Agenda in Brief

TUESDAY, FEBRUARY 11

10:00 am **Opening Session**
11:00 am **North Coast & Cascades Roundtable**
12:00 pm Brown Bag Lunch Groups: **Meet Your Neighbors** ROOM B*
1:00 pm **Spatially Planning for Climate Change Vulnerability: Climatic Refugia and Landscape Mosaics**
2:00 pm Lightning Talks: **Wildlife Can't Read the Map**
3:00 pm **The Art of Science**

WEDNESDAY, FEBRUARY 12

10:00 am **Parks as Cultural Landscapes**
11:00 am Lightning Talks: **Living History**
12:00 pm Brown Bag Lunch Groups: **Deeper Dive** ROOM B*
1:00 pm Lightning Talks: **Burning Questions**
2:00 pm **Poster Session** ROOM B*
2:50 pm Lightning Talks: **Microfauna and Mutualisms**

THURSDAY, FEBRUARY 13

10:00 am **Lightning Talks: Dynamic Earth**
11:20 am **Interconnected North Coast & Cascades**
12:00 pm Brown Bag Lunch Groups: **Focus Fields** ROOM B*
1:00 pm Lightning Talks: **At Land's Edge**
2:00 pm **Poster Session** ROOM B*
2:50 pm Lightning Talks: **Public Lands**

**Science Days will take place in a Zoom webinar. However, some sessions will utilize a separate Zoom meeting to allow for greater interactivity. Registrants will receive join information for both rooms prior to the event. Sessions taking place in* ROOM B *will be marked with a green box.*

Science Days is hosted by the National Park Service and coordinated by the North Coast & Cascades Research Learning Center. Live captions will available in Zoom and via Streamtext; please contact nps_ncc_rlc@nps.gov with any other accessibility needs.

TUESDAY, FEBRUARY 11

TUESDAY 10–10:50AM

Opening

10:00 Welcome

Sula Jacobs
Superintendent, Olympic National Park

Dr. Andy Ray
Program Manager, North Coast and Cascades Inventory and Monitoring Network

10:20 No park is an island: Stewardship through landscape-level conservation

Brent Johnson
Vegetation Ecologist, NPS Pacific West Region

Long-term conservation requires working beyond the boundaries of any individual park or protected area, and with an array of partners to advance protection of the full breadth of resources and areas protected by the NPS. This calls for biologically connected networks of lands, waters, air quality, and other resources, and collaborative communities of people and ideals. It requires partnerships across governmental, public-private, and international boundaries. This talk will share examples that show how the NPS is contributing to the development of these larger systems throughout the Pacific West Region and beyond.

TUESDAY 11AM–12PM

North Coast & Cascades Roundtable

Facilitator: **Ryan Monello** | Pacific West Region Program Manager, NPS Inventory & Monitoring Division

11:00 Panel Discussion

Meet park scientists! Subject matter experts from North Coast & Cascades parks will discuss big questions, challenges, and opportunities facing parks at a moderated roundtable discussion with an opportunity for audience Q&A.

Sara Dolan
Resources Stewardship Program Manager, San Juan Island National Historical Park

Kayla Fermin
Natural Resource and GIS Program Manager, Lewis and Clark National Historical Park

Hugh Anthony
Aquatic Ecologist, North Cascades National Park

Bill Baccus
Ecologist, Olympic National Park

Lissa Kramer
Curator & Cultural Resources Lead, Klondike Gold Rush National Historical Park – Seattle Unit

Meagan Huff
Curator, Fort Vancouver National Historic Site

TUESDAY 12–12:50PM **ROOM B**

Brown Bag Lunch Groups

Meet Your Neighbors: **Geography Breakouts**

- Olympic Peninsula
- Mount Rainier & Environs
- Columbia River
- San Juan Islands
- North Cascades
- Puget Sound

TUESDAY 1–1:50PM

Keynote

1:00 Spatially planning for climate change vulnerability: climatic refugia and landscape mosaics

Dr. Joshua Lawler
Professor of Environmental and Forest Sciences, University of Washington

Climate change poses significant threats to species, ecosystems, and U.S. National Parks. In a recent study, we determined that 67% of parks in the continental U.S. are likely to be highly vulnerable to at least one of five climate-related threats including fire, drought, forest pests and disease, sea-level rise, and storm surge inundation. I will discuss work on two approaches to address climate vulnerabilities at landscape scales—climatic refugia and landscape mosaic. Climatic refugia are areas that are likely to experience less climatic change and landscape mosaics are areas with multiple levels of protection designed to conserve biodiversity in the face of climate change. I will provide examples of planning processes for both of these tools in Washington State.

TUESDAY 2–3PM

Wildlife Can't Read the Map

Facilitator: **Miranda Terwilliger** | Wildlife Biologist, Olympic National Park

How are changing landscapes, shifting ranges, and stresses faced both within and beyond park boundaries reshaping wildlife communities of all types? The recent and future restoration of some long-absent species to NCCN parks poses timely questions about human-wildlife relationships and ecological resilience through biodiversity.

2:00 Warmer, drier years have countered recent declines in population density of many bird species in the North Coast & Cascades Network

Dr. Chris Ray
The Institute for Bird Populations

The population densities of many bird species have declined in recent years, according to estimates based on various bird counts conducted across North America. Annual bird counts conducted since 2005 at thousands of points within the North Coast & Cascade Network suggest a complex pattern of change. In a previous analysis of count data from 2005 through 2016, the densities of most species appeared to be stable or increasing with year, and many species also responded positively to the generally warmer and drier climate recorded during that period. In a more recent analysis of a longer record of counts from 2005 through 2023, the densities of many species again responded

positively to warmer and drier conditions, but there was also a negative effect of year on density for most species. These results suggest that a warmer, drier climate is currently boosting the population densities of many bird species in the North Coast & Cascades Network, and this boost has been able to counter what would otherwise be a long-term decline in the population densities of many bird species in these parks. Populations that are declining in density with year might be experiencing negative impacts that could cause net declines whenever warmer and dryer conditions fail to boost population densities.

2:06 Emerging technology helps track bird sounds through time at Lewis and Clark National Historical Park

Dr. Cathleen Balantic
NPS Natural Resource Stewardship and Science, Natural Sounds and Night Skies Division

Lewis and Clark National Historical Park is home to many bird species that sing to attract mates and defend territory. Some species live in the park year-round, while others visit to breed during the spring and summer months. Many species heard in the park today were documented by Lewis and Clark in the early 1800s and were known to Indigenous peoples long before that. Since then, average summer temperatures have changed, and future climate projections suggest continuing shifts. These changes may affect the timing of breeding bird activity in the park. Meanwhile, audio recordings have become valuable tools for studying wildlife. Recordings can help answer questions about which bird species live in an area, when birds are singing throughout the year, and how patterns are changing. Lewis and Clark National Historical Park has been collecting audio data from March through August at two sites since 2021. Here, we use machine learning to examine thousands of hours of audio collected in the park. We identify when different bird species are singing and consider how new technology positions the park to monitor bird vocalization activity through time.

2:12 Drivers of summer and fall bat activity in Olympic National Park

Katy Goodwin
U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center

Bats are important contributors to healthy ecosystems but face multiple environmental stressors including the disease white-nose syndrome, habitat loss, energy development, and changing weather patterns. Because bats are difficult to study, scientific knowledge on basic ecology and natural history is lacking for many species. Using acoustic surveys, we investigated bat distribution and ecology in Washington's national parks over multiple years. We will present preliminary results of our work at Olympic National Park. We deployed acoustic detectors to record bat sounds at 52 sites in Olympic during the summer and fall of 2019 and 2020, and then identified the recordings to species. We captured recordings of 10 species in the park, of which California Myotis was the most common. We observed the highest species diversity in the Quinault area, with an average of 7.5 species per site. We also analyzed how bat activity is related to elevation, long-term average precipitation, habitat, time of year, and nightly local weather. We will discuss results of our analyses to date. Our results will provide parks with critical baseline data on bat populations to better inform management and conservation actions, particularly as white-nose syndrome increases in the region.

2:18 Tracking the spread of white-nose syndrome in Washington’s national parks

Michael Hansen
U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center

The fungal disease white-nose syndrome (WNS) has killed millions of bats across North America. For the first 10 years of the epidemic, the disease was restricted to Eastern North America. In 2016 the western edge of WNS jumped over the Rocky Mountains when a bat in Washington State tested positive for the disease. In response, the National Park Service began an effort to monitor the spread of WNS in the North Coast and Cascades Network (NCCN). Since 2016, we have tested over 1500 skin swab and guano samples from six NCCN parks. We detected Pd, the fungus that causes WNS, in Mount Rainier National Park in 2017 and found the first bat with symptoms of WNS disease in 2022. There were no detections in any other NCCN parks until last spring, when a sample from Olympic National Park tested positive for the fungus. Our observations fit with the larger pattern of slower disease spread in western bat populations compared to their eastern counterparts and highlights how the process of disease monitoring and response varies across populations.

2:24 Mapping and protecting rock habitat in the Cascades Mountains for the conservation of climate sensitive species

Dr. Arjan Meddens
Washington State University

Rocky substrates provide habitat for >2000 vertebrate species worldwide, including many species of conservation concern. Despite its importance, the characteristics and quality of broken-rock habitat have not been mapped completely. Because management agencies are tasked with managing landscapes to protect natural resources, modeling and mapping of rocky environments that provide high quality habitat for a range of species is greatly needed. Our objectives are to: (1) characterize rocky landcover using remote sensing and field sampling, (2) predict and map broad-scale broken-rock habitat characteristics, and (3) develop habitat, connectivity, and broken-rock attribute maps for use in natural resource management and conservation efforts. We used multi-scale measurements of broken-rock areas with occupancy data from 3 focal animals. We used remote sensing and field measurements to characterize rocky landcover, size of rocks, vegetation, and microclimate, across the Cascade Mountains. Our research team consists of USFS, NPS, WDFW, and university collaborators for a 4-year project. We will report findings of our first 1.5 years, including detection of rocky landcover, extraction of rock size metrics, and habitat suitability modeling across the Cascades.

