

13th Annual

Graduate Student Symposium

The Interface Between Scientific
Research and Management

March 4, 2016



**School of Environmental
and Forest Sciences**

UNIVERSITY of WASHINGTON
College of the Environment

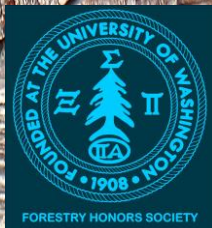


Table of Contents.....1

Acknowledgements and GSS Organizing Committee.....1

Schedule of Events.....2

Keynote Panel Discussion.....3

 Dr. Jon Bakker.....3

 Dr. Joe Casola.....4

 Dr. Richy Harrod.....4

 Dr. Regina Rochefort.....5

Session I.....6

 Shannon Kachel.....6

 Catherine Gowan.....6

 Emilio Vilanova.....7

 Daniel Sorenson.....8

Session II.....9

 Apryle Craig.....9

 Elliot Koontz.....9

 Kelly Broadlick.....10

 Sarah (Krueger) Lange.....11

Session III.....11

 Julia Jay.....11

 Russell Kramer.....12

 Nate Haan.....13

 Carol Bogezi.....13

 Christine Phelan.....14

Session IV.....15

 Loretta Fisher.....15

 Kai Ross.....16

 Anna Carragee.....16

 Clint Robins.....17

 Cole Gross.....18

Acknowledgments

Thank you to our keynote panelists: Dr. Jon Bakker, Dr. Joe Casola, Dr. Richy Harrod, and Dr. Regina Rochefort

This event was made possible with the generous help and support from:

- Director Tom DeLuca and the School of Environment
- Graduate and Professional Student Senate
- Sarah Thomas, Michelle Trudeau, Amanda Davis, and Karl Wirsing
- Our student moderators: Si Gao, Shyam Kandel, Tessia Robbins, and Daniel Sorenson
- Xi Sigma Pi Honor Society

GSS Organizing Committee

Caitlin Littlefield

Allison Rossman

Raona Mecka

Melissa Pingree

Rosemary Pazdral

Summer Kemp-Jennings

Thank you for coming to the 13th annual School of Environmental and Forest Sciences Graduate Student Symposium. Please take a moment to fill out an evaluation form (located on the table near the entrance) for each student presentation. Your constructive feedback and insights will help presenters refine their research approaches and hone their presentation skills.

Schedule of Events

9:00-10:00 a.m. Meet and Greet and Student Research Posters

10:00-10:10 a.m. Welcome by Director Tom DeLuca

10:10-11:30 a.m. Keynote Panel Discussion

Dr. Jon Bakker, UW SEFS

Dr. Joe Casola, UW Climate Impacts Group

Dr. Richy Harrod, USDA Forest Service

Dr. Regina Rochefort, NPS North Cascades

11:30 a.m.-12:30 p.m. Session I (Moderator: Shyam Kandel)

11:30 Shannon Kachel

11:45 Catherine Gowan

12:00 Emilio Vilanova

12:15 Daniel Sorenson

12:30-1:30 p.m. Lunch and Student Research Posters

1:30-2:45 p.m. Session II (Moderator: Tessia Robbins)

1:30 Apryle Craig

1:45 Elliot Koontz

2:00 Kelly Broadlick

2:15 Sarah (Krueger) Lange

2:45-4:00 p.m. Session III (Moderator: Si Gao)

2:45 Julia Jay

3:00 Russell Kramer

3:15 Nate Haan

3:30 Carol Bogezi

3:45 Christine Phelan

4:00-5:15 p.m. Session IV (Moderator: Dan Sorenson)

4:00 Loretta Fisher

4:15 Kai Ross

4:30 Anna Carragee

4:45 Clint Robins

5:00 Cole Gross

5:15-5:30 p.m. Awards Presentation

5:30 p.m. Reception Hosted by Dead Elk Society

Keynote Panel Discussion

The Interface Between Scientific Research and Management

Many students at SEFS aim for careers related to the management of land and natural resources, from conducting applied research at a university to on-the-ground operations. Many of us began wanting to “make a difference.” However, receiving our education at an academic institution and interacting primarily with other researchers can make our work feel distant from on-the-ground management practices. Does this “ivory tower” persist after graduation? To what extent, and how, does scientific research influence management decisions? Does this vary among organizations? We look to our expert panel to pass on their experiences and opinions about the interface between research and management.

