

Fifth Annual
College of Forest
Resources



Graduate
Student
Symposium

February 29, 2008

Schedule of Events

9:30 – 9:40: Dr. Bruce Bare, Dean College of Forest Resources

9:40 – 10:30: Keynote Speech

Dr. Erica Cline, Assistant Professor of Interdisciplinary Arts and Sciences and Environmental Sciences at the University of Washington, Tacoma.

10:30 – 11:20: Session I (Oral)

10:30 – 10:35: Moderator: Paul W. Footen

10:35 – 10:50: Reed Wendel

10:50 – 11:05: Maureen Kennedy

11:05 – 11:20: Luciana Santos

11:20 – 11:35: Chad Wilsey

11:35 – 12:40: Session II (Poster)

11:35 – 11:40: Moderator: Luciana Santos

11:40 – 11:45: Julie Mocklin

11:45 – 11:50: Amy Yahnke

11:50 – 11:55: Justina Harris

11:55 – 12:00: Kim Littke

12:00 – 12:05: Paul W. Footen

12:05 – 12:30: Q&A for All Posters

12:30 – 1:30: Lunch

1:30 – 2:35: Session III (Oral)

1:30 – 1:35: Moderator: Paul W. Footen

1:35 – 1:50: Akira Kato

1:50 – 2:05: Jeff Richardson

2:05 – 2:20: Rapeepan Kantavichai

2:20 – 2:35: Laura Blume

2:35 – 3:40: Session IV (Oral)

2:35 – 2:40: Moderator: Justina Harris

2:40 – 2:55: Erik Peterson

2:55 – 3:10: Ryan Haugo

3:10 – 3:25: Bianca Perla

3:25 – 3:40: Ben Peterson

3:40 – 3:45: Closing Remarks

3:45 – 4:00: Award Presentations

****Reception to follow****

Keynote Speaker

Dr. Erica Cline

Assistant Professor of Interdisciplinary Arts and Sciences and Environmental Sciences at the University of Washington, Tacoma.

Dr. Cline's research areas include the ecology of mycorrhizal and pathogenic fungi. Erica received her BS in biology from the University of Puget Sound, went on to get her M.S. in cell biology at the University of Leiden in the Netherlands and earned her Ph.D. at the University of Washington, Seattle in Forest Resources. Her dissertation was on the ectomycorrhizal diversity of Douglas-fir seedlings. After her Ph.D. she went on to be a Post-Doctoral researcher at the Systematic Botany and Mycology Lab for the USDA Agriculture Research Service in Beltsville, MD where she focused her studies on the systematics of plant pathogenic fungi. Since joining the faculty of the UW Tacoma she has redesigned a course TESC236 Plants and People: The Science of Agriculture. This course exposes undergraduate non-science majors to agricultural science within an interdisciplinary framework. She also designed and implemented an introductory biology curriculum incorporating field research opportunities, and has been responsible for integrating research and undergraduate education. She is currently working with several advanced undergraduates doing field research expected to result in peer-reviewed publications.

Session I (Oral)

Reed Wendel

Fire History of Geyser Valley in the Elwha River Watershed of Olympic National Park.

Wildfire plays a complex role in vegetative development along the Geyser Valley portion of the Elwha River in Olympic National Park. Until recently, all wildfires were suppressed in the park, but in 2005 the park adopted a fire management plan allowing lightning-caused fires to burn for a limited extent. Data about pre-suppression fire history were not available in most areas of the park when the plan was written. In order to gain a greater understanding of fire's role as a disturbance mechanism, my research addresses the following two questions: 1) What was the frequency and the extent of fires in the Geyser Valley before the period of fire suppression? 2) How does fire affect vegetation in the study area? 78 fixed area plots were installed in the summer of 2007 to measure vegetation. Cores from fire-

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Reed Wendel from previous page

scarred and unscarred trees are being used to reconstruct fire events in the study area. Initial results suggest that a period of fire activity in the late 1600's and early 1700's was followed by an inactive period lasting until the late 1800's. Results from this study will inform future park fire management plans.