2:30 Diet partitioning among mesocarnivores in the North Cascades

Dr. Laura Prugh
University of Washington

The degree of diet overlap between reintroduced fishers and existing mesocarnivores could affect their recovery in the North Cascades. We used fecal metabarcoding to construct detailed diet profiles for fishers, coyotes, bobcats, and marten in the North Cascades fisher recovery area. We assessed similarities in diet composition and measured dietary overlap among species pairings. Diet overlap values ranged from relatively low (0.36) to high (0.76), with more similarly-sized mesocarnivore species having greater diet overlap. While dietary overlap was high for common prey items, we found major differences among predator diets. Additionally, DNA metabarcoding enabled us to detect important prey species that facilitate resource partitioning at a fine-scale. Our findings indicate a competitive cascade may be occurring, wherein competition with bobcats leads to a dietary shift in fishers, thereby increasing competitive pressure on subordinate martens. Consequently, restricted access of fishers to energetically efficient prey may slow recovery efforts in this region, highlighting the importance of investigating the role of competition in species restorations.

2:36 Elk on the Clatsop Plains – Monitoring seasonal use and visitor viewing opportunities in and around Lewis and Clark National Historical Park

John Boetsch
NPS North Coast and Cascades Network

Beginning in 2008, the National Park Service collaborated with USGS to monitor Roosevelt elk in and around the Fort Clatsop unit of Lewis and Clark National Historical Park. Because elk populations are difficult to estimate in dense forests, and because elk home ranges span park boundaries, the decision was made to focus on pellet surveys to track seasonal use within the park and driving surveys to track visitor viewing opportunities in and around the park. Pellet surveys include data on light levels, vegetation cover, and pellet decay class, as well as replicate observations gathered by two observers to estimate detection error rates. An earlier analysis of the pellet survey data through 2012 showed early evidence of a downward trend in winter use in the Fort Clatsop unit, both in terms of relative pellet density and proportion of areas occupied by elk. Preliminary results of data collected through 2022 provide additional support of these downward trends and reveal shifts in the distribution of elk use across the unit that correspond with specific park management activities such as wetland restoration and forest management. Driving survey results also captured shifts in elk group observations in the context of considerable landscape change.

2:42 Monitoring Elk at Lewis and Clark National Historical Park using GPS Collars

Kayla Fermin
Lewis and Clark National Historical Park

Lewis and Clark National Historical Park has implemented a monitoring program to gather data on Roosevelt Elk (*Cervus elaphus roosevelti*) herds in and around the Fort Clatsop unit. In 2019, the park worked with partners to deploy 6 GPS collars on adult female elk. These first collars were configured on a 13- hour fixed interval throughout the year and a 7-hour interval during calving season. In the first three years, six collars were deployed over eight periods providing information about 7 individual female elk. These data provide us with insight into elk movement patterns, elk home ranges, and herd fidelity. To understand greater variation, the program deployed additional collars with an updated GPS fixing frequency. This increase in GPS information will provide us with more insight on how the elk spend their time. The GPS collars data compliment data from pellet and driving surveys serving a greater understanding of local elk ecology informing management decisions.

TUESDAY 3–4PM

The Art of Science

Facilitator: **Christine Loewe** | Executive Director, Port Angeles Fine Arts Center

3:00 Presentations & Panel Discussion

How else can we understand—and connect with—the stories taking place in our parks? Three artists whose work is entwined with park science and stewardship share their pieces and process.

Maddi Bacon | baconbitmadison.wixsite.com

Maddi Bacon is a conservationist, storyteller, and artist. They have spent the past several years working seasonally for conservation corps, national parks, and national forests, which has been the source of much inspiration for their work. Their art takes the form of many mediums including painting, animation, and comics.

Claire Giordano | www.claireswanderings.com

Claire Giordano is an environmental artist, writer, and educator creatively exploring the interwoven patterns of people, place, and climate change. In her interdisciplinary work Claire strives to create visual and virtual spaces that foster connections between individuals and our warming world. Whether she is painting in the wilderness or teaching online, Claire invites others into the painting process and shares the joy of exploring our world with watercolor.

Suze Woolf | www.suzewoolf-fineart.com

Suze Woolf's work is about human relationships to nature. A painter, she explores media from watercolor to paper-casting, artist books to pyrography and installation—sometimes all together.

WEDNESDAY, FEBRUARY 12

WEDNESDAY 10–10:50AM

Parks as Cultural Landscapes

Facilitators: **Kim DiCenzo** | Cultural Resources Program Manager, North Cascades National Park
Sara Dolan | Resources Stewardship Program Manager, San Juan Island National Historical Park

10:00 Presentations & Panel Discussion

Scott Schuyler
Natural & Cultural Policy Representative, Upper Skagit Indian Tribe

Scott Schuyler has worked on countless science and Tribal-based projects in Upper Skagit traditional homelands within North Cascades National Park. In this discussion, he will share about the cultural landscape in the park, the Tribe's story of origin, and how to build bridges with tribes.

Following talk cancelled; Sara Dolan will provide an overview of this project:
Emma Korteum
Natural Resource Technician, Samish Indian Nation Department of Natural Resources

The English Camp Unit of San Juan Island National Historical Park spans 943 acres and features diverse habitats, some of which are rare. The park has completed extensive work defining Special Ecological Areas (SEAs) within English Camp to determine what plants of interest are there and to inform future management actions. The Samish Nation's Department of Natural Resources (Samish DNR) conducted an ethnobotanical study of these SEAs to integrate cultural landscape information. The Samish regard the entire English Camp area as culturally significant as it used to be home to a village site known as Pe'pi'ow'elh (Garrison Bay). Evidence shows continuous occupation at Pe'pi'ow'elh from around 500 AD until 1860, when British Marines demolished a longhouse. This area has provided essential resources like food and medicine to Coast Salish groups since time immemorial. In 2020, a similar study was done at American Camp (Tl'íkweneng). For the English Camp study, Samish DNR used a similar methods including field surveys, extensive literature review, and interviews with Samish Knowledge Keepers to identify culturally significant plants.

WEDNESDAY 11AM–12PM

Living History

Facilitator: **Emilio Santiago** | Cultural Resources Program Specialist, San Juan Island National Historical Park

What challenges and opportunities lie ahead in our work to understand and protect cultural landscapes? While climate change threatens some important archeological sites, new technologies expand our toolbox for research and conservation while enhancing our understanding of our region's overlapping natural and cultural resources.

11:00 How to determine if a tree is historically significant?

Corinna Welzenbach
NPS National Park Cultural Landscapes Program

Historic trees are located within cultural landscapes throughout the region. Historic trees can range from an apple tree planted by homesteaders to an ornamental tree planted within a historic designed landscape. Determining if a tree is historic can be a multi-step process. This lightning talk will explain how to do determine if a tree is historic using the example of the former Old Apple Tree at Fort Vancouver National Historic Park.

11:06 Tracing the origins of glass beads from the Fort Vancouver National Historic Site

Dr. Alison Kyra Carter
University of Oregon

The Fort Vancouver site is the location of the former Hudson's Bay Company (HBC) Western Headquarters (1824-1845), which supplied a variety of goods to outposts in the Pacific Northwest. Over 100,000 glass beads have been uncovered in excavations at the site, which were sold by the HBC as part of the fur trade. Over 150 different types of glass beads were identified by archaeologist Lester Ross (1990), which were then published in a reference guide by Robert Cromwell and others in 2013. This presentation provides an update to a collaborative study between the Fort Vancouver Site, the University of Oregon, and the Elemental Analysis Facility at the Field Museum in Chicago, which aims to provide compositional data for almost all the bead types identified in the Fort Vancouver bead guide. Three major glass types have been identified. Based on the bead shapes and compositions, we can begin to trace these beads to their manufacturing locations. It is hoped these data will help other scholars working in the region identify beads in their own collections and assist with better understanding regional bead exchange networks in the 19th century.

11:12 Landcover changes at Ebey's Landing National Historical Reserve from 1963 to 2020

Natasha Antonova
NPS North Coast and Cascades Network

Ebey's Landing National Historical Reserve is a unique National Park Service unit that includes more than 17,500 acres of federal, state, county, city, and private land ownership and celebrates rich cultural and natural history of the area. The Reserve was created in 1978 to preserve and protect a rural community that was under development pressures from the greater Seattle area. How successful was the Reserve in achieving its goal in the 40 years following its establishment? We used historical aerial photos and Island County parcel data to look at the land cover changes and rates of development inside and outside the Reserve for three time periods: 1963 to 1990, 1991 to 2006, and 2007 to 2020. In this presentation we will report on how the land cover changed inside and outside the Reserve within each time period, help the audience visualize the extent and rate of development and forest cover loss within the Reserve since 1963, and discuss the effectiveness of NPS easements.

11:18 Visualizing legacy data at Lewis and Clark National Historical Park

Dan Teller
Lewis and Clark National Historical Park

To support park planning, preservation of cultural resources, and manage records, we are working to update legacy archeological data at Lewis and Clark NHP into useable "tidy data". Transforming legacy into trusted "tidy data" complete with metadata is an important part of geospatial data management. Legacy archeological data can be paper maps, field notes, synthesis reports, shapefiles, AutoCAD, ArcInfo, and other outdated file formats that make it difficult to work with. This presentation will cover working with legacy archeological data from Lewis and Clark National Historical Park which has digital datasets and paper files going back 25 years and how I turned it all into tidy data, challenges working with legacy data, and tips and strategies for this work.

11:24 Protecting cultural resources with wilderness toilets

Katy Perrier
Olympic National Park

While perhaps unexpected and far from glamorous, one of the most impactful ways to protect cultural resources in the wilderness is the management of human waste. High visitation is impacting culturally sensitive and tribally significant areas in Olympic National Park due to the inevitable increase in the use of wilderness pit toilets that are inadequate for the demand and consequently failing. Park staff are addressing this challenge by implementing an innovative design that has been an unexpected tool in protecting these resources.

11:30 Expanding preservation's role in mitigating climate change through a cultural landscape framework

Laurie Matthews
University of Oregon & MIG

While historic preservation is often seen as a past-focused endeavor, it can also be used as a future-focused tool to expand our approach for not just protecting against climate change but mitigating its impacts, particularly when using a cultural landscape preservation approach. That approach challenges us to consider how we can think more holistically and broadly about preservation minded solutions. A shift that can increase the resiliency of places while encouraging the preservation of their historic character.

