UNIVERSITY *of* WASHINGTON

School of Environmental and Forest Sciences

2026 Graduate Student Symposium

SCHEDULE - FRIDAY 3/13/2025

1:00 PM **Introductory Remarks**

1:15 PM **Mapping Drivers of Insect-induced Forest Mortality in the Western United States**
Keenan Ganz (Advised by: L. Monika Moskal)

1:30 PM **Scorch vs. Torch: Linking Field and Satellite Data to Map Qualitatively Different Levels of Severe Fire**
Madison Laughlin (Advised by: Brian Harvey)

1:45 PM **Silent—But Deadly**
Angie Liotta

2:00 PM **Sorption Enhanced Biodegradation for Destruction of PBDE (a brominated flame retardant) During Wastewater Treatment**
Pilar Santos, Chris Kleeves (Advised by: Heidi Gough)

2:15 PM **Mapping Soil Organic Carbon Stocks Using Wetland Probability and Hydrologic Connectivity Indicators**
Helen Miller (Advised by: David Butman)

2:30 PM **Climate Ready Conifers – Investigating the Relationship Between Drought, Temperature Tolerance, and Phenology in Coastal Douglas-fir**
Miro Stuke (Advised by: Soo-Hyung Kim)

2:45 PM **Modeling the Regeneration of Aspen Using Remote Sensing, Machine Learning, and Field Validation in Post-Fire Ecosystems.**
Mateo Alliende (Advised by: Ernesto Alvarado)

RECEPTION FOLLOWING

ABSTRACTS

Mapping Drivers of Insect-induced Forest Mortality in the Western United States

Keenan Ganz, PhD Student
RSGAL (Remote sensing and geospatial analysis laboratory)
Advised by: L. Monika Moskal

Climate change has increased the severity and frequency of insect-induced forest mortality. Prior research found that forest density, annual weather, and antecedent insect outbreaks are predictive of future mortality. Yet, forecasting future tree mortality remains difficult and data products that support proactive forest management remain sparse.

In this project, we developed tree-based regression models to forecast forest mortality caused by eight of the most damaging wood-boring insects in the western US. We then applied SHAP to partition mortality risk among site conditions, forest density, annual weather, and antecedent insect outbreaks. Our models outperformed a performance baseline in the literature and let us develop a map of relative mortality risk for the western US.

Of all drivers, we found that antecedent insect outbreaks had the greatest influence on future mortality risk. We further explored this driver by developing convolutional neural networks that forecast mortality based on the spatiotemporal context of tree mortality. This analysis revealed that insect outbreaks influence future mortality risk within 10 km and 1 year of prediction.

Overall, our forecasting models enhance our capacity for predicting forest mortality. Across all damage-causing insects, antecedent outbreaks were the most important predictor of future forest mortality. This result implicates timely and accurate insect monitoring as a key need for managing forests in a warmer world.

Scorch vs. Torch: Linking Field and Satellite Data to Map Qualitatively Different Levels of Severe Fire

Madison Laughlin, PhD Candidate
Harvey Lab
Advised by: Brian Harvey

Understanding how forests will recover from high severity fire requires improved characterization of burn severity and associated post-fire legacies. For example, stand-replacing fire can be produced by (a) crown fire that kills trees by consuming leaves and damaging vegetative buds or (b) severe surface fire that damages roots and cambium in tree boles, but leaves the crown of the tree relatively undisturbed. While these two versions of stand-replacing fire result in equal amounts of tree mortality, the fire behavior that caused them, vegetative structures that remain (i.e., legacies), and post-fire trajectories/implications for forest resilience to fire vary drastically. Here, we combine field and satellite data to create machine learning models that differentiate between stand-replacing surface and crown fire across the western U.S. Specifically we ask, (a) can stand-replacing surface and crown fire be reliably distinguished using satellite imagery? and if so, (b) how has the relative amount and configuration of stand-replacing surface and crown fire changed over time across western U.S. Ecoregions (1984 - 2024)? This research will inform how the nature of stand-replacing fire may be changing over time and prioritization of reforestation efforts.

Silent - But Deadly

Angie Liotta, PhD Candidate

Each evening when I return home from work, a small, fur-covered, four-legged creature waits at the door to greet me. His constant purring, persistent meowing, and complete disregard for my personal space make him both endearing and mysterious. One detail, however, stands out: he never smells.

But how is this possible? Do cats fart? Surely all animals produce gas, but how often does it happen, and what does it mean for the world around us? If livestock emissions contribute to global warming, could our beloved household pets also play a small role? And to what extent might our collective enthusiasm for pet ownership contribute to greenhouse gas emissions?
These questions led me to investigate an unlikely but intriguing topic: the hidden emissions of our furry companions. By examining pet physiology and the biological processes that produce gas, this presentation explores how much our pets may actually contribute to atmospheric emissions.

While the environmental impact of a single cat may be negligible, the global population of companion animals raises interesting questions about scale, responsibility, and the unintended consequences of human choices. Through this investigation, I aim to shed light on a surprisingly overlooked component of human–animal relationships.

After all, some environmental impacts may be silent—but still deadly.

