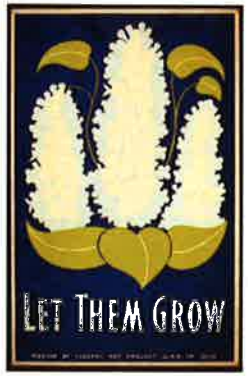
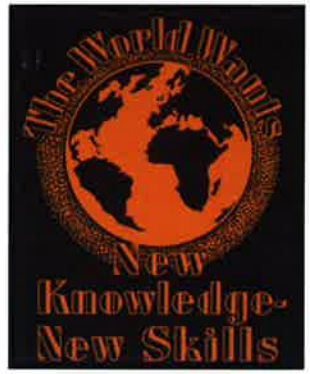
Sixth Annual

College of Forest Resources





Graduate Student Symposium

March 6, 2009

Schedule of Events

9:30: Opening of the Sixth Annual CFR GSS

9:40 – 9:50: Dr. Bruce Bare, Dean, College of Forest Resources

9:50 – 10:40: Keynote Address
Dr. Robert Paine, Professor Emeritus of Zoology, University of Washington

10:45 – 11:45: Session I
10:45 – 11:05: Nicole Hackman
11:05 – 11:25: Aditya Khanna
11:25 – 11:45: Eva Dettweiler-Robinson

11:45 – 12:30: Lunch

12:30 – 12:45: Poster Session
* Todd Erdody
* Lydia Putnicki
* Keum Young Lee

12:45 – 1:45: Session II
12:45 – 1:05: Jake Grossman
1:05 – 1:25: Eric Delvin
1:25 – 1:45: Rachel M. Mitchell

1:45 – 2:00: Break

2:00 – 3:00: Session III
2:00 – 2:20: Keum Young Lee
2:20 – 2:40: Hon Lin
2:40 – 3:00: Paul Footen

3:00 – 3:15: Break

3:15 – 3:55: Session IV
3:15 – 3:35: Vivan Bui
3:35 – 3:55: Aaron S. Ruesch
3:55 – 4:15: Jason Walter

4:15 – 4:30: Closing Remarks and Award Presentations
Dead Elk to Follow

Session I

Nicole Hackman
Measuring plant physiological responses to an expected urban CO_2 dome

Recent scientific research has revealed and documented trends in the environmental variables of dense urban centers such as the heat island effect (HIE) and an urban CO_2 dome. These occurrences are found mostly where anthropogenic sources of greenhouse gas (GHG) emissions are particularly high such as major cities throughout the U.S. and the world. Globally, researchers are seeing an exponential rise in both air temperature and CO_2 concentration and are attributing these trends to excessive GHG emissions which are brought on by anthropogenic influences including: urbanization, industrialization and the burning of fossil fuels. Predictions based on climate models foresee a global rise in air temperature and CO_2 levels similar to what the data currently depicts in dense cities today. Thus, it would seem sensible to use urban centers as harbingers for research involving future climate scenarios as many scientists have begun to do. One of the goals of this study is to reveal whether environmental trends similar to the HIE and urban CO_2 dome found in other cities including New York and Baltimore also exist in Seattle. I constructed weather-monitoring stations in Seattle and Forks, WA to monitor climatic variables including CO_2 and air temperature. Simultaneously, I grew two species of plants at these locations, which previous research shows physiologically respond to elevated CO_2. The final aspect of my research is to examine whether the stomatal numbers, and the biomass accumulation rates of these plants exhibit differences when exposed to the climatic variables of Seattle as compared to the rural location of Forks - and thus can be linked to CO_2 levels along the same transect. Evidence of these anticipated effects may lead towards a greater understanding of plant response to future climate scenarios.

Aditya Khanna
Circular migrations and HIV transmission dynamics

The objective of this work is to investigate the impact of circular migrations on the transmission dynamics of HIV. Circular migrations involve the movement of people from one place to another, followed by return and possible repetitions. An example is South Africa, where labourers have been sent from their home villages to mining towns, and these migrations have been a major component of the South African economy. The patterns of these migrations have changed over time, especially since the lifting of

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Aditya Khanna from previous page

apartheid mine workers are able to return home more frequently. It is known that HIV infectivity varies with increasing time since infection. Since AIDS has a long latency period, the high infectivity of HIV before symptoms appear can have a major impact if infected individuals are changing locations, potentially without knowing their infection status. I am investigating the dynamics of disease transmission using compartmental deterministic models, and also a stochastic network-based framework. The effects of timing since infection and variable infectivity are a major focus of my work. I will present an overview of the methods I am using and a comparison of my results so far.

