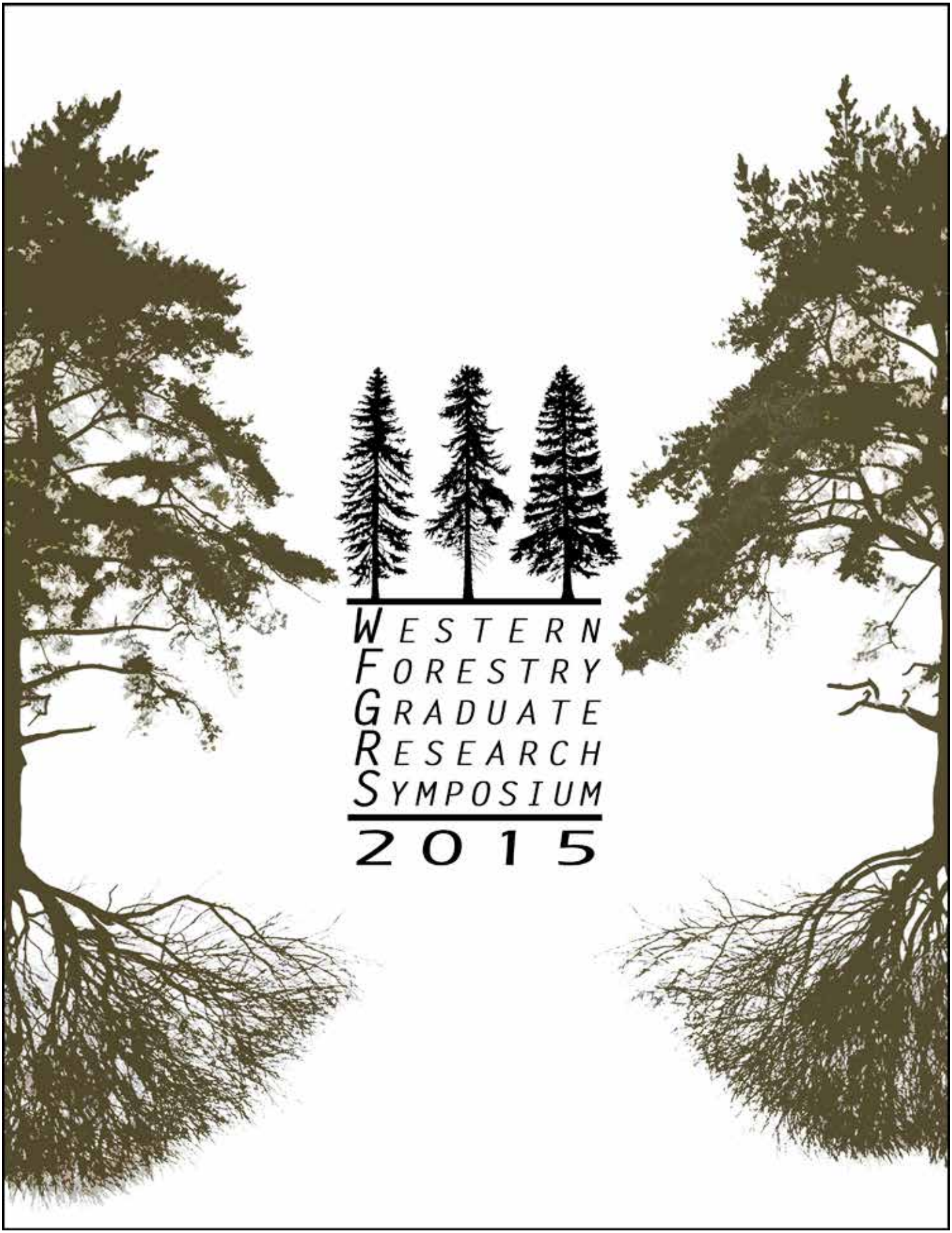
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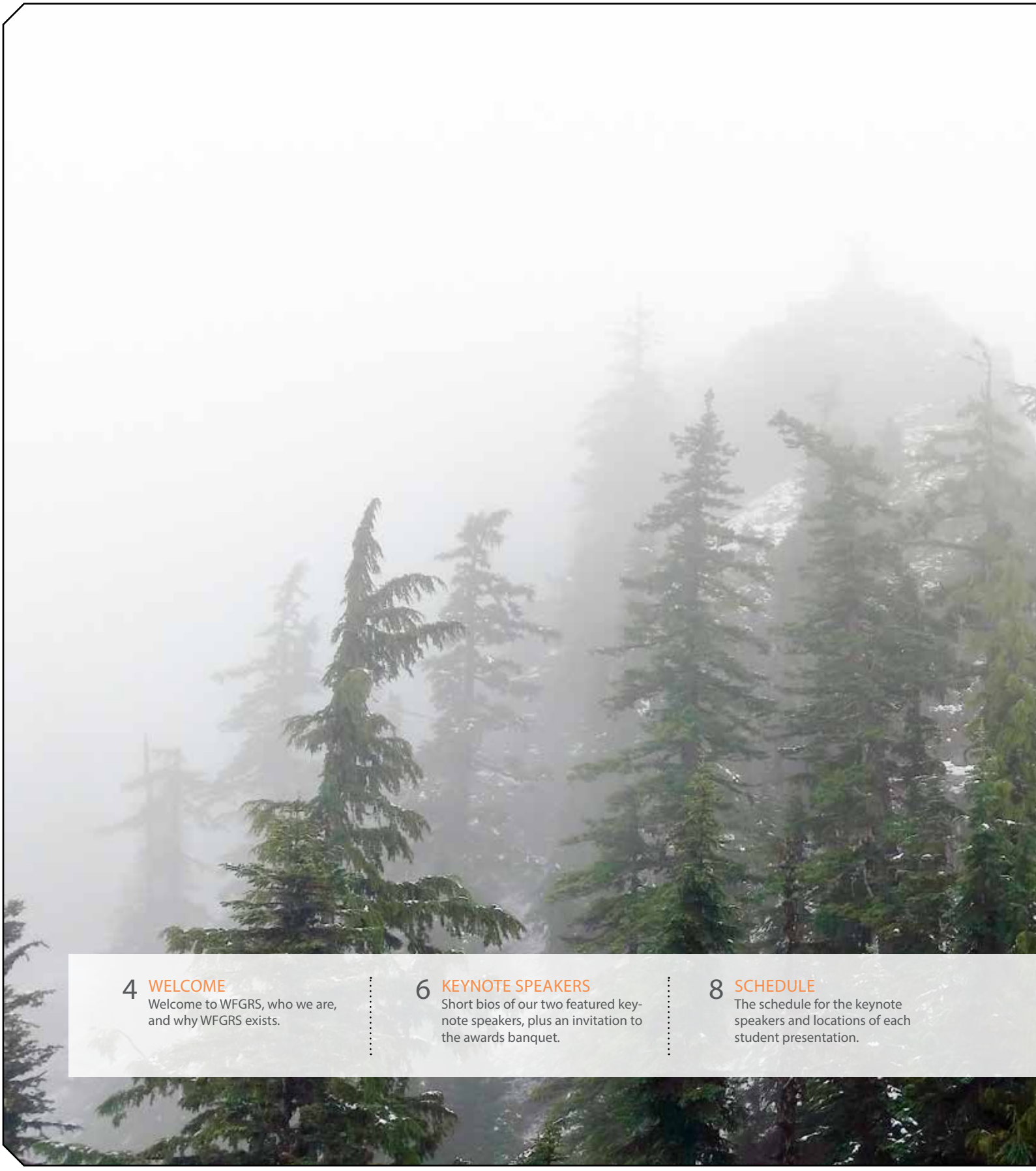
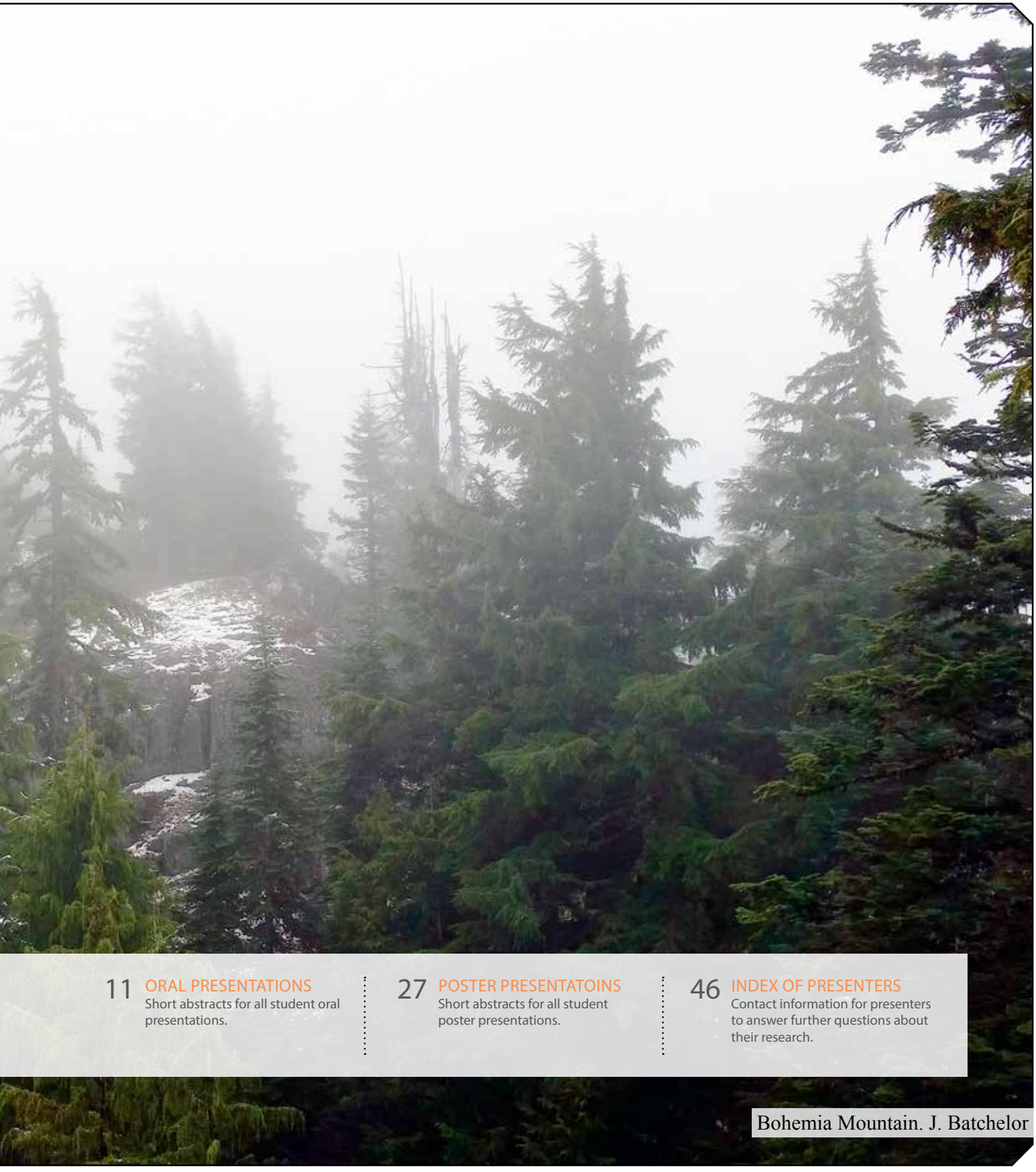




Bohemia Mountain. J. Batchelor

WELCOME TO THE WESTERN FORESTRY GRADUATE RESEARCH SYMPOSIUM!

FROM THE GROUND UP: MAKING YOUR RESEARCH MATTER

The annual Western Forestry Graduate Research Symposium (WFGRS), hosted by Oregon State University's College of Forestry, showcases current graduate student research. The purpose of this symposium is to promote academic excellence by challenging students to present their work to their academic and professional peers. This event offers graduate students a forum to receive feedback on their proposed and current research, fostering student engagement, enthusiasm, and interdisciplinary collaboration.

We are delighted to share oral and poster presentations by graduate student researchers on a variety of interesting subjects. Topics stretch across the realm of forests, forestry, and forest products, examining ecology, human uses, and interconnections between the two. This year's participants communicate an array of research spanning all three departments of Oregon State University's College of Forestry: Forest Ecosystems & Society (FES); Forest Engineering, Resources & Management (FERM); and Wood Science & Engineering (WSE). We are excited to offer an international session showcasing forestry students' research abroad and a forest research-inspired art gallery as new additions to this year's program.

The symposium also features two invited keynote speakers, offering perspectives on making research matter from their own successful careers. These distinguished speakers and the range of student work presented emphasize the collaborative and interdisciplinary nature of forestry today, as well as broader implications of forestry into the future.

WFGRS is an entirely student-organized event, though it would not be possible without generous support from the OSU College of Forestry. The organizing committee would like to thank Dr. Thomas Manness (Dean of the College of Forestry), Dr. John Bliss (Associate Dean for Graduate and International Programs), Dr. Lisa Ganio (Graduate Advisory Committee), and Dr. Troy Hall (Head of the FES Department). We would also like to thank this year's keynote speakers, Kristen Chadwick and Peter Hayes, and the faculty and research associates who participated on student presentation award panels for their time and support.

We welcome you to enjoy the symposium and invite you to share in the success of the graduate students' research efforts.