Dr. Jon Bakker *UW SEFS, Associate Professor*



Jon’s research centers on the restoration and management of terrestrial ecosystems, and thus spans the boundary between applied and basic ecology. He began his career in the North American mixed-grass prairie and then spent five years working in the forests of British Columbia. Together with his students, he has studied

grassland, shrubland, and forest ecosystems throughout the western hemisphere. His educational background includes a Ph.D. in Forestry (Northern Arizona University), M.Sc. in Biology (University of Regina), and B.A. in Biology and Environmental Studies (Dordt College). At present, Jon is an Associate Professor in the School of Environmental and Forest Sciences at the University of Washington, where he holds the David R. M. Scott Endowed Professorship. Since 2012, he has coordinated scientific reviews of protocols to guide long-term ecological monitoring by the National Park Service in the western U.S. In 2015, the Wilburforce Foundation selected Jon as a Wilburforce Fellow in Conservation Science; his goal as a Fellow is to improve the quality of conservation decisions by strengthening the linkages between land managers and scientific research.

Joe Casola *Deputy Director, Climate Impacts Group*



Joe Casola is the Deputy Director at University of Washington's Climate Impacts Group (CIG). Dr. Casola has worked on issues related to climate science and policy for more than 15 years. His career has focused on translating information about climate variability, climate change, and climate impacts for policy makers, resource managers, and business leaders. He previously served as Staff

Scientist and Program Director for Science and Impacts at the Center for Climate and Energy Solutions (C2ES) in Washington, DC; a Senior Associate at ICF International; and a Post-Doctoral Fellow at the National Research Council. Casola earned his PhD and MS degrees in Atmospheric Sciences from the University of Washington, where his research examined the response of snowpack in the Cascades to rising temperatures. He also holds a BS in Chemistry from Duke University.

Richy J. Harrod *USDA Forest Service, Deputy Fire Management Officer, Okanogan-Wenatchee National Forests*



Richy Harrod is the Deputy Fire Management Officer for Fuels and Fire Ecology on the Okanogan-Wenatchee National Forest. He has a B.S. in biology and terrestrial ecology and a M.S. in biology with an emphasis in botany, both degrees received from Western Washington University. He received his Ph.D. in ecosystem sciences from the University of

Washington. Richy started his career on the Okanogan National Forest in 1990 as a seasonal botanist and served as the District Plant Ecologist on the Leavenworth Ranger District, Wenatchee National Forest until summer 2000. In 2000, he moved to the fire program in Okanogan-Wenatchee National Forest Headquarters where he presently resides. Richy has been involved in forest and fire restoration planning and research for 25 years. He has been the primary author or co-author of over 40 published research papers and technical reports on various fire and forestry topics including forest restoration, fire effects on rare plants, biodiversity, and noxious weed management. Richy has been a

guest lecturer at several colleges and universities, has taught college level courses at Wenatchee Valley College and continuing education courses through the North Cascade Institute. He has given over 50 presentations at scientific and management conferences.

Regina M. Rochefort *Science Advisor and Plant Ecologist, North Cascades National Park Service*



Regina M. Rochefort is a Science Advisor and Plant Ecologist with North Cascades National Park Service Complex. She received her BS in Biology from Northeastern University, MFS from Yale University, and PhD from University of Washington, College of Forest Resources.

