) light restoration treatments. We measured predawn and midday water potential, stomatal conductance, and xylem water isotopic signatures. We found that tree water stress and stomatal conductance were both highest in open stands, lowest in heavily encroached stands, and decreased across the growing season. Xylem water isotopic signatures indicated that oaks draw water from deeper soil depths than neighboring Douglas-firs. Although conifers did not appear to directly compete for water with oaks but rather seemed to buffer oak water status, they reduced oak productivity, presumably due to shading. Conifer removal in heavily encroached stands increased oak gas exchange, demonstrating that these stands can respond positively to treatments. We observed higher stomatal regulation in open stands (likely due to xeric acclimation) and lower stomatal regulation in heavily encroached stands (likely due to mesic acclimation), suggesting acclimation to local conditions. This work indicates that oak woodland decline due to conifer encroachment is driven by shading rather than competition for water, oaks may be relatively plastic in physiological acclimation to their environment, heavily encroached oaks can respond positively to conifer removal, and conifer removal treatments should be relatively heavy to elicit the greatest oak responses.

LAND MANAGEMENT EXPLAINS MAJOR TRENDS IN FOREST STRUCTURE AND COMPOSITION OVER THE LAST MILLENNIUM IN CALIFORNIA'S KLAMATH MOUNTAINS. Knight, CA, L Anderson, M Champagne, D Wahl, US Geological Survey, Menlo Park, CA 94025; MD Potts, JJ Battles, Department of Environmental Science, Policy, and Management, University of California, Berkeley, Berkeley, CA 94720; MJ Bunting, Department of Geography, Geology and Environment, University of Hull, Hull, HU6 7RX UK; RM Clayburn, The Yurok Tribe, Klamath, CA 95548; JN Crawford, USDA Forest Service, Deschutes National Forest, Bend, OR 97701; A Klimaszewski-Patterson, J Wanket, Department of Geography, California State University

Sacramento, Sacramento, CA 95819; EE Knapp, USDA Forest Service Pacific Southwest Research Station, Redding, CA 96002; FK Lake, USDA Forest Service Pacific Southwest Research Station, Arcata, CA 95521; SA Mensing, Department of Geography, University of Nevada, Reno, Reno, NV 89557; A Watts-Tobin, The Karuk Tribe Department of Natural Resources, Orleans, CA 95556. cknight@usgs.gov

For millennia, forest ecosystems in California have been shaped by fire both from natural processes and Indigenous land management, but the notion of climatic variation as a primary controller of the pre-Colonial landscape remains pervasive. Understanding the relative influence of climate and Indigenous burning on the fire regime is key because contemporary forest policy management is informed by historical baselines. This need is particularly acute in California where 20th century fire suppression coupled with a warming climate has caused forest densification and increasingly large wildfires that threaten forest ecosystem integrity and the State of California's plan to manage forests as part of climate mitigation efforts. We examine climatic versus anthropogenic influence on forest conditions over three millennia in the western Klamath Mountains, the ancestral territories of the Karuk and Yurok Tribes, by combining paleo-environmental data with Western and Indigenous knowledge. A fire regime consisting of Tribal burning practices and lightning were associated with long-term stability of forest biomass. Before Euro-American colonization, the long-term median forest biomass was between 104 Mg ha^{-1} and 128 Mg ha^{-1}, compared to values over 250 Mg ha^{-1} today. Indigenous depopulation after 1800 AD coupled with 20th century fire suppression likely allowed biomass to increase, culminating in the current landscape: a closed Douglas-fir dominant forest unlike any seen in the preceding 3000 years. These findings are consistent with pre-contact forest conditions being influenced by Indigenous land management and suggest large-scale interventions would be needed to return to historic forest biomass levels.

TREE MORTALITY AND REGENERATION IN NORTHERN CALIFORNIA. Lemmo, S, R Sherriff, L Kerhoulas, Department of Forestry and Wildland Resources, Cal Poly Humboldt, Arcata, CA, 95521; J Beckmann, School of Forestry, Northern Arizona University, Flagstaff, AZ 86011. sl386@humboldt.edu

The 2012-2016 California drought contributed to the death of millions of trees and has been well-studied in the Sierra Nevada; however, less is known about its effects on northern California forests. We investigated how recent tree mortality and regeneration in northern California vary with climate, tree and site characteristics. In 54 0.25-ha plots spread across northern California, we quantified site characteristics, mortality, and regeneration. Ridge regression analyses examined the influence of numerous predictor variables on mortality and regeneration trends. Dendrochronological techniques identified tree death years and seedling/sapling establishment years to explore the influence of climate on forest demographics using Superposed Epoch Analysis. Drought-induced tree mortality was greatest in small size classes. In coastal habitats, *Abies grandis* had the greatest mortality rates, and drought-induced mortality was positively correlated with maximum temperature and topographic position index. In montane habitats, overall mortality was positively associated with climatic water deficit (CWD; drier than expected conditions) in the 1-2 years preceding death, and year of death. Additionally, mortality was greatest in montane white pines, pre-

drought mortality was greater at wet sites than dry sites, and drought-induced mortality was positively correlated with canopy openness. Regeneration was dominated by advanced regeneration of shade-tolerant species. In coastal habitats, regeneration was greater at dry sites than wet sites, and was positively correlated with stand density and maximum temperature. In montane habitats, regeneration was higher when the year preceding establishment was wetter. This information on forest demographics can improve management efforts to steward resilient and diverse landscapes in northern California.