Maureen Kennedy

Multi-objective Optimization for Fire Management. Integrating Ecological and Fuels Objectives in Decision-making.

Effective decision-making in environmental management requires the consideration of multiple objectives that may conflict. Common optimization methods use weights on the multiple objectives to aggregate them into a single value, neglecting valuable insight into the relationships among the objectives in the management problem. Specifically, the primary goal of any fuels management program is the minimization of fire risk. Yet, these programs have obvious consequences for wildlife habitat that might be under protection. I present a multi-objective optimization procedure that approximates the non-dominated Pareto frontier without the use of weightings, allowing for visualization of the trade-offs among objectives. I apply this method to a case study for the optimum distribution of forest fuels treatments that reduce the impact of fire on a forest. The multiple objectives are to protect habitat of an endangered species, protect late successional forest reserves and minimize the total area treated. In the comparison of three optimization searches, the number of non-dominated solutions increases with the dimensions of the objective space, but with only two objectives the search is ineffective in minimizing fire impact in the different landscape types. Key challenges include the extensive computation time required to approximate the non-dominated set, and reducing the number of solutions that are analyzed in detail. This tool provides decision-makers with a set of alternatives that estimates the full range of trade-offs among multiple objectives and provides a common ground from which dialogue can come to an informed compromise and decision in environmental management problems.

Reference:

Kennedy MC, Ford ED, Singleton P, Finney M, Agee JK. 2008. Informed multi-objective decision-making in environmental management using Pareto optimality. *Journal of Applied Ecology*/ 45: 181-192

Luciana Oliveira Santos

Monitoring Harbor Porpoise WA Inland Water Stock. Vessel or Aerial Survey?

Harbor porpoises (*Phocoena phocoena*) are among the smallest cetaceans. They are observed usually in small groups, found mainly in near-shore and swallow water, although some occur in deeper offshore waters. Some stocks in the North Pacific are isolated from each other and this is the case for the Washington stock. The population of porpoises in Washington is trans-boundary in nature and it is known to occur year-round in the island waters of Washington and British Columbia, Canada. The National Marine Fisheries Service (NMFS) in the Department of Commerce is required by the Marine Mammal Protection Act (MMPA) to prepare reports that describe the status of each marine mammal stock under US jurisdiction. The reports consist of the description of a marine mammal stock and its geographic range, population dynamics, estimates of human-induced mortality, status of the stock and an estimation of the level of potential biological removal (PBR). The PBR is the maximum number of animals that may be removed from a stock while allowing that stock to reach or maintain its optimum sustainable population (OSP). The main weakness of using PBR levels to manage a specific stock of marine mammal is that PBR level is based on direct human-caused mortalities such as fisheries entanglement and it is not intended to identify decline of marine mammal stocks caused by decrease on prey availability, changes in the ecosystem, predation, habitat degradation, or disease. Since there are many other threats to inland water harbor porpoises and entanglement data for this population are incomplete, there is no information on by catch by fisheries located outside of U.S. jurisdiction and no information on interaction between tribal gill-net fisheries and inland Washington stock harbor porpoise. In order to understand and monitor inland WA stock harbor porpoise it is necessary to survey the population more often to calculate trends. For this project I will be analyzing and comparing vessel and aerial surveys conducted in 2002 and 2003 by the NMML and incorporating measurement error from visual surveys and visual distance estimates. Also, I will be using Distance software and R to estimate a more accurate method to monitor and calculate trends of harbor porpoises in inland waters of Washington.

Chad B. Wilsey

Avian Communities and Vegetation Structure in Cacao and Banana Agroforestry Systems of Talamanca, Costa Rica.