Prior to working at North Cascades, she was the Botanist at Mount Rainier and Everglades National Parks and Fire Ecologist in Big Cypress National Preserve. She also worked seasonally for the Umpqua and Fremont National Forests in silviculture and timber presale. Currently she facilitates research in North Cascades, conducts prairie monitoring in San Juan Island National Historical Park, prairie restoration in Ebey's Landing National Historical Reserve, and vegetation monitoring in the alpine treeline ecotone of Mount Rainier, North Cascades, and Olympic National Parks. She is the Coordinator of the Cascades Butterfly Project, a citizen science program that monitors subalpine butterfly populations and plant phenology in Mount Rainier & North Cascades National Parks and Mount Baker-Snoqualmie & Okanogan-Wenatchee National Forests. She is the Coordinator of the North Coast and Cascades Research Learning Center and is working with the 8 Pacific Northwest national parks to celebrate the Centennial of the National Park Service with a BioBlitz on May 20-21.

Session I

Shannon Kachel, PhD Student

Advisor: Aaron Wirsing

Snow leopards, wolves and the ecology of fear on the roof of the world

Sometimes the tooth-and-nail competition of nature can have unanticipated winners. In the Pamir and Tien Shan Mountains of Central Asia, threatened snow leopards and wolves compete fiercely with each other for the same few scarce prey. But surprisingly, both predators may ultimately benefit from this competition by maintaining a landscape of fear that provides no safe haven to the prey. Because the two predators hunt in different parts of the landscape, prey avoiding risk from one predator may unwittingly expose themselves to greater risk from the other. Snow leopards are among the most poorly understood large carnivores in the world, due to their secretive, cryptic habits and rugged mountain habitats. Using cutting edge technology, including GPS collars, camera traps, and possibly even drones and thermal infrared cameras, I am conducting one of the most in-depth investigations of the species' ecology ever, the results of which will help inform snow leopard conservation efforts and policies throughout the species' range.



Catherine Gowan, PhD Student

Advisor: Stanley Asah

Role ambiguity and perceived organizational politics in wolf recovery: Washington state wildlife agency personnel perspectives

Wolf recovery in Washington (WA) State provokes contentions among stakeholders: livestock owners, environmental groups, government organizations, and the public. Wolf recovery in WA also incites internal disputes and strains working relationships within state government entities charged with wolf management. These divisions undoubtedly undermine wolf recovery and conservation efforts. Consequently, it is important to understand, in order to preemptively manage, emerging issues among disputing parties in the recovery process. To this end, we conducted 60 in-depth, semi-structured key informant interviews and two focus group interviews from October 2013

through March 2015 with primary stakeholders in the wolf recovery efforts: livestock owners, conservation organization officials, and Washington Department of Fish and Wildlife (WDFW) employees. The purpose was to ascertain salient perspectives regarding wolf recovery in WA, with an original focus on economic programs. Non-directive moderation techniques were used for all interviews. Interviews were recorded and transcribed verbatim before analysis. Data analysis followed the grounded theory approach, a predominantly inductive process, which allows for salient perspectives to emerge from the data rather than as predetermined by the researcher. Our findings suggest that role ambiguity and perceived organizational politics are intricately tied to the occupational performance of WDFW employees. If the WDFW focuses on reducing role ambiguity and changing the nature of organizational politics, there should be an increase in goal alignment and trust within the organization. Improvement in both of these areas will increase the effectiveness of the Agency by promoting organizational ambidexterity and a variety of positive occupational outcomes.



Emilio Vilanova, PhD Student
Advisor: Gregory Ettl

Using a trait-based approach to study the relationships between turnover and wood productivity in two contrasting forests of Venezuela

Functional traits can provide insights into a variety of ecological questions within a wide range of scales: from individuals, species, and potentially to communities and landscapes. The main goal of this proposal is to compare two contrasting forest types in Venezuela, South America, using a trait-based approach to: 1) characterize the functional composition of forests with an emphasis on tree populations; and 2) describe the relationship between the community weighted mean (CWM) of trait values and two ecosystem processes such as wood productivity and aboveground biomass. A group of 9 traits, at different scales (whole-plant, leaf and stem) will soon be measured in the field and/or obtained from selected literature from two areas: Mountain-cloud forests in the Andes (San Eusebio) and Lowland Western plain forests (Caparo). 12 permanent sample plots of 0.25 ha in area equally distributed at both sites serves as the study area. Here we discuss the details of the trait sampling scheme, hypotheses to be tested and expected results. We foresee

tree functional traits to be useful predictor variables to understand the role of species diversity in driving changes in these fundamental processes, which ultimately determine an important ecosystem service in the context of climate change such as carbon storage. Finally, we discuss the pros and cons of this research and its utility for development of general and predictive plant trait models as tools for management, conservation and restoration.