FACULTATIVE SEROTINY: PREDICTING SUCCESSFUL POST-FIRE RECRUITMENT OF NON-SEROTINOUS CONIFER SPECIES AS A FUNCTION OF MASTING BEHAVIOR AND THE TIMING AND SEVERITY OF WILDFIRE. Lindley, S, D Greene, Department of Forestry and Wildland Resources, Cal Poly Humboldt, Arcata, CA 95521. sean.lindley@humboldt.edu

In the western United States, there is an increase in the frequency and size of severe wildfire. Following fire exclusion, forests that historically experienced frequent, low-to-moderate severity wildfire are considered to be at risk under this new fire regime. Many are dominated by non-serotinous conifers, such as Douglas-fir, ponderosa pine, and sugar pine in mixed-conifer forests of northern California. These species repopulate a burned area from a living edge via wind- or rodent-driven seed dispersal. Following a severe wildfire, however, the distance to the center of the burn patch is often further than the maximum dispersal distance. In this scenario, the only seeds available for regeneration are those that survived the passage of the high-intensity flame front. We hypothesized that we would expect to find reliable regeneration beyond the dispersal constraint if a fire occurred during a species' mast year, after seed maturation and prior to the cone scales opening. We visited the 2020 Slater Fire in northern California, which occurred from early September to late November, to quantify seedling recruitment for Douglas-fir and sugar pine within severely burnt patches. We found that both species, which experienced a mast year in 2020, were able to achieve full or near-full stocking following the fire. Using spatially explicit forest dynamics modeling software, we found that seeds from fire-killed trees significantly contributed to the observed recruit densities. We interpret these findings as evidence of a timing-dependent mechanism of post-fire recruitment for non-serotinous conifers and speculate as to where we may find similar results.

INVESTIGATING SEED MATURATION AND MORTALITY: A MECHANISM FOR POST-FIRE REGENERATION IN NON-SEROTINOUS CONIFERS. Lopez, MA, J Kane, D Greene, Department of Natural Resources, Cal Poly Humboldt, Arcata, CA 95521. jkane@humboldt.edu

Current climatic warming and exceedingly dry conditions are contributing to increased fire frequency, severity, and size, for many regions. These changes in fire activity have prompted concern over the persistence of some conifer species, specifically those not adapted to withstand high-severity fire. However, regeneration of non-serotinous conifer species is possible if the timing of fire occurs following seed maturation, and within a heat range seeds can withstand, in a regenerative mechanism termed "facultative serotiny." To address this mechanism, we examined four conifer species using viability tests to determine the timing of conifer seed maturation and the threshold of heat that seeds can withstand before mortality.

Closed conifer cones were collected for the non-serotinous species throughout three summers in Burney, California. The accumulated heat sum was significantly associated with seed maturity, indicating over 50% maturity around late July to August (1358 to 1889) (P = 0.00125). Higher heat exposure was negatively associated with seed survival (P = 0.0156) but 10% or more of viable seeds survived with temperatures as high as 340 ℃. Our findings demonstrate the potential of "facultative serotiny" following stand-replacing fires for non-serotinous conifers, which can be incorporated into post-fire regeneration modeling and aid in future forest management.

LONG TERM EFFECTS OF FORB-SELECTIVE HERBICIDES ON GRASSLAND COMMUNITIES. Lugar, R, V Wagner, Department of Biological Sciences, University of Alberta, Edmonton, T6E2S8, AB, Canada; CR Nelson, Department of Ecosystem and Conservation Sciences, University of Montana, Missoula, MT 59812. lugar@ualberta.ca

Land managers use selective herbicides to suppress invasive non-native forbs in natural lands. However, the long-term non-target effects and efficacy of these herbicides, as well as potential for secondary invasions, are poorly understood because assessments have primarily focused on the first 1-2 years after treatment. Similarly, there is only limited understanding of the extent to which herbicide drift affects plant community structure. We conducted a six-year experiment in the intermountain grasslands of western Montana, USA to monitor the changes in cover of the target species, (*Centaurea stoebe* subsp. *micranthos*), and the plant community structure changes in response to the recommended and drift-simulated application rates of the herbicides Tordon® (picloram) and Milestone® (aminopyralid). As expected, knapweed cover and the richness of native and non-native forb species declined in the first three years in plots treated at recommended herbicide rates but not those at drift rates. Secondary invasion by non-native graminoids was significant but weak. Contrary to expectations, changes in native forb cover and both cover and richness of native graminoids were not affected by treatment, but differed significantly with year, perhaps due to annual variation in winter and spring precipitation. Surprisingly, six years post-treatment, we could not detect a difference among treatments in knapweed cover, nor the richness or cover of native and non-native graminoids and forbs. These results question the long-term efficacy and specificity of selective herbicides in controlling target species within plant communities. Our study supports previous calls for long-term monitoring of invasive species control measures in land management.

OLD-GROWTH DOUGLAS-FIR (*PSEUDOTSUGA MENZIESII*) FORESTS DEVELOPED WITH FREQUENT MIXED-SEVERITY FIRE IN THE SOUTHERN WESTERN CASCADES OF OREGON, USA. Merschel, AG, PNW Research Station, USFS, Corvallis, OR 97331; MA Krawchuk, J Johnston, Department of Forest Ecosystems and Society, College of Forestry, Oregon State University, Corvallis, OR 97331. andrew.merschel@usda.gov

Increasing wildfire activity in recent years including the extensive 2020 Labor Day fires, and a warming climate have raised concerns about the resilience of Coastal Douglas-fir *Pseudotsuga menziesii* var. *menziesii* forests. At the same time federal land managers are now tasked with restoration of natural successional and disturbance processes including fire to

maintain biodiversity and ecosystem services given natural and anthropogenic stressors. However, information that precisely describes historical fire regimes and successional dynamics in Coastal Douglas-fir forests sufficient to guide reintroduction of wildfire, restoration in plantations, and adaptation to climate change is lacking. This knowledge gap exists because rigorous dendrochronological research methods have been sparsely used in Coastal Douglas-fir forests due to the challenges of sampling intact fire-scarred trees, and the expectation that historical fires were infrequent and usually high-severity. We developed the first extensive annually resolved reconstruction of historical (1600 - 1910 CE) fires and forest development in the southwest Oregon Cascades. Sample sites were distributed across warm-dry to cool-moist microclimates. The majority of historical fire intervals prior to the early 19th century were <25 years, even in cool-moist western hemlock *Tsuga heterophylla* and Pacific silver fir *Abies amabilis* forest types. Historical fires were the primary disturbance driver of forest dynamics including the establishment of shade tolerant fire-sensitive species. We will describe how considerable variation in historical fire and forest development history relates to climatic and anthropogenic history over time, and how variation in historical fire frequency and severity relate to microclimate and topography.

