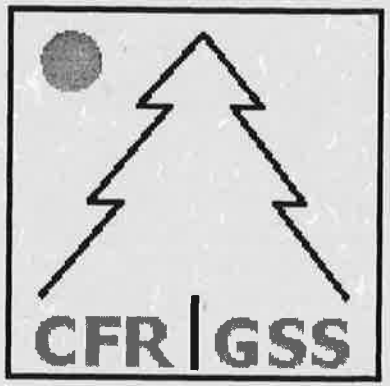
Second Annual

College of Forest Resources



Graduate Student Symposium

February 25, 2005

About the Keynote Speaker

Renée Brooks is a research plant physiologist with the EPA National Health and Environmental Effects Research Laboratory in Corvallis. Originally from Salem, Oregon, she received her bachelor of science degree at the University of Georgia at Athens and earned her masters degree and doctorate here at the College of Forest Resources. Her research includes work on photosynthetic and morphological acclimation to light, plant water relations (including demonstration of hydraulic redistribution in both east- and west-side Pacific Northwest forests), canopy nutrient fluxes, tree responses to climate, and the physiological effects of flooding in a Florida swamp. Foremost among her technical expertise is stable isotope analysis, which she has applied to a wide range of topics, including paleophysiology and, more importantly, evaluation of beer quality. Her list of collaborators is as impressive as her own accomplishments and includes Hinckley, Ford, Sprugel, Meinzer, Bond, Ryan, and Ehleringer.

Schedule of Events

9:00 – 9:10: Dr. Bruce Bare, Dean, College of Forest Resources

9:10 – 9:30: Keynote Speech
Dr. Renée Brooks, research plant physiologist
U.S. EPA, National Health and Environmental Effects Laboratory

9:30 – 10:50: Session I
9:30 – 9:35: Introduction and remarks by session moderator
9:35 – 9:50: Nicole Lang
9:50 – 10:05: Ryan D. Haugo
10:05 – 10:20: Bianca Perla
10:20 – 10:35: Kyle Petersen
10:35 – 10:50: Ming Qiao

10:50 – 11:10: Break

11:10 – 12:30: Session II
11:10 – 11:15: Introduction and remarks by session moderator
11:15 – 11:30: Finn Krogstad
11:30 – 11:45: Lauren Urgenson
11:45 – 12:00: Amy Ramsey
12:00 – 12:15: J. Robert Lewis
12:15 – 12:30: E. B. Sucre

12:30 – 1:30: Lunch

1:30 – 2:50: Session III
1:30 – 1:35: Introduction and remarks by session moderator
1:35 – 1:50: Jenna Tilt
1:50 – 2:05: Wendy Gibble
2:05 – 2:20: Adam Mouton
2:20 – 2:35: Nick Spang
2:35 – 2:50: Akira Kato

2:50 – 3:10: Break

3:10 – 4:55: Session IV
3:10 – 3:15: Introduction and remarks by session moderator
3:15 – 3:35: Andrew J. Larson
3:35 – 3:55: Garrett Liles
3:55 – 4:15: Derek Churchill
4:15 – 4:35: Sarah Murray
4:35 – 4:55: Jon M. Honea

4:55 – 5:00: Closing remarks

5:30 – 6:00: Session V (poster session)

Session I

Nicole Lang

Seed bank dynamics of an Oregon montane meadow: consequences of conifer invasion

Conifer encroachment into montane meadows has been widely observed and documented in various ecosystems in the western U.S. Proposed reasons for such a shift in tree establishment include climate change, cessation of grazing in meadows, and suppression of wildfire. A consequence of the invasion of trees into meadow is a potential loss of unique species assemblages that are sustained by uniquely treeless areas occurring on a landscape dominated by forest.

Bunchgrass Meadow is a montane meadow complex in the central Cascade Range (Willamette National Forest, OR) where conifer encroachment is currently being observed. In an attempt to conserve and expand open meadow, an adaptive management plan has been developed, using experimental plots and treatments to explore the range in community response to cutting and burning. Because the soil seed bank can be influential in determining the trajectory of a plant community, especially following disturbance, it is important to consider its role in any restoration attempt. In this study, I investigate the composition of the seed bank in relation to overstory and understory characteristics in order to gain insight into the vegetation patterns of this dynamic ecosystem.