Daniel Sorenson, Masters Student
Advisor: Sarah Reichard

An analysis of invasion potential of *Cortaderia seloana* and *Cortaderia jubata* in the Pacific Northwest

The distribution of two invasive *Cortaderia* species in the Pacific Northwest (PNW) has not been examined on a regional scale although geospatial information exists. *Cortaderia seloana* (pampas grass) continues to be sold in nurseries across Oregon and Washington and both plants are used as landscape plantings. With invasive tendencies in California, and multi-age populations found across WA and OR, what risk of invasion do these two species pose for the PNW? Research efforts focuses on three more specific questions: 1) Is there a pattern to distribution of *Cortaderia* occurrences/records that might help offer more evidence for the invasion risk to the Pacific Northwest? 2) What is each species' potential for invasion in the Pacific Northwest? 3) Is there a difference in species from what the documented records indicate? Two major analyses are being used to answer the above questions: geospatial and genetic. Geospatial analyses compared 175 existing records for both species with landscape features and other GIS data to find patterns or associations. In addition, species distribution modeling was performed using maximum entropy model program: MaxEnt. Preliminary results of the geospatial analysis show that both species favor human altered landscapes. There doesn't seem to be an association with railroad lines and location of occurrences. Species distribution modeling outputs under current climate conditions indicate a boarder range for *Cortaderia seloana* than *Cortaderia jubata*. Genetic analysis is not yet complete but will use microsatellite markers at predetermined loci to identify to species samples collected across WA and OR.

Session II

Apryle Craig, PhD Student

Advisor: Aaron Wirsing

Wolves, deer, & fear: how top predators shape prey behaviors

Gray wolves (*Canis lupus*) are recolonizing Washington after an absence of over 70 years. Their primary prey species, deer (*Odocoileus* spp.), employ a wide array of defensive tactics to protect themselves from predators including allocating more time to vigilance. From 2013-2015, we outfitted deer with animal-borne video collars in areas of Washington where wolves have recolonized and areas where wolves have yet to reappear. The collars recorded video from the deers' perspective, which we reviewed for the amount of time deer spent being vigilant (i.e., watching for predators). Our preliminary results show that deer in wolf-recolonized areas are spending significantly more time being vigilant than deer in areas not yet recolonized and therefore have less time available to forage and rest. These types of trade-offs could lead to changes in fecundity or body condition, which may have greater impacts on deer population than direct consumption by wolves.



Elliot Koontz, Masters Student

Advisor: Ashley Steel & Julian Olden

From fire to fish: quantifying the effect of wildfires on stream thermal regimes and the impact on freshwater fish across the Pacific Northwest.

The magnitude of past year's wildfire season in the Pacific Northwest emphasized the need for understanding the ecological implications of such disturbance events for freshwater ecosystems. The thermal regimes of streams and their resident fish communities are believed to be sensitive to wildfire effects, yet our current understanding of these impacts are limited to individual watersheds or burn events. In this talk, we report on the results of a broad-scale investigation of how stream thermal regimes across the Pacific Northwest have responded to wildfires, and explore the implications of these impacts for native Chinook salmon and nonnative smallmouth bass and northern pikeminnow. Our results demonstrate the spatial variability in streams

response to fire, and illustrate how changes to the thermal regime can have disproportionate effects on the phenology and distribution of native and nonnative species. Predicted changes in wildland fire behavior as a result of climate change give precedence for research such as this to inform the science and management of fire as it affects freshwater systems across landscapes.