Sincerely,

The 2015 Western Forestry Graduate Research Symposium Planning Committee

2015 SYMPOSIUM PLANNING COMMITTEE

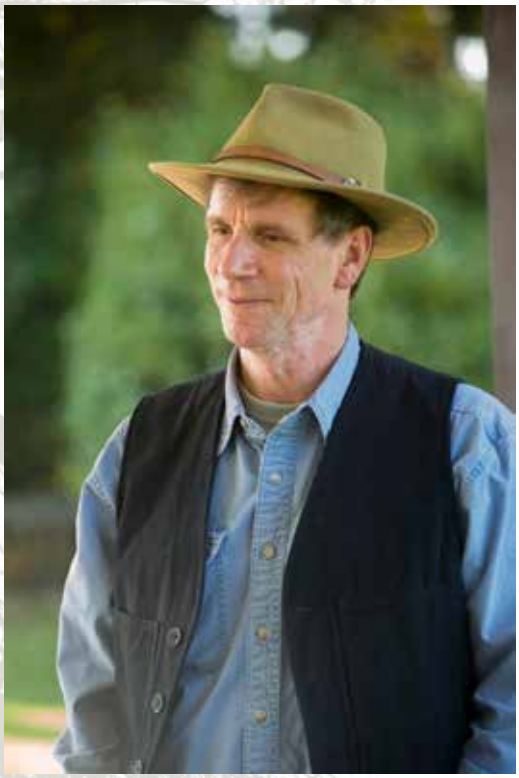
- Jonathan Batchelor
- Ariel Cowan
- Adrian Gallo
- Julian Geisel
- Francisco J. Guerrero
- Ben Hart
- Jennifer Johnston
- Blake Larkin
- Luciana Leite
- Meisam Shir Mohammadi
- Lauren Remenick
- Katherine Williams

LiDAR Scan of Mary's Peak. J. Batchelor

KEYNOTE SPEAKERS

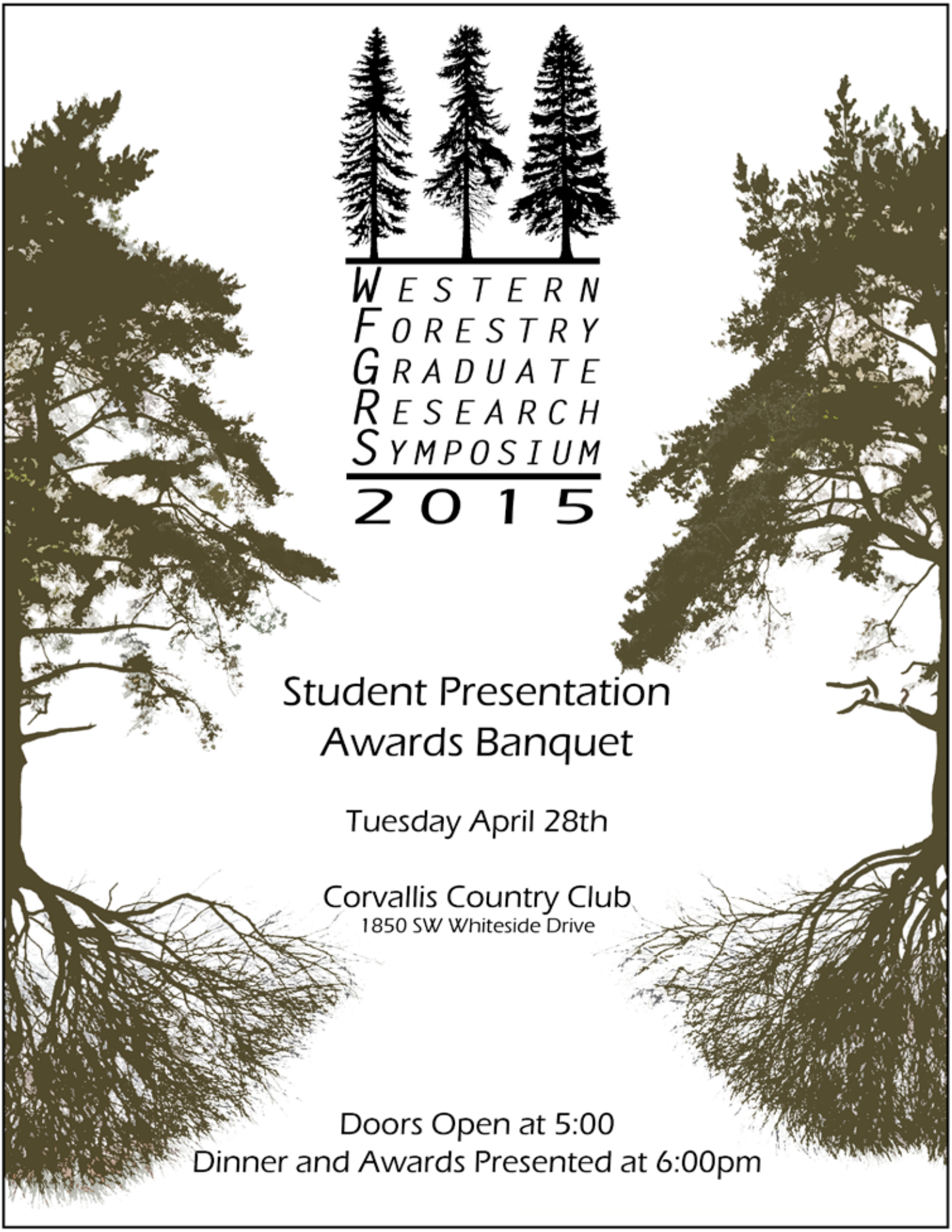
Kristen Chadwick

Kristen Chadwick is a forest pathologist with USDA, Forest Service, Forest Health Protection (FHP). Her career with Forest Health Protection started in 2002 and has given her the opportunity to work with forest health related issues throughout Oregon and Washington with a variety of Federal Land Managers ranging from the Forest Service, National Park Service, Tribal, and The Bureau of Land Management. She has been working with the FHP Westside Insect and Disease Service Center, based out of Sandy Oregon, for the past six years focusing on western Oregon and Washington forest ecology and disturbances. With FHP Kristen provides technical assistance to federal land managers covering a range of topics and specialties from native and non-native forest diseases, disease impact modeling, training for identification and management of insects and diseases, silvicultural prescription input and review, participation on interdisciplinary teams, and hazard tree training and identification. Kristen's passions include working on administrative studies in the high-elevation environments with Whitebark pine and subalpine fir and working with land managers to incorporate the best available science into their management practices.



Peter Hayes

Peter and his family own and care for working forest lands in the northern Oregon Coast Range. Their restoration forestry business, Hyla Woods, experiments with models of forestry and grower-consumer partnerships that lead to enriched forests and sustained people. Peter's community involvements include recent service on the Oregon Board of Forestry, leadership of the Build Local Alliance, and service on several non-profit boards.


WESTERN
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2015
Student Presentation
Awards Banquet
Tuesday April 28th
Corvallis Country Club
1850 SW Whiteside Drive
Doors Open at 5:00
Dinner and Awards Presented at 6:00pm

Monday April 27th

	Room 107	Room 115
9:00	**Welcome - Dean Thomas Manness, RH 107**	
9:30	Spatial optimization of restoration in fire prone forests: tradeoffs and production possibility frontiers - Kevin Vogler	Understanding Participant Experiences at a Non-formal Science Education Event - Lauren Remenick
9:50	Restoration of Riparian Areas Following the Removal of Cattle in the Northwestern Great Basin - Jonathan Batchelor	Diversity in the Outdoors: Student Attitudes About Wilderness in the National Outdoor Leadership School - Sara Gress
10:10	**Break**	
10:30	Sediment Transport Prototypes: Novel Methods to Disconnect Unpaved Roads from Streams - Erica Kemp	Effects of Wood Substitution in Commercial Construction - Kristina Milaj
10:50	"A Beautiful River that Eats People" The Value of Streamflow for the Salmon River Bioregion, Idaho - Brett Alan Miller	Cross-Laminated Timber diaphragm connections under seismic load - Kyle Sullivan
11:10	Role of storms and forest practices in sedimentation of an Oregon Coast Range lake - Kris Richardson	Effective adhesive systems and optimal bonding parameters for hybrid Cross-Laminated Timber (CLT) - Blake Larkin
11:30	**Lunch**	
12:00	**POSTER SESSION (Lunch continued)**	
13:00	**Keynote - Peter Hayes, "The Power of Questions" RH 107**	
14:00	**Break**	
14:20	Could you be more obvious? Exploring the value of argument analysis as a tool of transparency in natural resource management decision-making processes - Chelsea Batavia	
14:40	Land Managers And Geocachers: Potential For Impact Goes Both Ways - Dianna Fisher	
15:00	Machine learning methods to improve fire suppression policies on simulated landscapes - Hailey Buckingham	
15:20	**Break**	
15:40	Application Of extracted Fungal pigments as natural colorants on monocotyledons - Sarath Vega Gutierrez	
16:00	Preliminary assessment to the fungal colonization on Douglas-fir, western red cedar and red alder in ground contact exposure - Paola Torres Andrade	
16:20	**Closing Notes** - John Bliss	
16:40	**Social Hour (HandleBar)**	

Don't forget to visit our art submissions located on the 2nd floor of Richardson!

Tuesday April 28th

	Room 107	Room 115
9:00	**Welcome - Laurie Schimleck, RH 107**	
9:30	Finite element analysis to predict in-forest stored biomass moisture content - Francisca Belart	Fracture and fatigue in wood based materials - Babak Mirzaei
9:50	Life cycle assessment (LCA) of poplar plantations: global warming potential and energy consumption in the US PNW - Marcia Vasquez-Sandoval	A trait based approach to understanding meadow species abundance over a conifer encroachment gradient - Jessica Celis
10:10	**Break**	
10:30	Effects of height and live crown ratio imputation strategies on stand biomass estimation - Elijah J. Allensworth	Stand-level estimates of available water holding capacity in forest soils: the missing piece in the site quality puzzle? - Henry Rodman
10:50	Assessing Spatial Distribution and Availability of Forest Biomass by Harvesting System in the Pacific Northwest, USA - Michael Berry	Biophysical responses in soil following intensive biomass removal - Adrian C. Gallo
11:10	Douglas-fir Stem Modeling using a Terrestrial Laser Scanner - Richard Gabriel	Homogenization of Litter Leachate DOC in H.J. Andrews Andisols: DOC fluorescence signatures in soils undergoing litter manipulations - April Strid
11:30	**Lunch**	
12:00	**POSTER SESSION (Lunch continued)**	
13:00	**Keynote - Kristen Chadwick, "Forest Pathology: The Future of our Forests and Forest Pathologists" RH 107**	
14:00	**Break**	
14:20	Optimal Harvesting Model for Mountain Ginseng Production in South Korea - Hee Han	
14:40	Changing pattern of water use by Faidherbia albida during rainy season in Mojo, Ethiopia - Jeannette Krampien	
15:00	The Relation and Interaction among Forest Ecosystem Services – Corporations' Impacts – and Corporate Social Responsibility *activities in the Amazon basin* - Raul Dancé	
15:20	The Overview of China's Forest Products Markets - Xiaoou Han	
15:40	International Session Question and Answer	
16:00	**Closing Notes - Troy Hall**	
16:20		
17:00	**Doors open for the Awards Banquet at the Country Club**	

First Prize for Poster and Oral Presentations is a handcrafted hatchet! Runners up will recieve gift cards to the OSU Bookstore!

COLLEGE OF FORESTRY

INTERNATIONAL SESSION AT THE
GRADUATE STUDENT SYMPOSIUM

Presenters during the international session include:

- **Hee Han, Korea**: "Optimal Harvesting Model for Mountain Ginseng Production in South Korea" (FERM postdoc)
- **Jeanette Krampien, USA**: "Changing pattern of water use by *Faidherbia albida* during rainy season in Mojo, Ethiopia" (FES, MS)
- **Raul Dance, Peru**: "The Relation and Interaction among Forest Ecosystem Services, Corporations' Impacts, and Corporate Social Responsibility activities in the Amazon basin" (WSE, MS)
- **Xiaoou Han, China**: "The Overview of China's Forest Products Markets" (WSE, PhD)

TUESDAY
28 APR 2015
2:20 PM - 4:00 PM

RICHARDSON HALL 107
Free & open to the public
The two day symposium will be held in Richardson Hall, Oregon State University, Corvallis, OR 97331 on April 27-28, 2015

symposiumGradReps@oregonstate.edu

Accommodations for disabilities may be made by emailing symposiumGradReps@oregonstate.edu

gradsymp.forestry.oregonstate.edu

WESTERN FORESTRY GRADUATE RESEARCH SYMPOSIUM 2015

Oregon State UNIVERSITY

ART MATTERS

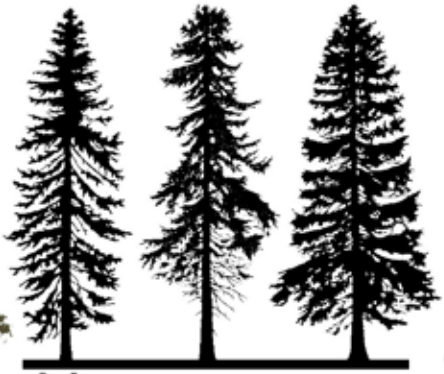
Humans are naturally attracted to beauty, to creativity, to novelty. We are somehow drawn to certain colors and shapes, to aesthetics in a way that is beyond our own understanding. Perhaps as a consequence of that, art has been such an important part of human history – communicating values, promoting social changes, or simply transmitting information across generations.

2015 Western Forestry Graduate Research Symposium

The inclination towards art unifies us and brings us closer. The WFGRS understands the importance of finding creative ways to communicate science. We believe art can help us disseminate scientific knowledge and engage with the general public. In light of that, we are proud to announce the incorporation of an art section in our 2015 Symposium. Throughout our event, you will have the opportunity to appreciate the art pieces produced by some of our students and faculty members. We hope our exhibition will inspire you and make you realize that not even science is black and white.

Thank you to all the artists who contributed to the 2015 exhibition and a special thanks to FES student Jamie Mosel – who painted the beautiful images that illustrate this page.