***PALAEOGALE* AND SEXUAL DIMORPHISM IN THE CARNIVORAN FOSSIL RECORD.** Orcutt, JD, J Lubisich, Department of Biology, Gonzaga University, Spokane, WA 99258.

The small carnivoran *Palaeogale* is a taxon of considerable paleobiological interest. Strongly convergent on mustelids, it first appeared in the Eocene of Montana, and had a Holarctic distribution by the time it went extinct in the early Miocene. Evolutionary and biogeographic analyses of *Palaeogale* are, however, complicated by the taxonomy of the genus. In the absence of clear diagnostic traits, body size is often used as the primary - and sometimes the only - criterion for distinguishing coeval species. Given that sexual dimorphism is the norm in extant small carnivorans, could "species pairs" of *Palaeogale* actually represent males and females of a single species? Two sites in Germany (Amöneburg and Wintershof-West) have yielded putative species pairs of *Palaeogale*, and we used published dental measurements from these sites and body mass data from extant mustelids and procyonids to determine whether size differences between the "species" of German *Palaeogale* exceed those seen between males and females of living sexually dimorphic species. At both sites, the smaller "species" was 70% the size of the larger one, which is equivalent to the size difference between males and females in sexually dimorphic species. These results call into question the status of the two larger "species" (*P. hyaenoides* at Wintershof-West and *P. praehyaenoides* at Amöneburg). Besides bolstering our understanding of *Palaeogale* systematics, ongoing morphometric analyses, development of body mass estimates allowing a larger fossil sample, and reconstructions of body size distributions in extant taxa will aid in building a framework for studying sexual dimorphism across carnivorans.

PLENARY

TRADITIONAL ECOLOGICAL KNOWLEDGE IN THE KLAMATH RIVER BASIN: A SALMON AND LAMPREY CASE STUDY. Parker, K, Senior Fisheries Biologist, Yurok Tribe, Klamath, CA 95548; kap742@humboldt.edu

For tens of thousands of years, salmon, sturgeon, lamprey, and other fish have been keystone cultural species for Native American tribes of the Klamath River Basin. Such a long-term successful relationship exemplifies indigenous people's ability to maintain a sustainable fishery. This illustrates the depth of knowledge tribes possess regarding fish and water management. As a tribal scientist, my work merges the paradigms of traditional ecological knowledge (TEK) and western ecological knowledge. Walking on both paths creates many challenges as the two concepts have significantly contrasting worldviews. The TEK worldview embodies that living resources and culture are singular, with nature completely intertwined with humanity. Language, ceremony, cultural construct, and food sources evolved synchronously. From a TEK conservation perspective, species loss not only represents a loss of biodiversity but a loss of cultural heritage as well. Therefore, protecting the remaining biodiversity on aboriginal lands is not optional because indigenous people and animal species share a common vulnerability – a struggle for survival. At the core of tribal sovereignty is food sovereignty. Traditional foods are a foundational part of tribal cultures which feed much more than physical bodies. Traditional foods feed Spirits because these foods represent a living link with the land. We truly are what we eat, we eat the earth.

BEDROCK MEADOWS – SPECIES ASSEMBLY AND FUNCTIONAL PATTERNS OF A DISTINCT AND OVERLOOKED VEGETATION TYPE IN THE NORTH AMERICAN INTERIOR NORTHWEST. Pätsch, R, Department of Botany and Zoology, Masaryk University, Kotlarska 2, Brno, Czech Republic, 61137 & Department of Biological Sciences, University of Alberta, Edmonton, Canada, AB T6G 2E1; T Spribille, Z Zapisocki, D Tucker, Department of Biological Sciences, University of Alberta, Edmonton, Canada, AB T6G 2E1; HG Stroh, Büro Áchero, Friedlaenderstrasse 17a, Friedland, D-37133; T Becker, Regional and Environmental Sciences/Geobotany, University of Trier, BehringstraVüe 21, Trier, D-54296; V Wagner, Department of Biological Sciences, University of Alberta, Edmonton, Canada, AB T6G 2E1. ricarda.paetsch@gmail.com

Bedrock Meadows are mid-altitudinal and vernally moist communities on shallow soils in the Interior Northwest of North America. Although easily recognized on the landscape, they have neither been studied nor included in national vegetation classification schemes. To fill this gap, we studied to what extent Bedrock Meadows differ from other open vegetation types in the region with respect to their vascular species composition, structural features, and functional makeup. We surveyed Bedrock Meadows in 110 plots and added data from six published plot-based studies of prairie and intermountain grasslands, maritime mountain, alpine, and timberline meadows (total number of plots: 1162). We used cluster analyses to identify groups based on vascular plant composition, with the optimal partition identified using average silhouette width. We related abiotic and structural characteristics to clusters using Non-Metric Multidimensional Scaling and compared the proportion of plant-life spans and growth forms applying chi-square tests of their summed proportions. According to our results, Bedrock Meadows had a distinct characteristic species assembly, combined with a high cover of vascular plants, bryophytes, and lichens. We found striking differences in their functional features including high proportions of annual plants (therophytes) and plants regenerating from

bulbs and corms (geophytes), a functional composition they shared with maritime mountain meadows. Given their distinct features, we propose that Bedrock Meadows are incorporated into national and international classification schemes. Future efforts need to explore in more detail their value for conservation as they host several rare vascular plant species.