Ryan D. Haugo

Conifer encroachment in a dry, montane meadow, western Cascade Range, OR

Conifer encroachment into montane and subalpine meadows is a widespread phenomenon throughout much of the Pacific Northwest. Numerous factors have been suggested as triggers of invasion including changes in climate, removal of grazing pressure, and long-term suppression of wildfire. Bunchgrass Meadow, a large mosaic of coniferous forest and dry, montane meadow in the Willamette National Forest, has experienced significant and rapid encroachment of conifers, and is currently the focus of a large-scale restoration study. As part of this study, we have completed a detailed reconstruction of stand development patterns in four 1-ha plots. In each plot, sizes, ages, and spatial locations of all stems have been determined. To explore the possible causes of forest expansion, temporal patterns of establishment are correlated with climate data and information on past human use.

Conifers primarily established during two time periods: 1850-1899 and 1920-1979. *Abies grandis* was the dominant species (4571 trees), often preceded by *Pinus contorta* (589 trees). Neither variation in climate nor grazing history showed a significant relationship to timing of establishment. However, possible changes in Native American activity may explain these trends. Subsequent analyses will document changes in forest structure through time and the consequences of these changes for the composition and diversity of the ground-layer vegetation.

Bianca Perla

A multi-index prioritization process for conservation projects on Vashon-Maury Islands

Due to limited resources, conservation agencies must have methods for choosing projects that deliver the most gain per unit effort. Current prioritization models present problems to conservation practitioners because they require large amounts of data, often have a black-box feel, and present only a descriptive view of a landscape's natural characteristics while largely failing to provide information on levels of risk and social considerations necessary in addressing today's conservation problems. We present preliminary results for a multi-index method of prioritizing lands for conservation on Vashon and Maury Islands. The multiple index process combines a coarse filter and fine filter that explicitly include both social and ecological information. The course-filter analysis combines information about private parcel development status, parcel size, and connectivity with other protected lands. The fine-filter analysis that is currently in development consists of four indices measuring more detailed elements: ecological value, rural character value, risk of change, and feasibility. The use of multiple indices is unique in its flexibility. Indices can be combined in different ways to deliver information from multiple angles which allows conservation practitioners to better evaluate trade-offs between risk, feasibility, and social and ecological value of proposed projects. Preliminary results indicate that conservation projects ranked by this method are reasonable and that the use of multiple indices successfully increases the amount of relevant information available to practitioners as they seek to prioritize conservation efforts.

Kyle Petersen

The effects of competing vegetation control on the early growth of Douglas-fir on a highly productive site in coastal Washington

The Fall River Long-term Productivity Study was initiated in 1998 to investigate the impact of management actions on the growth of Douglas-fir over a 40-year rotation. The 12.24-hectare site chosen for the study is located in the Willapa hills of southwest Washington at an elevation of 300 meters. In 1999, the 47-year old, second growth, mixed Douglas-fir and western hemlock stand occupying the site was harvested. A randomized complete block design was implemented to test the effects of twelve treatment combinations including 4 levels of organic matter removal, tillage, compaction, fertilization, and intensive control of competing vegetation. Douglas-fir seedlings were planted at 2.5 m x 2.5 m spacing in forty-eight 0.25-hectare treatment plots arranged in four blocks. Control of competing vegetation was accomplished with the herbicides Oust ®, Accord Concentrate ®, Atrazine 4L ®, Transline ®, and VelparL ® in target plots since the establishment of the plots and seedlings.

The main objectives for the 1st quarter of 2005 are to estimate the dry biomass/ha and nutrient content of above-ground Douglas-fir components for two of the treatment combinations. The two treatment combinations of interest are referred to as bole-only with vegetation control (BO+VC) and bole-only without vegetation control (BO-VC). Both treatments have the same level of organic matter removal. The only difference between the two treatments is that vegetation control was carried out for five years in the BO+VC treatment. The main

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Kyle Petersen continued

questions to be answered are 1) how do the treatments effect the above-mentioned tree parameters, 2) what are the relationships between the parameters, and 3) is there a difference in the relationships between parameters that is dependent on treatment?

Ming Qiao

Fundamental study on kraft pulp uniformity

The objective of chemical pulping is to deliginify the wood to liberate the fibers and make them easier to bleach. The uniformity of these fibers with respect to their lignin content has a significant impact on pulp performance. Non-uniform pulp results in inferior paper and is harder to bleach. The focus of our research has been to develop methods and instruments to assess the kappa number (a measure of pulp lignin content) of single fibers such that the uniformity of the pulp can be determined. Previous studies with these instruments suggest that kappa number non-uniformity results from heterogeneous reactor conditions and from heterogeneity at the fiber scale. This fiber scale heterogeneity has not been previously observed, and its nature is poorly understood.