ORAL PRESENTATIONS



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2015

Oral Presentations

April 27th room RH 107 | April 27th room RH 115 | April 28th room RH 107 | April 28th room RH 115

Effects of Height and Live Crown Ratio Imputation Strategies on Stand Biomass Estimation

Elijah J. Allensworth[1] and Temesgen Hailemariam[2]

1 M.S. Candidate in Sustainable Forest Management, Department of Forest Engineering, Resources, and Management

2 Professor, Department of Forest Engineering, Resources and Management

The effects of subsample design and imputation of total height (ht) and live crown ratio (cr) on the accuracy of stand-level estimates of component and total aboveground biomass are not well investigated in the current body of literature. In this study, we evaluate the predictive performance of different ht and cr models, and the effect of subsample size in estimating total and component aboveground biomass. This study uses a data set of 3,454 Douglas-fir trees obtained from 102 stands in southwestern Oregon. The predictive ability of the regional ht and cr imputation methods on estimates of component and total aboveground biomass for a range of randomly-selected subsample sizes

(n = 0,…, 15) were evaluated using the leave-one-out cross validation technique simulated over 500 iterations. The southwestern Oregon variant of the ORGANON model is used to impute cr and a Chapman-Richards model form is used to impute ht; variants of both models with random effects or correction factors were also used. Root mean squared error (RMSE) and bias were used to evaluate predictive performance. Using measured ht and cr predicted with mixed-effect models produced the lowest total tree biomass RMSE with a maximum of 397.7 dry lbs/acre (0.73% of mean stand-level estimate) when n = 1 and a minimum of 105.8 dry lbs/acre (0.19%) when n = 15. The RMSE for tree bole biomass was lowest using a mixed-effect model to impute ht and a fixed-effect model to imputer cr with a maximum of 2,389.8 dry (4.76%) lbs/acre when n = 1 and a minimum of 743.0 dry lbs/acre (1.48%) when n = 15. The RMSE for tree crown biomass was lowest using measured cr and a mixed-effect model to impute ht for subsamples of 7 trees or less and a fixed-effect model for subsamples of 8 to 15 trees with a maximum of 157.8 dry lbs/acre (3.82%) when n = 1 and a minimum of 49.4 dry lbs/acre (1.19%) when n = 15. Stand-level estimates of total and bole biomass are primarily driven by ht and estimates of crown biomass are driven by cr. Based on our findings, we recommend measuring ht and cr for at least 5 trees in a stand and using mixed-effect models to impute ht and cr for all other trees.

Could You be more obvious? Exploring the Value of Argument Analysis as a Tool of Transparency in Natural Resource Management Decision-making Processes

Chelsea Batavia, Michael P. Nelson

Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR

The task of managing forests in the 21st century is complex, not least because decisions are so often surrounded by controversy that erupts when diverse stakeholder perspectives come into conflict with one another. When the social climate is highly contentious, managers and decision-makers are challenged not

only to operate in the face of uncertainty, but also to navigate the difficult social terrain of public values. In these situations, argument analysis is a tool that might be used to encourage transparency and facilitate communications between stakeholders, scientists, and decision-makers. With argument analysis, the arguments people use to represent their opinions are formally constructed and systematically assessed. In my presentation I will discuss this process and explain how it can reveal assumptions, uncertainties, and ambiguities that may otherwise remain hidden, even as they stand in the way of effective communication. I will also discuss some of the results from my thesis work, an analysis of current debates over the implementation of ecological forestry on the BLM O&C lands in western Oregon. After presenting some of the arguments I have formulated, I will point out the significant gaps, both empirical and normative, that my analysis suggests might need to be filled before we can make an informed decision about future management of the O&C lands in western Oregon.

Restoration of Riparian Areas Following the Removal of Cattle in the Northwestern Great Basin

Jonathan L. Batchelor[1], William J. Ripple[1], Todd M. Wilson[2] & Luke E. Painter[3]
1. Department of Forest Ecosystems and Society, Oregon StateUniversity
2. US Forest Service, Pacific Northwest Research Station
3. Department of Fisheries and Wildlife, Oregon State University

We assessed the effects of the elimination of livestock in riparian systems at Hart Mountain National Antelope Refuge in southeastern Oregon, 23 years after the removal of cattle grazing, using 64 photos taken before grazing was removed compared with later retake photos. Two methods were used for this assessment: (1) a qualitative visual method comparing seven cover types and processes and (2) a new quantitative method of inserting digital line transects into photos. Results indicated that channel widths and eroding banks decreased in 64 and 73 % of sites, respectively. We found a 90 % decrease in the amount of bare soil (P\0.001) and a 63 % decrease in exposed channel (P\0.001) as well as a significant increase in the cover of grasses/sedges/forbs (15 % increase, P = 0.037), rushes (389 % increase, P = 0.014), and willow (388 % increase, P\0.001). We also assessed the accuracy of the new method of inserting digital line transects into photo pairs. An overall accuracy of 91 % (kappa 83 %) suggests that digital line transects can be a useful tool for quantifying vegetation cover from photos.

Finite Element Analysis to Predict In-forest Stored Biomass Moisture Content

Francisca Belart, Ben Leshchinsky and John Sessions
Department of Forest Engineering, Resources, and Management, College of Forestry, Oregon State University

One of the biggest challenges for logging residue biomass to be economically competitive with traditional fuel sources in the U.S. is high transportation costs. Reduced transportation costs can be achieved through improved efficiency in biomass shipping. These costs are directly affected by residue moisture, which increases weight and decreases volume of transported material, making transportation less efficient and more expensive. Residue moisture can be reduced in the forest by natural phenomena, such as transpiration and air drying. It has already been shown that drying rates, and therefore field storage time, will depend on weather conditions (e.g. wind, temperature, precipitation), residue species, and storage configuration. However, preparation and

storage time of biomass residues will incur capital costs, interest and risk. Storage costs must be weighed against savings associated with transportation and customer premiums for dryer, lighter materials. Determining the best strategies and timing to maximize drying would help decrease these transportation costs. The objectives of this study are to use finite element (FE) analyses to model drying rates for in-forest stored logging residues; validate these rates with data collected in the field and using an FE approach, determine best storage configurations to maximize drying under specific field conditions. Moisture content measurements and environmental variables are been monitored in different regions of Oregon to determine actual drying rates in piled residue. A field measuring protocol has been successfully implemented and will be used to gather information over a one year period. The multi-physics FE model has been implemented with physical behaviors of fluid flow, heat transfer and mass (moisture) diffusion. Data obtained from the field tests will help adjust and validate FE models to be representative of realistic conditions, followed by a parametric study that will inform drying rates for different weather, site conditions and field storage configurations.

Assessing Spatial Distribution and Availability of Forest Biomass by Harvesting System in the Pacific Northwest, USA

Michael Berry, Rene Zamora, John Sessions
Forest Engineering, Resources & Management, Oregon State University

This research evaluated the spatial distribution of biomass by harvesting system and estimated distance to road to support the biomass supply model for a regional forest residue to aviation fuel project (NARA). The NARA project is a USDA funded project with the objective of evaluating a supply chain from forest biomass to aviation fuel production. The base resource data used in this evaluation are FIA plots. To improve our understanding of the distribution of forest residues a GIS-based model was developed to estimate harvest system. A methodology based on the processing of vector and raster data that can be used at the regional level is presented. Regional data (digital elevation models, road networks, ownership, etc.) was collected from the primary federal and state agencies. Digital elevation models were processed to estimate the amount of forested land that could be suitable for either ground-based or cable equipment. The harvest system overlay was then combined with road system information for analysis. In cable terrain, residues were assumed at roadside. For ground-based systems it is assumed that residuals were distributed over the harvest unit. Outputs include the number of acres of forest area for state and private owners at various distances from existing roads by harvest method. The results from the analysis will be used to characterize the biomass collection and comminution costs for biomass. Validation of the GIS processing will be done by comparing model results with the harvest unit layers on the state of Oregon forests.

Machine Learning Methods to Improve Fire Suppression Policies on Simulated Landscapes

Hailey Buckingham[1], Rachel Houtman[1], Sean McGregor[2], Tom Dietterich[2], Claire Montgomery[1],

1. Dept. of Forest Engineering, Resources, and Management, Oregon State University
2. School of Electrical Engineering and Computer Science, Oregon State University

Any policy which informs wildfire suppression decisions may affect the future evolution of a landscape as patterns of growth, harvest, and fire each adjust to the influence of that policy. Improving such a policy is difficult because the long-term effects of policy changes may not be obvious a priori. As a landscape evolves under the influence of such a policy, the landscape's character may change, which will also alter the influence of future application of that same suppression policy on future landscape states. In this study, we use machine learning techniques and monte carlo simulations of forested landscapes to improve a wildfire suppression policy. A simple machine learning algorithm is used to optimize the expected present net-value of a large number of simulated landscapes. Simulations model forest growth, logging, wildfire ignition and spread, and weather. Once an optimal policy is "learned," the long-term results of using that new policy are compared to those when using a standard, "suppress all fire" policy on the same set of simulated landscapes.

A Trait Based Approach to Understanding Meadow Species Abundance Over a Conifer Encroachment Gradient.

Jessica Celis[1*], Charles B. Halpern[2], and F. Andrew Jones[1, 3]

1 Department of Botany and Plant Pathology, Oregon State University, Corvallis OR, 97331
2 School of Environmental and Forest Sciences, University of Washington, Seattle WA, 98195
3 Smithsonian Tropical Research Institute, Balboa, Ancon, Panama

In the Oregon Cascade Range, conifer encroachment has reduced the extent of mountain meadows by as much as 50% since the mid 1940's. A study in the Oregon Cascades demonstrates that meadow species differ in their sensitivities to tree influence: some species show rapid decline and others persist in the understory for decades. We explore whether this variation can be explained by differences in functional trait plasticity, i.e., the ability of species to adjust resource-acquiring structures (independent of genotype) in response to changing resource conditions. We focus on morphological traits that are directly or indirectly related to light capture (the most limited resource): specific leaf area (SLA), above-to below-ground biomass ratio (Ma/Mb), clonality, and maximum shoot height (SHmax). We hypothesized that sensitivity is greater in non-clonal species and in those showing less plasticity in trait expression across the light gradient. We chose 13 target species (10 forbs and three grasses) at Bunchgrass Ridge, OR, that represented the range of species' sensitivities and measured their traits (15-17 individuals per species, 216 total). Indices were created to describe species sensitivity (SEI, derived from the coefficient of variation of each species predicted cover-light relationships) and trait plasticity (slope of each species trait-light relationship) and clonality (ordinal variable). Our results suggest that species morphological plasticity and clonality explain little of the variation in species SEI. However, species leaf area was significantly related to SEI ($r = 0.56$, $p = 0.05$). Those species that were able to develop larger leaves in the shade had a low SEI. Species that are considered highly clonal were less sensitive to encroachment than those with no clonal structures, however, this difference was not significant ($p=0.1$). We found no relationship between species Ma/Mb, or SHmax and SEI. Understanding the causes of variation in meadow species response to

encroachment will require complementary approaches involving observational and experimental models.

The Relation and Interaction Among Forest Ecosystem Services – Corporations' Impacts – and Corporate Social Responsibility Activities in the Amazon basin

Raul Dancé

The tropical rainforests provide multiple ecosystem services to the entire planet. In the Amazon rainforest, human activities and economic expansion are proximate and direct drivers of its deforestation and degradation. Corporations are aware of the negative impacts caused by their activities and the potential risks for their businesses, as a consequence they have taken the path of Corporate Social Responsibility – CSR to measure, prevent, mitigate or compensate these impacts.

This research focuses on the analysis of the CSR Sustainability Reports prepared by the top corporations located in the Amazonian countries, aiming to find the mutual dependence relationship between forest ecosystem services and corporations' economic activities. For this study, primary productive business activities that are directly linked to deforestation rates were selected (such as agriculture & cattle raising), but, at the same time, analyses of other economic sectors that despite the fact that are not in direct contact with forest resources, they benefit from their products and services (e.g. food & beverage, retailers).

Data was collected from the web pages and the CSR sustainability reports of selected companies in Latin American region whose business and activities are linked to the Amazon Basin. Company characteristics and geographical location were taken in consideration in this selection. The findings of this research describe the relation and interaction among forest ecosystem services – corporations' impacts – and CSR activities.

Land Managers And Geocachers: Potential For Impact Goes Both Ways

Dianna Fisher, Jo Tynon
Department of Forest Ecosystems & Society, Oregon State University

Geocaching, an outdoor treasure hunt using GPS, is a worldwide phenomenon. There are over six million registered geocachers and 2,521,354 active geocache sites. The sport, first recognized in 2001, has gone through many changes, including the addition of a code of geocaching conduct. Although many US geocaches are on public lands, this presentation suggests that many land management agency policies regarding geocaching may no longer be relevant. We offer an overview of current policies, introduce the latest types of geocaches – both those with and without containers, and detail the geocachers' code of conduct. Geocachers' perceptions of their impact compared to the perceived impact policymakers attribute to them are discussed. Also discussed is the potential for land managers to have a meaningful impact by engaging geocachers in Citizen Science, park clean-up and invasive species removal along with opportunities for educational outreach.

Douglas-fir Stem Modeling using a Terrestrial Laser Scanner

Richard Gabriel, Kevin Boston
Dept. of Forest Engineering, Resources, and Management, Oregon State University

Terrestrial laser scanning collects far more information about a target tree than could be measured using traditional methods. With this added information comes the task of interpretation, which in the past meant using geometric primitives to represent the tree structure. This project uses a novel approach in the modeling of stem characteristics of target Douglas-fir poles. Using approaches traditionally used in digital surface modeling we are able to produce a model that more closely represents the true structure of a tree than previous methods. This will allow for better volume estimations and tree valuations than previously thought possible using field data.

Biophysical Responses in Soil Following Intensive Biomass Removal

Adrian Gallo, Jeff Hatten
Dept. of Forest Engineering, Resources, and Management, Oregon State University

Tree-based metrics of productivity have limitations when attempting to predict long-term sustainability of forest stands. However key soil variables, as affected directly by management, regulate the capacity of a site to maintain a sustainable carrying capacity over many rotations. The aim of this project is to identify the apparent mechanisms of resilience seen in tree growth, following intensive biomass removal through key soil indices. Both soil porosity and site organic matter content are known to change following forest management activities.