TREE-RING DATING OF THE ELECTRON MUDFLOW, A LARGE CLAY-RICH LAHAR FROM MOUNT RAINIER, TO LATE 1507 CE. Pringle, PT, Science Department, Centralia College, Centralia, WA 98531; B Black, Laboratory of Tree-Ring Research, University of Arizona, Tucson, AZ 85721; JW Vallance, U.S. Geological Survey, Cascades Volcano Observatory, Vancouver, WA 98683. patrick.pringle@centralia.edu

The Electron Mudflow originated as a landslide from the west flank of Mount Rainier, Washington, and swept more than 60 km down the Puyallup River drainage into areas now heavily populated. Recent wiggle-match radiocarbon dating, and tree-ring analyses of subfossil trees now confine the age of the Electron to late 1507 CE. Wiggle-matching of five radiocarbon ages from a buried, bark-bearing Douglas-fir (*Pseudotsuga menziesii*) stump indicates the mudflow age as 1488-1520 CE with 95 percent certainty. To narrow this date, we used dendrochronology methods of crossdating on multiple samples collected from 19 trees killed by the lahar, six of which had bark. Eighty time series were measured to the nearest 0.01 mm, and the crossdating statistically verified using program Cofecha. All trees with bark died the same year, and those having outer decay had final growth increments formed in preceding years. To establish an absolute date of death, the 475-year Electron chronology was crossdated against old-growth Douglas-fir chronologies located at Sequim, Washington, Vancouver Island, Canada, and Soapgrass Mountain, Oregon. Of all possible placements in time, an Electron chronology end date of 1507 CE yields a single, highly significant correlation that far exceeds all other possible cross correlations. Moreover, the final growth increment is nearly fully formed, indicating the mudflow occurred late in 1507. A trigger for the Electron Mudflow has not been identified, but this precise date will help assess possible relationships with other events, assist in interpreting Indigenous narratives about the mudflow, and improve understanding of potential hazards.

HOW IS CARBON AFFECTED BY ACTIVE FOREST MANAGEMENT FOR OLD-GROWTH FOREST CONDITIONS? Quick, SA, DG Fischer, Department of Ecology, Evergreen State College, Olympia, WA 98505. Steven.Quick@Evergreen.Edu

Changes in forest carbon (C) associated with ecological restoration activities is poorly understood in west-cascades and coast range temperate rainforests. Management practices on late-successional forests aimed at restoration of old-growth forests in the Ellsworth Creek Preserve represents an opportunity to examine how active management can interface with forest carbon dynamics. Active forest management could generally accelerate development of structural complexity toward old-growth conditions faster than a natural forest but impacts on forest carbon dynamics could paradoxically reduce C storage in forests. Here, we model 100 years of change in forest carbon using the Forest Vegetation Simulator (FVS) in combination

with fourteen-year repeat measurements of aboveground forest conditions at Ellsworth Creek. We use the repeat measurements to refine model behavior and generate forecasts of forest carbon in control and active management basins. Models generally show reduced carbon pool aboveground in most active management scenarios, and reduced soil organic matter carbon in response to thinning operations. A comparison of soil organic matter (OM) depth and mass from 2022 field measurements similarly suggests reduced OM carbon in soils. This research can inform policy and our general understanding of the significance of mature and old-growth forests and the services they provide.

CONTEMPORARY FOREST CHANGE IN A DIVERSE MONTANE LANDSCAPE: LESSON LEARNED FROM THE RUSSIAN WILDERNESS, NORTHERN CALIFORNIA, USA. Reilly, M, USDA Forest Service, Corvallis, OR 97331; M Desiervo, Department of Biology, University of Wyoming, Laramie, WY 82071; D Bost, E Jules, Department of Biology, Cal Poly Humboldt, Arcata, CA, 95521; R Butz, USDA Forest Service, R5 Area Ecology Program, Eureka, CA 95501. matthew.reilly@usda.gov

Climate warming, fire exclusion, and increasing biotic disturbances are affecting species distributions and patterns of forest community and landscape composition. However, predicting community and landscape level effects from species change in the context of resilience to future climate and disturbance is complex as species often respond individualistically to both. We resampled 148 legacy plots to assess 46-years (1969 to 2015) of species, community, and landscape response in an exceptionally diverse, montane landscape in the Klamath Mountains. We found high levels of mortality and proportions of trees affected by biotic disturbances, particularly in Shasta red fir (dwarf mistletoe and fir engraver beetle). Landsat time series analysis found spectral decline was unevenly distributed across the landscape with the greatest declines at high elevations and on more exposed, southwestern slopes. Six species declined significantly in total cover and five declined significantly in at least one life stage, and one drought- and fire-intolerant species, white fir, increased by 30.7%. The largest declines were at lower elevations in drought-tolerant, early seral species (*Pinus* spp.) and at higher elevations for Shasta red fir and subalpine fir. Engelmann spruce and Brewer spruce experienced reductions in early life stages. Multivariate analyses revealed a minor but significant shift in composition and a slight decrease in species turnover driven by expansion of white fir. Species level declines, especially in early life stages, suggest lagged shifts towards communities and landscape conditions that are inconsistent with dynamics documented in paleo-historical studies, and that will likely be maladapted to future climate and disturbance.