WEDNESDAY 12–12:50PM **ROOM B**

Brown Bag Lunch Groups

Deeper Dive: **Professional Interest Breakouts**

- Youth Engagement
- Data Management & Data Access
- Managing for the Unknown
- Remote Sensing & Emerging Technologies
- Science Communication & Art

WEDNESDAY 1–2PM

Burning Questions

Facilitator: **Dr. Beth Fallon** | Vegetation Ecologist, North Cascades National Park

Pacific Northwest forests are vast organic sponges, sequestering globally significant quantities of carbon and keeping it out of the atmosphere. However, monitoring shows a rise in area burned in and around Olympic and Mount Rainier over 30 years, while new regional simulations project a fire future beyond all historical norms. How are research and monitoring informing stewardship in the face of fire and other forest threats?

1:00 Monitoring old-growth forests in the Pacific Northwest using forest inventory data and remote sensing

Dr. David M. Bell
USDA Forest Service, Pacific Northwest Research Station

There is rising concern about the conservation of mature and old-growth (MOG) forests both in the northwest and nationally. The Northwest Forest Plan (NWFP) Interagency Regional Monitoring Program aims to monitor MOG forest status and trends on all forest lands by incorporating forest inventory plot data with annual remotely sensed data. We present and compare status and trends in MOG forests for federal lands and North Coast & Cascade Network (NCCN) to highlight the role they play in the conservation of MOG forests. In particular, we assess how common threats, such as wildfire, have altered the extent of MOG forests on NCCN lands and federal lands in general. These results highlight how NWFP monitoring can place NCCN lands within a broader regional discussion around the conservation of MOG forests.

1:06 How is forest carbon changing in and around northwest parks and why?

Dr. Andy Gray
USDA Forest Service, Pacific Northwest Research Station

Carbon stored in forests has the potential to mitigate global warming caused by fossil fuel emissions. Despite years of research, however, there is still uncertainty and disagreement around some of the fundamental issues around carbon management – including the importance of carbon stocks versus sequestration, the role of harvest rotation lengths and harvested wood products, and the need for fuel reduction in forests prone to severe wildfire. While older forests in the Parks store a lot of carbon, they do not accumulate much new carbon on an annual basis. Surrounding federal lands, however, are accumulating large amounts of carbon due to reduction of harvest in the 1990s. Wildfires on the east side of the Cascades are starting to reduce that carbon accumulation, but reducing wildfire severity involves tradeoffs between carbon storage and forest resilience. Through the long-term monitoring of the Forest Inventory and Analysis (FIA) program and their online tools, tracking changes in forest carbon in our region has become easy and useful.

1:12 Monitoring trends in landscape change within the North Cascades National Park Service Complex, Olympic National Park, and Mount Rainier National Park

Madison M. Laughlin
University of Washington

Understanding trends in landscape change facilitated by disturbance (e.g., wildfire or floods) within parks can help inform park management and resource use by providing information on the condition of natural resources and associated environmental indicators like wildlife habitat and water quality. Here, we assessed qualitative and statistical trends in landscape change from 1987 to 2017 within the North Cascades National Park Service Complex, Olympic National Park, and Mount Rainier National Park and adjacent protected areas. We used remote sensing techniques to identify areas that experienced change, and labeled the agent of change as one of the following: fire, riparian change, avalanche, defoliation, mass movement, or blowdown. Overall, we found that fire was the most extensive disturbance affecting the study area, accounting for 78% of the cumulative disturbance area. Disturbance activity was concentrated in the eastern portion of parks, suggesting these areas may continue to be more disturbance prone in the future under climate warming and drying. Finally, defoliation activity peaked in the early to mid-2000s consistent with regional insect outbreaks. These findings have important implications for natural resource planning and management within the National Park Service.

1:18 How do wildfires influence the water we drink? A case study from watersheds in the North Cascades National Park.

Kate McCredie
Oregon State University

Across the world, communities depend on high quality source water provided by forests—almost two-thirds of communities in the United States rely on water from forests as their source of drinking water. After wildfire, sediment, carbon, nutrients, and heavy metals can increase in streams and rivers for years to multiple decades. While wildfire is a natural and necessary disturbance for ecosystems, the annual area burned and burn severity have increased substantially in recent decades. For example, over the last 30 years, there has been a rise in area burned in and around Olympic and Mount Rainer. In 2023, the Sourdough Fire burned ~6,400 acres, providing a unique opportunity to compare water quality in a burned and unburned watershed in the North Cascades National Park. Approximately one year after the Sourdough Fire, we installed monitoring equipment at Stetattle Creek (burned) and Bacon Creek (unburned) to quantify key water quality parameters, such as turbidity, dissolved organic Carbon, temperature, and pH. As part of a larger trans-disciplinary project across the Pacific Northwest, observations from these study sites will help to fill regional knowledge gaps about the resiliency of forests and community risk to increasing wildfire activity.

1:24 Whitebark pine status and recovery planning in western Washington national parks

Eve Bernhard
American Forests

Whitebark pine was listed as a threatened species in 2022, primarily due to the invasive fungal pathogen, white pine blister rust. Mount Rainier, North Cascades, and Olympic National Parks and the North Coast and Cascades Network Inventory and Monitoring are cooperating to inventory and monitor whitebark pine at the three western Washington national parks where whitebark occurs. Long term monitoring is in place at North Cascades and Mount Rainier, where we found white pine blister rust infection rates of 49% and 76.4% in recent monitoring and mortality of 27% and 25%. Mount Rainier has over 50 Elite trees (tested resistance to white pine blister rust) in three populations, with proven resistance in field plantings; North Cascades has only 9 Elite trees identified in smaller and fire-threatened populations. Much less is known about the status of whitebark pine in Olympic. Efforts are under way to inventory additional potentially resistant Plus trees across all three parks while also collecting population status data on mortality, rust infection rates, and mountain pine beetle presence. This information will be used to plan cone collection in 2025, to prioritize conservation actions, and to support work with partners to map species occurrence across the parks.

1:32 Tracking the Forest's Giants: Large Tree Abundance at Mount Rainier National Park

Dr. Ella Gray
Oregon State University

Large trees play a unique role in forests of the Pacific Northwest. Despite being a small percentage of all trees, they have strong influence on forest structure, nutrient cycling, carbon sequestration, hydrology, and wildlife habitat. They are also culturally important and recreation focal points. Changes to the abundance of large trees on a landscape can have outsized effects on forest character and ecosystem services. Here, we are exploring the dynamics of large trees (greater than 76.1 cm diameter at breast height (DBH)) within late-successional and old growth forests at Mount Rainier National Park. Specifically, we used long-term data from permanent sample plots to understand the demographics of large trees in the park and quantify changes in their abundance over the past 50 years. Preliminary results show many of the park's tree species are present in the biggest size classes and that all stands contain at least one tree >76.1 cm DBH. There has been no significant change in the number of large trees present within the stands over the study period, with some variation by species. These results show a stable population of large trees, spread across a diversity of species, and indicate potential resistance to climate change.

1:38 Cross-Park RAD Project: Insights for Responding to Ecological Transformation in the National Park Service

Julia Goolsby
Cornell University

Natural & cultural resource managers are facing many new challenges for managing public lands, due to climate change and human-driven stressors. In some cases, the very landscapes and species they manage are transforming from one condition to another. As a result, previously successful management strategies may become less effective. Managers can respond in three ways: resist, accept, or direct change (RAD). These difficult decisions cannot be fully answered by scientific information. Instead, decisions are influenced by several social factors, both unique to the individual manager and from outside sources. Our USGS-led research project examines how key institutional and emotional factors shape management decisions about changing resources. Four national parks experiencing significant ecological transformation are the focus of the analysis: Sequoia & Kings Canyon, Acadia, Glacier, and North Cascades. The team used interviews and focus groups to study how the culture and policy of individual parks, and the psychological experiences of managers responding to landscape changes, influence management decisions. This presentation will focus on the North Cascades National Park case study, specifically fire-driven transformation to the western half of the park.

1:44 Modeling Ecosystem Resilience: Adaptive Strategies for PNW National Parks under Climate Change

Dr. James Lamping
University of Oregon

Climate change poses significant threats to the ecosystems of the Pacific Northwest (PNW) national parks, with potential impacts to biodiversity, forest dynamics, and public accessibility. A changing fire regime, shifts in species habitat, and potential loss of old growth forests hinder effective conservation and require a comprehensive assessment to inform adaptive management strategies. Our research aims to address this challenge by assessing climate vulnerabilities within the PNW national parks through the integration of field-based ecological data with advanced modeling techniques to create spatial predictions of current overstory and understory forest structure, composition, and age. The resulting maps of forest composition will then be used in a large landscape model to explore how a changing climate influences the structure and resilience of National Park ecosystems. It will also allow for testing a variety of adaptive management strategies that provide flexible approaches to forest management, allowing managers to adjust actions over time based on management outcomes. The results of this study will provide actionable recommendations for park management, informing strategies to conserve biodiversity and ecosystem services amid a rapidly changing climate.

WEDNESDAY 2–2:40PM **ROOM B**

Poster Session

Flora of the Olympics

Patrick Loafman
Olympic National Park

Determining a plant species list for Olympic National Park is a daunting task that is never fully complete. Many species are small and cryptic and difficult to identify, so they cannot be surveyed remotely. This is a task that is not benefitted by AI or any other technology, rather it requires skilled botanists on the ground surveying. Some species currently considered rare might be fairly common with more surveys, while other species not known for ONP may be present. Eight years ago, I began writing a flora for Washington State's Coastal Range, and my current estimate is there are 1,584 plant species on the Olympic Peninsula and 1,116 are native. How many of these species are known for Olympic National Park is uncertain. "In order to care, you need to know what's there!" is written on the NPS.gov inventory page, so this need for inventory level work is deemed a necessity for management. How do you protect a plant if you do not know it's there?

Understanding Cascadia seismic hazard at the Cascadia Region Earthquake Science Center

Dr. Shannon Fasola
Cascadia Region Earthquake Science Center

Great earthquakes (Mw > 8.5) on the Cascadia subduction zone pose a looking threat to the Pacific Northwest region of the US and Canada. Geologic data demonstrating instantaneous land level changes along the coast in Washington and then Oregon provided the first definitive evidence in the late 1980s that active subduction generated the largest imaginable earthquakes. Over the next ~40 years a simultaneous explosion of scientific investigation and societal awareness created an opportunity to establish a scientific research hub to catalyze new research, build and extend partnerships between public, private and government entities and to train and educate the next generation of scientists and citizens. The Cascadia Region Earthquake Science Center (CRESCENT) was established in 2023 to meet that opportunity. This presentation will describe the structure, goals and aspirations of CRESCENT, with special emphasis on opportunities for partnerships in education and training afforded by the 'Geoscience Education and Inclusion' branch of the Center's structure.