Our study addresses the following questions: (i) do sites lacking residual organic matter content (forest residuals) have higher soil moisture and temperature compared to sites with an intact O-horizon and slash, (ii) do sites with higher soil moisture and temperature have higher rates of heterotrophic respiration, (iii) do sites with higher heterotrophic respiration have higher rates of N-mineralization?

We are measuring soil temperature and volumetric water content on an hourly basis at 10, 20, 30, and 100cm depth. Zero-tension lysimeters and throughfall collectors will be used to quantify inputs from the O-horizon and atmosphere respectively. CO2 respiration measurements on a variable-depth collar system identifies auto/heterotrophic contributions. Density fractionation followed by stable isotope analysis on soil samples will be used as a proxy for carbon and nitrogen mineralization.

We expect soil microclimate conditions to accelerate heterotrophic activity on sites with complete biomass removal, compared to sites with slash left on the surface. We predict these sites will also have higher mineralization rates that may offset, to varying degrees, the nutrient pool reduction from biomass removal. Identifying the degree to which these mechanisms buffer the loss of nutrients from forest residuals will be examined with potential impacts to long-term sustainable productivity.

Diversity in the Outdoors: Student Attitudes About Wilderness in the National Outdoor Leadership School

Sara Gress, Troy Hall

Department of Forest Ecosystems & Society, Oregon State University

Outdoor experiential education (OEE) programs often consist of mainly White, upper-class individuals. With major demographic shifts occurring in the United States, OEE organizations must confront this imbalance. The National Outdoor Leadership School (NOLS) is addressing this issue with its Gateway Scholarship Program. The purpose of this mixed methods study was to determine if Gateway Scholarship and non-Gateway students held different wilderness attitudes pre- and post- NOLS course, if wilderness attitudes changed during NOLS courses, and if selected predictor variables were related to wilderness attitudes. A retrospective pre- and post-test was administered online to students, with follow-up telephone interviews. Results show that Gateway students held less positive pre-course wilderness attitudes than non-Gateway students; however, post-course scores were not significantly different for all but one attitude construct. Both groups experienced positive change in wilderness attitudes. The predictor variables were inconsistently significant. Interview data revealed potential reasons for attitude change, and areas of possible concern about the conceptualization of wilderness promoted by NOLS.

Application Of Extracted Fungal Pigments as Natural Colorants on Monocotyledons

Sarath Vega Gutierrez, Auna Godinez, Megan Huber, Savanah Stanton, Sara Robinson

Monocotyledons have a growing presence on the decorative market and are particularly attractive for their 'sustainable' nature. The most popular of the monocots, bamboo, is now routinely used for kitchenware, furniture, and flooring, however the techniques developed to modify the natural color of these products relies on dyes with heavy metals and petroleum bases. In this study, extracted fungal pigments of Scytalidium cuboideum, Scytalidium ganodermophthorum and Chlorociboria aeruginosa were applied to bamboo (Bambusa gigantea) and black palm (Borassus flabellifer) in varying concentrations and then evaluated for the color change on external and internal surfaces. If the pigments are successful, they can be offered in the market as natural colorants for commercial bamboo products as an alternative to the common dyes.

Optimal Harvesting Model for Mountain Ginseng Production in South Korea

Hee Han1, Woodam Chung1, Joosang Chung2

1Department of Forest Engineering, Resources and Management, Oregon State University,
2Department of Forest Sciences, Seoul National University, Seoul 151-927, Republic of Korea

With the wellbeing trends, the cultivated mountain ginseng (Panax ginseng) is rising as one of the most profitable herb species. It has a high potential to provide an additional opportunity for income of forest owners in South Korea. In this study, we developed a spatial-and-temporal decision-

making model for supporting the intensive mountain ginseng production. The model solves for optimal solutions, using the 0-1 integer programming, to maximize the profit by allocating forest farmlands spatially over time. As the major constraints for the intensive ginseng management, included in the formulation, are sustained yield, non-continuous cropping, annual budget and ending inventory conditions. In applying the model to a case study, the site productivities of grids were assessed as a function of such site environmental factors as solar radiation, topographic wetness and soil moisture content using GIS and geographically-weighted regression analysis.

The Overview of China's Forest Products Markets

Xiaoou Han

Along with its economic growth, China's forest sector has been developing rapidly in the past decade. It is now one of the largest manufacturers of forest products in the world. China is also one of the largest players in terms of the global forest products trade. Some of the major global forest products trade flows occur between the U.S. and China: China imports large amount of raw materials from the U.S. and exports the final products back to it. The trade between China and the U.S. is essential to both of their forest products markets. This overview contains information of China's forest products markets, forest resources and policies and institutions. It also provides insights of the importance of China's forest products markets to the U.S.

Sediment Transport Prototypes: Novel Methods to Disconnect Unpaved Roads from Streams

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Unpaved roads are a critical form of infrastructure in forested landscapes. Multiple industries benefit from their low cost and ease of construction. Despite their practical utility, unpaved forest roads are a potential source of fine sediment that can be transported to nearby aquatic habitat and degrade sensitive ecosystems. Improved management of aggregate road surfacing can reduce sediment generation, lengthen its useful life span, reduce maintenance costs, and more importantly, mitigate the impacts of road sediment on hydrologically connected ecosystems.

This study reconstructed an unpaved forest road in Dunn Research Forest to test novel applications of geotextile materials and their effect on road aggregate performance and road sediment sequestration. Three road construction treatments were evaluated: an aggregate-only control (no treatment), a biomass waddle-type filtration bale, and a geotextile-wrapped filter sand berm with a geogrid underlay. Two different aggregate varieties were used totaling six road treatment sections. A worst-case sediment scenario was produced with simulated rainfall and heavy truck traffic to mimic wet-weather timber hauling. Ditch runoff was collected to determine filtration effect of each road treatment and surface aggregate was testing for degradation through time to determine rate of sediment production. Data analysis is ongoing and preliminary findings are presented herein.

The geogrid reinforcement effectively reduced subgrade stress and improved aggregate performance. The geotextile-wrapped sand filtration berm produced variable results in the field, but follow-up laboratory testing indicated a substantial reduction in effluent turbidity. In contrast, the biomass filtration bale provided no discernable filtration benefit from road aggregate sourced

runoff. Investigators are currently developing recommendations for new best management practices employing the use of geotextile materials in unpaved forest road construction as a means of improving runoff water quality, and aggregate performance.

Changing Pattern of Water Use by Faidherbia albida During Rainy Season in Mojo, Ethiopia.

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In parkland agroforestry systems, where trees and crops are managed as an integrated system, there are both facilitative and competitive interactions for light and water resources. Farmers manage the trees in these systems to obtain tree products and protect soils, but they also try to reduce competition. A common management strategy, especially in semi-arid areas of sub-Sahara Africa, is to prune branches before the rainy season starts. Faidherbia albida, a commonly grown species, is known for its reverse phenology, where the leaves are dropped during the rainy season. This feature can make it less competitive with crops, which is one of the reasons why the species has been widely promoted for use in revegetation projects. However, pruning of F. albida may alter its leafing pattern, effectively eliminating the reverse phenology benefit. In this study I address how pruning alters the pattern of water use by F. albida during a cropping season in Mojo, Ethiopia. Preliminary results suggest that pruned trees may actually be using more water than unpruned trees due to regrowth. While pruning increases light availability for crops, it may also result in increased competition for water; therefore in environments where water is the limiting factor for crop growth, it may be advisable to avoid pruning F. albida.

Effective Adhesive Systems and Optimal Bonding Parameters for Hybrid CLT

Blake Larkin

The objective of this project is to determine effective adhesive systems and bonding parameters (adhesive spread rates and bonding pressures) for the hybrid Cross laminated timber (CLT) combinations. The Hybrid CLT combinations include both structural grade lumber and underutilized, low-grade lumber. For a reference species, we selected structural-grade beetle-killed pine (BKP), since lodgepole pine is a member of the US-SPF group closely related to the European species commonly used for CLT construction. The structural-grade, local species will be represented by Douglas-fir (DF), while the low-grade species will be represented by stud-grade BKP, DF, and Western Hemlock. The two adhesive systems investigated are: PUR, an adhesive currently used by the CLT industry that will serve as a reference, and phenol-resorcinol formaldehyde (PRF), a cold setting adhesive commonly used by the engineered wood products industry in North America that will represent a potential domestic alternative. The variables will include species combinations (6), adhesive types (2), clamping pressures (3), and, in some cases, spread rates (3), with repetition of 10 specimens per combination.

Effects of Wood Substitution in Commercial Construction

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Wood is the primary building material in single-family residential construction, however, it lacks application in mid-rise and commercial buildings. Wood being a natural, renewable material that sequesters carbon is a natural fit for newer construction with enhanced sustainability goals. Despite this, new construction for commercial buildings is predominantly steel or concrete. The objective of this study is to assess the environmental impacts of steel and concrete structural materials in commercial construction in Oregon, and compare them with the impacts of employing different substitution levels of wood products. Comparative cradle-to-gate, life-cycle analysis (LCA) is used with the help of the Athena Impact Estimator for Buildings software. Three case studies are presented that represent different building functionalities, material systems, and construction techniques. Evaluations are made of the global warming potential and impacts on fossil fuel consumption when structural materials are progressively substituted with wood. Preliminary results, from one case study, suggest that substituting wood products for steel in an existing office building results in over 25% reduction in the Global Warming Potential and Fossil Fuel Consumption for the structural system. The findings could help promote wood in commercial construction as a green building material, encouraging architects, engineers, and building owners to use wood, and increasing markets for Oregon wood products.

"A Beautiful River that Eats People" The Value of Streamflow for the Salmon River Bioregion, Idaho

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2. Human Dimensions of Natural Resources, Colorado State University
3. College of Letters, Arts & Social Sciences, English, University of Idaho
4. College of Natural Resources, Conservation Social Sciences, Director of Bioregional Planning and Community Design, University of Idaho

To assess both monetary and non-monetary benefits of Ecosystem Services (ES), constructivist theories such as Symbolic Interactionism and critical theories such as Political Ecology provide insight where economic analysis alone fails. This research also incorporated the theory of Bioregional Imagination related to place attachment constructs within a grounded mixed-methods assessment of streamflow benefits for residents of the Salmon River Basin (SRB), Idaho where climate change models predict reductions in streamflow rates as high as 20-40%.

What is the value of the ES of streamflow for residents of the SRB and how will streamflow reductions and alterations impact the SRB? Findings indicate that streamflow in the SRB provides cultural benefits as well as employment that provides both fiscal and heritage and/or other intangible benefits; many residents report a monetary trade-off for living in the SRB in favor of nonmonetary values. Combined with economic analysis, this research provides, through qualitative narratives and statistical consideration of the river as a significant symbol, actual measurements of those value.

Fracture and Fatigue in Wood Based Materials

Babak Mirzaei

This presentation goes over the fundamentals of fracture mechanics and fatigue phenomena in materials. Also addressed are the relevant standard protocols for various materials followed by a discussion on their applicability to wood and wood composites. Wood as well as some fiber reinforced composite materials has raising resistance to fracture. Therefore, its toughness should be monitored until it reaches steady state toughness. The concept of wood fatigue is incorporated in the load duration factor of wood design which indicates the reduced capability of material to carry load over time. Damage tolerance fatigue analysis is much more reliable than the conventional S/N approach through reduced failure probability which is critical for some industries. However, it can be a matter of discussion whether the former can be applied to wood based materials.

Keywords: Wood, fracture, R-curve, fatigue.

Understanding Participant Experiences at a Non-formal Science Education Event

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For the past several years, HJA Day, a non-formal science education event, has been held in an effort to educate the public about research and educational programs taking place at the HJ Andrews Forest in Blue River, Oregon. The event has traditionally been well attended, but little is known about participant' experiences or perceptions about the event. Data from 76 participants was used to answer three questions about HJA Day: 1) Who are HJA Day participants? 2) What are their experiences and outcomes? and 3) What is the relationship between those outcomes? A mixed-method approach was used to determine the main outcomes and the factors that affect those outcomes. We found that HJA Day participants attended HJA Day primarily to learn, network, and spend a day in the forest. Participant outcomes were impacted by three main factors: structural aspects, people and networking, and participants' teaching/learning style preference. These factors both positively and negatively impacted the main outcomes that resulted from HJA Day: perceived knowledge gain, change in thinking, overall appreciation, and overall satisfaction. Most participants responded that: they learned something, HJA Day changed their thinking, their overall appreciation of the event increased, and they were generally very satisfied with the event. All main outcomes positively and significantly correlated except for overall satisfaction and change in thinking, which had no relationship. These findings have implications for the improvement of future HJA Day events and are relevant for participant experiences at other adult non-formal science education events. By understanding participant experiences and outcomes, we may aid adults in their pursuits of continuing lifelong learning and help to form a scientifically literate population of responsible decision-makers.

Role of Storms and Forest Practices in Sedimentation of an Oregon Coast Range Lake

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The design of better management practices in forested watersheds to face climate change and the associated increase in the frequency of extreme events requires a better understanding of watershed responses to extreme events in the past and also under management regimes. One of the most sensitive watershed processes affected is sediment yield. Lake sediments record events which occur in a watershed and provide an opportunity to examine the interaction of storms and forest management practices in the layers of the stratigraphy. We hypothesize that timber harvesting and road building has resulted in increases in sedimentation; however, the passage of the Oregon Forest Practices Act (OFPA) has led to a decrease in sedimentation. Sediment cores were taken at Loon Lake in the Oregon Coast Range. We use sedimentological tools to measure changes in sediment production as motivated by extreme floods before settlement, during a major timber harvesting period, and after installation of forestry Best Management Practices. Quantification of changes in particle size and elemental composition (C, N, C/N) throughout the cores elucidate changes in watershed response to extreme events, as do changes in layer thickness. Given the instrumental meteorological data and decadal climate reconstructions, we disentangle climate driven signals from changes in land use practices. The sediment shows distinct laminations and varying thickness of layers throughout the cores. Background deposition is composed of thin layers (<0.5 cm) of fine silts and clays, punctuated by thicker layers (3-25 cm) every 10 to 75 cm. We interpret the thick layers in Loon Lake to be deposited by sediment-producing floods throughout the 1500-year lifespan of this lake. We explore the relationship between sedimentation, land use, and climate forcing events to determine if the OFPA is having an effect on reducing sedimentation rates as a result of extreme magnitude storm events.