FACTORS CONTRIBUTING TO LEGACY HARDWOOD MORTALITY FOLLOWING PRESCRIBED FIRE IN KARUK ANCESTRAL TERRITORY. Rickard, H, JM Kane, Cal Poly Humboldt, Arcata, CA 95521; FK Lake, Pacific Southwest Research Station, Arcata, CA 95521. hdr3@humboldt.edu

Interruption of Indigenous stewardship has resulted in hardwood decline along the middle Klamath River in Northern California related to adverse effects to Tribal food sovereignty and community wellbeing. Prescribed fire following a century of fire exclusion has resulted in unanticipated mortality of legacy hardwood trees. We quantified legacy hardwood mortality in prescribed burn areas for legacy tanoak (*Notholithocarpus densiflorus*), California black oak (*Quercus kelloggii*), and madrone (*Arbutus menzieseii*). Legacy hardwood mortality

was estimated in six burn units (burned 2017-2019) using 4-6 fixed area transects (1000 m^2), and were compared to six representative unburned areas. Legacy hardwood size ranged 25-173 cm diameter at breast height (DBH), with a median size of 39 cm DBH, and 42% of all trees had pre-existing fire scars. Using a generalized linear model, mortality due to prescribed fire was not statistically significant at the stand scale, though it appeared slightly elevated (10.4% prescribed fire vs. 8.1% control, p = 0.816). Tree scale analysis using a generalized mixed effects model suggests that treatment due to prescribed fire (p = 0.0753), tree size (p = 0.0185), species (p = 1.079e-06), scar width (p = 0.0259) and associations among stated factors were significantly associated with tree mortality. Preliminary results warrant further investigation to assist managers in retaining legacy trees.

EFFECTS OF LONG-TERM DROUGHT ON CONIFERS ACROSS NORTHERN CALIFORNIA. Robinson, WL, University of California Cooperative Extension, Eureka, CA 95503; L Kerhoulas, Department of Forestry and Wildland Resources, Cal Poly Humboldt, Arcata, CA 95521; R Sherriff, Department of Geography, Environment, and Spatial Analysis, Cal Poly Humboldt, Arcata, CA 95521; G Roletti, Department of Forestry and Wildland Resources, Cal Poly Humboldt, Arcata, CA 95521; P van Mantgem, United States Geological Survey, Arcata, CA 95521. wallisrobinson@gmail.com

Numerous studies indicate that competition, species, and climate are important predictors of drought response, but few studies have considered the collective influence of these factors across a wide range of conifer species at a regional scale. We used growth and ^{13}C discrimination rates ($\Delta^{13}C$) in annual tree-rings to assess the interplay of these factors on tree response prior to and during the 2013-2015 drought for six conifer species throughout northern California forests. In total, 270 trees were cored across 54 sites. At each site, competition and tree- and stand-level data were also collected. Linear mixed-effects (LME) models were used to evaluate the effects of species, habitat, climate, competition, and focal tree characteristics on annual $\Delta^{13}C$. We also tested for species- and habitat-level differences in drought resistance (Drought $\Delta^{13}C$/Pre-Drought $\Delta^{13}C$). We found important differences in drought survival strategies between coastal and montane species based on annual growth and $\Delta^{13}C$ metrics. Isotopic data indicated that coastal species employed a conservative stomatal regulation strategy during drought, suggesting that coastal species may be more vulnerable to long-term droughts. Conversely, montane species employed a less regulated strategy which may reduce hydraulic capacity via xylem cavitation, especially if droughts increase in frequency. Coastal drought responses were likely influenced by the positive relationship measured between annual water-year precipitation and $\Delta^{13}C$, as well as the negative relationship measured between tree density and $\Delta^{13}C$. In contrast, montane drought responses were species-specific, illustrating a greater importance of site and climate conditions on drought responses than in coastal species.

POST-MORTEM CHANGES OF EGG VIABILITY IN HATCHERY-RAISED RAINBOW TROUT (*ONCORHYNCHUS MYKISS*). Roche, DJ, BJ Fujita, R Cuevas-Uribe, Department of Fisheries Biology, Cal Poly Humboldt, Arcata, CA 95521. Rafael.CuevasUribe@humboldt.edu

In the fall of 2002 the Klamath River experienced a catastrophic fish kill estimated to have killed 34,000 adult fall Chinook salmon (*Oncorhynchus tshawytscha*) and other native fish

species. This was followed up with a similar event this past summer, with both fish kills as a result of water diversion projects upriver due to agricultural needs. With the effects of climate change being felt more every year, these fish kills represent events where large portions of the population's genetic diversity are lost. Our project is to find the viability of eggs from deceased female salmonids after time of death through the harvest of euthanized rainbow trout (*Oncorhynchus mykiss*) raised at the Cal Poly Humboldt fish hatchery. Killed trout were placed in a floating cage in the hatchery settling pond, with 2 fish being chosen every 6 hours for 2 days. Each spawning session involved one unspawned fish and one previously spawned fish, with the milt being taken from 2 new live males each time. Egg viability will be determined through the volume of eggs that have survived to the "eyeing-up" phase. We hope that the results of this project will help guide future studies into this subject matter.

DIVERSITY OF CONIFER RESPONSES TO DROUGHT ACROSS HABITAT AND COMPETITIVE GRADIENTS IN NORTHERN CALIFORNIA. Roletti, G, R Sherriff, L Kerhoulas, W Robinson, Department of Forestry and Wildland Resources, Cal Poly Humboldt, Arcata, CA 95521; J Beckmann, School of Forestry, Northern Arizona University, Flagstaff, AZ 86011. gjr136@humboldt.edu

Frequent and intense drought is rapidly altering stand dynamics in western North American forests. Climate, competition, and site characteristics can affect the growth responses of individual trees to drought stress. The ecological and geographical diversity of Northern California provides a unique opportunity to measure these responses across species, habitat types, and levels of competitive pressure. This study used dendrochronological techniques and linear mixed effects models to assess growth responses to drought in four montane and two coastal conifer species. We surveyed 54 study sites (9 sites per species and 270 trees total) and found significant differences among species and habitats in growth, drought resistance and resilience, and annual latewood proportion. Growth in montane species was generally correlated with increased moisture availability (Palmer Drought Severity Index, PDSI) and negatively correlated with competitive pressure. These species also maintained relatively stable drought resistance, resilience, and latewood proportion. In contrast, the growth response of coastal species was influenced more by tree size than moisture availability or competition. As the drought proceeded, coastal species showed marked reductions in drought resistance and resilience and increases in latewood proportion. The focal species in both habitat types endured the 2013-2015 drought in Northern California with reasonably high resistance and resilience; however, the lower resistance observed in coastal species suggests that they may be at risk for increased stress and mortality in the event of more severe, prolonged, or frequent droughts.