Long-term Pacific Northwest climate monitoring stations fill gaps in national datasets

Rachel Fricke
National Park Service & University of Washington

Long-term mountain climate datasets can help scientists and practitioners understand climatological change over time and give context for ecological trends. However, maintaining climate data stations in remote mountainous landscapes requires significant time, money, and employee effort. Interpolated climate datasets model climate data for spatial gaps between physical climate station networks, and offer an opportunity to estimate climatological conditions in remote locations that lack on-site stations. We sought to understand how similar interpolated datasets such as gridMET, PRISM, and Daymet are to local measurements recorded at climate stations across a range of locations and elevations. We compared maximum and minimum temperature and precipitation from 20 climate stations within the North Coast and Cascades Monitoring Network (NCCN) to data at the same time frequencies and locations from gridMET, PRISM, and Daymet. We assessed how well climate station data and interpolated measurements align with one another at a daily scale, and found that estimated measurements differ significantly from climate data collected by physical climate stations. This suggests that NCCN's climate stations could fill significant spatial data gaps in interpolated networks.

How does water pollution contribute to eelgrass decline near the San Juan Island National Historical Park?

Avantika Dutt
Friday Harbor Laboratories, University of Washington

Eelgrass is a vital marine plant that supports marine life and providing essential environmental services. It serves as habitat for species such as Dungeness crabs, Pacific herring, and salmanoids. Eelgrass enhances water quality, reduces pollution, and stores carbon, benefiting our climate, and holds cultural significance for Native American and First Nations communities in the Pacific Northwest. However, eelgrass has been declining in the San Juan Islands, with one-third of sampled beds showing signs of deterioration, particularly in Garrison Bay. The decline's causes remain unclear but may include disease, rising temperatures, boat damage, and pollution. Our proposed research will assess water pollution in Garrison Bay and nearby sites like Reef Net Cove and Mosquito Pass. We will collect water samples using open-cell foam devices called "Pom Poms" at various locations and depths. Monthly analysis of these samples will help us measure chemical concentrations. By correlating these data with eelgrass health, we aim to identify pollution factors contributing to its decline, ultimately guiding conservation efforts to protect this vital ecosystem for future generations.

Developing methods for cultivation of eelgrass seeds used in restoration

Mckenna Sweet
University of Washington

Eelgrass (*Zostera marina*) is a marine plant that plays a vital role in coastal ecosystems, providing shelter for fish, food for small animals, and helping to combat climate change by storing carbon and preventing erosion. Unfortunately, eelgrass is disappearing in many places, including the San Juan Islands in Washington State. This loss could harm the environment if we don't act quickly to restore it. Our project focuses on improving eelgrass restoration methods to make them more efficient. First, we designed a system to store eelgrass while it naturally releases seeds. We used fine mesh bags in a large tank to keep the eelgrass from sinking to the bottom, ensuring the seeds stayed separate and ready for planting. We also built a device called a flume to sort out the best seeds for restoration. We adapted and scaled up a method developed by researchers in Sweden, adding features like valves to make it easier to remove seeds and prevent clogs. By refining these tools and techniques, we hope to produce more seeds that can be used to restore eelgrass on a larger scale. This work will support ongoing restoration projects promoting healthier coastal ecosystems.

Watch for grass underfoot: Impacts of recreational boating on eelgrass health in San Juan Archipelago embayments

Marco Martinez
Friday Harbor Laboratories, University of Washington

In the past decades, there has been a noticeable and disproportionate decline in the native eelgrass populations at sites in the San Juan Islands, reaching as high as a 75% decline. Despite knowing that there is decline, the prominent factors are not well known. One of those factors however, may be recreational boating which is known to harm seagrasses in other parts of the world. Beginning from 2018, we conducted a preliminary analysis utilizing the Automatic Identification System (AIS) and aerial views across bays in the San Juan Islands which revealed a significant increase in boating activity during the height of the COVID-19 pandemic. With the given data, we will construct heatmaps at selected spots such as Echo Bay, Sucia Islands and Blind Bay, Shaw Island to identify spots of high density recreational boat presence. These analyses will then be compared to maps of eelgrass populations at these sites, which are monitored by the Submerged Vegetation Monitoring Program administered by Washington State Department of Natural Resources. Our heatmaps will make it possible to direct research towards possible impacts from attributes associated with boating presence such as shading, anchor scarring, gray and black water discharge, and fuel and oil leakage.

Comprehensive high-resolution geophysical mapping and sediment coring in Lake Chelan, WA: A deep, steep lacustrine environment

Dr. Boe Derosier
US Geological Survey

Lake Chelan (WA, USA), the third deepest lake in the contiguous United States, may hold records of glacial retreat and advance, volcanic eruptions, and earthquakes. In 2023, the USGS conducted a 3-week field operation in Lake Chelan to acquire high-resolution bathymetry data, chirp sub-bottom profiles, and sediment cores. These new data reveal previously unknown slope failures, mass transport deposits (MTDs), subaqueous deltas, and relic glacial features (e.g., kettles). Lake Chelan can be divided into two physiographic basins: the deeper (445.8m) and narrower (~2–3 km wide) Lucerne Basin to the north and the shallower (127.8 m), wider (5–10 km) Wapato Basin to the south. The northern Lucerne Basin is dominated by very steep flanks and pervasive subaqueous deltas fed by fluvial catchments; its depocenters are dominated by coarser-grained sediment and stacked MTDs. The southern Wapato Basin is characterized by numerous slide scars, scarps, debris aprons along its gently sloping margins, and abundant kettle structures infilled with fine-grained sediments. Geophysical mapping of Lake Chelan suggests the Lucerne Basin is most affected by fluvial processes, and the Wapato Basin is a prime candidate for paleoseismic investigations.

Microfauna and Mutualisms

Facilitator: **John Boetsch** | Ecologist, North Coast and Cascades Inventory and Monitoring Network

Pacific Northwest ecosystems are knit together with players of all sizes. This session explores the roles of microbes, pollinators, and other small but mighty actors on the large stages of forests, rivers, and mountain lakes. How do changes like rising temperatures or the introduction of nonnative species ripple through invertebrate communities and into the broader ecosystem?

2:50 What are the primary drivers of bumble bee range contractions?

Dr. Erica Sarro Gustilo
University of Washington

In the Northern Hemisphere, most animals and plants are shifting their ranges northward in response to climate change to track warming temperatures. Bumble bees, however, are disappearing from the southern edge of their range without expanding at the northern edge of their range, resulting in range contractions. Bumble bees are among the most important native pollinators in agricultural and natural systems, yet many species are currently in decline. My work will I will investigate the drivers of climate-driven range contractions in bumble bees. Drawing on the dramatic elevational gradients and associated climate gradients at Mount Rainier National Park, I will ask how climate and body size interact to influence dispersal, overwintering survival, and thermal tolerance of individual bumble bees. Fieldwork will begin in summer 2025 with the help of community science volunteers. The results of this research will enable prediction of future bumble bee population dynamics in the face of global change.

2:56 Understanding the impacts of tree encroachment on meadow plants and pollinators at Mount Rainier National Park

Madeleine Strait
University of Washington

Mountain meadows are important habitats that host unique biodiversity and provide many benefits to the ecosystem. These meadows are vulnerable to climate change because changes in temperature and precipitation can have large effects on the snowpack and timing of snowmelt, which influences water availability and season length. Global warming has created conditions at higher elevations that are more suitable for trees, which has led to the invasion of trees into areas that were previously meadows. Past research has examined what is causing this phenomenon, commonly called tree encroachment, but little is known about the impacts to meadow communities. The goal of this project is to understand how tree encroachment impacts meadow plants and pollinators within Mount Rainier National Park. This past summer we observed plant-pollinator interactions at multiple locations within the park in two types of meadows: ones without any established trees, and ones in the early stages of tree encroachment. We compared the diversity of plants and insect pollinators between meadow types and examined differences in the patterns of interactions we observed. We are planning on continuing data collection next summer to observe more interactions and hopefully gain a better understanding of the impacts.

3:02 How adaptive mechanisms influence species diversity and distributions of montane ground beetles (*Nebria*)

Zach Farrand
University of Wisconsin–Madison

The ground beetle genus *Nebria* includes over 400 species that specialize in cold climates among mountainous and high latitude regions across the Northern Hemisphere. This incredible species richness has been driven by oscillating glacial climate cycles over the last few million years, where patterns of isolation and mixing have led to the formation of new species. Mount Rainier and North Cascades National Parks harbor a particularly striking amount of *Nebria* diversity compared with other regions, including 12 species co-occurring on a single mountain. These species are distributed from near sea level to over 9000 feet, where each species inhabits a particular elevational zone. Genetic comparisons of high and low-elevation species have led to the identification of adaptive mechanisms that could

enable transitions to challenging high elevation environments. Our findings could be especially relevant in advancing understanding of how genetic variation could enable, or restrict, movement during climate change, as there is a general pattern among cold-specialized organisms in mountains to move up in elevation in response to warming.

3:08 Lake sedimentary DNA records top-down and bottom-up effects of anthropogenic stressors on plankton biodiversity in Western US mountain lakes

Jordan Von Eggers
University of Wyoming

Mountain lakes are being changed by multiple human influences including nutrient pollution from the atmosphere, warmer temperatures, and the introduction of fish into historically fishless lakes. Here, we use DNA stored in the bottom of lakes to track how these human impacts change plankton communities in 14 mountain lakes of Washington, California, and Wyoming over the past few hundred years. We found that nutrient pollution affected plankton at the bottom of the food chain including algae and smaller plankton. Introduced trout affected larger plankton that were higher up on the food chain. Surprisingly, Washington had the lowest level of nutrient pollution compared to California and Wyoming, and at the same time, we saw less changes in the plankton communities at the bottom of the food chain. This suggests Washington lakes may be experiencing less rapid change compared to other mountain lakes in the West. Using sediment cores helps us understand what happened in the past before we started monitoring lakes and place current changes into a historical perspective. This information allows us to compare across regions and time to help us better preserve these unique lake ecosystems.