The objective of my research is to understand the source of the fiber scale heterogeneity and to develop a mathematical description of its behavior. This fiber scale model can then be integrated into pulping reactor models we have already developed to produce a comprehensive pulping model. The model will then be used to investigate digester configuration and operating policies that can produce more uniform pulp

Session II

Finn Krogstad

Evaluating the management implications of research

When doing scientific research, rigorous frameworks influence the hypotheses we propose, the data we collect, the models we use, and the statistical inferences that we draw. No similar framework seems to govern the implications that we draw for guiding management decisions.

Several equally valid and seemingly contradictory management implications can be drawn from a given statistical analysis for a given model and data set. Each implication, however, can be shown to apply to a different management decision, so the 'correct' management implication is the one that applies to the decision at hand. A framework is proposed for evaluating statements of management implication according to the management decisions that they support.

Applying this framework to the literature analyzing the H.J. Andrews logging-flooding data fundamentally reverses the original conclusions and suggests strong evidence that timber harvest has large impact on peak streamflows and that this impact increases with larger floods.

Lauren Urgenson

The ecological consequences of knotweed invasion into riparian forests

Japanese (*Polygonum cuspidatum*), giant (*P. sachalinense*) and bohemian (*P. bohemicum*) knotweed are closely related congeners invading riparian areas, roadsides, and parklands throughout the Pacific Northwest. The rapid spread of knotweed along river corridors has been of particular concern to natural resource agencies and conservation organizations. Knotweed invasions appear to simplify the structural and taxonomic composition of riparian forests by displacing native vegetation, and may impair habitat quality of adjacent streams by altering nutrient and energy resources from allochthonous inputs. Currently, there is limited quantitative evidence on the level and significance of these suspected ecological impacts.

My research investigates four questions: 1) Does knotweed invasion alter the vegetation composition and diversity of riparian forests? 2) Is the regeneration of native tree species inhibited by knotweed invasion? 3) What is the effect of knotweed invasion on the annual quantity, quality, and timing of leaf litter inputs into streams? 4) How does nutrient availability, decomposition, and aquatic macroinvertebrate colonization of knotweed leaf litter differ from the litter of native riparian species? To answer the first two questions vegetation cover and density data were gathered from forty 20 m belt transects located along a tributary of the Skagit River, Washington. Impacts of knotweed on litter quantity and quality are being investigated by comparing litter collected in an array of 42 baskets within and outside of knotweed stands. Effects on aquatic macroinvertebrate assemblages and instream leaf decomposition are being assessed using experimental leaf packs composed of knotweed leaves or leaves from multiple species of native trees. Measurements of leaf nutrient composition and biomass, as well as aquatic macroinvertebrate biomass and diversity, will help identify potential impacts to aquatic decomposers. Results from this study will form the basis of future experiments to further elucidate the ecological impacts of knotweed on riparian forests and stream food webs.

Amy Ramsey

Fungal endophytes: What are they and what is their function?

Fungal endophytes live within plant tissues. They have been found in every plant examined for their presence. Until recently, endophytic fungi had not been examined in the woody roots of plants, but a recent survey of fungal root endophytes in Douglas-fir and ponderosa pine trees has shown there are numerous fungal species living within the roots. *Byssochlamys* is a dominant fungal endophyte in the roots of Douglas-fir and ponderosa pine trees on the eastern side of the Cascade Mountains. *Byssochlamys* has been isolated from the rhizosphere near Douglas-fir and ponderosa pine roots and from the roots of multiple-sized trees. The dominance of this fungus suggests that it does play a significant role in the ecosystem, but the relationships remain unclear. In vitro experiments have been conducted to try and determine the functional roles and to increase the basic biological knowledge of these organisms. In vitro experiments have been conducted with two dominant root inhabiting fungal endophytes, *Byssochlamys* and *Umbelopsis*, to determine the

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Amy Ramsey continued

possibility of antagonistic relationship formation with two common root pathogens, *Armillaria ostoyae* and *Heterobasidion annosum*, but it remains unknown how well these in vitro experiments represent what is actually occurring in nature. Basic biological understanding of organisms is important when trying to determine functional roles, thus, temperature optimums have been determined for two isolated species of *Umbelopsis* and have been compared to temperature optimums for *Byssochlamys*. *Byssochlamys* has a greater heat-tolerance than *Umbelopsis*.

J. Robert Lewis
Dynamic modeling and control of kraft pulp bleaching.

Profitable operation of a bleach plant requires that the delignification stages of the bleach sequence be operated in a stable and optimal manner. Optimal performance of these first stages is often difficult to achieve in practice because of sensitivity to disturbances, long residence times which make control difficult, and complex reaction kinetics coupled with non-ideal pulp and liquor flows.