Eva Dettweiler-Robinson
Abiotic and biotic aspects of recovery of biological soil crusts in sagebrush steppe experiencing frequent fires

Biological soil crusts (BSC) are surface dwelling lichens, algae, bacteria, fungi, and mosses that provide soil stabilization, cycle nutrients, and affect water retention in arid lands. After a disturbance such as fire, altered abiotic conditions can inhibit establishment and growth of BSC and biotic factors, such as lack of source population can prevent community recovery. In the sagebrush steppe in eastern Washington, there have been multiple large fires that have affected the vascular plant community and BSC community. I propose to investigate change in BSC cover over time, before and after large fire events, and the effects of nutrient availability, soil stability, and dispersal on recovery of BSC after fire. I will manipulate biotic and abiotic soil stabilization and will provide artificial inoculation of mature BSC organisms. I will also conduct ex situ nutrient addition trials to determine limitations to growth. Understanding how the community recovers will aid land managers in preserving both BSC and plant community under increased fire frequency.

Poster Session

Todd Erdody
Fusion of LiDAR and imagery for estimating canopy fuel metrics in eastern Washington forests

Fuel regimes of the American west have been altered as a result of fire suppression and timber management. This has led to increased fuel loading, and as a result land managers are in need of precise information about the fuels they manage. Canopy fuel metrics such as canopy height (CH), canopy

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Todd Erdody from previous page

base height (CBH) and canopy bulk density (CBD) are specific inputs for wildfire models such as FARSITE and FlamMap. Available canopy fuel (ACF) is another metric used for estimating canopy weight for particulate and smoke emissions. Currently, the raster layers for these metrics in these models are homogenous at coarse spatial resolutions. If finer resolution data were used, accurate quantification of the forest with more spatial heterogeneity can be accomplished. Light Detection and Ranging (LiDAR) and color near-infrared imagery are spatial and spectral systems, respectively, that have been utilized for measuring various forest structure characteristics at high resolution. Regression models were developed for Ponderosa pine (*Pinus ponderosa*) and mixed-mesic conifer stands representative of eastern Washington State using field data collected in the Ahtanum State Forest and metrics derived from LiDAR and imagery. Strong relationships were found with LiDAR alone (CH: R^2=0.94; CBH: R^2=0.79; ln(CBD): R^2=0.85; ln(ACF): R^2=0.88) and with LiDAR and imagery fusion (CH: R^2=0.96; CBH: R^2=0.84; ln(CBD): R^2=0.88; ln(ACF): R^2=0.91). By improving the ability to estimate canopy fuels at higher resolutions, spatially explicit fuels layers can be created and used in wildfire models leading to more accurate estimations of crown fire risk.

Lydia Putnicki
The identification of Rhododendron powdery mildew in the Pacific Northwest

Powdery mildews are plant pathogenic ascomycetous fungi (order Erysiphales) that infect a broad spectrum of urban landscape hosts, including rhododendrons. The rhododendron powdery mildews in the Pacific Northwest have never been adequately determined. The species *Erysiphe azaleae* and *Erysiphe vaccinii* are thought to have originated in North America, and because they were reported on Rhododendrons it is possible that one or both occur in this region. Modern powdery mildew taxonomy uses morphological characters of both the sexual and asexual states, complemented with analysis of DNA sequences, to classify these fungi.

In this study, fresh samples of powdery mildew-infected Rhododendron leaves were collected from plants in urban botanical gardens, residential gardens, and parks, with additional specimens collected from herbaria. Collection sites included University of Washington Botanical Garden,

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Seattle, Washington, Rhododendron Species Botanical Garden, Federal Way, Washington, and Van Dusen Botanical Garden, in Vancouver, British Columbia. Disease symptomatology was assessed, and morphological traits of the fungi were characterized using light microscopy. Both asexual and sexual states were characterized; in many specimens only one of the states were present. Samples of mycelia, spores, and chasmothecia (if present) were collected from infected rhododendron tissue and DNA was extracted. The regions chosen for PCR amplification were the ITS region of rDNA, and the RPB1 and RPB2 genes (which encode for subunits of RNA polymerase II). Sequences were aligned with Se-Align.