Identifying the structural elements of agroforests correlated to animal diversity will inform conservation efforts on private lands located in habitat

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Chad B. Wilsey from previous page

buffers and corridors. I examined the relationships between vegetation structure and avian communities in four shaded agroforestry systems in Talamanca, Costa Rica: abandoned cacao, cacao, cacao with banana, and banana. During two field seasons, I identified 2,791 trees from approximately 59 species and 2,605 birds from 106 species. Canopy, understory, and groundcover vegetation as well as avian community composition differed between systems, while avian species diversity was similar. Agroforestry systems lacking banana had significantly more forest birds and fewer agricultural generalists than systems with banana. Understory- and ground-foraging birds were also more abundant in agroforests without bananas. Small (<15cm diameter) tree diversity and groundcover explained a substantial portion of the variation in avian community composition in one season ($r^2=0.48$). Vegetation measures (e.g. groundcover, canopy height, and small tree diversity) also explained portions of the variation in the abundances of forest birds and understory- and ground-foraging birds. Results indicate that cacao agroforests should be positioned near remnant forest to maximize their conservation value for forest birds, while banana and cacao with banana agroforests should be adjacent to disturbed areas.

Session II

(Poster)

Julie A. Mocklin

Bowhead Whale Feeding Behavior as Evidenced in Aerial Photography.

Photographic aerial surveys of the Bering-Chukchi-Beaufort bowhead whale population have been conducted intermittently over the past 30 years. In this period, scientists have amassed approximately 17,000 photographic images. The utility of photo-identification as a research tool has been well documented, and applications include mark-recapture abundance estimation, survival analysis, calving intervals, and measurement of individual growth rates. Apropos to the Bowhead Whale Feeding and Ecology Study (BOWFEST) that commenced in 2007, I began analyzing photo-data to determine which whales in the collection appeared to be feeding. Images of individual whales will be categorized as feeding based on the presence of an open mouth, feces, or mud on the body. Because whales feeding on epibenthic prey seem to entrain mud on their bodies, 'muddy whales' will be the main focus of this research. The study will systematically examine images from 1985, 1986, 2003, and 2004. Surveys in those years covered most of the spring migration near Point Barrow, as well as much of the eastern Beaufort Sea and Amundsen Gulf in 1985 and 1986.

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Julie A. Mocklin from previous page

We will also examine images for evidence of feeding in the Bering Sea (April 2005) and near Barrow in the summer (2006 and 2007). This study will investigate temporal and spatial trends relative to when and where muddy whales were photographed. Analyses will also provide indices of whales that were muddy (relative to date and location), age classes of muddy whales (estimated via whale lengths), and environmental parameters that may be associated with bottom-feeding bowhead whales. All data will be plotted in a series of GIS maps to show locations and percentages of feeding whales in our photographic database. Analyzing photographic data on feeding whales will constitute an important contribution to the current BOWFEST research and will add to the general body of knowledge on bowhead whale ecology.

Amy Yahnke

Environmental Factors Governing Amphibian Reproduction in Stormwater Detention Ponds.

Stormwater detention ponds are installed in developing landscapes to mitigate for the effects of increased impervious surfaces. They are designed to attenuate water flows and pollutants entering wetlands and streams from precipitation. However, even when not designed for ecological functions, stormwater ponds are often used as habitat by wildlife. Six native pond-breeding amphibian species in King County, Washington use stormwater ponds for breeding. Species such as northern red-legged frogs (*Rana aurora*) and northwestern salamanders (*Ambystoma gracile*) lay egg masses on available wetland plants or over-hanging woody material but large water-level fluctuations, a frequent phenomenon in stormwater ponds, can strand egg masses, often desiccating them. Additionally, the pollution abatement function of the ponds may expose amphibians in vulnerable life stages to a suite of pollutants (pesticides, oils, heavy metals, etc) that are components of the stormwater run-off. Stormwater pond selection as breeding sites may result from development-related wetland loss and degradation, or because water or ambient temperatures associated with stormwater ponds is more attractive to amphibians breeding during the cooler late winter-early spring. Stormwater pond management, including dredging to increase storage capacity and mowing pond edges for aesthetics and access, reduces available cover and food resources for amphibians, and is reflected in reduced amphibian abundance. However, amphibians will continue to lay eggs on available substrates such as fallen branches in ponds that were recently dredged. I am evaluating relative effects to amphibian reproduction from water quality factors and exposure to contaminants in stormwater ponds.

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Amy Yahnke from previous page

Ultimately, the role of stormwater ponds either as a viable habitat or an attractive sink to amphibian populations needs evaluation to inform stormwater pond management and design.