3:14 Long-Term monitoring of mountain lake benthic macroinvertebrate communities

Ty Stephenson
Western Washington University

High mountain lakes, often formed by glaciers, are typically isolated aquatic ecosystems cut off from fish populations. Their isolation provides an opportunity for amphibians and macroinvertebrates to be the top predators. Introduced fish can drastically alter the community structure of the lakes, often eliminating amphibians and certain macroinvertebrates. While many lakes in North Cascades and Mount Rainier National Parks have been stocked, over the past 20 years the parks have removed fish from select mountain lakes. During this time period park biologists sampled macroinvertebrate communities in lakes with and without fish providing an opportunity to study the effects of fish stocking and subsequent removal on the lake communities. We used these data to describe the structure of macroinvertebrate communities and how communities change over time. Our findings show that both stocked and unstocked lakes can harbor diverse assemblages of macroinvertebrates, with chironomid midges being the most diverse group. The majority of taxa found were sampled very rarely throughout the sampling period. This study helps us understand how mountain lake communities are structured and changing over time and will help inform future lake management research and management within the NCCN.

3:20 Influence of fish on aquatic food webs of alpine lakes in Mount Rainier National Park: A stable isotope approach

Naomi Wurtzel, Dr. Kena Fox-Dobbs
University of Puget Sound

All alpine lakes within Mount Rainier were historically fishless. From 1915 to 1972, several species of fish were introduced to these lakes for recreational fishing. Since stocking efforts stopped in 1972, fish removal programs have occurred in many lakes. The introduction of fish influenced many alpine lakes by altering water conditions, increasing competition with native fish in downstream river systems, and changing the behavior and abundance of amphibian populations. In August 2024 we collected aquatic food web samples for stable isotope analysis from five lakes that have been monitored annually since 1988. Each lake had a different fish history, and we used isotopic data to reveal interactions among common and abundant aquatic taxa within each lake. Specifically, we sampled macroinvertebrates across a range of consumer types, vegetation including periphyton, and fish and amphibian species. Nitrogen stable isotope values provide insight into nutrient flow and trophic structure with each food web, and carbon stable isotope values vary among primary producers and track energy sources through the food web. These combined isotopic datasets will be used to model differences in food chain length and role of fish in lakes with different stocking and removal histories.

3:26 Emerging ecology of native and non-native ticks (*Ixodida*) and their hosts in the San Juan Islands

Russel Barsh
Kwiaht: Center for the Historical Ecology of the Salish Sea

Native Blacklegged Ticks and exotic ticks introduced from the eastern United States appear to be increasing and expanding their range in the San Juan Islands, which historically were believed to be tick-free. In the islands, native ticks are most active in winter and spring; exotic ticks in summer. Domestic dogs, including dogs accompanying visitors to public lands, are implicated in introducing and dispersing ticks. However, native Alligator Lizards (*Elgaria coerulea*), rather than pets, livestock, or small wild mammals, are the most likely primary host of larval ticks (nymphs). Initial investigations suggest that Alligator Lizards are unaffected by tick loads, despite the fact that roughly 6 percent of ticks in the islands are infected with pathogens that may symptoms in dogs and humans. Islands that have lizards also have ticks; islands without lizards have few ticks and they are mostly exotic. Visitors on public trails including San Juan Island National Historical Park need to be more tick-aware and take precautions that were unnecessary in the past. Range expansion by ticks and their pathogens is an example of how climate change (in this case, warmer winters) can affect recreational uses of parks.

3:32 Leaf-associated microbes mediate organic matter decomposition in rivers on the Olympic Peninsula

Cody Spiegel
University of California San Diego

Land-use changes pose significant threats to the delicate balance between ecosystems. Logging practices, especially on the Olympic Peninsula, can impact riparian zones. Our project addresses fundamental questions about the role of microbial communities in regulating ecosystem functions. Specifically, we investigate how microbes from land, carried into rivers by leaves, interact with aquatic microbes to decompose organic matter. The decomposition of organic matter such as leaves is essential for nutrient cycling which supports ecosystem health. This natural process is also critical for other important ecological services such as recreation and water quality. Understanding how microbes interact in breaking down plant material helps us gain insight into the mechanisms underlying ecosystem stability. Ultimately, understanding the interactions between terrestrial and aquatic microbes allows us to develop effective conservation and restoration practices that enhance ecosystem resilience. This research informs land managers in adopting sustainable practices that protect water quality and promote biodiversity, ensuring that these ecosystems continue to provide crucial services for both the environment and communities.

THURSDAY, FEBRUARY 13

THURSDAY 10–11:10AM

Dynamic Earth

Facilitator: **Scott Beason** | Geologist, Mount Rainier National Park

What's new in the Cascadia Subduction Zone? New techniques are improving our ability to predict and detect geologic hazards in our parks. Meanwhile, lidar and other remote sensing technology is revealing information and trends invisible from the ground. How can these new tools and perspectives inform stewardship priorities?

10:06 Using machine learning to classify landscape disturbances in Pacific Northwest national parks

John Boetsch
NPS North Coast and Cascades Inventory and Monitoring Network

To track and map disturbances such as landslides, fires, and avalanches, the National Park Service uses repeat satellite imagery and computer software to detect changes in spectral greenness at Olympic, Mount Rainier, North Cascades, and Lewis and Clark. Changed areas are then reviewed individually and labeled by NPS staff. This greatly increases the information value but also requires significant time and delays the ability to finalize and share results. With over 35 years of data and nearly 30,000 human-labeled disturbance patches, we turned to machine learning to automate this labeling process. Predictive variables included spectral information from imagery, terrain variables, disturbance patch shape and size, and data representing the timing and location of the disturbances. Preliminary results indicate that some disturbance categories were easier to predict than others, depending in part on the number of disturbances used to train the models. We then developed a way to optimize each category separately, resulting in 73.3 to 99.6% of disturbance patches being confidently labeled and reducing the need for human labeling time by about 83%. Increased efficiency will allow faster sharing of results and detection of more subtle and small-scale disturbances in northwestern parks.

10:12 Measuring changes in Mount Rainier's debris-covered glaciers

Jose Jimenez, Dr. Claire Todd
California State University San Bernardino

Many of Mount Rainier's glaciers are covered by rocky debris at lower elevations. Debris cover that is only a few centimeters thick can heat up and accelerate ice melt, but a thicker cover of debris can insulate glacier ice from solar radiation. We are studying how debris cover has affected the retreat of Emmons Glacier, the largest glacier on Mount Rainier. Our findings show that thick debris cover may slow but does not prevent ice melt, and that patterns of debris thickness can reveal how the shape of Mount Rainier's glaciers may change in the future.

10:18 Unraveling the details of the 2023 Tahoma Creek debris flow with multidisciplinary observations

Dr. Alex Iezzi, Dr. Wes Thelen
US Geological Survey Cascades Volcano Observatory

Mount Rainier has had at least 11 large lahars over the last 6,000 years, including one occurring without evidence of eruptive activity (Electron Mudflow). Lahars have the potential to impact life and infrastructure tens of kilometers downstream with little warning, thus, their early detection and characterization is critical. Because large lahars are infrequent, we have engaged in field campaigns to record data from smaller events, including debris flows that are common at Mount Rainier National Park, to test novel monitoring techniques as well as detection and characterization algorithms. A debris flow occurred in the Tahoma Creek drainage on Aug 15th, 2023, that was well-recorded by the newly upgraded lahar detection system network, as well as a dense deployment of temporary sensors. Sensor types that recorded the debris flow include seismometers (ground shaking), infrasound (sound waves), laser rangefinder (flow depth), and satellite imagery. Using a combination of these observations, we can better understand characteristics of the flow which can help inform how these flow characteristics such as velocity and pulses appear on the permanent monitoring network. The recording of this small debris flow will help fine-tune detection algorithms at Mount Rainier and elsewhere.

10:24 Use of Distributed Acoustic Sensing as a tool for monitoring geohazards at Mount Rainier

Verónica Gaete-Elgueta
University of Washington

Distributed Acoustic Sensing (DAS) is a new technology that uses fiber optic cables to monitor seismic events. In this study, we explore using a "dark fiber"—a fiber optic cable installed for telecommunications—to observe seismic activity around Mount Rainier National Park. We utilized a 48-kilometer-long cable with over 4,000 channels buried beneath the road between Ashford and the Henry M. Jackson Memorial Visitor Center on Mount Rainier. By applying pattern-matching techniques, we searched the DAS data for seismic events not detected by the permanent monitoring network. We used a large-magnitude event from the USGS catalog as a template to find similar events in our DAS data. In addition to volcanic activity, our experiment recorded a swarm of tectonic earthquakes in August

2023, located in the Western Rainier Seismic Zone. This more complete earthquake catalog will help us better understand fault structures in the area. We also conducted preliminary analyses to detect and identify other types of events, including surface events, volcano-tectonic earthquakes, and other volcanic activities. Our study lays the groundwork for using DAS to monitor volcanoes in near real-time.

10:30 Monitoring near-surface environmental changes at Mount Rainier using Distributed Acoustic Sensing (DAS)

Manuela Köpfli
University of Washington

Monitoring near-surface environments is critical for landslide risk mitigation. However, traditional methods like soil sensors and satellite imagery often lack spatial detail. Distributed Acoustic Sensing (DAS) offers a solution by using fiber-optic cables to continuously record strain along the fiber, providing high spatial and temporal resolution without invasive techniques. This makes DAS a promising tool for tracking subsurface conditions such as soil temperature (freeze-thaw cycle) and soil moisture, key factors in landslide risk assessment. Monitoring changes in these is crucial for predicting landslide susceptibility. By using DAS, we aim to assess how environmental factors, including vegetation, lithology, and weather exposure influence landslide risk.

10:36 Erosion of river valleys downstream of retreating glaciers: Observations from the Hoh and Puyallup River watersheds

Scott Anderson
US Geological Survey, Washington Water Science Center

Glaciers in Mount Rainier and Olympic National Parks are retreating. There are concerns that glacier retreat, by exposing unstable glacial sediment, could lead to excess sand and gravel delivery that accumulates in downstream river channels, increasing local flood hazards. In the Hoh and Puyallup River watersheds, topographic datasets derived from aerial imagery and lidar were used to better understand recent landscape change in deglaciating headwaters and downstream river channels. We find that erosion in recently deglaciated areas is often modest and that much of the eroded material accumulates within a few miles of source areas. Farther downstream, erosion of river banks and bluffs has generally exceeded in-channel deposition, such that most main stem river valleys have been acting as sediment sources, not sinks, over the past 10-20 years. River valley erosion likely supplied a third to a half of all sediment leaving the watersheds. Why these rivers are eroding, and if erosion will continue, are unknown. However, initial findings do not support the notion that modern glacier retreat necessarily leads to persistent infilling of downstream river channels. This does not negate hazards posed by more intense storms and high channel migration rates expected in the coming decades.