Kelly Broadlick, Masters Student

Advisor: Jon Bakker

Determining seed dormancy and germination requirements for restoration of two upland prairie sedges

Seed dormancy, where seeds fail to germinate even under ideal conditions, is an important strategy for many plants. Dormant seeds require additional cues to initiate germination, which could indicate the season (allowing the seed to distinguish between spring and fall) or the presence of a disturbance (which would give a seedling a higher chance of survival in areas where resources are scarce). Establishment from seed is a key aspect of maintaining genetic diversity within a species and is a desirable technique for restorationists, but the complex dormancy requirements of some native species can pose a real challenge in the context of propagation. *Carex inops* ssp. *inops* and *Carex tumulicola* are upland sedges native to the prairies of Western Washington where the most common disturbance is anthropogenic fire. I hypothesize that treatments which simulate the natural disturbances and conditions that occur in these prairies will break seed dormancy and enhance germination. My first trial measures the effects of 0-4 months of cold wet stratification, followed by one of three incubation temperature regimes (spring, intermediate, or summer). The importance of fire will be assessed by evaluating germination responses to smoke water, liquid smoke, and purified karrikin (the main active component in smoke that stimulates germination). Perigynia removal to increase light exposure will be tested on *Carex inops*. The focus is on methods that can be used operationally by conservation nurseries and restoration practitioners, with the ultimate goal of facilitating the incorporation of these species into restoration projects throughout their native ranges.



Sarah (Krueger) Lange, Masters Student
Advisor: Clare Ryan

Changes in policy beliefs since adoption of the Northwest Forest Plan

The adoption of the Northwest Forest Plan in 1994 marked a major change in U.S. Forest Service practices within the Pacific Northwest and the accompanying monitoring of biological and socioeconomic indicators generated an unprecedented amount of technical information about the outcomes of implementation. The goals of my research are to evaluate the extent to which policy-oriented learning has occurred among long-term National Forest stakeholders in the Pacific Northwest policy subsystem since adoption of the plan and to describe the influence of scientific information in changing individual beliefs about public policy. My work tests hypotheses of the Advocacy Coalition Framework. Using a purposive sampling strategy, I reached out to individual stakeholders whose history of involvement with federal forest policy in the Pacific Northwest extends to the era preceding the 1994 adoption of the Northwest Forest Plan. I conducted semi-structured interviews with 20 participants representing timber interests, conservation organizations, and state and federal resource management agencies. Interviews solicited reflection about participants' past and present beliefs about the management of Pacific Northwest national forests. I am currently applying qualitative content analysis techniques to systematically describe and assign meaning to the interview transcripts. My presentation will summarize preliminary results, describing current policy beliefs among long-term stakeholders, belief transformations over the past 25 years, and insight into the policy preferences and beliefs that may shape pending national forest management plan revisions in the Pacific Northwest.

Session III

Julia Jay, Masters Student
Advisor: Sally Brown

Bioretention soil media: the importance of science-based regulations

Increasing concern about our water resources have put stormwater management under the microscope, especially in urban areas with high percentages of impervious surfaces. Bioretention systems are living filters that clean stormwater of pollutants while allowing it to infiltrate into the ground rather than run off directly into lakes and streams. Though these systems are increasingly popular, regulations are highly variable across states and municipalities, and are often based on convention rather than science. This

column study analyzes 15 different bioretention soil media (BSMs) for nutrient and metal contaminant removal, infiltration rate, plant yield, and other soil properties. Performance is compared with the western WA BSM regulations, and predictors of BSM performance such as soil P ratios and soil stability are explored.



Russell Kramer, PhD Student

Advisor: Jerry Franklin

How do tree age, forest structure and tree injury influence canopy habitat development in coastal Douglas-fir?