Justina Harris

Sitka spruce, (Picea sitchensis), in Swamp Creek Watershed: Urban refuge or last stand?

Sitka spruce (*Picea sitchensis*) has been present in the Puget Lowland of Washington State since the last glaciers receded. Little scientific research exists on the distribution and reproduction of Sitka spruce in urban watersheds like Swamp Creek (30% impervious surface), part of the Greater Lake Washington Watershed within the Puget Lowland. I will locate Sitka spruce trees throughout Swamp Creek Watershed, will measure a subset of spruces for stand and tree characteristics, and then map all the data using a Geographic Information System. Is Sitka spruce reproducing in this urban environment or are the existing trees remnants from a prior time? What do the landscape patterns of Sitka spruce in this still-growing urban watershed and the conditions under which they survive indicate for their future? Preliminary results indicate that there are at least 236 Sitka spruces in Swamp Creek with about 60% of those located in people's front and backyards. These are often individual spruce trees but may also be a pair or a row of trees planted as a hedge. The other 40% occur in wetland and swamp habitats, with a few occurring in upland forests. Many of the upland areas are currently in the process of being developed. Further expected outcomes include visually illustrating the watershed distribution in relation to other watershed features, and to tree and stand characteristics such as plant associations, substrates, and numbers of seedlings.

Kim Littke

Predicting Response to N-Fertilization in the Pacific Northwest.

Nitrogen fertilization is common in Pacific Northwest plantation forests, although there is not always a growth response to fertilization. The Stand Management Cooperative will set up a series of 15-25 year-old Douglas-fir plantations to study fertilizer response. The study will be set up as a paired tree study where tree matching characteristics include DBH, height to live crown, and height. One tree from each pair will be randomly selected to receive nitrogen fertilization at 200 lbs N/acre. Sites will be characterized by site properties (site index, LAI, slope, etc), physiology (precipitation, soil moisture and temperature, etc) and nutrition (soil and foliar nutrition, bulk

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density, etc). Equipment will be used to measure rainfall, temperature, and soil moisture over a long-term period. Tree growth characteristics and foliage nutrition will be measured two years after fertilization, while soil nutrition will be measured four years after fertilization.

Paul W. Footen

Long-term Effects of Past Nitrogen Fertilization on Subsequent Stands of Douglas-fir in the Pacific Northwest.

Forest growth in the Pacific Northwest is frequently limited by the supply of plant-available nitrogen (N). To increase productivity, N-fertilization is a commonly utilized silvicultural practice. The long-term effects of this practice have not been investigated to our knowledge. The objective of this study was to learn if subsequent stands of Douglas-fir were affected by previous fertilization. The carryover effects of N-fertilization on understory vegetation and Douglas-fir seedling growth were quantified in five stands in the Puget Sound Region of western Washington. Biomass and N-content of understory vegetation, and average height and diameter at breast height (dbh) of 12-year-old Douglas-fir seedlings were assessed on control (untreated) and N-fertilized plots that had been fertilized with urea 28-30 years ago (total amount of applied N 810-1120 kg/ha). Measurement plots were 0.04 ha with one control and one fertilized plot in each of the five stands. Understory vegetation was sampled to ground level in five random 0.25 m² subplots on each measurement plot. Samples were dried at 70° C to a constant weight and weighed to obtain biomass estimates. The samples were then finely ground and analyzed for N-content (using a Perkin-Elmer CHN Analyzer). Installation-level values were calculated by averaging all subplots within one installation. Statistical analyses were performed on installation-level data using the paired-sample t-test of these installation means ($\alpha = 0.1$). Understory vegetation biomass on previously fertilized plots was 73% greater ($p = 0.005$), and N-content was 97% greater ($p = 0.004$) than on control plots. In 2006, mean seedling height was 15% greater ($p = 0.06$) and mean dbh was 29% greater ($p = 0.04$) than on control plots. These results show that past N-fertilization markedly increased seedling growth, and understory biomass and N-content in a subsequent rotation. Use of N-fertilizer can potentially increase site quality decades after application. This finding has multiple implications for silviculturalists and forest ecosystem managers. The trends in this study should continue to be monitored, and similar studies should be established, to further understand the carryover effects of N-fertilization on forests.