10:42 Age and origin of a low-lying coastal terrace, Olympic National Park, Washington State

Dr. Brian Sherrod
US Geological Survey

We identified elevated shoreline terraces at a number of sites along ~150 km of western and northern Olympic Peninsula coastlines using LiDAR-based elevation profiles. Many of the terraces lie in formerly glaciated areas and at those locations the terraces are likely post-glacial in age. Present day Mean Higher High Water (MHHW) levels range from ~2.2 m and the Highest Astronomical Tides (HAT) are ~3 m in elevation (relative to NAVD88). Raised shoreline angles likely approximate the elevation of the former HAT and lie between ~2 m to ~4 m above present day HAT. At one site, an elevated notch in a bedrock sea stack corresponds closely to the elevated shoreline angles associated with the elevated terraces nearby. Archeaological and geological investigations on terrace sites suggest that the terrace deposits are less than >2 ka in age. Possible explanations for these elevated shoreline terraces include ongoing isostatic response to deglaciation of the Cordilleran Ice Sheet (GIA) and slow/rapid tectonic uplift. We consider tectonic uplift as a viable explanation for these terrace elevations and our proposed work plan seeks to map, describe, and constrain the ages of the terraces in an effort to more fully explain the terrace origin and paleoenvironments.

10:48 Structure and properties of the Cascadia plate interface: Evidence from a newly-discovered exhumed paleomegathrust in the Olympic subduction complex

Anna Ledeczi
University of Washington

Earthquakes and their resulting tsunamis at the Cascadia subduction zone, where the Juan de Fuca plate subducts under the North American plate from northern California to Vancouver Island, pose great hazard to coastal communities. The rocks that make up this extensive subduction zone are exposed at the surface only in the central-western Olympic Mountains within Olympic National Park. A record of subduction is preserved in outcrops of mélange, highly chaotic and jumbled masses of rock. These rocks formed by initial subduction to a depth of 15 kilometers beneath the Cascadia plate boundary; transfer to the base of the North American plate accretionary wedge through underplating as new faults formed; and uplift and exhumation to the surface over millions of years. The geology of the region surrounding Mt. Olympus and Mt. Tom preserves evidence of these key processes, and we hypothesize that it specifically preserves examples of prominent subduction faults from depths relevant to great earthquakes. We conducted geologic mapping and extensive sampling of outcrops in the Lake of the Gods region in summers of 2023 and 2024. We present evidence that these rocks document subduction zone processes through field mapping, outcrop photogrammetry, and analysis of microscopic structures.

THURSDAY 11:20AM–12PM

Interconnected North Coast & Cascades

Facilitator: **Matt Nicholson** | Landscape Ecologist, NPS Pacific West Region

11:20 Panel Discussion

Threats, such as landscape fragmentation, shifting fire regimes, invasive species, and pathogens, impact resources at large scales and are often interconnected. Therefore, conservation and management actions often need to be at the landscape scale. During this moderated discussion, hear from three experts meeting broad-scale challenges with landscape level approaches to research and conservation.

Raymond Davis
Monitoring Module Lead, USDA Forest Service | Northwest Forest Plan

Dr. Thomas Rodhouse
Ecologist, NPS Biological Resources Division Landscape Restoration & Adaptation Branch | Northwestern Bat Hub

Dr. Beth Fallon
Vegetation Ecologist, North Cascades National Park | Whitebark Pine Restoration and Management in the NCCN

THURSDAY 12–12:50PM **ROOM B**

Brown Bag Lunch Groups

Focus Fields: **Topic-Based Breakouts**

- Vegetation & Forest Ecology
- Wildlife Biology & Management
- Geology & Physical Sciences
- Coastal & Marine Sciences
- Interpretation & Education
- Aquatics & Fisheries
- Cultural Resources & Archeology

At Land's Edge

Facilitator: **Dr. Steven Fradkin** | Coastal Ecologist and Limnologist, Olympic National Park

From the San Juan Islands and the Olympic coast to the mouth of the Columbia River, our parks' coastlines are plugged directly into the global ocean system. Vibrant coastal ecosystems collide with marine debris, human use, and shifts like ocean acidification in ways that reach beyond just tidepools and estuaries. What does research and stewardship of our "blue planet" look like in the North Coast & Cascades Network?

1:00 Mitigation in action: Tracking behavioral changes in critically endangered Southern Resident killer whales

Kimberly Nielsen
Oceans Initiative

The Southern Resident killer whale (*Orcinus orca*) (SRKW) population is federally listed as endangered under the Endangered Species Act. Mitigation measures have been introduced in Washington State and British Columbia to address vessel impacts on SRKW behavior, particularly feeding activity. The waters around San Juan Island, a critical summer feeding habitat, host a thriving whale-watching industry and extensive recreational boating traffic. Since 2018, Oceans Initiative has monitored vessel behavior (number, distance, speed) and its effects on SRKW feeding from land-based sites on San Juan Island. While vessels in close proximity reduce SRKW foraging time, the introduction of restricted approach distances for private boaters and licensing requirements for commercial whale watch (CWW) operators have mitigated some impacts. Notably, CWW vessels exhibit a "sentinel" effect, modeling compliant behavior around whales and reducing private boater infractions. Despite these improvements, the presence of additional vessels continues to indirectly affect SRKWs by increasing overall disturbance, underscoring the need for ongoing monitoring and adaptive management.

1:06 Clams under pressure: Pacific razor clams in acidic oceans

Amelia L. Ritger
University of California Santa Barbara

Coastal communities face increasing threats from climate change-induced stressors such as ocean acidification and heatwaves. These impacts extend beyond the environment, affecting economic, social, and cultural systems. Shellfish fisheries of the Pacific Northwest U.S. exemplify this vulnerability, as this region has been identified as highly susceptible to ocean acidification, a stressor that is a particular risk to shellfish survival and growth. The Pacific razor clam fishery is one of the most popular recreational fisheries in Washington state and also provides enormous cultural value to coastal tribal communities. Over the last two decades, however, the razor clam population on Kalaloch Beach in Olympic National Park has been in decline. To investigate biogeographic patterns in razor clam shell characteristics and their relationship with local oceanographic conditions, we collected razor clams from 13 sites spanning over 700 km of coastline, including Kalaloch Beach. By comparing modern shells to historical specimens, we identify both spatial and temporal trends in shell size, thickness, and strength.

1:12 Preliminary testing data and hypothesis for what chemicals of concern may be contributing to water pollution and the eelgrass decline near San Juan Island National Historical Park

Scott Smith
Blue Shirt Justice League Inc.

Eelgrass is a vital marine plant that supports marine life and providing essential environmental services. It serves as habitat for species such as Dungeness crabs, Pacific herring, and salmonoids. Eelgrass enhances water quality, reduces pollution, and stores carbon, benefiting our climate, and holds cultural significance for Native American and First Nations communities in the Pacific Northwest. However, eelgrass has been declining in the San Juan Islands, with one-third of sampled beds showing signs of deterioration, particularly in Garrison Bay. The decline's causes remain unclear but may include disease, rising temperatures, boat damage, and pollution. Our proposed research will assess water pollution in Garrison Bay and nearby sites like Reef Net Cove and Mosquito Pass. We will collect water samples using

open-cell foam devices called "Pom Poms" at various locations and depths. Monthly analysis of these samples will help us measure chemical concentrations. By correlating these data with eelgrass health, we aim to identify pollution factors contributing to its decline, ultimately guiding conservation efforts to protect this vital ecosystem for future generations.

1:18 Invasive European green crabs in Washington's national parks

Dr. Emily Grason
Washington Sea Grant

Adrianne Akmajian, Dawson Little
Makah Tribe

First detected in Washington State in 1998, it took several decades for invasive European green crabs to establish populations in coastal estuaries or expand their range into the Salish Sea. In the past eight years green crabs have dramatically increased abundance and spread. In response, tribes and the state of Washington have issued disaster and emergency declarations. In their role as predators and competitors, green crabs threaten shellfish, eelgrass and many native species. The San Juan Island National Historical Park has several sites near where green crab were first detected within Washington's Salish Sea (Westcott Bay). However, despite trapping at these sites that dates back to 2016, no evidence of green crabs has been found on parks land to date, and green crabs remain below detectable limits on the island. On the Olympic Peninsula, the Makah Tribe has been actively managing green crab on the Makah Reservation since the first detection in 2017, and populations have generally been growing. In 2024, green crabs were trapped for the first time on shorelines of Olympic National Park, signifying green crabs are using new habitats as they grow their populations, and increasing concern that the invasion will threaten park habitats and species.

1:24 Identifying environmental controls on the infaunal community structures of Olympic National Park's sand beaches

J. Andres Marquez
Stanford University

Open-ocean sand beaches are coastal ecosystems that make up approximately 30% of the intertidal zone within Olympic National Park. They provide key ecosystem services such as storm buffering, nutrient cycling, water purification, habitat, and have important cultural and economic value. Additionally, sand beaches are home to diverse and productive infaunal marine invertebrate communities. However, the extent to which infaunal invertebrate community structures are influenced by their physical abiotic environment is yet to be fully understood. This study uses data collected between 2005 and 2024 to describe the infaunal invertebrate community structures, physical abiotic environment, and fundamental relationships between the infaunal communities and abiotic environment at six sand beaches within Olympic National Park. Ultimately, understanding the influence of environmental drivers on infaunal community structures will be essential for preserving these valuable ecosystems for generations to come in the face of a changing climate.