Preliminary morphological analysis and DNA sequencing suggested that only one species of powdery mildew occurs on evergreen rhododendron in the Pacific Northwest. However, on deciduous azaleas, distinct differences in teliomorph characteristics suggested that more than one species occurs. Comparison of sequences obtained from evergreen rhododendron samples with sequences deposited in GenBank revealed 99% similarity with *Erysiphe alphitoides* (Oak powdery mildew); however, it should be noted that there are no sequences from *Erysiphe azaleae* or *Erysiphe vaccinii* deposited in GenBank. The next phase of this project is to obtain DNA sequences from deciduous azalea powdery mildews and to compare them with collections from evergreen rhododendrons. In addition, morphological and DNA sequence data will be assessed to compare the rhododendron powdery mildew fungi with those found on *Quercus* species, as well as those on other ericaceous hosts.

Keum Young Lee (presenter), Sharon L. Doty & Stuart E. Strand
Phytoremediation of chlorpyrifos

Chlorpyrifos is one of the commonly used organophosphorus insecticides and causes serious environmental and human health problems. Our hypothesis was that these problems may be partially or thoroughly solved by the emerging phytoremediation technology. To evaluate plant potential for degradation of chlorpyrifos, several selected plant species such as aspen, cottonwood, and willow were investigated. The species tested in this study were: willow clone SV1 (*Salix dasyclados*), SX61 (*S. sachalinensis*), SX64 (*S. miyabeana*), SX67 (*S. miyabeana*), 94006 (*S. purpurea*), black cottonwood (*Populus trichocarpa*), and poplar hybrid clone INRA 717-1B4 (*Populus tremula*

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x *P. alba*). Analysis of the percent removal of chlorpyrifos from solution showed that chlorpyrifos can be taken up by plant roots and degraded into TCP which is nontoxic. The best performing line, SX 64, removed chlorpyrifos in the highest uptake rate (micrograms of chlorpyrifos $\cdot day^{-1} \cdot g^{-1}$ plant wet weight $\pm$ SEM), 21.27 $\pm$ 2.09, showing the highest statistical difference in uptake rate between SX64 and the unplanted vials. In addition there was a significant difference between three species (hybrid poplar, cottonwood, and SX61) and SX 64 at the 5% significant level ($p = 0.011$). To our knowledge, this work represents the first report for phytoremediation of chlorpyrifos using plants and it is expected that these types of trees will feature largely in phytoremediation research in the future.

Session II

Jake Grossman

Differences in plant species diversity, spatial heterogeneity, and water quality dynamics between planted and unplanted constructed wetlands

Wetland restoration can increase local biodiversity and enhance important ecosystem services such as nutrient capture and storm water retention. Following the first four years of an on-going study of a series of 0.18 ha constructed wetland cells at a rural location in north central Ohio, we assessed 1) the effects of two planting treatments and a control treatment on resulting plant species diversity and the removal of invasive species control on plant diversity, 2) the impact of plant diversity on ecological function as measured by water quality, and 3) the implications of using different metrics for quantifying certain components of biodiversity. Wetlands planted with desired species at least once with desired species became more diverse than unplanted wetlands. Removal of *Typha* spp. L. and *Phalaris arundinacea* L. also likely reduced the abundance of these species during the study period. Planted wetlands did not differ from unplanted wetlands in water quality. Although the different indices of alpha-diversity utilized in this study generally agreed, metrics that took into account the abundance of hydrophytic and/or native plants relative to the abundance of upland or exotic species proved more useful for post-restoration monitoring than measures of total species richness or total diversity. Two indices of spatial heterogeneity, Routledge's and Whittaker's Beta, appeared to measure different dimensions of beta-diversity.

Eric Delvin

Restoring highly degraded habitats for rare species in Puget Sound prairies

The prairies of Puget Sound are one of the most endangered ecosystems in the United States, and include populations of several rare plants and animals. Less than 2% of historic prairies are currently protected; many of these areas are degraded, and potential additional acreage largely consists of agricultural land. Thus, restoration of existing and new sites is critical to ensuring the viability of this system. To date, prairie restoration efforts in Washington have focused exclusively on restoring moderately degraded sites that still retain a significant component of native species. In 2008, we began a multi-year research project to develop restoration and seeding treatments for highly degraded sites. We use an adaptive, iterative approach that explicitly addresses spatial and temporal variability in restoration success. We expect that the results from this project will significantly increase the breadth of potential sites that can be considered for restoration. The project specifically focuses on restoration of critical habitat components for four rare butterfly species (Taylor's Checkerspot, Mardon skipper, Puget Blue, and Valley Silverspot) and a rare plant (Golden Paintbrush) that historically occurred in these habitats. This holistic approach is critical in creating sites to support future translocations of these species. By restoring compositional, structural, and functional components of these prairie systems, the project will also benefit many other species, common and rare, within the prairie ecosystem.