MONITORING IMPACTS OF TIMBER HARVEST AND LANDSLIDES, RAILROAD GULCH, ELK RIVER, CALIFORNIA. Stubblefield, AP, Department of Forestry and Wildland Resources, Cal Poly Humboldt, Arcata CA, 95521; CP Faubion, Shane Beach, Humboldt Redwoods Company, LLC, Scotia, CA 95565. aps14@humboldt.edu

We report on an 8-year paired watershed experiment to evaluate best management practices for avoiding sedimentation from timber harvest on Railroad Gulch in the Elk River

drainage of northern coastal California. Suspended sediment is a major impairment of water quality in the mountainous watersheds of the north coast. Continuous turbidity-monitoring was used to quantify suspended sediment loading from 2014-2020. The East Branch was selectively harvested in 2016, road construction in 2015. The West Branch was undisturbed; however, a landslide occurred in 2017. Annual sediment yields on the East Branch ranged from 49 t km^2 to 1178 t km^2. Yields in the West Branch ranged from 37 t km^2 to 774 t km^2. The largest sediment yield reflected landslide-derived inputs. Sediment loading increases appeared to result from timber harvest and roading, but also from greater treatment branch drainage density. Elevated sediment loading from timber harvest and landslides declined rapidly in subsequent years. River cross sections, bank erosion and bed material surveys indicated scouring and coarsening trends, and greater bank erosion during wetter years. The landslide clearly affected river channel conditions, but the influence of timber harvest was not detected in the channels. Increases in rill erosion and plume deposition after road construction were detected, but were stabilized rapidly by revegetation. Sediment fences yielded road erosion estimates of 0.0 kg m^2 yr^{-1} to 4.8 kg m^2 yr^{-1}. Road crossings resulted in consistent increases to turbidity in tributary watercourses at several locations. Removal or upgrading of crossings appeared to reduce impacts at several locations.

REGIONAL VARIATION IN THE STRENGTH OF FIRE-VEGETATION FEEDBACKS AND RESISTANCE TO REBURNING ACROSS THE NORTH AMERICAN BOREAL FOREST. Tepley, A, M-A Parisien, X Wang, Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, AB T6H 3S5, Canada. tepleya@gmail.com

The climate is warming across the North American boreal forest at roughly twice the mean global rate. With such rapid warming, we might expect a marked increase in wildfire activity. However, the vegetation that develops after fire in the boreal region tends to resist reburning due to slow fuel accumulation and abundant deciduous trees in some sites. This resistance to reburning could partially counteract the increase in wildfire activity otherwise expected in a warming climate. Here, we quantify variation in the strength of resistance to reburning across the boreal forest over recent decades (1986-2018). We divide the region into 27 Fire Regime Units (FRUs), and for each FRU, we generate a null model of the area expected to have burned more than once (reburned) under the null hypothesis that the annual probability of burning is independent of previous fires. Then, we use a spatial simulation to quantify the departure of the observed reburn area from the null model while accounting for stochastic variation in fire patterns. The observed reburn area was significantly less than the null value in 16 of the 27 FRUs, representing a 5 million-ha reduction in reburn extent. The remaining FRUs had fire rotations >280 years, and the analysis window may have been too short to detect a difference. The strong resistance to reburning in the most fire-prone FRUs (fire rotations <100 years) under current climate suggests that resistance to reburning will continue to dampen climate change-driven increases in wildfire activity for the foreseeable future.

A CHARACTERIZATION OF THE NORTHERN CALIFORNIA SAND BEACH SURF ZONE FISH AND MACROINVERTEBRATE COMMUNITY AND THE EFFECT OF MARINE PROTECTED AREAS.

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Falling in line with global trends, the sandy beach surf zone ecosystem in Northern California has yet to be thoroughly researched and the effect of MPAs on the fish and macroinvertebrate community fully ascertained. This thesis sought to fill these knowledge gaps by studying four MPAs and four matched reference sites in sandy beach surf zones between San Francisco Bay and the California/Oregon border during the summers of 2019 and 2020. The community was sampled by deploying baited remote underwater video cameras (BRUVs), seining, and collecting data on water and physical beach variables. 24 taxa were identified on the underwater BRUV cameras, such as *Triakas semifasciata*, *Amphistichus* ssp. and *Cancer* ssp. 23 species from 12 families were identified in the seine sampling, including *Amphistichus rhodoterus*, *Hyperprosopon ellipticum*, and *Leptocottus armatus*. The results showed that most of the variability in community composition, species richness, and abundance was between the six northern vs. the two southern beaches, while MPAs or year had little effect on the community. Water temperature (+), salinity (+), and total dissolved solids (-) were correlated with species richness and abundance in the BRUV data, while wave height (-) and salinity (+) were with species richness and abundance in the seine data. These findings demonstrate that surf zones are inhabited by a diverse fish and macroinvertebrate community that varies spatially among beaches and with several environmental variables, but not due to protection from MPAs, perhaps because of their age, lack of enforcement, or minimal fishing pressure outside the MPAs.