Optimization and control of the delignification portion of a bleach sequence may be facilitated by development of an accurate and robust bleaching model. This model must correctly represent the reactions that occur within the bleaching stages and must simulate the non-ideal pulp and liquor flows within the towers. In addition, these phenomena must be coupled in the model to achieve an accurate representation of the reactor's dynamics.

A first principles-based dynamic simulation of the first stage of a commercial bleach plant has been developed at the University of Washington. The model was developed using published bleaching kinetic data and data taken from mill trials. The flow characteristics of the bleach sequence are modeled using coupled systems of stirred tanks and plug flow reactors. The bleaching kinetics are based on a scheme that divides the lignin into fast and slow reacting lignin species with an unreactive floor lignin. Using the chemical charges, pulp flow rates, lignin carryover, and process temperatures the model predicts the outlet kappa and brightness for each bleaching stage. The model is compared against mill data with good prediction results.

E.B. Sucre (presenter), R.B. Harrison, E.C. Turnblom, and D.G. Briggs
Estimating response of Douglas-fir to urea in western Oregon and Washington

Estimating the response of Douglas-fir [Pseudotsuga menziesii (Mirb.)] stands to nitrogen fertilization is extremely difficult due to the high variability that exists between sites. Our objective was to determine how various site (site index, age, relative density and total precipitation) and soil variables (total N, soil cation exchange capacity, available N, bulk density, pH, and C/N ratio) influence stand response to multiple applications of 224 kg N ha-1 as urea. Composite samples of the forest floor and three depths of mineral soil (0-15 cm, 15-30 cm, and 30-50 cm) for six fertilized Stand Management Cooperative (SMC) Douglas-fir stands located in western Washington and Oregon were used to quantify soil variables. The response variable (relative difference in volume growth between fertilized and control plots) was regressed against site and soil variables. The data were stratified by three different stocking levels [ISPA (initial stems per acre), ISPA/2, and ISPA/4).

Session III

Jenna Tilt
Understanding rural character at the urban/rural interface

One of the human side effects of increasing urbanization in rural areas is the loss or One of the human side effects of increasing urbanization in rural areas is the loss or transformation of rural character of those areas. Rural character is a term used by local residents, land use planners and policy-makers alike to advocate a variety of growth containing or limiting measures in rural areas, Unpacking what "rural character" means is rarely done, however.

This paper presents the results of a study that explored cognitive and visual perceptions of rural character among recent and long-term rural residents of two rural communities along the urban/rural interface outside of Seattle, Washington. In addition, perceptions of urban recreationalists and land use planners were also studied to more fully understand the multi-faceted dimensions involved in perceptions of rural character and adjustment to change.

Many of the cognitive and visual perceptions of rural character explored in this study have implications for the ecological aspects of developing at the urban/rural interface. For example, natural spaces near homes and natural-resource industry jobs in the community play an important part in residents' ideas of rural character. Natural spaces are important to residents not only for the scenic beauty they provide, but also because they function as informal community gathering places. Natural resource industry jobs provide a continuity of history to many rural towns important to many rural residents.

Lastly, this study also presents social science methodologies (Conceptual Content Cognitive Mapping (3CM) and photo-questionnaire) that could be useful to natural resource professionals and land use planners when trying to understand how urban/rural interface communities perceive a variety of important issues.

Wendy Gibble
The importance of growth plasticity in facilitating plant invasions

Invasions by non-native plant species of natural communities pose a major threat to biodiversity and ecological functioning. High resource abundances, such as those created by disturbances, have clearly been shown to favor establishment of non-native species with ruderal characteristics. Yet, some of these same non-native species have been documented to persist in landscapes without frequent disturbances. This raises the question of why invasive plants, which fit the ruderal profile, successfully persist and further invade native-plant communities that are not frequently disturbed. The purpose of this study is to investigate the interaction

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Wendy Gibble continued

between changes in resource availability and the ability of a nonnative plant to adapt and compete in a changing environment. Three prairie species, two native and one non-native, will be grown in the greenhouse to assess relative growth rates, competitive status, and biomass allocation under varying resource levels. Each species will be grown in individual pots for a 12-week period to assess their growth strategy by comparing relative growth rates and specific leaf area. In a separate experiment, I will assess competitive status of each species at low and high nitrogen and water availability and each species' ability to adapt to changes in resource availability. Plants will be harvested and measured for root biomass, shoot biomass, chlorophyll levels and specific leaf area. Competitive status will be assessed using a relative competition intensity (RCI) index for each species. Plasticity in growth allocation will be assessed by comparing changes in total biomass, root weight proportion, and chlorophyll levels before and after manipulation of resources. The results of this study will further our understanding of factors influencing the ability of many non-native species with ruderal life history traits to invade ecosystems where disturbances are small and/or infrequent.