Rachel M. Mitchell

Exploring phenotypic plasticity in invasive species

Invasive species are present in a wide range of habitat types: individual of the same species may be found in nutrient poor grasslands and in nutrient rich agricultural fields and gardens. Phenotypic plasticity, the ability of an organism to alter morphology or physiology in response to environment, has been suggested as a possible explanation for invasive presence in such disparate conditions. If invasive species exhibit greater phenotypic plasticity than native species over a wide range of habitat conditions, this may allow invasive species to out-compete natives. In addition, invasive species may experience unique selection pressures that favor rapid evolution of increased phenotypic plasticity. Nitrogen (N) is an important limiting nutrient in temperate ecosystems, but available N can vary widely in different habitat types. I will examine the phenotypic plasticity of six species of native and invasive Asteraceae under various levels of soil N (0, 2.8, 5.7, 8.4 and 11.2g/m^2, equivalent to 0 to 100lbs/acre) in the

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greenhouse. Morphological and physiological measurements will be taken over the course of the growing season, including height, basal diameter, number of leaves, above and belowground biomass, flower and seed production, chlorophyll content and gas exchange. Species response curves will be generated and compared across species to determine whether the invasive species express greater phenotypic plasticity under varying levels of soil N.

Session III

Keum Young Lee (presenter), Sharon L. Doty, & Stuart E. Strand
Phytoremediation of chlorpyrifos

See abstract in Poster Session section of program

Hon Lin (presenter), Richard Gustafson, Renata Bura & Shannon Ewanick
Application of ceramic membranes to recover high value hemicellulose from alkaline peroxide pretreated wheat straw

A new pulping technology allows Washington companies to produce recycle grade pulp from wheat straw using mild conditions and low cost equipment. In this process the waste pulping liquor (black liquor) needs to be concentrated and it is desirable to recover high value chemicals from this stream before disposal. The black liquor is produced by alkaline peroxide pretreatment of wheat straw and is comprised of dissolved lignin and hemicellulose polymers. The hemicelluloses is a valuable component because it can be further processed to fuels – such as ethanol – or high value chemicals such as xylitol or water soluble polymers. The purpose of our research is to investigate use of membranes to recover hemicellulose from the wheat black liquor. Results of the research show that excellent hemicelluloses recovery is achieved with the membranes. It is found that 85% of hemicelluloses polymers can be recovered with a 5000 molecular weight cutoff ceramic membrane. Recovery of xylan, the dominant sugar component of these hemicellulose polymers, is above 90%. The permeate flux of the membrane is thoroughly assessed as a function of temperature and pressure. The application of membrane back-flushing to enhance the permeate flux is also presented. Results of this study provide data for a techno/economic analysis of the potential of using this membrane in a commercial scale biorefinery.

Paul Footen (presenter), R.B. Harrison, & B.D. Strahm
Long-term effects of nitrogen fertilization on the productivity of subsequent stands of Douglas-fir in the Pacific Northwest

The carryover effects of N-fertilization on five coastal Pacific Northwest Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) plantations was studied. "Carryover" is defined as the long-term impact of N fertilizer added to a previous stand on the growth of a subsequent stand. Average height and diameter at 1.3 m above-ground (DBH) of 7-9 year old Douglas-fir trees and biomass and N-content of understory vegetation were assessed on paired control (untreated) and urea-N fertilized plots that had received cumulative additions of 810-1120 kg N ha^{-1} to a previous stand. Overall productivity was significantly greater in the fertilized stands compared to the controls. In 2006, the last growth measurement year, mean seedling height was 15% greater ($p = 0.06$) and mean DBH was 29% greater ($p = 0.04$) on previously fertilized plots compared to control plots. Understory vegetation biomass of fertilized plots was 73% greater ($p = 0.005$), and N-content was 97% greater ($p = 0.004$) compared to control plots. These results show that past N fertilization markedly increased seedling growth in these plantations as well as biomass and N-content of understory vegetation in a subsequent rotation. These findings suggest that N fertilization could potentially increase site productivity of young Douglas-fir stands found on low quality sites in the Pacific Northwest 15-22 years after application by a carryover effect. These plantations have not yet reached the age where marketable materials can be harvested from them, and the growth of trees should be monitored over a longer time period before potential impacts on older stands, if any, can be determined.