Most canopy epiphytes and soils are held by relatively few trees in the forest. Canopy epiphytes, soil, and decay pockets provide food and habitat supporting a diversity of animals, including insects, spiders, amphibians, birds, and mammals. Rich pockets of diversity within tree crowns coalesce around structures such as crotches between multiple side trunks, large diameter appendages, and candelabra tree tops. These structures grow as trees age at a rate that is likely modified by tree injury and shading from neighbors. Vast tracts of old-growth forest harboring abundant within-tree structure have been converted to Douglas-fir plantations composed of trees with simple bottle-brush crowns and small branches. Rising from social backlash to old-growth conversion to young plantations is a management imperative to accelerate old-growth characteristics in many federal forests within the jurisdiction of the Northwest Forest Plan. Management to do so focuses primarily on widening the species composition, tree spacing, and distribution of individual tree heights in these forests with little attention to within-tree structure. This study proposal aims codify relationships between tree age, forest density, and injury on the rate of within tree structural development in tall Western Olympic Douglas-fir. These relationships will complement management to accelerate old-growth characteristics by focusing within, as well as among trees. Presenting this research plan is meant to elicit feedback and comments from professors and peers in preparation for field work and an official PhD proposal defense.



Nate Haan, PhD Student

Advisor: Jon Bakker

Clarifying ambiguous interactions between a rare butterfly and its host plants

Taylor's checkerspot is an endangered butterfly endemic to grasslands in the Pacific Northwest. Recovery efforts currently include large-scale habitat enhancement and a captive rearing and release program for founding new populations at restored sites. These efforts are hampered by a number of knowledge gaps about the basic biology of Taylor's checkerspot, especially its relationship to its larval host plants. The butterflies lay eggs on three species, but managers aren't sure which ones to focus on with their restoration efforts. One host plant, lance-leaf plantain, is an invasive exotic, so managers are hesitant to include it in habitat restoration efforts. Another host, golden paintbrush, is a threatened species with its own ongoing recovery efforts. Due to its rarity, managers aren't sure whether it is a suitable host or not. The third host, harsh paintbrush, is native and a known historical host for Taylor's checkerspot, but it hybridizes with golden paintbrush. This compromises recovery efforts for golden paintbrush, so managers try to keep the two species separate. This results in controversy about whether sites should be designated for Taylor's checkerspot recovery, golden paintbrush recovery, or whether both aims could actually be achieved on the same sites. My dissertation research focuses on interactions between Taylor's checkerspot and these three plant species. I am measuring how they differ in terms of their phenology (i.e., timing of availability as food for larvae), nutritional suitability, and secondary chemistry. I will share preliminary findings and comment on the interface between this research and applied management.



Carol Bogezi, PhD Student

Advisor: John Marzluff

What fosters ranchers' commitment to participate in wolf conflict mitigation strategies?

Fostering ranchers' commitment to participate in carnivore conflict mitigation strategies is an important goal of achieving human-carnivore coexistence and conservation, especially in rural settings where humans live in proximity with carnivores. However, little empirical evidence exists to describe factors that

influence such commitments. We interviewed 46 ranchers to investigate their commitment towards participating in wolf conflict mitigation strategies designed to reduce conflict and increase human-wolf coexistence in Washington State. This data collection was part of a larger project to assess the social and economic feasibility of wolf recovery in Washington State. We analyzed ranchers' responses to three questions: (1) How do they feel or what do they think about the return of wolves to Washington State? (2) What mitigation strategies are they currently implementing to prevent depredation of their livestock? And (3) what other mitigation strategies would they participate in and what would increase their participation? We analyzed the data using qualitative methods specifically structural and in vivo initial coding in order to gain a deeper understanding of the data patterns, followed by second phase coding and grounded theory to recognize and develop nuanced but salient theories from the data. Preliminary results show that ranchers' perspectives towards the return of wolves are related to their commitment to participate (or not) in wolf conflict mitigation measures. There are wide variations of what types of mitigation strategies ranchers can commit to, and the reasons for their commitment (or lack of) also varied widely depending on their attitudes and value orientations towards wolves.