Stand-level Estimates of Available Water Holding Capacity in Forest Soils: the Missing Piece in the Site Quality Puzzle?

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Dept. of Forest Engineering, Resources and Management

Background: In comparison to our ability to measure and describe stand attributes, our ability to characterize soil attributes that control forest stand dynamics and productivity is lacking. One site attributes that we are unable to efficiently estimate at the stand level is available water holding capacity. To address this gap in knowledge, I seek to develop a method for producing reliable estimates of soil available water holding capacity at the stand level that can be used by practitioners.

Hypotheses: I hypothesize a) that there is a correlation between a site's topography and soil attributes that contribute to the spatial variability of available water holding capacity, b) that remotely sensed information can be used to predict the spatial distribution of these soil attributes, and c) that these predictions can be used to estimate forest site quality.

Methods: At several study areas in Oregon's Coast Range, I will use a LiDAR-derived digital terrain model to perform a terrain analysis. The resulting terrain indices will be used in tandem with the NRCS soils information and a systematic, stratified soil-sampling framework to build a predictive model for available water holding capacity.

Interpretation: If the predictive model of available water holding capacity can be verified by field data, the methodology could be applied across Oregon's Coast Range to estimate site quality.

Importance: Stand-level estimates of available water holding capacity may be correlated with a stand's maximum size-density index and/or site index. This information could then be considered by silviculturists to improve the efficiency of management prescriptions and optimize productivity or other stand management objectives. A method that estimates site quality with sufficient accuracy using remote-sensing techniques could also increase precision of timberland appraisal.

Homogenization of Litter Leachate DOC in H.J. Andrews Andisols: DOC Fluorescence Signatures in Soils Undergoing Litter Manipulations

April Strid, Baek Soo Lee, Kate Lajtha

Soil dissolved organic carbon (DOC) is a small but crucial part of the forest carbon cycle. Characterizing the relationship between organic matter inputs to soil and DOC chemistry is crucial to understanding the ultimate fate of root carbon, fallen wood and needles. Chemical differences in the DOC pool may help to explain whether fractions are sorbed to mineral surfaces and contribute to accumulation of soil organic carbon, respired as CO2, or exported. Soil solution DOC was sampled from the detrital input and removal treatment (DIRT) plots located in the H.J. Andrews Experimental Forest, OR to determine whether detrital inputs impart a detectable signal on DOC in mineral soil. Multiple types of fresh litter extracts, along with lysimeter and soil extracts from DIRT treatment plots were characterized using UV-Vis and fluorescence spectroscopy coupled with the Cory and McKnight (2005) parallel factor analysis (PARAFAC) model. Principal component analysis of 13 unique fluorophores distinguished using PARAFAC show that litter and soil extracts (needles, wood of decomposition Class 1, Class 3 and Class 5, O-horizon, and A-horizon) each have distinct fluorescence signatures. However, while litter-leached DOC chemistry varies by litter type, neither lysimeter-collected DOC or soil extracts show statistically significant differences in fluorescence signatures among treatments, even after 17 years of litter manipulations. The lack of observed differences among DIRT treatments suggests a "Soil Blender" hypothesis whereby both abiotic and biotic mechanisms effectively homogenize organic carbon constituents within the dissolved pool. The results of this work emphasize the ability of sorption and biodegradation to homogenize soil DOC and demonstrate that fluorescence can be an effective fingerprinting technique for soil DOC composition.

Cross-Laminated Timber Diaphragm Connections Under Seismic Load

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The goal of this project is to examine the following characteristics of shear connections between Cross-Laminated Timber panels as they form the horizontal diaphragms (floors and roofs) of the seismic load resisting system for buildings: 1) strengths/stiffnesses of several connection types, and 2) ductility/energy dissipation of the connections. ASTM E455 will be the standard used for these experiments, which calls for third-point loading on a simply-supported panel. CLT floor diaphragms

experience lateral loading along both their strong and weak axes depending on the direction of earthquake ground motions or wind loadings, and the orientation of the panels. The analysis will determine how lateral loads parallel to either axis are transferred through diaphragm shear connections due to different strengths and stiffnesses of the fastening systems. Looking at how CLT floor diaphragm connections transfer lateral loads would most likely lead to design provisions in the National Design Specification for Wood Construction and the International Building Code, which will help facilitate structural engineers to confidently use CLT in designing lateral-force-resisting systems. This information is important because the structural strengths and stiffnesses of CLT will help make it a choice structural system for taller wooden buildings. These buildings, made with renewable materials, will then be much more competitive with construction from materials which are energy intensive to produce.

Preliminary Assessment to the Fungal Colonization on Douglas-fir, Western Red Cedar and Red Alder in Ground Contact Exposure

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Wood that is exposed in outdoor applications tends to remain wet for extended periods of time, although the moisture level can vary depending on climatic conditions. Untreated wood in contact with the ground is at greater risk of maintaining favorable moisture contents that allow fungal colonization. Natural resistance of wood to biological degradation varies widely among wood species and even among samples of the same wood species. Untreated western redcedar and Douglas -fir heartwood are less susceptible to decay, in contrast to the untreated sapwood of Douglas -fir or red alder. Drivers of change in fungal community composition over the course of wood decay in ground contact are poorly understood because the complexity of these communities and the absence of long-term studies. Such studies would help to better understand the patterns of fungal colonization in wood exposed under varying environmental regimes, which could have important implication for wood performance under changing environmental conditions. This presentation will show preliminary results of the sequence of fungal colonization on three wood species exposed in ground contact under varying environmental regimes at the Oregon State University field test site. Preliminary results revealed that moisture content was higher in Douglas-fir sapwood and Alder in the wood stakes towards the below groundline section. As might be expected, fungal frequency was much higher the below ground zone, with Ascomycetes dominating the fungal flora.

Life Cycle Assessment (LCA) of Poplar Plantations: Global Warming Potential and Energy Consumption in the US PNW

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Biomass is a renewable source of energy but its production causes some environmental consequences. The goal of this study was to use Life Cycle Assessment (LCA) to compare global warming potential (GWP) and energy consumption of producing biomass in plantations irrigated with different sources of water. Four Oregon poplar (Populus, sp.) plantations were surveyed. One used no irrigation. The others were irrigated with river water, wastewater from a treatment facility,

or landfill leachate. Biosolids from water treatment were also applied, reducing some burdens of nitrogen fertilizer. Two poplar plantations were managed under short rotation and the other two were long rotation plantations. SimaPro v.8 and the USLCI and Ecoinvent databases were used to create a Life cycle inventory and TRACI was used to determine impact indicators. The energy consumption was calculated from cradle-to-gate inventory and process contributions provided by the SimaPro simulation software. GWPs were 79, 54, 93, and 90.5 kg CO2•t-1 for sites with no irrigation, irrigated with river water, waste water, and leachate, respectively. Energy consumption was 1377.7, 873.7, 1406.9, and 1482.9 MJ•t-1 respectively. The site irrigated with river water had the lowest GWP and energy consumption. The utilization of treated wastewater and leachate provided some source of natural fertilizer, however, no total substitution of fertilizer was noticed in these sites. It was also observed that plantation under short rotation woody crops (SRWC) management had less GWP impact and energy consumption. Process with the highest GWP and energy contribution was harvesting in all sites under study. This research showed that GWP and energy consumption differed among sites due to not only inputs and plantation managements, they also differed in biomass yield that had a tremendous effect on apportioning environmental impacts.

Spatial Optimization of Restoration in Fire Prone Forests: Tradeoffs and Production Possibility Frontiers

Kevin Vogler[1], Alan Ager [2], Stuart Brittain [3], Michelle Day [4]

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(4) Oregon State University, College of Forestry, Department of Forest Ecosystems and Society, Corvallis, OR

National forests in the western U.S have been widely impacted by logging practices, grazing, and fire suppression, leaving an estimated 25 million hectares with altered fire regimes and vulnerable to high severity wildfire, insects and disease. New policy initiatives call for a significant increase in restoration activities in order to keep pace with the scale of forest disturbance events. Restoration actions include thinning overstocked stands to reduce ladder fuels, mastication and site removal of surface fuel and broadcast burning. These efforts aim to reduce stand densities to create forest structure where wildfire can be managed without undesirable ecological effects. Despite extensive investment in restoration programs, a quantitative decision support framework to locate optimal project areas and examine tradeoffs among alternative restoration strategies is lacking. Current prioritization of restoration projects uses ad hoc methods that do not examine a range of scenarios considering management constraints, budgets, and spatial planning options. The net result is that we do not understand the opportunity cost associated with specific restoration investment decisions, and the associated management tradeoffs. This research introduces a new spatial optimization program for prioritizing forest restoration projects. Preliminary results on the colocation of forest stressors and restoration tradeoffs at a range of spatial scales will be presented.

POSTER PRESENTATIONS

WESTERN
FORESTRY
GRADUATE
RESEARCH
SYMPOSIUM

2015

Poster Presentations

April 27th

Amy Comstock
Bryn Morgan
Darren Goodding
Erda Celer
James Priebe
Jamie Mosel
Julian Geisel
Kat Morici
Kate Fickas
Kira Puntenney
Michael Hoe
Sarah Greenleaf
Sean Prive
Steven Huff

April 28th

Danielle E. Marias
Josée Rousseau
Randi Shaw
Teresa Wicks
Thomas Stokely
Yung-Hsiang "Sky" Lan
Christopher Wolf
Jennifer Johnston
Jonathan Batchelor
Jonathan Degner
Katherine Williams
Kristina Milaj
Russell Bair

Modeling Geomorphic Response to Large Wood Addition and Habitat Implications for Fish in a Managed Forest Watershed

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2.Forest Engineering, Resources & Management, College of Forestry, Oregon State University

Large wood (LW) additions are often part of fish habitat restoration, however their success is rarely reported in terms of ecological significance. Under natural conditions, northwest coastal streams recruit LW and develop forced-pool-riffle morphologies. This creates ideal habitat for anadromous fish. However, historic forest operations allowed clear-cutting, limiting contemporary natural recruitment. ODFW is making LW additions in Mill Creek, a salmonid monitoring site. This presents an opportunity to study LW effects on geomorphic processes and link them to long-term fish data. Three plane-bed reaches on commercial timberland that lack LW were selected. LW will be added after one year and pre and post geomorphic data is being collected to build and calibrate a 2D hydraulic flow model that will be used to calculate spatial distributions of shear stress and investigate sediment transport before and after LW addition. We will use the modeling results combined with a basin wide geomorphic survey to extrapolate the results to other sites. We hypothesize that most change will occur near new LW. Finer sediment will increase directly downstream of the LW whereas coarse material will be more frequent upstream. The sediment flux through the reach will decrease but will be more spatially variable. Reaches are ~100m in length, range in width from 4 - 10 m, have drainage areas between 2.2 and 16 km2 and slopes between 0.025 and 0.033 , surface median grain size D50 varies ~ 0.030 - 0.045 m and subsurface is ~0.026 m in all reaches. Rating curves for each site were made based on at least 10 discharge measurements. This study will contribute information on geomorphic change triggered by LW additions interpreted in the context of long-term biological data. It will enhance our ability to define concrete and effective restoration targets allowing forest management while maintaining and/or recovering habitat.

Ecological Forest Structure Characterization using Ground Based Lidar

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2. US Forest Service, Pacific Northwest Research Station
3. Department of Civil Engineering, Oregon State University

Airborne lidar collects data describing crown heights and some basic structure of trees. In an especially complex or dense forest stand, airborne lidar returns may be limited to only the upper part of a canopy. In contrast, ground-based lidar (GBL) captures a three dimensional image of a forest at much higher resolutions (millions of points per scan) with spatially explicit data that can be quantified. GBL applications in forestry to date have largely focused on measuring timber metrics, including board feet and basal area. Little has been done using GBL to characterize forest structure along ecological principles. Our research questions for this study were: (1) What new metrics can be derived from single-plot ground-based lidar (light detection and ranging) scans that can characterize differences in the amount and arrangement of structure in multi-dimensional forest space, and (2) how do these metrics compare to traditional non-spatially explicit forest structure indices? We used stratified random sampling to select 27 forested Research Natural Areas (RNAs) in Oregon and Washington for study. Nine scans (3x3 grid, 100-m spacing) were taken at each site (N=243). We created two-dimensional isovists (area of space visible from a single point) with a 56.4m horizontal radius at 1.4m. This allowed for detection of individual tree locations and DBH, as well as percentage of area visible at increasing distances. Also, using a 2D raster image of each scan, each column was divided into 100 segments depending on where each column hit ground. Average point distance and percent open in each horizontal segment was calculated. Metrics derived in this study can be used to describe the similarities and differences between forest stands in a new and comprehensive way. The data collected for this study will allow for future metric development and monitoring as our understanding of forest ecosystems continues to grow.