Session III (Oral)

Akira Kato

Reconstruction of 3D Tree Structure from LiDAR and Color of Aerial Photos.

The active remote sensing technology, Light Detection and Ranging (LiDAR), has a wide range of uses from creating Digital Terrain Models (DTMs) to forestry and ecological applications. More recently, reconstruction of terrestrial features has become as important as creating DTMs from LiDAR. With current technology, LiDAR point density is high enough to detect the detail of the objects on and above the ground. In this study, I used LiDAR data from Washington State Park Arboretum, Seattle, WA with a point density of 20 points/ m² to reconstruct realistic, three dimensional tree crown shapes. I then used aerial photographs of the same tree canopy to apply visual textures to these surfaces. Due to shaded and shadowy pixels, identification of tree crown information from traditional remotely sensed data is difficult. Furthermore, classical aerial photogrammetric techniques cannot reconstruct the objects accurately in three dimensional space if they are not clearly visible on the photos. LiDAR is more suited for the characterization of tree crowns in three dimensional space. Creating three dimensional models of trees is a very challenging task because of irregular reflectance of LiDAR returns from tree canopies. The conventional approach does not exactly fit actual tree shape. We, therefore, took a computer graphic approach to reconstruct tree shapes from discrete LiDAR points and wrap the bottom of the tree crown. LiDAR data have the highest resolution of three dimensional structures, while the finest resolution two dimensional images are aerial photographs. I fused these two datasets to extract the color from aerial photos and drape the color on the wrapped surface of the tree canopy. This approach allows visualization of fine resolution three dimensional tree structures with the color of aerial photos.

Jeffrey J. Richardson

Derivation of Leaf Area Index from Aerial Discrete-Return LiDAR in a Heterogeneous Mixed Forest.

Leaf Area Index (LAI) has traditionally been difficult to estimate accurately at the landscape level, especially in heterogeneous forests with a large range of LAI values, but remains an important parameter for many ecological models. I have used aerial discrete-return LiDAR to estimate the effective LAI in a heterogeneous, mixed conifer and deciduous managed forest with

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Jeffrey J. Richardson from previous page

a wide variability in LAI values. I have compared four different LiDAR metrics: mean LiDAR return height, canopy volume, total 1st return frequency, and the LiDAR Canopy Index (LCI) to indirect ground based estimates using the gap fraction. Each metric is correlated to ground estimates. I have developed a linear model using the LCI and mean LiDAR return height to explain 71% of the variability compared to ground based hemispherical estimates, and applied this model to six 30 m by 30 m plots where LiDAR derived LAI estimates were compared to 49 averaged hemispherical photograph estimates. The results show that LiDAR can be used to estimate LAI in a heterogeneous forest, but with a tendency to lose accuracy with increasing LAI greater than three.

Rapeepan Kantavichai

Effect of Pre-commercial Thinning followed by a Fertilization Regime on Branch Diameter in Coastal US Douglas-fir Plantations

The effect of pre-commercial thinning in age 6-13 Douglas-fir (*Pseudotsuga menziesii* (Murb.) Franco) plantations with and without repeated fertilization with 224kg ha⁻¹ N as urea on the mean diameter of the largest limb at breast height (DLLBH) of trees was investigated. DLLBH is a simple, non-destructive field measurement that is related to log knot indices used as measures of log quality in product recovery studies. DLLBH was measured at age 21-31 when virtually all BH branches were dead. Mean DLLBH of trees of treatment plots as modeled in four ways using multiple regression in cross section data: Model 1 investigated use of site, initial stocking, and treatment variables alone; Model 2 investigated use of mean tree variables alone; Model 3 investigated combinations of both groups of variable; and Model 4 investigated use of variables that can be measured with LIDAR, a high resolution remote sensing technology. Model 2, using only mean tree variables, had lower error and higher adjusted r² than Model 1 which used only site, initial stocking, and treatment variables. However, Model 3, which used a combination of both groups of variables, produced the best model. Model 4 successfully predicted mean DLLBH using variables measured from LIDAR and provides an opportunity to assess this measure of quality of stands across a landscape with this remote sensing technology. In addition, we also run the logistic model to predict the probability of crown recess at breast height by using Generalized Estimation Equation and Bootstrapping. These models indicate that mean DLLBH of managed Douglas-fir plantations can be estimated using variables obtained from stand-level growth models or remote sensing, providing a metric of quality indicator that can be easily verified in the field that would be useful in harvest scheduling and silvicultural planning.