Adam Mouton

Comparison of flow direction algorithms for computing stream networks using LiDAR derived digital elevation models and 10-m USGS DEM

We examined the effects of digital elevation model (DEM) grid size for stream network predictions in the northwestern United States to test the accuracy of high-resolution LiDAR (Light Detection And Ranging) digital elevation data. Elevation data were gridded at 2-, 6-, and 10-m scales from the LiDAR data and flow paths were predicted by four common routing algorithms known as D8, D-Infinity, Multiple Flow, and DEMON, D8 being the least sophisticated. These routing algorithms were also applied to a 10m USGS DEM to compare LiDAR with the previously used data for hydrology modeling. Our preliminary analyses indicate that for our landscape, all models create more streams with increased topographic detail and locate the streams in their topographically correct position when compared with a 10m USGS DEM. Stream maps generated by either D8 or DEMON converge as the DEM resolution is increased. The data suggests that increased DEM resolution decreases the need for sophisticated models, reducing processing times required by complex models for high-resolution DEM's.

Nick Spang

A case study of federal agency leaders managing organizational change: describing the first steps of implementing performance measurement in the Mount Baker-Snoqualmie National Forest

I want to study how the managers of the Mount Baker-Snoqualmie National Forest address the challenges and opportunities of changing to a strategic budgeting system based on performance measurement. This study will clarify how leaders steer their organizations through periods of change and how federal agencies adapt to evolving political and economic circumstances. In addition, this information can serve as baseline data to test hypotheses in organizational theory and policy research.

The Forest Leadership Team (FLT) decided to implement strategic budgeting using a Performance Accountability System (PAS). Through PAS, the MBS has the opportunity to receive increased funding and avoid a suite of layoffs and the loss of institutional capacity. There is a lot of uncertainty in how the system works, what the impacts on the budget and personnel will be, and how to best implement the administrative of the system, and the FLT must devise a performance measurement system that works within the current organization.

I will rely on ethnography, using extended contact with subjects, including participation in activities, interviews, conversations, observational periods, and archival data collection. I will describe how leaders, in this setting, understand and manage their changing environment using successive observations, reviewed analytically for further data collection. Analysis will proceed through data reduction, display, and conceptualization/verification. The results will graphically describe the current organizational and policy frameworks and predict future organizational challenges and opportunities.

Akira Kato

Fusion of 3-D LiDAR and low altitude aerial photos, a case study in Capitol Forest, WA

Light Detection and Ranging (LiDAR) is new remote sensing technology to analyze the forest structure. LiDAR sends out a laser pulse and receives a low altitude and high-resolution return (4 pulses per m^2) with accurate three-dimensional coordinates. Moreover, aerial photos are two-dimensional data with 0.16 m high resolution. The fusion of these data can produce three-dimensional images with high resolution. Our study area is the Capital Forest near Olympia WA where the main species are Douglas-fir and western hemlock. Conventionally, the ortho-photo was used for the fusion image. But ortho-image over the overlapped areas have some shadow, because the position of pixels on ortho-image have been rearranged and corrected by the ortho-rectification process, but the color value on ortho-photo is made up of only one image. Therefore, in this study the original photo was rectified by LiDAR three-dimensional coordinates. As a result, the overlapped area can get more information from different perspective images, because the values that come from different photos can be displayed spatially and can obtain more values about the different direction over the projection area. The fusion of LiDAR data and the original center projected photos allows retention of original color values over the overlapped area. Moreover, photo illumination color is different among photos. Therefore we used the statistical interpretation and color theory to standardize the photo values that come from different images. The characteristic of distribution or result values is useful for the species identification and vertical sun radiation of the individual tree figure.

Session IV

Andrew J. Larson

Conifer tree seedling coexistence following fire in the central western Oregon Cascade Range, USA

A primary goal of ecology is to elucidate mechanisms that facilitate species coexistence. I investigated the effect of fire severity and environmental conditions on coexistence of conifer tree species seedlings following fire in the central western Oregon Cascade Range.

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Aspect was used as a proxy for environmental conditions. Pre-fire conditions, fire severity, aspect and conifer regeneration were characterized at 72 systematically located points with 500 m^2 plots, each containing 4 systematically located 10 m^2 subplots.