A Micro-Nursery Approach to Provenance Testing of Forest Trees: Proof-of-concept for Inferring the Effects of Climate Change

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Douglas-fir (Pseudotsuga menziesii) is one of the most ecologically and economically important trees in the world. Climate change is likely to adversely affect Douglas-fir forests, and assisted migration may be required to maintain healthy Douglas-fir populations. Provenance tests can be used to understand how trees will respond to climate change. However, traditional provenance tests have limitations; they are typically established (1) on a small number of sites and (2) using planted seedlings. Therefore, they do not provide robust information on how climate change will affect seed stratification, germination, and early seedling establishment, which is key to understanding how climate will affect naturally regenerated forests. Due to the limitations of traditional provenance tests, a new approach needs to be developed. I will test an alternative 'micro-nursery' approach to provenance testing. Micro-nurseries are small rectangular structures (roughly 3'x3'x6") in which seed can be sown and then easily moved to many field locations. My research questions are (1) can a micro-nursery approach be used to quantify adaptive differences in germination and growth among

Douglas-fir provenances? (2) Are micro-nurseries cost-effective enough to be used for large-scale provenance testing at many locations? (3) What challenges will be encountered in implementing a micro-nursery approach? The micro-nursery approach is a new method and, therefore, involves many unknowns. We will test a limited number of locations using Douglas-fir seeds from 99 open pollinated families from 30 provenances from western Oregon and Washington. We will place the micro-nurseries at different elevations representing five different climate regimes. In the future, the method can be refined and replicated at a larger scale (i.e., greater number of locations and provenances). This study will offer valuable insights on methods used to infer how forest trees will respond to the effects of climate change.

An Investigation of Avian Use of Created Snags in Managed Forests

Amy Comstock Joan Hagar (USGS) and James Rivers (Oregon State University, FES)

Snags provide important habitat for nearly one-third of forest wildlife species in the Pacific Northwest of North America. Managers can create snags from live trees to mitigate the scarcity of snags in managed forests, but information regarding the long-term function of created snags is absent from the literature. My research will quantify changes in the characteristics of created snags over 25 years, and the associated long-term habitat that they provide for cavity-nesting birds. My project will: (1) quantify contemporary characteristics of snags created 25 years ago among silvicultural treatment (2) quantify contemporary use of created snags as foraging and nesting substrates for birds (3) evaluate differences in cavity-nester abundance and richness among silvicultural treatments (4) compare measurements of decay, active nest cavities, and overall abundance and richness of cavity-nester guilds to data from 1991-1995 and 2001 to assess changes in use of snags and stands by cavity-nesters over a 25 year period. I will quantify created snag characteristics and evaluate associations between silvicultural treatment and snag decay by resurveying all created snags and measuring attributes such as percent bark cover, softness, and status (standing/down). I will quantify use of snags by cavity-nesting birds by determining avian nesting and foraging on created snags, number of active nests, and number of successful nests through focal observations on a subset of snags throughout each silvicultural treatments and snag arrangement. Cavity-nester abundance and richness will be evaluated among treatments by conducting aural and visual surveys for cavity-nesters in all stands, including controls. Use of stands and created snags by birds over 25 years will be evaluated by comparing contemporary data with historic data from these same treatments and snags. The results of this study will inform decisions about management of snags in conjunction with silvicultural prescriptions, leading to more effective long-term conservation of cavity-nesting birds in managed forests in the Pacific Northwest.

Using Genotyping-by-sequencing (GBS) to Elucidate Population Structure in Oregon White Oak (Quercus garryana)

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A pilot study was performed to obtain basic information on population differentiation across the species range of Oregon white oak (Quercus garryana) and to assess the validity of the three currently accepted taxonomic varieties, as well as to test the applicability of genotyping-by-sequencing (GBS) for obtaining genetic data for this species. Eighty-seven individuals representing 11 populations were sequenced in a single multiplexed GBS library, resulting in 18.1 gigabases of sequence data covering 20 megabases of unique sequences, estimated to represent ~2% of the genome. 20,751 high-quality single nucleotide polymorphisms (SNPs) were obtained, which were used to determine population differentiation and genetic structure. A selectively-neutral and unlinked set of 2,194 SNPs was developed and used for Bayesian genetic clustering analysis. Ordination-based and Bayesian clustering analyses revealed two distinct genetic clusters, one corresponding to Q. garryana var. garryana and the other to both vars. semota and breweri. Some evidence supports the presence of additional hierarchical structure within both of these genetic clusters, although no evidence could be found to support the taxonomic division between vars. semota and breweri. FST averaged 0.091, and was strongly correlated with physical distance (multiple $R^2=0.93$, $p<0.0001$). Population pair-wise FST was significantly higher between populations of different genetic clusters than among them. Heterozygosity was negatively correlated with latitude ($R^2=0.72$, $p=0.001$), and was higher in vars. semota and breweri than in var. garryana ($p<0.0001$). The success of sequencing and analyses using GBS merited expansion of this pilot project into a larger-scale study with higher representation within and among populations. Collections have been made for this expansion and further genetic data is pending.

Spatio-Temporal Mapping and Monitoring of U.S. Wetland Dynamics Through Continuous Change Detection and Classification of All Available Landsat Imagery

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Wetlands are known to cleanse polluted waters, protect shorelines, recharge groundwater aquifers, buffer flood and drought severity, and provide unique habitat to a wide variety of plants and animals. Despite their importance, nearly half of all U.S. states have lost more than 50% of their wetland area. In order to protect and conserve the nation's remaining wetlands, it is essential to know and understand where, when, and how wetland resources are changing. This study proposes the use of the Continuous Change Detection and Classification (CCDC) to describe long-term spatio-temporal trends of wetlands within six Landsat Worldwide Reference System-2 path/row scenes associated with the Landscape Change Monitoring System (LCMS) in ten U.S. states (Oregon, Colorado, Wyoming, Minnesota, Wisconsin, Maine, Pennsylvania, New York, New Jersey, and Delaware). Using Landsat MSS, TM/ETM+, and OLI imagery within LCMS scenes from 1972 to 2015, the objectives of this study are to: (1) Use the CCDC algorithm to continuously monitor every clear pixel of validated National Wetlands Inventory data to explore and attribute ecological and climate patterns related to wetland spectral response on inter-annual and intra-annual temporal scales; (2) use discovered spatio-temporal, spectral and ecological patterns found within the CCDC analysis along with 1-meter lidar data, to develop a detailed, automated wetland mapping and monitoring methodology that utilizes all available cloud-free Landsat pixels and classifies observed change; (3) evaluate patterns detected from known, stable wetlands and compare them to patterns seen in mitigated and/or restored wetlands.

By utilizing continuous, multi-seasonal imagery, this study will create a powerful methodology that integrates seasonal variability in hydrology regimes and vegetation dynamics within wetland classification. Additionally, long-term monitoring of mitigated wetlands will support a critical step of the restoration process and yield insight into the persisting stability of altered wetlands in the U.S.

Potential for Alternatives in Silviculture and Forest Products Marketing in Corvallis-centric Western Oregon

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Western Oregon small woodland owners are a very diverse group and can potentially mobilize significant volumes of wood for the forest products sector while providing an important and diverse set of ecosystem services. However, these resources, especially those that could potentially generate continuous revenue for the owner, are often not entering the market place. Current practices of the mainstream Oregon forest industry are focused on large quantity, homogeneous product streams and thus not well-suited for marketing small volumes of goods. Similarly, the associated silviculture (mainly variations of 1 species, fixed rotation length, single age, clear-cut harvest practiced by larger timber companies) is often not suitable for smaller woodlots. Continuous revenue generation requires the maintenance of a robust ecosystem through proper silviculture and also the techniques appropriate for selling small and varying amounts of diverse products. In my thesis research in the Departments of Wood Science and Engineering and Forest Ecosystems and Society, I am investigating whether and how alternative practices in silviculture and forest products marketing can change that. An interactive map on my poster provides a graphical overview of the area of application. The underlying data provide the foundation for identification of woodland owners that can potentially participate in my research and their options for alternative management and marketing opportunities. I will investigate through a mix of qualitative and quantitative methods that will be clear after a pilot study at the end of this summer until Summer 2017.

Recreation Behavior on Urban-Proximate and Rural U.S. Forest Service Lands in the Pacific Northwest

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Resource managers need an understanding of recreation behaviors and visitor characteristics to provide desired recreation opportunities that foster positive recreation experiences and connections between people and nature. However, in the face of changing natural resource landscapes and visitor preferences, there has been increasing uncertainty about the trends in recreation use patterns and changes in visitor behavior. The focus of this research project is to better understand national forest visitor behavior in settings with different levels of urbanization and on trips of different lengths. We use data from the Forest Service National Visitor Use Monitoring (NVUM) program collected on national forests in Oregon and Washington to compare visit behavior and visitor characteristics in

urban proximate national forests with visitation in forests in rural and amenity growth areas and for those visitors recreating close to home and those traveling farther away. Results from our research will provide recreation managers with more information about how visitors interact with the natural environment and help to inform resource management decision-making.

Do Conifer Provenances from Lower Rainfall Regions Have Higher Resistance to the Pathogen Fusarium Commune?

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Understanding the effects of abiotic and biotic variables on forest health is an important realm of study and can contribute to better forest management. This study looks at how tree seedlings whose seeds came from contrasting rainfall regimes respond to drought, the pathogen Fusarium commune, and a combination of both stressors. Drought is known to exacerbate pathogenicity and the effect of drought and fungal infection in this study will likely uphold this idea. The particular question of interest is whether the ensuing decline in seedling vigor will depend on the corresponding moisture regime of the seed's provenance. If seeds are collected from a dry climate, will the seedlings have a higher drought tolerance and therefore be less impacted by the pathogen than seeds from moist climates?

To investigate response to drought and pathogen induced stress, three different provenances that reflect wet and dry seed sources for both Douglas-fir (Pseudotsuga menziesii) and loblolly pine (Pinus taeda) will be grown in a greenhouse trial. For each provenance and each species, both droughted and well-watered seedlings will be inoculated with Fusarium commune, a common forest nursery pathogen. Throughout one growing season, measurements including survival, vigor, and disease impact will be collected to determine the individual and cumulative effect of drought and pathogen. It is predicted that both species of conifer seedlings from dry origins will exhibit more drought tolerance and therefore fewer symptoms of pathogen infection compared to seedlings from wet origins. Loblolly pine and Douglas-fir are economically and ecologically important tree species in the southern United States and Pacific Northwest, respectively. Increased understanding of provenance performance will aid in appropriate seed selection and potentially enhance seedling survival in adverse forest conditions.

Using Multi-temporal LiDAR to Quantify Burn Severity in a Mixed-ownership Landscape of Southwestern Oregon, USA

Michael S. Hoe, H. Temesgen, Christopher J. Dunn

The cost of fire suppression in the United States continues to rise, prompting concern from multiple landowners and agencies. Being able to provide current information about the spatial distribution and accumulation of hazardous fuel material is essential for mitigating losses, prioritizing fuel treatments, and protecting personal property and valuable wildlife habitats. My main goal is to provide more information about fire effects and burn severity over a mixed-ownership landscape. My specific research questions will address the feasibility of using LiDAR variables to quantify the amount of loss due to fire. The amount of basal area, biomass, and fuel loading removed by fire will

be explanatory variables of burn severity. My hypotheses are: [1] the difference in mean canopy cover, pre- and post-fire, has the highest correlation to existing burn severity estimates; and [2] burn severity maps created from calibrated LiDAR metrics are more accurate. I will begin by: [1] generating a raster for each specific metric for pre- and post- fire images; [2] compare the relative difference between each metric to those of Landsat imagery; [3] identify which LiDAR metric has the highest correlation to current burn severity estimates (LandSat); [4] compare the accuracy in predictions between LandSat and LiDAR to ground measurements; [5] calibrate LiDAR metrics using a correction factor(s) derived from field measurements; and [6] develop a LiDAR derived burn severity map. Provided that my hypotheses are true, these methods could be applied to any location with pre- and post-fire LiDAR data. Once the metrics have been refined, the resolution of the map will be improved 900 fold by utilizing the potential level of detail available from LiDAR relative to a LandSat pixel. Fire effects could then be studied across heterogeneous landscapes in higher detail, which would provide the basis for future research.

Biomass Estimation of Common Shrubs in Northeastern California

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The quantification of biomass is important to the fields of forestry, ecology, and range management. The prediction of aboveground shrub biomass can help land managers set and develop natural resource goals. Analysis of shrub biomass equations is often an overlooked problem because of the difficulty in estimation for plants that do not have an excurrent form. The equations that will be generated from this research will be useful in predicting fuel loading behavior and for calculating aboveground carbon levels. This information will benefit natural resource managers because biomass estimates can be used to build upon existing knowledge of how forest structure and understory components interact. The primary goal of this research is to assist land managers who are interested in mitigating climate change and reducing wildfire. A secondary goal is to obtain allometric relationships of woody shrubs so that aboveground carbon sequestration levels and estimates of fuel loading can be calculated more accurately. Research question: A question of interest is what predictive models best estimate biomass for eight shrub species using selected predictors, including plant height, crown width, and basal diameter in Lassen National Forest, CA? Methods: All data will be analyzed using the statistical program R. Biomass and allometric equations will be fit using nonlinear least squares regression. Leave one out cross validation will be used to estimate the accuracy of predictive models. All results will be evaluated using RMSE and by calculating bias. Interpretation: The scope of inference are eight species of shrubs that are common to Lassen National Forest, CA. Importance: Having access to species-specific biomass equations for individual shrubs common to the area can aid land managers in planning for the future.

A Matter of Trust: Public Perceptions of Oregon's Marine Reserves

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Oregon recently designated five new marine reserves, and research on biophysical conditions and stakeholder opinions (e.g. scientists, commercial fishermen) informed this designation process. Although more recent research has since been conducted on coastal resident attitudes toward these marine reserves, little is known about how other Oregonians, especially residents of this state's major population centers, perceive these reserves. It is critical to understand public support and trust associated with protected areas such as these because an absence of support and citizen-agency trust can decrease the ability of protected areas to accomplish conservation goals. This study investigates public knowledge, trust, and support associated with Oregon's new marine reserves. Date will be obtained from a mail survey (with an option to complete online) administered to a representative sample of residents (n=700) along Oregon's I-5 corridor, which includes major population centers such as Portland and Eugene. Results from these data will be compared to those previously collected from coastal residents (n=596). Three hypotheses will be tested. First, different sources of information about these marine reserves will differentially influence both factual knowledge about these reserves, and, support for these reserves. Second, there will be positive relationships between trust in the managing agency and both factual knowledge about these reserves and support for these reserves. Third, coastal residents will have greater trust, knowledge, and support than residents along the I-5 corridor. This study will aid agency managers as they seek to understand their relationship with the public and build trust where needed. This study also contributes to literature on citizen-agency trust by: (a) addressing an issue in a politically important population (e.g., voting majority) that is distant from the protected resource, and (b) illuminating potential differences between coastal and non-coastal residents in how they perceive marine protected areas.