Christine Phelan, Non-matriculated Graduate Student
Advisor: Aaron Wirsing

Terrain tactics: topography-dependent vigilance in deer

After an absence of over 70 years, gray wolves (*Canis lupus*) have begun to recolonize regions of Washington State. Risk of depredation brought about by the return of this apex predator may cause changes in deer behavior that ultimately affect deer body condition, fecundity, and even lead to trophic cascades in the plant community. As a result of their individual flight gaits, Mule deer (*Odocoileus hemionus*) and White-tailed deer (*Odocoileus virginianus*) may exhibit levels of vigilance that vary according to the terrain that they are in and their preferred method of escape. In order to test this prediction, we used animal-borne camera collars during the winters of 2013-2015 to capture video footage from the deer's perspective and observed the time spent vigilant for 16 Mule deer and 16 White-tailed deer across various terrain types in wolf-recolonized and wolf-absent areas of Northeastern Washington. I will present the results of my analysis to determine if Mule deer

are more vigilant in lowland terrain compared to White-tailed deer, as well as the degree to which this is affected by wolf presence. If the deer exhibit higher levels of vigilance in areas outside of their preferred escape topography, this could provide additional understanding of habitat preference and thereby aid deer population management efforts particularly with the recent decline of Mule deer.

Session IV

Loretta Fisher, Masters Student
Advisor: Jon Bakker

Seed production and viability of putative *Castilleja levisecta* x *C. hispida* hybrids

Castilleja levisecta (CALE) is one of the most vulnerable plants in Puget Sound prairies and is federally listed as a threatened species. *C. hispida* (CAHI) also occurs in some prairies but is not a listed species. CALE and CAHI can be intentionally crossed, but it is unclear how often hybridization can occur in the field. A key unresolved question is whether CALE × CAHI hybrids are sterile or produce viable seed, as sterile hybrids would be of less concern to CALE recovery efforts. We determined the seed production and viability of putative hybrids (plants with morphological traits of both species) observed in the field. Fruiting stems were gathered from 25 putative CALE × CAHI hybrids and from one plant of each species. Seed production and germination were assessed on a per-capsule basis for 4 capsules per plant, two from the top and two from the bottom of the fruiting stem. These data were supplemented by previous experimental data testing effects of host plant identity on CALE seed production. Hybrid plants produced smaller capsules containing half as many seeds as in CALE. Capsules from the bottom of the stem had lower seed densities than top capsules. On average, 77% of putative hybrid seeds germinated, though this rate ranged from 26 to 95% among maternal plants. Genetic analyses are currently underway to determine the hybridization history of these plants and further elucidate the implications of hybridization for the recovery of CALE.



Kai Ross, PhD Student

Advisor: Sandor Toth

The line graph approach (LGA) for dynamic routing

The maintenance of forest roads is one of the most expensive management activities in forestry both financially and in terms of environmental impact. Unfortunately, most practitioners maximize net timber revenues first and account for road costs only post-optimization. I'll demonstrate that there are lost opportunities by not accounting for road maintenance in an integrated spatial optimization approach. The purpose of this work is to obviate a common practice in the forest industry that uses predefined hauling routes for timber operations. The new approach leaves it to an integrated harvest scheduling model to identify the best hauling routes in conjunction with the optimal harvest decisions to maximize net present value (NPV). This allows the model to make routing decisions that are based on the entire system, as opposed to individual least-cost paths. Unlike conventional network models, we used a line graph approach (LGA) that represents roads with vertices and intersections with edges. This allows for a more consistent and parsimonious model formulation because each road segment is represented only once as a single feature regardless of the hauling direction. After describing the proposed model, I'll demonstrate the model with preliminary results from a case study in the Pacific Northwest United States.



Anna Carragee, Masters Student

Advisor: Kern Ewing

SER-UW native plant nursery: closing the loop on plant materials for student restoration projects