1:30 Cobble berm monitoring in Olympic National Park to inform designs of nature-based coastal protection structures

Taylor Skaggs
Washington State Department of Ecology Applied Coastal Research & Engineering

Dynamic revetments (or cobble berms) have emerged in the Pacific Northwest as a form of nature-based shoreline stabilization for high energy coasts. Dynamic revetments are constructed with smaller materials than traditional revetments and are designed to be mobile, adjusting to changing wave and water conditions, while absorbing and dissipating wave energy. With limited quantitative data on dynamic revetments performance, sites with natural cobble berms like at South Beach near Kalaloch in Olympic National Park serve as an analog to inform engineers on how to design dynamic revetments to function as natural cobble berms. Since 2019, the Washington State Department of Ecology has conducted seasonal monitoring of the beach and berm using GPS, digital photos, and tagged rocks to track how the beach is evolving over time. This monitoring data allows us to investigate the evolution of the berm shape and volume, grainsize distribution, and cobble mobility to inform suitability and design of engineered dynamic revetments. By examining the seasonal and annual changes of this site, we can better understand the types of shorelines suited for dynamic revetment installations and enhance future design and implementation of nature-based shoreline stabilization.

1:36 How do different sediment densities affect early bull kelp (*Nereocystis Luetkeana*) life stages in sandy environments?

Spencer Hill
University of Washington

Bull kelp (*Nereocystis luetkeana*) has declined by 63% in South Puget Sound from 1878–2017. This species is vital for ecosystem health, buffering waves, providing habitat, and serving as a carbon sink. One potential cause for its decline is the increase in fine sediment concentrations from urbanization and climate change. We investigated how different sediment levels affect gametophytes, the earliest life stage of bull kelp. We collected spores from adult fronds and allowed them to develop into gametophytes on glass slides. Then, we added one of four sediment densities to each beaker containing the slides. Weekly, we photographed the gametophytes to assess their development and survival. Counting gametophytes proved difficult because they adhered to the sediment, and rinsing methods did not remove enough. Our observations suggest that higher sediment concentrations reduce gametophyte size, development, and density. Next, we aim to refine experimental methods for easier analysis. Future studies will explore sediment sources and strategies to mitigate their impacts on kelp beds.

1:42 Distribution and diversity of kelps and rockweeds in the California Current ecosystem from the Olympic Peninsula to Southern California

Dr. Christopher Janousek
University of Washington

Large brown seaweeds such as kelps and rockweeds are important species in rocky shore ecosystems because they create habitat structure and are highly productive. However, kelp forests and beds are threatened by changing ocean conditions including marine heat waves and increasing urchin populations. In this study, I investigated the distributions of large brown algae at about 100 intertidal sites from the Olympic Peninsula to southern California to determine patterns of species abundance, composition, and diversity. Data indicated that only a small number of species were widespread, many were moderately frequent in occurrence, and a few were rare or limited to a small geographic region. Analysis by latitude showed that kelps reached their maximum diversity in the Pacific Northwest while rockweeds had maximum richness in southern and central California. Conducting natural history observations at regional scales can help identify locations or species of high conservation interest and provide baseline data for monitoring to assess the impacts of climate change.

Poster Session

Bryophyte community structure in the understory and in the canopy in Olympic rainforests

Dr. Carrie L. Woods
University of Puget Sound

Bryophytes may be tiny but are essential to the structure and functioning of forest ecosystems in the Pacific Northwest. In temperate rainforests on the Olympic peninsula, bryophyte species cover every surface from decaying logs to standing, live trees. Here I highlight the importance of structural diversity on bryophyte communities using 8 years of bryophyte research in the understory and in the canopy in Olympic National Park forests. Olympic rainforests have high horizontal heterogeneity due to the abundance of large, slow-decaying logs. Our surveys of bryophyte communities in the Hoh rainforest understory have found species specialized to different decay stages of nurse logs and the forest floor. Bigleaf maple (Acer macrophyllum) trees harbor an incredible biomass and diversity of epiphytic bryophytes. Our research in these trees has highlighted the importance of structural complexity on the patterns of epiphytic bryophyte communities. The high structural diversity in the understory and in the canopy in northern temperate rainforests influenced the fine-scale distribution of bryophytes, which suggests niche partitioning as a mechanism of coexistence.

Conditions and trends of ecosystem responses to air pollution in North Coast & Cascades Network parks

Dr. Michael D. Bell
NPS Natural Resource Stewardship and Science, Air Resources Division

Nitrogen and sulfur air pollutants are released from human activities and travel across park boundaries where they can harm ecosystem health. Recent research has developed national- and regional-scale datasets that provide increased spatial resolution and species-specific responses for where ecosystem components are harmed by deposited nitrogen air pollution. In an effort to make the data more accessible to park managers and scientists, the Air Resources Division (ARD) developed a standardized methodology for applying data to parks through the ARD Conditions and Trends tool. This presentation will share the conditions and trends for the eight ecosystem components for nitrogen deposition and the 5 ecosystem components for sulfur deposition used in the risk assessment. Seven of the eight parks in the NCCN have data for at least one ecosystem component that responds to nitrogen or sulfur deposition. The outcome of the assessment gives a good, fair, or poor rating for each component and allows us to ask where and by how much an ecosystem is at risk. This tool also allows us to work with staff to influence management decisions and integrate local data to better represent a park's sensitive ecosystems.

Long-term Pacific Northwest climate monitoring stations fill gaps in national datasets

Rachel Fricke
National Park Service & University of Washington

Long-term mountain climate datasets can help scientists and practitioners understand climatological change over time and give context for ecological trends. However, maintaining climate data stations in remote mountainous landscapes requires significant time, money, and employee effort. Interpolated climate datasets model climate data for spatial gaps between physical climate station networks, and offer an opportunity to estimate climatological conditions in remote locations that lack on-site stations. We sought to understand how similar interpolated datasets such as gridMET, PRISM, and Daymet are to local measurements recorded at climate stations across a range of locations and elevations. We compared maximum and minimum temperature and precipitation from 20 climate stations within the North Coast and Cascades Monitoring Network (NCCN) to data at the same time frequencies and locations from gridMET, PRISM, and Daymet. We assessed how well climate station data and interpolated measurements align with one another at a daily scale, and found that estimated measurements differ significantly from climate data collected by physical climate stations. This suggests that NCCN's climate stations could fill significant spatial data gaps in interpolated networks.

Understanding Cascadia seismic hazard at the Cascadia Region Earthquake Science Center

Dr. Shannon Fasola
Cascadia Region Earthquake Science Center

Great earthquakes (Mw > 8.5) on the Cascadia subduction zone pose a looking threat to the Pacific Northwest region of the US and Canada. Geologic data demonstrating instantaneous land level changes along the coast in Washington and then Oregon provided the first definitive evidence in the late 1980s that active subduction generated the largest imaginable earthquakes. Over the next ~40 years a simultaneous explosion of scientific investigation and societal awareness created an opportunity to establish a scientific research hub to catalyze new research, build and extend partnerships between public, private and government entities and to train and educate the next generation of scientists and citizens. The Cascadia Region Earthquake Science Center (CRESCENT) was established in 2023 to meet that opportunity. This presentation will describe the structure, goals and aspirations of CRESCENT, with special emphasis on opportunities for partnerships in education and training afforded by the 'Geoscience Education and Inclusion' branch of the Center's structure.

Watch for grass underfoot: Impacts of recreational boating on eelgrass health in San Juan Archipelago embayments

Marco Martinez
Friday Harbor Laboratories, University of Washington

In the past decades, there has been a noticeable and disproportionate decline in the native eelgrass populations at sites in the San Juan Islands, reaching as high as a 75% decline. Despite knowing that there is decline, the prominent factors are not well known. One of those factors however, may be recreational boating which is known to harm seagrasses in other parts of the world. Beginning from 2018, we conducted a preliminary analysis utilizing the Automatic Identification System (AIS) and aerial views across bays in the San Juan Islands which revealed a significant increase in boating activity during the height of the COVID-19 pandemic. With the given data, we will construct heatmaps at selected spots such as Echo Bay, Sucia Islands and Blind Bay, Shaw Island to identify spots of high density recreational boat presence. These analyses will then be compared to maps of eelgrass populations at these sites, which are monitored by the Submerged Vegetation Monitoring Program administered by Washington State Department of Natural Resources. Our heatmaps will make it possible to direct research towards possible impacts from attributes associated with boating presence such as shading, anchor scarring, gray and black water discharge, and fuel and oil leakage.

How does water pollution contribute to eelgrass decline near the San Juan Island National Historical Park?

Avantika Dutt
Friday Harbor Laboratories, University of Washington

Eelgrass is a vital marine plant that supports marine life and providing essential environmental services. It serves as habitat for species such as Dungeness crabs, Pacific herring, and salmanoids. Eelgrass enhances water quality, reduces pollution, and stores carbon, benefiting our climate, and holds cultural significance for Native American and First Nations communities in the Pacific Northwest. However, eelgrass has been declining in the San Juan Islands, with one-third of sampled beds showing signs of deterioration, particularly in Garrison Bay. The decline's causes remain unclear but may include disease, rising temperatures, boat damage, and pollution. Our proposed research will assess water pollution in Garrison Bay and nearby sites like Reef Net Cove and Mosquito Pass. We will collect water samples using open-cell foam devices called "Pom Poms" at various locations and depths. Monthly analysis of these samples will help us measure chemical concentrations. By correlating these data with eelgrass health, we aim to identify pollution factors contributing to its decline, ultimately guiding conservation efforts to protect this vital ecosystem for future generations.

Developing methods for cultivation of eelgrass seeds used in restoration

Mckenna Sweet
University of Washington

Eelgrass (*Zostera marina*) is a marine plant that plays a vital role in coastal ecosystems, providing shelter for fish, food for small animals, and helping to combat climate change by storing carbon and preventing erosion. Unfortunately, eelgrass is disappearing in many places, including the San Juan Islands in Washington State. This loss could harm the environment if we don't act quickly to restore it. Our project focuses on improving eelgrass restoration methods to make them more efficient. First, we designed a system to store eelgrass while it naturally releases seeds. We used fine mesh bags in a large tank to keep the eelgrass from sinking to the bottom, ensuring the seeds stayed separate and ready for planting. We also built a device called a flume to sort out the best seeds for restoration. We adapted and scaled up a method developed by researchers in Sweden, adding features like valves to make it easier to remove seeds and prevent clogs. By refining these tools and techniques, we hope to produce more seeds that can be used to restore eelgrass on a larger scale. This work will support ongoing restoration projects promoting healthier coastal ecosystems.