Relationship Between Canopy Structure, Microclimate, and SNC Severity Among Different Ages of Douglas-fir Forests

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Swiss needle cast (SNC) is an endemic disease of Douglas-fir caused by Phaeocryptopus gaeumannii. The fungus infects newly emerged needles between April and August via stomata. As the fungus develops, the fruiting bodies (pseudothecia) block the stomata and affect gas exchange, dramatically reducing the photosynthesis rate in infected trees. Based on observations, SNC is more severe in young trees than in mature trees. Since leaf wetness may be a crucial factor for fungus reproduction, we hypothesize that the complexity in mature forests may cause several different microclimates, which is the key for needle infection susceptibility. We expect that there is more diversity of structure and micro-environments in mature forests than in young forests. Our question is, what is the relationship between canopy structure, microclimate, and SNC severity (% of stomates occluded by pseudothecia) among different ages of Douglas-fir forests? To answer this question, we will climb three trees at 4 paired young and mature forest sites (each about 120 years old) to measure

the tree, crown, and branch characteristics of Douglas-fir, as well as set up meteorological sensors to record the temperature and humidity on low-, mid- and top-canopy position. Also, we will sample 1-year and 2-year needles near the sensors and analyze the severity of SNC by counting the percent stomata occluded by pseudothecia. The scope of inference includes mature and young tree canopies of Douglas-fir forests in western Cascade Mountains at 2 different elevations in central Oregon.We only know about the ecology of P. gaeumannii in young forests. This study will provide increased knowledge on SNC disease in mature forests. In addition, we can use canopy station data to learn more about the relationship between disease and climate, and ultimately make inferences on climate change issues.

Thermotolerance of Coffea arabica: Potential Implications in a Warming World

Danielle E. Marias, Frederick C. Meinzer, Chris Still

Climate models predict increasingly frequent and more intense high temperature events that may impact plant species' distributions. Although high temperature events and drought stress are known to negatively affect photosynthetic performance, the legacy effects of these environmental stresses on the capacity to recover are largely unknown. Additionally, there is a poor understanding of the variation in thermotolerance among species. Shade-tolerant coffee (Coffea arabica) is the second most traded commodity in the world (after oil), but it is unclear how heat waves and drought might impact physiological responses, damage thresholds, and legacy effects on photosynthesis and productivity. The goal of this project is to evaluate the thermotolerance and aftereffects of short duration heat and drought stress on C. arabica using gas exchange, chlorophyll fluorescence, carbohydrate dynamics, and carbon isotope ratios. We used chlorophyll fluorescence to evaluate thermotolerance. The ratio of maximum variable fluorescence (Fv) to maximum total fluorescence (Fm) reflects the potential quantum efficiency of photosystem (PS) II and is used as a sensitive indicator of photosynthetic performance. To assess in situ responses of whole plants to simulated heat wave and drought, four treatment groups (n=5) included: control, heat, drought, and drought+heat. Heat and drought+heat groups were heated in a growth chamber for 1h45m at 49°C. Physiological measurements were made to monitor recovery. The thermotolerance curves Fv/Fm declined from 0.75 to 0, indicating that increasing temperatures decreased photosynthetic performance and that the photosynthetic performance is significantly diminished by increasing temperatures above ~40˚C. The in situ experiments demonstrated that recovery time was positively related to maximum damage caused by heat. Drought exacerbated the effects of heat damage on recovery.

Effects of Wood Substitution in Commercial Construction

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Wood is the primary building material in single-family residential construction, however, it lacks application in mid-rise and commercial buildings. Wood being a natural, renewable material that sequesters carbon is a natural fit for newer construction with enhanced sustainability goals. Despite this, new construction for commercial buildings is predominantly steel or concrete. The objective of this study is to assess the environmental impacts of steel and concrete structural materials

in commercial construction in Oregon, and compare them with the impacts of employing different substitution levels of wood products. Comparative cradle-to-gate, life-cycle analysis (LCA) is used with the help of the Athena Impact Estimator for Buildings software. Three case studies are presented that represent different building functionalities, material systems, and construction techniques. Evaluations are made of the global warming potential and impacts on fossil fuel consumption when structural materials are progressively substituted with wood. Preliminary results, from one case study, suggest that substituting wood products for steel in an existing office building results in over 25% reduction in the Global Warming Potential and Fossil Fuel Consumption for the structural system. The findings could help promote wood in commercial construction as a green building material, encouraging architects, engineers, and building owners to use wood, and increasing markets for Oregon wood products.

The Influence of Topography on the Efficacy of Stand Thinning in Enhancing Soil Moisture Availability and Tree Growth

Bryn Morgan, Klaus Puettmann, and David Woodruff

Global climate change is predicted to have a wide variety of impacts on forest ecosystems. Douglas-fir (Pseudotsuga menziesii) is of particular interest in the Pacific Northwest, where increasing temperatures and changes in the intensity of seasonal precipitation may have direct impacts on future tree growth. The study sites will be located in the Willamette National Forest (used as baseline) and near Roseburg (selected to represent potential future climate on the Willamette National Forest). Our objective is to assess whether thinning can be used as a tool to reduce the trees' sensitivity to drought by evaluating how the impacts of thinning on Douglas-fir growth and the influence of water usage on the growth response vary across the landscape. We will investigate these relationships across various topographic features, including contrasting aspects (northern versus southern facing), and hillside locations (upper, middle, and lower slope positions). In these locations we will select dominant tree samples to measure basal area increment (BAI) and use stable carbon isotope ratios (δ13C) in rings laid down prior to thinnings and 5-10 years after thinnings to provide insight into variations in yearly growth and intrinsic water-use efficiency (iWUE), respectively. In addition, we will measure other factors that may influence tree growth, and water availability and use, including slope, soil depth, soil texture, local tree density around the sample trees, and leaf area through measurements of sapwood basal area. The analysis will determine whether the relationship between weather conditions (as represented by the Palmer Drought Severity Index) and tree growth and water-use efficiency focus (as indicated by the isotope ratios) is different between the pre-and post-thinning periods. Specifically, we will test whether these relationships vary with aspect and slope positions. The other variables will be used a covariates that may provide improved, more detailed insights into why and how these relationships are influenced by thinning. The proposed study will inform future forest management plans in terms of the potential for drought mediation through density management, and for prioritizing landscapes where thinning practices are most necessary and effective in this context.

Fuel Treatment Longevity in the Blue Mountains

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Very large wildland fire is a growing occurrence in the western US. Fuel treatments are designed to reduce fire behavior, promote a resilient forest structure, and facilitate control efforts. Although there is widespread recognition that repeated treatments are needed to maintain desired stand structure, few studies have evaluated the length of time that fuel treatments meet objectives. In addition, fuel treatments tend to open the forest canopy, which increases light and stimulates vegetation growth. The length of time fire hazard is decreased within treated stands varies with different forest types. Dry ponderosa pine and mixed conifer forests are areas commonly targeted for fuel reduction. This study proposes to re-measure the Hungry Bob Fire and Fire Surrogate study site in the Blue Mountains of northeastern Oregon. In 1998, sixteen units were delineated and assigned to four treatment groups: mechanical thin, prescribed burn, both thin and burn, and no treatment control. My research question is: How does fuel loading and dominant understory vegetation type vary between fuel treatments, measured 15-17 years post-treatment, in the Blue Mountains of northeastern Oregon? Treatment longevity can be examined by comparing pre- and post-treatment understory vegetation type and fuel loading. My hypotheses are: 1) Fire increases the abundance of grass and fine forbs. 2) Shrubs are more prevalent in untreated units. 3) Fifteen to seventeen years after treatment, all treated units have lower fuel loading compared to pre-treatment fuel loading. The research I propose to conduct evaluates the status of fuel treatments that are nearing the end of their suspected lifespan. Quantifying the persistent changes in fuel loading and understory vegetation can aid in the planning and analysis of future fuels treatments, along with scheduling maintenance of existing treated areas.

Drought Stress and Performance of Douglas-fir and Loblolly Pine Seedlings from Wet and Dry Provenances in Oregon and the Southeast

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Due to climate change, environmental stresses such as drought are predicted to increase in many parts of the world. Plants, and trees in particular due to their longevity, must cope with an array of abiotic stresses, such as drought, throughout their lives in order to survive. Therefore, many trees have strategies to cope with periods of drought induced water stress, frequently accompanied by high temperatures, during the growing season. While there has been considerable research on drought and seedling physiology, there has been less work done on the combination of water and temperature stress.

This study will investigate the physiology, hydraulic properties, adaptability, recovery, and vulnerability of seedlings of two major timber species, Douglas-fir and loblolly pine, from wet and dry provenances in Oregon and the southeast of the United States (correlated with high and low putative drought resistance). The aim of this study is to determine whether there are certain identifiable characteristics of high-end performers, such as xylem conductivity or non-structural carbohydrates, in relation to performance under drought and in relation to provenance. Furthermore, this study

investigates whether those relationships hold with the addition of temperature stress. Lastly, the study examines whether various seedlings, when faced with a second drought or xeric growing conditions, are better adapted to handle stress, or whether they are more vulnerable. It is hypothesized that the different provenances will exhibit varying characteristics which determine their performance under drought, and that seedlings from drier provenances will be better prepared, physiologically and morphologically, to handle drought conditions.

Thinning and Vegetation Control Impacts on Understory Dynamics in Mature Douglas-Fir Forests

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Silvicultural practices such as thinning and vegetation control have the potential to significantly influence the development of understory vegetation. This study will investigate two of the ways in which these practices can influence forest understories: by altering vegetation dynamics and influencing the response of underplanted saplings to disturbance, in this case an ice storm. The study will take place on the Mature Forest Study, an ongoing study in mature Douglas-fir forests in the Oregon Coast Range. The Mature Forest Study was designed to examine the effects of vegetation control treatments and thinning treatments that incorporate different retention levels on tree regeneration and understory vegetation. I will use existing long-term data to examine how different levels of overstory retention, in combination with understory spray treatments, influence the development of understory plant communities over the first 20 years after thinning. Understory response will be quantified using measures of both shrub layer species and structural diversity. In addition, this study will address whether spray treatments influence the development of late seral vegetation by reducing the "legacy effect" of pre-treatment plant communities. I will also examine how thinning practices and overstory environment affect the types and severity of damage caused by an ice storm to underplanted saplings. I will assess the severity (e.g., percent live crown or height loss), type (e.g. crown loss, bending), and source (direct or indirect) of damage that occurred to understory saplings, and how that differs among tree species, amount of overstory cover, amount of hardwood present in the overstory, and slope. This information will greatly expand understanding of understory response to management. Few studies have examined either the interacting effects of vegetation control and thinning on understory community dynamics, or the impacts of storm damage on tree regeneration in Douglas-fir forests.

Overstory Structure and Community Characteristics of Oregon Ash Forests of the Willamette Valley, Oregon

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Oregon ash (Fraxinus latifolia) is often a dominant component of forested Willamette Valley wetlands. These forests often persist in areas that are otherwise unusable due to duripan soil horizons that lead to seasonal flooding. These remnant ash-dominated forests likely harbor elevated levels of biodiversity relative to the surrounding landscape. In particular, they serve as refugia for epiphytic

lichens and wetland plants. All North American Fraxinus species are threatened with functional extirpation due to the invasive insect, the emerald ash borer (EAB). EAB has largely removed ash from forest canopies in the US Midwest, altering ecological and hydrological regimes in those systems. The loss of ash in Midwestern forest canopies (and the resulting changes in overstory structure) has shifted the composition of understory plant communities, often leading to increased exotic cover. Currently, the ecology of Oregon ash forests and their associated biota is poorly understood. I will describe the range of stand conditions and plant assemblages that are associated with Oregon ash forests and how patterns of community composition are related to local hydrology. I will establish plots in 15 Willamette Valley ash stands in which I will measure community composition (species present and functional diversity) and overstory structure (species present, stand density, age, height). Plots will be arranged along a hydrologic gradient in each stand (increasing in distance from the nearest stream). Vegetation plots will also be stratified into those that are regularly inundated and those that are not. Relationships between hydrologic regime, overstory structure, and community composition will be tested using community ordinations and multiple regression modeling. This study will provide a baseline description of Willamette Valley ash forests prior to the arrival of EAB. This will allow land managers and ecologists to track or predict changes brought about by future ash mortality.

Assessing Riparian Buffer Effectiveness: The Role of Antecedent Moisture Conditions in Predicting Erosion and Sediment Transport

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Fixed-width riparian buffers have been widely adopted as a forest harvesting guideline to minimize the amount of eroded sediment that is transported from harvested cutblocks to streams. However, there is still uncertainty on the effectiveness of these buffers at controlling runoff, erosion, and sediment transport, especially during infrequent, high intensity precipitation events. The objective of this research is to examine the influence of antecedent soil moisture conditions on rainfall infiltration, runoff, and erosion following land cover alteration from timber harvesting. Research will occur in high elevation (~ 1482 to 2657 m), snow dominated, forested catchments on the eastern slopes of the Rocky Mountains. Sites are dominated by Pinus contorta var. latifolia at lower elevations and Picea engelmannii and Abies lasiocarpa at higher elevations. The catchments, Star Creek West (variable retention with reserves), Star Creek East (strip cut), and McLaren Creek (shelterwood) will be harvested with 30 m, fixed width buffers, while North York Creek will serve as an unharvested, reference catchment. Data collection in spring/summer 2015 will be used to assess the a) spatial and temporal variation in soil moisture within a riparian buffer, b) sediment yield from the harvested hillslopes to the riparian buffer, and c) runoff response to simulated, high intensity, rainfall events (using a rainfall simulator) under different antecedent soil moisture conditions. Comparisons will be made between plots within the undisturbed control catchment and the three harvested catchments. Site features such as slope, aspect, soil texture, vegetation cover, and ground cover will be characterized and serve as independent variables to help describe differential erosion and sediment responses. This study will improve understanding of riparian buffers effectiveness at mitigating sediment transport from harvested areas to streams, specifically in steep, snow-melt dominated,

headwater catchments, which are vital to healthy aquatic habitat and drinking water supply.