The University of Washington's Society for Ecology Restoration student guild (SER-UW) native plant nursery was established at the Center for Urban Horticulture in the spring of 2013. The SER-UW nursery maintains an inventory of 2400 containerized plants native to the Puget Sound and used in planting efforts at two on-campus restoration sites and various sites associated with the Restoration Ecology Network capstone course. The nursery also delivers educational benefits to students studying horticulture and ecological restoration at UW by providing experiential learning through volunteer activities. On average, 60 students per quarter participate in nursery work

parties that focus on basic horticultural practices. The work that SER-UW conducts is an applied complement to the curricula of the Master of Environmental Horticulture program (MEH) and the undergraduate Restoration Ecology concentration. Learning objectives include producing propagation protocols for 10 common restoration species, practicing efficient resource allocation for determining what plants to grow, and volunteer outreach and management skills. Although often overlooked, horticulture is an important facet of ecological restoration; understanding proper growing techniques and identifying or growing high quality nursery stock is imperative to successfully achieving restoration project goals. Other restoration groups and not just schools may consider incorporating volunteers into the plant production process as it is an excellent way to boost community involvement and volunteer hours. This presentation will outline the essentials for establishing and running a native plant nursery with extensive volunteer involvement.



Clint Robins, PhD Student
Advisor: Aaron Wirsing

Investigating the role of managed landscapes in cougar foraging ecology along the urban-wildland gradient of western Washington

Humans have historically altered ecosystem structure through landscape manipulation. Large carnivores are especially vulnerable to such habitat alterations because large predators tend to have low population densities and roam widely in search of prey. Cougars (*Puma concolor*), however, are highly resilient to urbanization and have demonstrated a tolerance for fragmented and managed landscapes. How urbanization has influenced aspects of cougar foraging behavior, however, still remains unclear. Our goal is to better understand whether and how cougar foraging behavior is shaped by habitat quality and the transition from wildland to urban environments. More specifically, how do landscape characteristics, particularly understory cover, slope, and patch size, influence where cougars choose to hunt for prey. We hypothesize that cougars will stalk and hunt prey based on levels of local vegetative cover (“selective stalk-and-ambush” hypothesis), and that kill site habitats will exhibit strong edge effects compared to random locations spread across the landscape. We study the foraging behavior of cougars in Snoqualmie Forest, Marckworth Forest, and surrounding areas to determine whether habitat features at cougar kill sites differ in stalking cover from other forested

areas along the urban-to-wildland gradient. Preliminary results will be presented following the winter season. By contrasting levels of concealment and obstruction in the understory between kill and non-kill site habitat, we hope to determine whether a threshold exists for cover and patch size to support successful cougar foraging behavior.



Cole Gross, Masters Student

Advisor: Rob Harrison

Soil nutrition: effects of nitrogen fertilization and thinning treatments on subsurface carbon and nitrogen

Soils are an important long-term carbon (C) reservoir in terrestrial ecosystems. However, the common practice of sampling only surface soil underestimates soil C and thus ecosystem C budgets. This study aims to provide data for regional responses of soil C and nitrogen (N) by depth to fertilization and thinning treatments. Soil was sampled by depth to at least 1.0 m at an intensively managed Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) plantation in northern Oregon. Three pits were excavated at nine 0.2-ha plots with differing management regimes, including thinning treatments and fertilization. Bulk density and chemical analysis samples were taken in the middle of succeeding soil layers at depths of 0.1, 0.2, 0.5, 1.0, and 1.5 m. Preliminary results show an increase in soil C and N of 53 and 51%, respectively, in the fertilized compared to unfertilized plot when soil is sampled to 1.5 m. Subsoil, defined here as below 0.2 m, contained 42, 46, and 55% of total soil C and 42, 49, and 59% of total soil N when sampled at the fertilized plot to depths of 0.5, 1.0, and 1.5 m, respectively. Roots were observed in all soil profiles to the depth of excavation, evidencing that failing to sample subsurface soil can bias N pool estimates by ignoring biologically available N. Preferential flow along roots and through networks of macropores had visibly translocated significant amounts of organic matter to the subsoil in several soil profiles, highlighting the importance of deep soil processes and the need for further research.



Graduate Student Symposium Vision

A forum for graduate students to share their research with fellow School of Environmental and Forest Sciences and College of the Environment students, professors, staff, and members of the larger University of Washington community.

A symposium that will continue to grow as the years go on, becoming an annual event supported and encouraged by the School of Environmental and Forest Sciences.

A time for graduate students to share ideas.

A place for the School of Environmental and Forest Sciences to gather and show others the wealth of knowledge housed in these buildings.