Pseudotsuga menziesii, *Tsuga heterophylla* and *Thuja plicata* comprised 99.0% of the seedlings measured in the study. *Pseudotsuga* seedling density was greater on sites that burned with moderate and high severity compared to low fire severity. *Tsuga* seedling density was greater on north aspects than on south aspects. *Tsuga* and *Thuja* seedling density were strongly correlated with pre-fire conspecific basal area, indicating seed source limitation. Coexistence of the three principal conifer species was more likely on sites that burned with moderate severity, supporting the Intermediate Disturbance Hypothesis. *Tsuga* dominated the larger seedling size classes on north aspect, low and moderate severity sites, indicating that *Tsuga* will likely competitively exclude *Pseudotsuga* on these sites following canopy closure. *Pseudotsuga* dominated larger seedling height classes on all other sites.

Seed source acts as a first "filter" on seedling recruitment and coexistence. Environmental heterogeneity and residual overstory trees influence recruitment rates of dispersed propagules, regulating species coexistence and community composition soon after disturbance. Species coexistence and successional pathways shift as trade-offs between species' unique biotic abilities and environmental conditions alter interspecific competitive relationships.

Garrett Liles

The effects of riparian harvesting on headwater streams in western Washington

Scientists and land managers have considerable interest in understanding nutrient export from forested headwater streams in the Pacific Northwest. To address this question an experimental watershed has been established at the Capitol State Forest near Olympia, Washington. Discharge and chemical parameters of 14 headwater streams (1st order) are being monitored testing the influence various stand age classes (~5-year-old, ~15-year-old and uncut stands) and harvest practices have on stream chemistry. Past investigation of nutrient export in similar stream systems is limited, with most research focusing on temperature and some biological indicators.

Individual stream hydrographs are being generated using a V-notch weir with stage recorded by a pressure transducer. Biweekly water sampling and analysis will provide data for calculating annual nutrient export budgets. Chemical analysis includes N (NH 4+, NO3- and DON), C (TOC, DOC, DIC and pCO_2), total P, major ions and pH. Soil is a major source of stream nutrients. Attempts to quantify a linkage by assessing soil conditions through analysis for N status (ion exchange resins), C/N, CEC, base saturation, pH and bulk density is another project goal. Stream and soil data generated will be used to calibrate a coupled hydrologic/geochemical model to predict water and nutrient export from individual stream basins and the entire watershed. This experimental watershed and associated modeling is part of PRISM (Puget Sound Regional Synthesis Model) with the intention of scaling the operating predictive model up to larger landscape areas. This research will increase our knowledge of these aquatic systems while strengthening and the quantitative linkage between land and stream.

Derek Churchill

Factors influencing understory Douglas-fir vigor in multi-cohort prairie colonization stands at Fort Lewis, Washington

Forest stands on Fort Lewis are being managed for multiple values under an uneven-age silvicultural system consisting of light thinning entries approximately every 10 years and reliance on natural regeneration. In stands that were former prairies and have excessively drained, outwash soils, Douglas-fir is the only understory conifer present and the principal regeneration species. The effects of different levels of overstory density and understory competition on the vigor of Douglas-fir advanced regeneration were investigated at the stand, plot, and individual tree levels. Indices of understory vigor (live crown ratio, height-to-diameter ratio, and crown density) were combined into a model that predicts a single vigor metric: volume growth as a percent of maximum site potential. A strong relationship between this vigor metric and overstory density and understory competition was observed. Overstory and understory guidelines were developed to achieve desired levels of understory vigor.

Sarah Murray

Farm-to-college programs: A survey and comparison with the University of Washington

Farm-to-college programs are part of a movement concerning local food systems, direct connections between producers and consumers, and the provision of fresh and healthy food to students. The programs involve some level of food purchasing from local farmers for campus cafeterias. This study explores the current landscape of farm-to-college programs in the United States, with a focus on programs at large public universities and on student involvement.

Farm-to-college programs are linked with other farm-to-cafeteria initiatives that serve elementary schools, hospitals, and other institutions. Because such programs are relatively new (most have started within the last decade), there has been limited discussion of them in the literature. This research seeks to build on previous studies and add new information about where these programs are and how they function. Specifically, this study has four primary research questions: 1) What is the nature of current farm-to-college programs in the United States? 2) What large public universities have farm-to-college programs, and how are they operating? 3) How does the University of Washington's program compare with those at other large public universities? and 4) How are students involved in farm-to-college programs, and what is their impact?

To answer these questions, I worked with a nonprofit organization to identify farm-to-college programs and conduct an online survey of program managers. Based on survey responses, I selected a handful of programs at large public universities to examine in greater depth through semi-structured phone interviews with key participants. Expected findings include a general description of current farm-to-college programs; mini-case studies of programs

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Sarah Murray continued

at large public universities, and a comparison between these programs and UW's; and a discussion of students' roles in and impacts on these programs. These results will help those working with farm-to-college programs and provide a basis for further studies.