AIR TEMPERATURE AND SNOW EXTENT FROM iBUTTON TEMPERATURE MEASUREMENTS ON THE SOUTHERN ASPECT OF MT. BAKER, WA USA. Town, M, Geophysical Institute, University of Bergen, Postboks 7803, 5020 Bergen, Norway; C Mehring, L Searl, D Parry, Lakeside School, Seattle, WA 98125; T Anand, Redmond, WA 98053. michaelstown@protonmail.com

We present a new and ongoing data set for the Cascades, Washington, USA, as well as a visceral and engaging secondary/university education model for weather and climate studies. The data are atmospheric and sub-surface temperature collected along the southern aspect of Mt. Baker (Washington, USA) from July 2018 - July 2021. The measurements are done along a common southern ascent of Mt. Baker in collaboration with a high school outdoor program, and a summertime data science experience for high school students. Sixteen Maxim iButton temperature sensors were deployed in nine different locations, arranged as arrays of buried, shaded, and unshaded combinations with data collection at intervals of ~4 hours. The summer diurnal temperatures observed at Schriebers Meadow (1200 m) ranged from 10 to 30 ℃, while winter diurnal temperatures were -15 to 0 ℃. The temperature arrays are used to derive snow extent (Lundquist and Lott, 2008) and act as a proxy for insolation (Lundquist and Huggett, 2008), algorithms for which have been developed using iButton data collected on school grounds. The temperature time series at Schriebers Meadow is extended to seven years (2014-2021) through multiple linear regressions against meteorology data from the north side of Mt. Baker.

SIMILARITIES AND DIFFERENCES OF POST FIRE RESPONSE BETWEEN COAST REDWOOD AND GIANT SEQUOIA, USING THE AUGUST 2020 LIGHTNING SIEGE AS AN EXAMPLE. Van Pelt, R, School of Environmental and Forest Sciences, University of Washington, Seattle, WA 98195. abies2@uw.edu

During a 72-hour period in mid-August, 2020, California endured a record 15,256 lightning strikes, which started 650 fires around the state. In the end, over 1.7 million hectares were burned, including some coast redwood and giant sequoia forests. These two species are perhaps the most fire-resistant tree species on the planet. Not only do they have the thickest bark, they also have incredibly decay-resistant wood. Beyond these similarities, however, their life histories are quite different, including their primary response to severe fire. The lightning siege burned through four permanent plots previously established in old-growth forests of both species with sponsorship from Save the Redwoods League, two plots of each species were affected by fires. Among the coast redwood plots, the CZU August Lightning Complex Fire burned through the Santa Cruz Mountains beginning on September 16th, and the Dolan Fire began on September 18th along the Big Sur coast. The Castle Fire, later renamed SQF Complex Fire, burned through our giant sequoia plots in the Freeman Creek and Mountain Home Groves during September 13-16, 2020. Fire behavior was very different in all four plots, despite similarities between initial conditions. In both plots with coast redwoods, aggressive sprouting occurred, with new shoots growing 1-2 m tall in one year. The giant sequoia plots, however, had an abundant seed crop that sprouted. After 140+ years of fire suppression, these events could be used as an opportunity for a new management direction, given a clean slate with the catastrophic removal of white woods.

NON-NATIVE INVASIONS IN NATIVE PRAIRIE GRASSLANDS OF ALBERTA, CANADA. V Wagner, Zapisocki, Z, R Murillo, Department of Biological Sciences, University of Alberta, Edmonton, T6E 2S9, Canada. viktoria.wagner@ualberta.ca

Prairie grasslands have strongly declined due to land conversion and fragmentation. Meanwhile, remaining grasslands are threatened by invasive non-native plants, which can outcompete native flora and negatively impact ecological functioning. Although several studies have reported invasions in northern prairie grasslands, only some have investigated overall patterns across a large regional gradient, and few have tested their relationship with environmental predictors and anthropogenic disturbance. We surveyed 140 plots across a latitudinal gradient in prairie grasslands of Alberta to (i) identify the most frequent and abundant non-native species, (ii) test whether levels of invasions are linked to environmental factors or anthropogenic disturbance, and (iii) inspect whether these relationships differ between mesic and semi-arid grasslands. Our results show that Kentucky bluegrass (*Poa pratensis* subsp. *angustifolia*), is the most frequent and abundant non-native plant in Alberta prairie grasslands. Across all plots, abundance and richness of non-native plants were positively linked to a shared effect by aridity, soil texture, and agricultural activity, with mesic loamy grasslands having the highest levels of invasion. In mesic grasslands, non-native plant abundance and richness was highest in areas with high agricultural activity and fine-textured soils. By contrast, topography explained most variation in the levels of invasion in the semi-arid prairie. A priority for future research is to identify the mechanisms underlying the differences in

invasion across mesic and semi-arid prairie grasslands. To counteract invasions, practitioners need to diminish the propagule pressure by invasive agronomic grasses, protect and restore grasslands remnants in the mesic region, and proactively control new invaders.

FOREST VEGETATION STRUCTURE AND SNOWSHOE HARE RELATIVE OCCUPANCY IN YOUNG MANAGED WESTERN LARCH STANDS IN THE NORTHERN ROCKIES. Wright, DK, JS Crotteau, E Kennedy Sutherland, USDA Forest Service, Rocky Mountain Research Station, Forestry Sciences Laboratory, Missoula, MT 59801; AJ Larson, WA Franke College of Forestry and Conservation, University of Montana, Missoula, MT 59812; CC Reed, USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, MT 59808. david.wright2@usda.gov

With multiple-use management directives on federal lands, conflicts arise when management activities for one species creates a negative effect on another. Precommercial thinning (PCT) is a common stand management activity that is used to promote long-term development of multiple canopy layers and complex forest structure. In contrast, snowshoe hare (*Lepus americanus*) populations are initially reduced in the short-term in PCT stands due to a reduction of forage and hiding cover. This study investigates snowshoe hare recovery by measuring vegetative metrics and relative pellet occupancy in young western larch (*Larix occidentalis*) stands (between 9- and 51-years old) with and without PCT in northwest Montana. Height stratified vegetation metrics and presence/absence pellet plots were measured in twenty paired stands (n = 40) located in northwest Montana. Vegetative structure in non-PCT stands, had significantly higher overstory tree and sapling density with smaller average overstory diameters. Horizontal cover using the coverboard technique was not significantly different between stand treatments. Snowshoe hare pellets were found in all stands with plot occupancy percent ranging from of 2.7 to 80.0% (mean = 48.7%) in PCT and 24.0 to 96.0% (mean = 67.5%) in non-PCT stands, indicating that snowshoe hares occupied virtually all stands at a low frequency. Relative snowshoe pellet occupancy was significantly lower in PCT stands with odds of pellet presence being approximately a third less than non-PCT stands. Snowshoe hares could be considered commonly present in many of the PCT stands as 13 of the 20 stands had pellet occurrence in over 50% of all plots.