Laura Blume

Effects of Post-planting Treatments on Seedlings and Variations in growth Rates and Morphology in Mature Stands.

Garry oak (*Quercus garryana*) is important to the Pacific Northwest landscape, providing habitat for species such as gray squirrels and Lewis' woodpeckers. Fire exclusion and land clearing have recently led to Garry oak decline. Most Garry oak research has occurred west of the Cascades despite recent models suggesting that suitable oak habitat is likely to expand east of the Cascades as the climate warms. The first component of this project will address the question of how post-planting treatments and seedling age at planting affect survivorship and growth in a Garry oak restoration planting east of the Cascades. A randomized block design will be used to test the effects of tree shelters, brush blankets, irrigation and seedling age at planting on seedling survivorship, diameter increment and height increment for the first year after planting. A mature stand survey will examine understory composition, spatial patterning, growth rates and age structure in Garry oak stands in eastern Washington. Three stands within each of two watersheds will be included in the survey. Measurements at each stand will include elevation, slope aspect, slope gradient, temperature, snow-pack, photon flux, soil moisture, and physical and chemical soil characteristics. The restoration experiment will provide information on the relative importance of planting treatments useful for future projects with limited budgets. The mature stand survey will help develop targets for plantings in various environments as well as indicate whether existing stands are expanding, contracting or stable.

Session IV

(Oral)

Erik Peterson

Forest Resources and Livelihoods: Opportunities and Obstacles for Sustainable Forest Management in Barjomot Village, Tanzania.

Deforestation in sub-Saharan Africa is a threat to both the livelihoods and the environment upon which rural subsistence farmers depend. Although substantial scholarship has described numerous factors contributing to this problem, systems for identifying local solutions and local solutions themselves are insufficient. Therefore, the goal of this intensive case study

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Erik Peterson from previous page

is to (i) identify the specific opportunities and obstacles for sustainable forest management (SFM) in Barjomot Village, Tanzania and (ii) develop a methodology for the identification and evaluation of SFM opportunities and obstacles. These two goals are addressed through two research objectives. The first objective is to measure local forest resource adequacy. How do local farmers perceive their forest resource? Is deforestation a problem? The second objective, motivated by findings of significant threats due to deforestation, is to explain why SFM has not occurred. Explaining SFM in the study setting is accomplished with a content analysis on a unique set of SFM enabling conditions. SFM conditions considered fall into three categories: (i) bio-physical, (ii) socio-economic and (iii) institutional. Some results from the analysis are that variables associated with the following SFM conditions have presented obstacles to the maintenance of forest resource adequacy: unclear physical boundary of village forest reserves, inadequate monitors' capacity, low levels of trust between rule makers, enforcers and resource users and difficulty in rules enforcement. Significant opportunities for SFM are identified as well: the local forests' semi-degraded condition still enables feasible improvement, goods and services from the local forest resource are an important livelihood strategy and *de jure* restrictions on harvests match natural regeneration rates.

Ryan D. Haugo

Competitive and Facilitative Interactions Between Encroaching Conifers and Herbaceous Vegetation Within a Montane Meadow.