Jon M. Honea

Effect of marine-derived nutrients from spawning salmon on seasonal changes in structure and function of the macroinvertebrate community of Kennedy Creek

This study tested the hypothesis that spawning salmon affect freshwater macroinvertebrates both negatively and positively—the former due to the disturbance of redd excavation and the latter over a longer period due to the fertilization effect of marine-derived salmon nutrients released during spawning and salmon carcass decomposition. To test this hypothesis, I monitored changes for five seasons in density, biomass, and salmon-derived carbon (C) and nitrogen (N) in the benthic macroinvertebrates of Kennedy Creek, a small stream in southern Puget Sound with a large run of chum salmon (*Oncorhyncus keta*). Stable isotope analysis showed that the macroinvertebrates contain salmon-derived C and N year around, as indicated by the results of pre-spawning samples: 20-41% salmon-derived C and 25-50% salmon-derived N, representing 22% of total macroinvertebrate biomass. Near the end of the spawning run, all macroinvertebrates sampled showed increases in salmon-derived C (41-68%) and N (51-87%) incorporated into their tissues; however, the total macroinvertebrate biomass decreased due to the disturbance of redd excavation. The percentage of salmon-derived C and N in macroinvertebrates remained high 3 months after spawning (49-88% and 60-97%, respectively). Because total macroinvertebrate biomass also increased, this period had the highest salmon-derived macroinvertebrate biomass. By 6 months, the salmon-derived portion approached levels detected in the initial sample before spawning. Macroinvertebrates consumed an estimated 2.2-5.6% of the total biomass of the 2000 spawning run of chum in Kennedy Creek. The observed pattern of uptake shows salmon nutrients are retained by macroinvertebrates in the highest quantities in the first 3 months after spawning; however, macroinvertebrates continue to cycle substantial quantities of salmon-derived nutrients throughout the period between yearly spawning events. By doing so, aquatic macroinvertebrates prolong the availability of salmon nutrients to higher consumers, including juvenile salmonids.

Session V (Posters)

L. Heida Diefenderfer, Jeffrey A. Ward, and Ronald M. Thom

Approach for assessing potential contaminant releases from coastal and estuarine habitat restoration projects

Restoring tidal flushing to restricted areas through the use of dike breach and removal techniques may expose sensitive organisms to toxic residues of prior land use practices. Because of concerns raised during the planning phase of the project, an approach to assess the potential for detrimental effects was developed at the Willapa River estuary in Washington state using principles from ecological risk assessment. Transforming the system from terrestrial to estuarine through restoration alters the exposure pathways and ecological receptors, as well as the applicable environmental standards for contaminants. The assessment approach 1) identifies contaminants of concern based on land use history, 2) develops a conceptual model and identifies species of interest to managers, 3) selects sampling locations, 4) collects and analyzes soil, sediment, water and/or tissue samples, 5) compares analytical data to terrestrial and marine regulatory standards to identify existing or potential contaminated areas, and 6) provides recommendations for remediation or changes to features of project design. The implementation of this approach at sites with land use history indicative of contamination has the potential to reduce the risk of harm to wildlife. It is applicable to the protection of species that inhabit a site, visit a site, or contact effluents from a site such as tidal waters.

Julie Forcier

Long-term effects of a high biosolids application rate on coarse-textured soils

Before regulations regarding composting and heavy metal concentrations were enforced, biosolids usually contained significantly greater amounts of heavy metals than those used today. It was also a common practice to apply these amendments in excess of the land's needs. These applications represent "worst case" scenarios and therefore, can be studied to improve our understanding of the effects of biosolids on soil and plants.

Two WA State sites that received excessive biosolid applications (300 Mg ha-1) over 20 years ago were revisited to determine heavy metal and nutrient retention in the soils. Both sites' soils formed from glacial outwash; however, one is a silicious sandy outwash while the other is a coarse gravelly outwash with varied parent-material mineralogy. The sites were previously studied to illustrate how low C/N ratio biosolids could be utilized to enhance forest productivity; however, the silicious sandy outwash soil was negatively impacted by the excessive application. Those results indicated that the excessive loading caused extreme nitrification and soil acidification resulting in deficiencies of magnesium, an essential plant element (Harrison et al., 1996, Harrison et al., 1994).

Soils and foliage were collected and analyzed for total metals, C, N, and pH. Diagnostic field tests such as structure, color, and percentage of roots further support the impact that

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Julie Forcier continued
the heavy metals are remaining locked up within the organic matter of the top 30cm of mineral soil and the coarser soil seems to have greater metal and nutrient concentrations. The site of the Mg-induced deficiency has recovered due to the application of Mg-containing fertilizers.