Sorption Enhanced Biodegradation for Destruction of PBDE (a brominated flame retardant) During Wastewater Treatment

Pilar Santos and Chris Kleeves, Master's Students
Gough Lab
Advised by: Heidi Gough

Recent detection of the emerging contaminant polybrominated diphenyl ethers (PBDEs) has revealed pollution in natural streams and rivers in the Pacific Northwest. Detected concentrations exhibit toxic and lethal effects on endangered juvenile Chinook salmon and Steelhead trout in the Snohomish and Nisqually Rivers of Washington State. These fish species have critical cultural and economic relevance in the Pacific Northwest. Effluent discharge following wastewater treatment has been identified as point sources of PBDEs to these rivers. Although conventional wastewater treatment partially removes PBDEs, this is primarily through sorption to activated sludge. In this study, an approach was investigated that integrates sorption with the existing microbial community in wastewater to enhance PBDE removal. A fluidized-bed reactor was selected for study based on its ease of incorporation into a wide range of wastewater treatment facilities. Sustainable and readily available sorptive materials, such as granular activated carbon (GAC) or biochar, provided binding sites for PBDEs and attached growth of slow-growing microbial species, thereby enhancing PBDE degradation. The system was tested using wastewater primary effluent from multiple regional wastewater facilities, including analysis of how wastewater characteristics impacted biodegradation and sorptive kinetics. PBDE was monitored using GC-MS to detect the low ng/L concentrations. This treatment approach demonstrated an affordable and adaptable process that can be used at wastewater treatment plants of varying sizes and influent characteristics.

Mapping Soil Organic Carbon Stocks Using Wetland Probability and Hydrologic Connectivity Indicators

Helen Miller, PhD Candidate
RSGAL (Remote Sensing and Geospatial Analysis Lab) and Butman Lab
Advised by: David Butmanl

Soils are a critically important global carbon pool, exceeding vegetation and atmospheric pools combined. Soil organic carbon (SOC) stocks are closely linked to hydrologic conditions which have high spatial variability. Modern SOC stock maps do not account for this high degree of spatial variability, making them less useful for land management. This is partially due to incomplete wetland inventories, which are important for identifying high-carbon soils. In this research we aim to improve estimates of SOC stocks and uncertainty, and to better understand the role of hydrologic connectivity in SOC stocks. We fit a multivariate Bayesian spatial model to predict SOC stocks and uncertainty across Washington State. Our model utilizes wetland probability maps developed within the Remote Sensing and Geospatial Analysis lab at UW, paired with topographic and spectral indicators of hydrologic connectivity and land cover, to resolve spatial variation at a 30-meter scale. Initial results indicate that SOC increases with wetland probability across the state. Furthermore, wetlands with low connectivity to surface flow generally have higher carbon than those close to rivers or lakes such as low-lying floodplains.

Climate Ready Conifers – Investigating the Relationship Between Drought, Temperature Tolerance, and Phenology in Coastal Douglas-fir

Miro Stuke, PhD Candidate
Plant Ecophysiology and Modeling Lab
Advised by: Soo-Hyung Kim

Assisted migration of coastal Douglas-fir (Pseudotsuga menziesii, PSME) is increasingly used to introduce populations adapted to future heat and drought conditions into historically cooler regions. However, successful seed transfer must also account for current environmental constraints, particularly low temperature extremes that affect trees during the vulnerable establishment phase. In addition, drought is projected to intensify across the western United States, interacting with temperature stress, making it critical to evaluate tolerance to multiple stressors when selecting seed sources.
This study characterizes temperature- and drought-related traits across the native U.S. range of PSME to evaluate population suitability for assisted migration. Physiological, phenological, and morphological traits were measured in 23 populations (18 wild-collected and 5 orchard sources). Cold hardiness was quantified using controlled freeze tests and electrolyte leakage, budburst phenology was monitored weekly, and high-temperature thermotolerance was assessed to determine population-specific phenology and critical temperatures. Multivariate analyses linking these traits with provenance climate variables are used to identify climatic drivers of stress tolerance and potential trade-offs among traits.
Preliminary results indicate that non-lethal summer drought delays budburst by approximately one week the following spring, while northward transfer advances budburst by roughly one day per degree latitude. Northern populations also exhibit greater winter cold tolerance, while southern sources show minimal seasonal variation in cold hardiness. Together, these results highlight the importance of considering both phenology and physiology when selecting seed sources for assisted migration under climate change.

Modeling the Regeneration of Aspen Using Remote Sensing, Machine Learning, and Field Validation in Post-Fire Ecosystems.

Mateo Alliende, Master's Student
PWFS Lab
Advised by: Ernesto Alvarado

This study investigates post-fire recovery in encroached aspen and mixed-conifer forests following the 73,000-acre Monroe Canyon Fire. As a keystone species, aspen is vital for North American biodiversity and ecosystem services; however, successional shifts and fire suppression have altered its resilience. Utilizing the Fire and Smoke Model Evaluation Experiment (FASMEE) framework, this research examines how pre-fire fuels, treatments, climate, and burn severity interact to drive regeneration. Our primary objective is to develop a predictive spatial model of post-fire landscape recovery to assist the Fishlake National Forest in distinguishing areas likely to self-recover from those requiring intervention. We integrated ground-truth data, airborne laser scanning, and satellite imagery to identify the strongest predictors of regeneration. Pre-fire conditions were mapped using LANDFIRE and NLCD datasets, while USFS treatment polygons—including mechanical thinning and prescribed fire—were analyzed to quantify their influence on canopy fuels and fire behavior. Burn severity, mapped via RdNBR, was evaluated alongside species composition to test the link between high-severity fire and increased aspen ramet density. Using random forest machine learning, we modeled regeneration likelihood as a function of topographic, climatic, and severity metrics. Model performance was validated using R^2 and RMSE. The final output, a high-resolution regeneration likelihood raster, provides stakeholders, including NASA, the USFS, and USGS, with a functional tool for planning forest resilience. These findings advance our understanding of "precocity" in forest development, offering a scalable methodology for post-fire management across the Western United States.