Does Songbird Habitat Selection Change During Migration?

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We know that bird migration is associated with high mortality rates, yet because of their small size, little is known about the songbirds' whereabouts during migration, the factors affecting their choice of route, and ultimately their survival. Many songbird species select different habitat on the breeding versus wintering grounds, but we have yet to document habitat selection along migration routes. While limitations in technology make tracking of individual songbirds difficult, recent advances in data sharing and archiving have made possible the study of population migration routes at a continental scale. Such data are provided by eBird, an online bird checklist program that compiles and archives citizen bird observations using a standardized protocol. I aim to model habitat selection along migration routes at two levels: 1) individual songbirds for which geolocator data has been retrieved, and 2) at a population scale using eBird data. I expect that habitat selection at individual scales should reflect population-level habitat selection along migration routes. Rates of change in habitat selection across latitudes and time should be gradual, although geographical barriers and weather may introduce abrupt changes over space and time. In addition, those habitat components may become more or less stringent as migration progresses. My second objective is to identify whether habitat selection along routes varies inter-annually, possibly influencing the choice of migration routes. Are songbirds selecting a yearly migration route based on the conditions along the route? I hypothesize that songbirds are selecting specific habitat components at an individual level which should be reflected in variation of migration routes at the population level. While key migration stopover habitat sites are sometimes protected, this study will guide conservation of additional habitat along migration routes, thus facilitating survival of songbirds during this challenging phase of their life.

Ecological Thinning In Mature Ponderosa Pine Forests: Investigating Vigor Response In Two Spatial Distributions

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Dense ponderosa pine stands in the American West face increasing vulnerability to stand-replacing wildfire and bark beetle outbreak, especially given projected warming climate trends. Ecological thinning and burning of ponderosa pine forests have been shown to increase tree growth and decrease pathogen susceptibility. However, there is recent debate among managers as to whether thinning for a patchy (containing clumps and gaps) or an individualized tree distribution will better achieve these goals, especially for older trees. To explore these potentially opposing management approaches, I seek to answer the question: How does tree vigor differ between patchy and individualized spacing for thinned mature ponderosa pine stands in east-central Oregon? My objective is to compare tree vigor responses between two sites with different spatial distributions. To measure tree vigor, I will gather physiological data on tree water use, resin flow and diameter growth rate over June to September 2015. Data will be collected in two stands in east-central Oregon: one at

Pringle Falls Experimental Forest (individualized distribution), and another in the Deschutes National Forest (patchy distribution). Both are mature stands (~160 years), treated within the past 5 years. The major hypotheses of this study are (1) tree vigor responses differ between uniformly thinned stands and those with a clumped distribution, and (2) tree vigor overall (across different sample measures) is higher in uniformly thinned stands. By examining this aspect of thinning strategy, I will reassess a key divide in management thinking. By better defining the response of stands to different spacing arrangements, managers can more appropriately formulate approaches for enhancing ponderosa pine stand resilience.

Interactions Between Silvicultural Herbicides and Cervid Herbivory: Implications for Reforestation and Biodiversity

Thomas D. Stokely, Matthew G. Betts

Modern forest management practices include uniform timber harvesting, reforestation and herbicide treatments used in conjunction to truncate succession and increase the production of crop trees over non-commercial species. Intensive forest management may have substantial effects on biodiversity, ecological functioning and wildlife-habitat associations. For instance, timber harvests promote the production of early seral plant species, providing a diverse habitat substrate for wildlife, including large cervid herbivores. However, intensively managed stands often lack the diversity commonly associated with early seral. As cervids are attracted to harvested stands, selective foraging can have substantial effects on plant communities and reforestation efforts. I hypothesize that the effect of herbicide treatment on competition between early seral plant communities and planted conifer trees is mediated by cervid herbivory. A) The extent of foraging by cervids should be greatest in naturally regenerating and lightly treated stands where forage is readily available. However, cervids will still frequently (but less extensively) utilize heavily treated stands where forage has been removed. B) Cervid herbivory should cause greatest reductions in early seral competition where herbicide treatments reduce the diversity and abundance of native forage species. The interactive effect of herbivory and herbicide will result in depauperate plant communities, dominated by non-palatable herbs and planted conifers. C) Cervids positively affect planted conifer growth within intermediate treatments, where forage availability is high and herbivory is focused on competing vegetation. However, cervids should negatively affect conifer growth and survival with heavier herbicide treatments, where forage availability is low and herbivory is focused on dominant conifer trees. To test these hypotheses, we developed a large-scale experiment in the Oregon Coast Range consisting of herbicide treatments (Control, Light, Moderate, Heavy) applied at the stand scale (~13 ha) and replicated using blocks (7 blocks, N=28), with a cervid exclusion treatment (15x15 m) nested within each herbicide treatment stand.

Fire and Cavity Nesting Bird Communities: Do Fire Severity and Time-Since-Fire Mediate Community Composition and Nest-Web Assemblages?

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Secondary cavity nesting bird species depend on cavities created by woodpeckers, known as primary excavators. Because of the hierarchical relationship between woodpeckers and secondary cavity nesting birds, cavity nesting bird communities can be studied as nest-webs. Nest-webs, like food webs, diagram hierarchical relationships in an ecosystem. Nest-webs are an important concept for understanding cavity-nesting bird community assemblages. Current studies of cavity nesting bird species and fire focus on guilds or species, while few studies examine cavity nesting bird species community response to fire. Previous research indicates that the proportion of cavities created by a woodpecker species (e.g. Northern Flickers, Colaptes auratus) selected by a secondary cavity nesting bird species (e.g. Tree Swallows, Tachycineta bicolor) is not the same in all ecosystem types. Cavity quantity and quality vary across forest types, explaining some but not all of the differences in these relationships. In this study I will determine the influence of fire severity (high-, low-, and unburned) and time-since-fire on cavity nesting bird communities and nest-web assemblages. To meet this objective, I will diagram the nest-web in a highly diverse cavity nesting bird community in six mixed-severity fires, ranging from 1 – 13 years-since-fire, in the Sisters Ranger District, in central Oregon. I will use community analysis to determine community response to fire severity and time-since-fire. Finally, in this study I will analyze nest-webs with network analysis to identify the strength of the relationships between woodpeckers and secondary cavity nesting bird species.

Student Citizen Science: Developing and Evaluating an Environmental Education Program

Katherine Williams, Troy Hall, Matthew Betts
Department of Forest Ecosystems and Society, College of Forestry, Oregon State University

Environmental education and outreach (EEO) programs seek to foster an appreciation for the natural world while introducing students to scientific thinking. Connectedness to nature has been demonstrated in the literature as an important predictor of environmentally responsible behavior. One promising EEO technique is citizen science, which engages non-scientists in the systematic collection and analysis of data. The Betts Forest Landscape Ecology Lab presents fifth grade students in Corvallis, Oregon and the surrounding areas with information about hummingbird identification, the utility and necessity of pollinators, and hummingbird sighting data collection. These students are invited to participate in a citizen science project which monitors hummingbird populations in the region. This type of educational programming is increasingly popular; however, research to investigate its actual effects on students is limited. This 2 phase, mixed-methods project aims to answer this question: what is the impact of this program, if any, on students' knowledge of hummingbirds, students' scientific identity, and their connectedness to nature? Phase 1 will develop and adapt the current curriculum to adhere to best pedagogical practices through a thorough literature review and consultation with environmental educators. Phase 2 will be conducted in two parts. Quantitative

pre- and post-test questionnaires will assess the impact of the program on students' knowledge of hummingbirds, their scientific identity, and their connectedness to nature. Questions to measure dependent variables will be adapted from the literature to fit the specific context of the hummingbird project. Pre-test questionnaires will collect information on factors known to relate to the dependent variables - parental education level and gender being two examples. Semi-structured interviews with participants who indicated significant changes will subsequently explore the reasons behind these changes, and why change in scientific identity and connectedness with nature did or did not occur.

A Global Analysis of Large Carnivores' Prey

Christopher Wolf and William J. Ripple

The large terrestrial carnivores are an ecologically important, charismatic, and highly endangered group of species. As a result, considerable effort has been devoted to understanding the causes of large carnivore endangerment to aid large carnivore conservation efforts. We assessed the importance of prey depletion as a driver of large carnivore endangerment globally. To carry out this research, we first used the literature on carnivore diets to list the prey of each large carnivore species. We then summarized and mapped the statuses of large carnivores' mammalian prey both regionally and worldwide using data from the International Union for Conservation of Nature (IUCN) Red List. We found that the clouded leopard, Sunda clouded leopard, tiger, dhole, and Ethiopian wolf all have at least 40% of their prey species endangered. In addition, at least 40% of the prey of each of these carnivores show decreasing population trends. From 1996 to 2008, the prey of 11 of the 17 large carnivores in our analysis became more highly endangered on average. We found the highest rates of prey endangerment in southeast Asia and other parts of the developing world. Our research may benefit large carnivore conservation by clarifying the relationship between prey depletion and large carnivore endangerment at a global scale. We have identified species and regions where prey depletion is particularly severe, potentially helping large carnivore conservation projects better conserve the prey upon which predators depend.

Photo: L. Leite

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RESEARCH IN BRIEF

Presenters at this year's Western Forestry Graduate Research Symposium are invited, and encouraged, to submit a 1400+- word, 2 to 4 figure briefing/summary paper about their current research for a magazine and website designed to highlight current research of students in forestry related sciences.

Submission is open to all students with award winners given the opportunity to have their piece featured. This is a student run, and directed project intended to be an opportunity for us to help support and share fellow student's research and work. Please indicate if you are interested in being part of the editorial collective.

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Photo: Jonathan Batchelor

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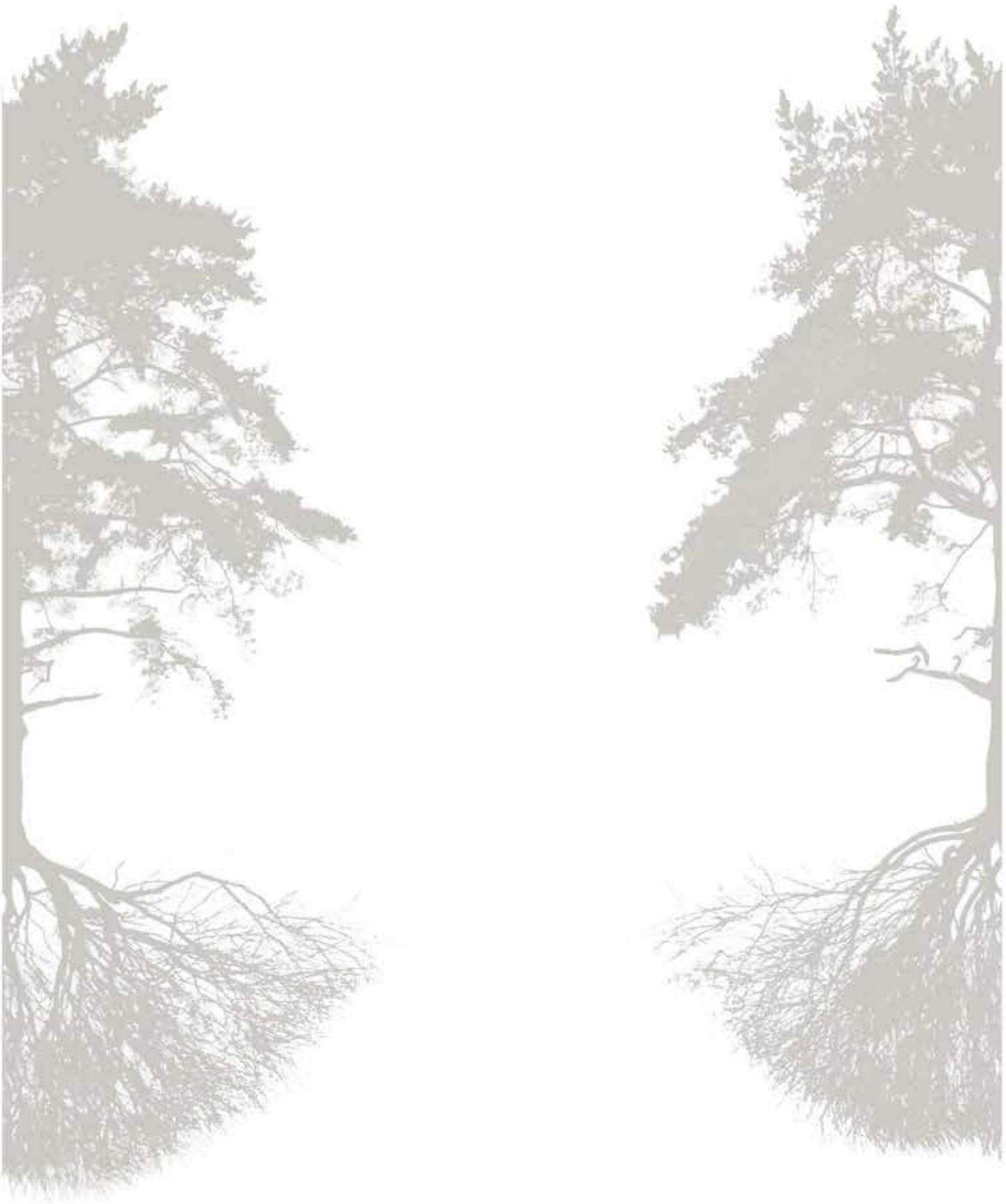
Notes



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