Carrie Lee
Evaluating carbon sequestration potential through forest management

Rising levels of carbon dioxide in the atmosphere threaten to radically change global climate and force us to look toward renewable energy sources and means to increase carbon sequestration. Although many, including proponents of the Kyoto Protocol, believe management of forests provides great potential for carbon sequestration, few studies have provided conclusive evidence on successful management strategies. This investigation aims to address the potential for carbon sequestration in managed stands and to evaluate the balance of above- and below-ground carbon allocation to fine tune our ability to use forest stand models to predict the potential and the thresholds for additional carbon storage in forests with management.

Suzanne Osborne (presenter), Mike Brett, Jeff Richey, Bob Edmonds
Influence of anthropogenic activities on stream nutrient transport and hypoxic conditions in south Hood Canal

In recent years, several well documented hypoxic events in the south Hood Canal have motivated a series of collaborative research and monitoring efforts. TASK 3 for the Hood Canal Dissolved Oxygen Program is focused on determining whether nutrient loading from streams discharging to the Hood Canal exacerbate these hypoxic events. The objective of my study is to examine stream nutrient transport in order to quantify anthropogenic contributions to Hood Canal eutrophication. Monthly grab and integrated storm sampling will be carried out by several state, county, public, and private entities for approximately 30 streams. These samples will be analyzed for the major species of dissolved and particulate nitrogen, phosphorus and carbon, with emphasis on nitrate loading. These data will be statistically analyzed to ascertain the impact of agricultural and urban land cover, septic drain fields, and vegetative cover (especially years since timber harvest and the prevalence of red alder) on stream nutrient concentrations. Ultimately, this dataset will be used to develop and calibrate a watershed-based mechanistic model of stream nutrient transport under the Puget Sound Regional Synthesis Model (PRISM) umbrella.

Brian D. Strahm (presenter) and Robert B. Harrison
Nitrate sorption in a variable-charge soil of the Pacific Northwest

Few studies have investigated the potential of physicochemical mechanisms to retain nitrate (NO_3^-), particularly in the Pacific Northwestern United States. The specific objectives of this study are to: (i) determine the capacity of different horizons of a mesic, Typic Fulvudand under intensive forest management in southwestern Washington to sorb NO_3^-, (ii) determine the point of zero net charge (PZNC) for each horizon of this soil, and (iii) relate specific mineralogical characteristics to the aforementioned physicochemical soil properties. Five soil pits were excavated to a depth of approximately 150 cm, and soil samples were composited by genetic horizon, including A, AB, 2Bw1 and 2Bw2 horizons. Through batch equilibration, NO3- sorption isotherms were created for each horizon, indicating an increase in sorption with both depth and increased NO_3^- solution concentrations. The PZNC of the 2 Bw horizons was determined to exist between a pH range of 3.5-3.6. Selective dissolution techniques of the mineral soil were employed to determine the presence of short-range-order aluminosilicates, and to associate Al/Si ratios with the physicochemical behavior of mineral soil matrix. Based upon average NO_3^- solution concentrations over a three-year period, these soils exhibit the capacity to retain a significant proportion of NO3-, relative to the observed leaching rates at a depth of 100 cm.

Elizabeth Wheat (presenter), Linda Gaulke, Tho Nguyen, Amanda Henck
Assessing the causes of the oxygen dead zone in the Hood Canal

Despite a growing awareness of how land use impacts water quality, the Hood Canal continues to suffer from seasonally occurring 'dead zones' caused by a lack of dissolved oxygen. The deteriorating water quality is a result of nutrient loading, potential sources of nitrogen include septic systems, fertilizers, pets, boats, and alder trees (*Alnus rubra*). An interdisciplinary group of students brought together by the international IGERT for coupled human, natural and materials systems are researching the possible causes of nutrient loading in the Hood Canal. Representative areas from Quilcene south will be selected for analysis based on remote sensing, GIS, land use and coverage. Parameters will be evaluated on a temporal scale to try and determine which N impacts are having an effect. The feasibility of using stable isotopes of dN15 in pacific oysters (*Crassostrea gigas*) to track the impact of sewage on the food web and energy dynamics of the estuary will be evaluated; and a model will be developed to assess the water quality impacts of future development within Hood Canal watersheds. This interdisciplinary research has international applications, there will be a comparison to a watershed in Japan, and an evaluation of how effective the developed approach works in other locations.

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Thank you for coming today!

We hope you enjoyed the second 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 symposia and tailor the event to a variety of needs.

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GRADUATE STUDENT SYMPOSIUM VISION

A forum for graduate students to share their research with fellow College of Forest Resources 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 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.