Individual woody plants are known to have strong competitive and facilitative effects on herbaceous vegetation. Numerous studies have investigated the influence of environmental stress and resource availability on woody-herbaceous interactions. Yet few have clarified how these interactions change over time and/or vary between woody species. Using a space for time substitution, I addressed these questions by reconstructing 80+ years of vegetation response to encroachment by individual conifers in montane meadows of the western Cascade Range, Oregon. Herbaceous responses to conifers were assessed using vegetation transects with paired "under-canopy" and "adjacent meadow" segments. Transects ran either to the northeast or southwest from the base of individual *Pinus contorta* ($n = 31$ NE and 36 SW) and *Abies grandis* ($n = 38$ NE and 36 SW). General linear models were used to determine the effects of tree age, tree species and directional shading. Under-canopy vegetation dynamics were simultaneously dominated by the progressive decline of resident meadow

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Ryan Haugo from previous page

vegetation and an increase in forest herbs. While forest herbs established more quickly beneath *Abies*, conifer species was neither a significant main nor interaction factor for models predicting meadow richness and abundance. Unexpectedly, 37% of transects displayed greater cover of meadow species beneath the conifer canopies. Facilitation of meadow species abundance occurred more frequently for *Pinus* than for *Abies* ($p < 0.001$), more frequently on SW than on NE transects ($p < 0.01$), and more frequently for younger (< 30 yrs) than older trees (> 60 yrs; $p < 0.0001$). This study demonstrates both the variety of competitive and facilitative interactions between conifers and herbaceous vegetation and the complex role of time and species identity in shaping these interactions.

Bianca S. Perla

National Park and Wilderness Protection Affects the Composition and Structure of Riparian Vegetation Across Multiple Scales.

Parks or protected areas are the most widely used tool for biodiversity conservation worldwide. Globally, more land exists in parks than exists in arable cropland. We are just beginning to understand that parks do not exist in isolation--protecting land has both social and ecological consequences that interact to influence landscapes far beyond park boundaries. Understanding the ecological effects of protection is one essential piece in determining how social and ecological systems interact in areas surrounding parks and the implications this has for long-term ecological sustainability. In this study, the effect of park and wilderness protection on structure and composition of riparian vegetation is explored using field data collected from 13 streams, with different protection patterns, that feed into the Skagit River. Two main questions are addressed: 1) how does riparian vegetation composition and structure vary between protected and unprotected lands and; 2) is the effect of protection localized to the protected area or does it propagate across scales? Preliminary results indicate significant differences in riparian structure and composition between protected and unprotected lands. Protected lands may also confer some benefits to adjacent unprotected lands. This research is part of a larger interdisciplinary dissertation project seeking to understand both social and ecological dimensions of land protection and how they interact to influence land-use in areas surrounding parks.

Ben Peterson

Shade Tolerant Conifer Transplant Survival in an Urban Forest.

Urban forests in the Puget Sound region have been protected and managed to ensure the health of conifer and hardwood trees. While hardwood trees such as bigleaf maple (*Acer macrophyllum*) and red alder (*Alnus rubra*) have been able to re-generate on their own, conifers such as shade tolerant western redcedar (*Thuja plicata*) and western hemlock (*Tsuga heterophylla*) have been less successful. Normally new conifer trees are not able to establish on their own in dense urban forests because of competition for space from understory vegetation, including invasive exotic species such as Himalayan blackberry and English ivy. Additionally, often the resource most lacking in restoration projects is funding. If a lower cost method for achieving restoration goals can be established it is more likely that restoration projects in urban forests will be accomplished. Establishing a successful low cost method for establishing these conifers in urban forests will help to ensure that when the existing mature trees die there will be younger trees able to take their place. The goal of the study is to determine the most cost effective technique to establish bare-root conifer trees in Puget Sound region urban forests. The planting of two types of bare-root conifers (western red cedar and western hemlock; approx 580 total) in cleared plots within three urban forest parks on Mercer Island was investigated. Each tree received one of four treatments: "control" (bare ground), "mulch" (a ring of woodchip mulch around the base of the tree), "irrigation" (an irrigation supplemental installed with the tree at the time of planting), and "combined" (woodchip mulch + supplemental irrigation). The "combined" treatment resulted in higher than expected survivorship for both tree species. Results and conclusions are currently under review.

Symposium Participants

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Thank you for coming today!

We hope you enjoyed the fifth 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:

Dean Bare and the College of Forest Resources
Bob Edmonds
Michelle Trudeau
Student Services Operations
The Long Fund

Thank you for your support!

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