Session IV

Vivian Bui
Nest predation by common ravens on greater sage-grouse in relation to land cover in western Wyoming

Human populations are growing in western Wyoming due to increased oil exploration and high levels of tourism. As towns expand, they subsidize some wildlife species, such as the Common Raven, while negatively impacting others, such as the Greater Sage-grouse. In 2007-2008, we surveyed for raven activity at 166 random locations and 249 locations near grouse nests/broods in Pinedale and Jackson, Wyoming, using 20-minute point counts. We used observed densities in our analyses because

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Vivian Bui from previous page

detectability did not vary by landcover. Raven abundance varied significantly by landcover. The highest densities occurred within towns, supporting the hypothesis that increased human populations increased raven populations. Occupancy was highest at city, road, and oil points. Avian predation accounted for 3% of known grouse nest failures. Observed raven densities near grouse nests/broods were not significantly greater than predictions based on landcover, and densities near failed grouse nests/broods were not significantly greater than at successful nests/broods. We conclude that ravens are subsidized by human activity, but are not attracted to areas with high levels of grouse reproductive activity and do not significantly negatively impact grouse reproductive success.

Aaron S. Ruesch

Spatially forecasting climate change effects on coldwater fishes in the John Day Basin, Oregon

Anadromous salmon and trout on the southern extent of their global distribution have experienced major declines over the last century. Declines in the Pacific Northwest are attributed to overexploitation, dams, and habitat degradation. Reductions in marine harvest have provided relief to some local salmon populations. However, conclusive results for the potential effects of climate change and habitat degradation have not yet caused a shift in the way we approach habitat management for coldwater fishes such as salmon and trout. The John Day River in central Oregon supports populations of native salmon and trout (*Oncorhynchus tshawytscha, Oncorhynchus mykiss, Salvelinus confluentus*, and *Oncorhynchus clarki lewisi*) that we estimate are likely to be affected by climate change in the coming century. Increased stream temperature stresses coldwater fishes metabolically and ecologically by forming thermal barriers to migration, compressing available habitat, exacerbating inter- and intraspecific competition, and increasing predation by encroaching warmwater fishes. Thermal stresses resulting from climate change in the John Day basin will not be uniformly distributed longitudinally throughout the river system due to spatial variation in topography, climate, geology, and riparian and upslope vegetation. Here, I outline a research agenda for projecting changes in stream temperature in the John Day River basin under future climate scenarios. Using these temperature projections, I will then assess the potential effects of increased water temperatures on the distribution of coldwater fishes. All model projections will be based on empirical relationships derived from studies in the John Day or similar basins.

Jason Walter (presenter), Christian Torgersen, Robert Bilby, Thomas Quinn & Brian Fransen

Variability of coastal cutthroat trout abundance and LiDAR-derived channel morphometry in headwater catchments

Current practices in place to protect aquatic biota and their habitats potentially impacted by forest management typically recognize differences among these habitats at the coarse-scale. This approach does not address the significant heterogeneity of headwater habitats that exists at finer-scales, and contributes to the inability of scientists, managers, and regulators to agree on best management practices to provide protection to aquatic systems. We propose to conduct spatially continuous, single-pass electrofishing and habitat surveys within the fish-bearing portions of 16 catchments where coastal cutthroat trout are the sole salmonid species present. Initial surveys were conducted in the autumn of 2008, with a plan to resurvey those catchments in the spring of 2009. A different set of eight catchments will be surveyed in 2009/2010. Spatial and temporal variability of cutthroat trout abundance within each study catchment will be assessed using both fine-scale stream habitat data collected during field surveys and intermediate-scale channel morphometry derived from lidar remote sensing. Geostatistical and multivariate modeling techniques will be used to quantify spatial structure in the distribution of cutthroat trout in relation to habitat heterogeneity associated with channel slope, valley width, and network structure. By identifying intermediate-scale habitat characteristics associated with high cutthroat trout abundance land managers can better identify areas of high biological potential where specific habitat protections or restoration efforts may be warranted or most productive.

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Thank you for coming today!

We hope you enjoyed the fourth annual College of Forest Resources Graduate Student Symposium. Please take a moment to fill out an evaluation form (located on the table near the entrance). Your comments will help us plan future symposiums and tailor the event to a variety of needs.

Please come again next year!

This event was made possible with generous support from:

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

A time for graduate students to share ideas.

A place for the College of Forest Resources to gather and show others the wealth of knowledge housed in these buildings.