LONG-TERM TREE REGENERATION RESPONSES TO THINNING AND PRESCRIBED BURNING IN A SIERRA NEVADA MIXED-CONIFER FOREST, CALIFORNIA, USA. Zald, H, AN Gray, Pacific Northwest Research Station, USDA Forest Service, Corvallis, OR 97333; MP North, Pacific Southwest Research Station, USDA Forest Service, Mammoth Lakes, CA 93546; CJ May, MD Hurteau, Department of Biology, University of New Mexico, Albuquerque, NM 87131. harold.zald@usda.gov

Fire exclusion has altered composition, structure, and function of frequent-fire forests throughout western North America. Thinning and prescribed burning are widely used to reduce fuels and restore ecosystem dynamics, but few studies have examined long-term (>10 years) regeneration responses to fuel reduction treatments. We examined tree regeneration measured one year prior to mechanical thinning and prescribed burning, and periodically for fifteen years after treatment in a mixed-conifer forest in the Sierra Nevada, California, USA.

Fifteen years after treatments, the combined natural regeneration density of white fir (*Abies concolor*) and incense-cedar (*Calocedrus decurrens*) exceeded 1,000 trees per hectare (tph) in all treatments except overstory thinning, an order of magnitude greater than regeneration of Jeffrey pine (*Pinus jeffreyi*) and sugar pine (*Pinus lambertiana*). White fir regeneration density was highest in the burn only treatment, and lowest after overstory thinning with or without burning. Regeneration of incense-cedar was highest after understory thinning with or without burning. Regeneration of pine species was not influenced by thinning or burning. Planting increased median density of white fir in burned and unburned overstory thinned treatments, and sugar pine in unburned overstory thinned treatments, but had no effect on Jeffrey pine regeneration. Total conifer regeneration density after treatments was mediated by pre-treatment vegetation patch types (closed canopy, *Ceanothus cordulatus* shrub dominated, and open sparse). Our findings suggest no combination of thinning and prescribed burning achieved desired regeneration composition and density, and more proactive planting may be required to maintain pine species in these forests in the future.

STATUS OF NIGHT SMELT (*SPIRINCHUS STARKSI*) POPULATIONS IN HUMBOLDT AND DEL NORTE COUNTIES. Zenobia, Z, JM Jarrin, Department of Fisheries Biology, Cal Poly Humboldt, Arcata, CA 95521; J Ray, California Department of Fish and Wildlife, Eureka, CA 95501; R Laucci, Tolowa Dee-Ni' Nation, Smith River, CA 95567. Jrm261@humboldt.edu

Night smelt occurs from Central California to Southeast Alaska and spawn on the shore of sandy beach surf zones. This species is a vital part of regional food webs and in California, is fished commercially, recreationally and for subsistence, primarily in Humboldt and Del Norte counties. Despite the ecological, commercial and cultural importance of this species, very little is known about its biology and ecology. Consequently, there are currently no criteria to identify when this fishery is overfished or in decline. To study the status of these populations we collected adult night smelt with an A-frame net at six beaches in Humboldt and Del Norte counties once a month from March to September 2021. We then statistically compared length (mm, Total Length), weight (g) and sex ratio with data collected at the same beaches in 2014. We caught 529 fish on 9 of 35 days sampled in 2021. Length and weight averaged (± Standard Deviation) 11.7 ± 0.8 cm TL and 10.4 ± 1.9 g, and were significantly lower than 2014 values (12.2 ± 6.0 cm TL, 11.5 ± 2.5 g, respectively, $p < 0.01$). Most of the fish were males (96%), which was slightly higher than during 2014 (93%, $p < 0.05$). Our study suggests that at present Humboldt and Del Norte night smelt are smaller, lighter and more of them are males than they were a decade ago. These results suggest that these populations are in decline, potentially due to overfishing or unfavorable oceanographic conditions, and may require stricter regulations such as seasonal or annual closures.

FOREST AGE AND FLORAL RESOURCE AVAILABILITY DRIVE NATIVE BEE ABUNDANCE AND DIVERSITY IN INTENSIVELY MANAGED FORESTS OF THE OREGON COAST RANGE. Zitomer, R, Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR 97331; S

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Native bees are the most important pollinator group in temperate ecosystems and play a key role in maintaining forest biodiversity, but little research has focused on how forest management practices affect bees in temperate coniferous forests. We conducted a large-scale study (*n* = 60) in regenerating Douglas-fir (*Pseudotsuga menziesii*) plantations in the Oregon Coast Range during the spring and summer of 2018-2019 to evaluate how native bee communities were influenced by stand age, floral resource availability, and landscape composition. We captured more than 12,000 individuals representing five families, 24 genera and 158 species/morphospecies. Bee abundance and species richness were inversely related to stand age, peaking within three years of harvest and declining sharply as canopy cover increased, with few bees detected in stands greater than 15 years old. Community dissimilarity between younger and older stands was driven by loss rather than turnover of species and no unique species were detected in older stands. Bee abundance and richness were positively related to floral resource availability: doubling in flower density was associated with a 20% increase in mean bee abundance and a 16% increase in mean bee richness. Surprisingly, neither bee abundance nor richness were related to landscape composition. Our results indicate that regenerating conifer plantations can harbor diverse bee communities, but only during the period of succession prior to canopy closure. They also suggest that stand-scale management actions that extend this period and enhance flower density are likely to be the most effective in promoting bee abundance and richness in forest landscapes.