Flora of the Olympics

Patrick Loafman
Olympic National Park

Determining a plant species list for Olympic National Park is a daunting task that is never fully complete. Many species are small and cryptic and difficult to identify, so they cannot be surveyed remotely. This is a task that is not benefitted by AI or any other technology, rather it requires skilled botanists on the ground surveying. Some species currently considered rare might be fairly common with more surveys, while other species not known for ONP may be present. Eight years ago, I began writing a flora for Washington State's Coastal Range, and my current estimate is there are 1,584 plant species on the Olympic Peninsula and 1,116 are native. How many of these species are known for Olympic National Park is uncertain. "In order to care, you need to know what's there!" is written on the NPS.gov inventory page, so this need for inventory level work is deemed a necessity for management. How do you protect a plant if you do not know it's there?

Comprehensive high-resolution geophysical mapping and sediment coring in Lake Chelan, WA: A deep, steep lacustrine environment

Dr. Boe Derosier
US Geological Survey

Lake Chelan (WA, USA), the third deepest lake in the contiguous United States, may hold records of glacial retreat and advance, volcanic eruptions, and earthquakes. In 2023, the USGS conducted a 3-week field operation in Lake Chelan to acquire high-resolution bathymetry data, chirp sub-bottom profiles, and sediment cores. These new data reveal previously unknown slope failures, mass transport deposits (MTDs), subaqueous deltas, and relic glacial features (e.g., kettles). Lake Chelan can be divided into two physiographic basins: the deeper (445.8m) and narrower (~2–3 km wide) Lucerne Basin to the north and the shallower (127.8 m), wider (5–10 km) Wapato Basin to the south. The northern Lucerne Basin is dominated by very steep flanks and pervasive subaqueous deltas fed by fluvial catchments; its depocenters are dominated by coarser-grained sediment and stacked MTDs. The southern Wapato Basin is characterized by numerous slide scars, scarps, debris aprons along its gently sloping margins, and abundant kettle structures infilled with fine-grained sediments. Geophysical mapping of Lake Chelan suggests the Lucerne Basin is most affected by fluvial processes, and the Wapato Basin is a prime candidate for paleoseismic investigations.

Interactive effects of pH and eelgrass wasting disease on *Phyllaplysia taylori* behavioral physiology

Flora Vaught, Ansuya Somashekar
Friday Harbor Laboratories, University of Washington

Zostera marina is an essential marine habitat, holding ecological importance and cultural significance among indigenous tribes. *Phyllaplysia taylori*, a sea hare exclusive to the west coast, fulfills a vital role in maintaining the health of eelgrass meadows. As climate change progresses, ocean pH continues to drop and the prevalence of eelgrass wasting disease may rise due to heightened ecological stressors. We explored the effects of these factors on *P. taylori* behavior with the eelgrass collected from 4th of July Beach. Adult *P. taylori* of similar size were selected from a tank at FHL and starved before being placed either in a flow through table or one of four pH treatments. Test subjects were exposed to healthy and visually identified diseased eelgrass leaf samples while the pH treatments utilized only healthy samples. The mass of epiphytes grazed by *P. taylori* was used as a metric of behavioral impact for both ocean acidification and eelgrass wasting disease treatments. We also recorded reaction time, measured as the time it took the sea hare to right itself in each pH treatment. Neither yielded statistically significant results although the flip test data displayed a weak trend of slower reaction times as pH decreased.

Art of Science: Continuing the Conversation

Claire Giordano
Adventure Art Academy

Connect with Claire Giordano, panelist in the Art of Science session on Tuesday! Claire is an environmental artist, writer, and educator creatively exploring the interwoven patterns of people, place, and climate change. In her interdisciplinary work Claire strives to create visual and virtual spaces that foster connections between individuals and our warming world. Whether she is painting in the wilderness or teaching online, Claire invites others into the painting process and shares the joy of exploring our world with watercolor.

THURSDAY 2:50–3:50PM

Public Lands

Facilitator: **Kim Popek** | Ecological Restoration Supervisor, Mount Rainier National Park

With growing visitation compounding outside stresses, parks are grappling with novel challenges around rising human use. At the same time, new tools are emerging to understand these effects and restore impacted areas. How can social science guide effective communication for resource protection, while welcoming a broader coalition of stewards?

2:50 The effects of visitor use on small scale plants at Mount Rainier National Park

John Villella, Jason Clark
Siskiyou BioSurvey LLC

Mount Rainier National Park supports a remarkably diverse assortment of smaller-scale plants including a number of species that are globally or regionally rare. As the highest mountain in Washington, Mount Rainier provides a uniquely cold, arctic-like habitat, and this is reflected in the flora. Our study highlights that the distribution of these species is sensitive to both disturbance and environmental conditions at fine scales. Trampling by visitors in heavily used areas of the park has a strong, negative effect on these communities, particularly in alpine areas. In these areas species richness was lowest immediately adjacent to trails and rare species are less likely to occur in areas that have experienced more severe trampling. Maintaining visitor access to the park is critical for the enjoyment of this park and for obtaining public buy-in for conservation, and we believe that visitor use can be facilitated while providing for the wellbeing of sensitive plant communities. In areas of high use, some degree of trampling seems inevitable. Park staff should consider deploying additional infrastructure to protect sensitive habitats, such as railings, signage, and boardwalks in strategic places where reducing visitor impacts is feasible.

2:56 Assessing impacts of off-trail hiking on subalpine meadows in Paradise, Mount Rainier

Lindsey Skidmore
University of Washington, Americorps

Subalpine meadows in Mount Rainier National Park are fragile environments, particularly vulnerable to vegetation damage from off-trail hiking. Paradise Meadows, a popular destination for over a million visitors annually, has experienced significant impacts from increased visitor activity. To assess the extent and severity of these impacts, this project combined satellite imagery and field data collected over three field seasons. A model was developed to predict the likelihood of social trail existence based on satellite imagery and trained with field data. While the model was effective in areas with subalpine vegetation, its accuracy was limited in rocky or heavily forested areas because of the lack of high-resolution imagery captured during peak vegetation. This research provides valuable insights into the spatial patterns of impacts and can help park managers prioritize areas for restoration and implement effective management strategies to protect these fragile ecosystems.

3:02 Monitoring the restoration of the Hurricane Ridge septic meadow

Deneb Maine
Dungeness River Nature Center, Miami University

Restoration is one of the key tools in protecting our ecosystems and building resiliency to visitor use. In the summer of 2020, a new septic system was installed at Hurricane Ridge in Olympic National Park which involved disturbing about three acres of subalpine meadow. This study established initial monitoring efforts of the restoration process and looked at how the plant communities differ between the disturbed meadow and the surrounding meadow. The amount of vegetation cover is similar between the two sites, however which plant species were present and most common differed between the locations. Subalpine meadows are vulnerable to climate change and understanding this recovery process and which restoration methods have been successful will help inform decision making to protect these ecosystems. I plan to continue to monitor this meadow to see how the plant communities change over time with the hopes of turning this study into a community science project.

3:08 Assessing and addressing effects of invasive reed canarygrass on aquatic habitats, cutthroat trout and coho salmon in Olympic Peninsula watersheds

Jill Silver
10,000 Years Institute

Robert Vadas
Washington Department of Fish and Wildlife

Reed canarygrass is an aggressive invasive species that thrives in the shallow edges of lakes, streams, in wetlands and floodplain side-channels. Described in literature as an ecosystem engineer, reed canarygrass (RCG) has been planted for 100 years to transform wet pastures to dry for livestock forage. Rooting in silt, soil, or gravel, the rhizomes sprout 4 - 8' stems forming dense stands impeding flow and trapping fine sediment from which islands of stems develop. Each stem produces florets with hundreds of seeds that float to new sites, while broken fragments of root and stem form new stems and roots. With these highly competitive strategies, RCG is expanding in coldwater streams critical to Pacific salmon and trout, displacing diverse plant communities in the forested web of food and structure. Focusing on declining cutthroat trout in Irely Creek, non-profit and agency ecologists, biologists, and college students are advancing several studies to explore RCG's effect on populations vulnerable to climate disruption. Years of collected data and a model overlaying coho rearing habitat and RCG, combined with satellite and LiDAR imagery, will inform actions to maintain the high-quality salmonid habitat through the development of a scientifically based management program for RCG.

3:14 Mortality risk for coho salmon landed in recreational troll fisheries using 1/0 and 6/0 hooks

Ryan Walsh
Makah Tribe

Recreational salmon fisheries in the state of Washington are managed with size-selective and mark-selective rules to promote the release of wild and undersized salmon. In order for this management approach to be effective, the fishery must have low mortality of hooked and released salmon. In this study, we directly compared the fishing performance of small (1/0) and large (6/0) hooks in recreational coho salmon troll fisheries with the goal of evaluating differences in drop-off rates, size of salmon caught, and the probability a fish would be hooked in a region documented to have low, intermediary, or high risk of mortality. Our results showed that 6/0 hooks were 2.8 times more likely than 1/0 hooks to hook coho salmon in body regions in which hooking injuries are associated with high or intermediary risk of mortality. Additionally, we observed that drop-off rates were 1.8 times greater for fish hooked on a 1/0 hook than when hooked on a 6/0 hook. Careful consideration is needed to determine if these results support restrictions in hook sizes used in recreational coho salmon troll fisheries. Additional studies should be conducted to monitor mortality rates of hooked and released salmon caught on the two hook sizes.

3:20 Deploying Chronologs in Olympic National Park to support coastal research and interpretation

Dr. Ian M. Miller
Washington Sea Grant

Dr. Steven Fradkin
Olympic National Park

Environmental monitoring systems that rely on photographs submitted by users with their smartphones are growing in popularity. In late October 2024, after reviewing three of those systems, our team deployed five Chronolog stations at Kalaloch Lodge and campground with the goal of monitoring conditions on the coast while delivering targeted interpretive content to engaged visitors. This presentation will describe lessons learned after over a year of experience with the Chronolog stations at Kalaloch. Specifically, we will focus on three questions: First, what are Chronologs and why are they the best available tool for the conditions at Kalaloch, and to accomplish our monitoring objectives? Second, what have we learned about how they are used by visitors? Third, have the Chronolog stations at Kalaloch provided new insights about coastal conditions? In summary, the Chronolog stations have been well-used by visitors, but with variations between the five stations that we believe point to important lessons about how to best configure them. They have also provided insights about episodes of coastal erosion and the movement and stability of large wood on the coast that would have otherwise been very difficult to gain.

THURSDAY 3:50–4PM

Closing

3:50 **Gregory Dudgeon**
Superintendent, Mount Rainier National Park