Forest Health Assessment of King County’s Park Lands
David Kimmett\textsuperscript{a,b}

Forested areas of urbanized landscapes provide a wide range of ecosystem services - environmental, social, and economic. King County, like many local jurisdictions, has strategically acquired numerous forested parcels through long-term open space preservation initiatives. The first need for a long-term forest stewardship effort that conserves and enhances forest health is to establish baseline forest conditions. King County Parks is collaborating with Forterra, a Seattle-based land conservation organization, and forest consultants International Forestry (INFO), on a forest assessment of over 23,000 acres of public open space lands distributed across 150 park sites in the greater Seattle metropolitan area. The partners have developed a rapid “Forest Landscape Assessment Tool” (FLAT) that allows field staff to gather descriptive data about forest conditions quickly. Habitat management units (HMU) are delineated and mapped for each site based on forest type and other site characteristics and uses. Once the data is collected and geo-referenced, a matrix analysis can be conducted across the multiple forest attributes for each park site. King County’s collaboration with Forterra and INFO on the forest assessment will produce the following outcomes: establish baseline forest data that identifies conditions that may need corrective and restorative actions; develop long-term forest stewardship recommendations for King County managers; develop rapid forest assessment protocols that can be replicated on other public lands; and, identify opportunities to collaborate with public and private agencies on forest stewardship.

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Valuing Environmental Stewardship: A Cost Approach in King County, Washington
Jean Daniels\textsuperscript{a,b}, Alicia Robbins\textsuperscript{c}, Weston Brinkley\textsuperscript{d}, Kathleen Wolf\textsuperscript{c}, and John Chase\textsuperscript{b}

Communities and agencies are increasingly challenged to find more cost-effective strategies for natural resource conservation and management. Many organizations enlist volunteers to care for the land and particular resource systems such as forests, waterways, and shorelines. Volunteer programs incur costs, such as staffing and project materials. Environmental stewardship volunteers contribute valuable time and expertise, as well as consumable and non-consumable goods to planned maintenance and restoration events. Little is known about the value of citizen stewards’ contributions or the contributions of host organizations. Studying the economic aspects of civic environmental stewardship can contribute to a better understanding of the impacts and implications of volunteer programs. We developed a cost-based approach to account for the economics of stewardship activities per field event (rather than a per person basis). Measures included expenditures of sponsoring or host organizations, volunteer travel costs to and from events, contributed consumable and durable goods, and labor value. Results show that contributions made by volunteers and hosts are significant. Using a survey administered to volunteers and host organizations at restoration events in King County, WA we estimate the valuation of 17 sampled events to be approximately $59,000. Extrapolating to all stewardship volunteer events in King County Parks during the Spring 2011 field season, contributed values may be as high as $121,000.

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Are We Safer? Analyzing the Federal Human Factors/Leadership Training
Bob Loveless\textsuperscript{a,b} and Adam Hernandez\textsuperscript{c}

A human factors/leadership (HF/L) training program (L-courses) was initiated in 2000 by the National Wildfire Coordinating Group. This training addresses human decision-making errors with the expectation of reducing injuries, entrapments and fatalities in wildland fires. Six courses are progressively available during a firefighter’s career. At the end of 2009, over 40% of federal wildland firefighters have had at least one L-course but only 0.11% had completed all six courses. Firefighters take successive L-courses on average once every two years. Using Poisson regression, the annual rate of firefighter entrapments (number/1000 person-hours exposed on the fire line) was examined for six years prior and ten years after program implementation. Since program inception, rate ratio estimates indicate an 80% (0.49 – 0.92, \(a = 0.05\)) reduction in the annual entrapment rate for all (federal and non-federal) wildland firefighters after controlling for variation in annual acres burned and exposure time. A similar 73% (0.13– 0.92) reduction was observed for federal firefighters. We recommend continuation of the HF/L courses and suggest data collection improvements for continued monitoring.

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Prescott, Arizona: A Case Study in Community Wildfire Defense
Hylton Haynes\textsuperscript{a,b}

Firewise Communities/USA® is a national program designed to encourage residents of wildfire-prone areas to take action to reduce wildfire risks to their homes and neighborhoods. In 2001, 10 pilot communities were identified nationally and formally recognized. One of these communities is Timber Ridge located in Prescott, Arizona. This paper examines how this effective community action movement has evolved in the city of Prescott and how local, state and federal stakeholders are collaboratively sustaining and enhancing community resilience in the wildland/urban interface.

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Integrating Fire Risk Reduction and Carbon Management in Western Forests
Elaine Oneil, a,b James McCarter, a Bruce Lippke, b and Kenneth Skog d

A decision support tool was developed to identify treatments where the synergy between reduced fire risk and carbon management objectives is most likely to occur. The tool automated the process of extracting relevant stand and site data from 18,000 forest inventory plots covering major forest types in 11 western states. Each plot was simulated in FVS using 9 different management strategies. Random fire events based on historic fire occurrence by ecosystem type were included in the simulation in order to provide insight on where to prioritize management of fire prone ecosystems and to identify the thresholds for treatment effect based on forest inventory attributes at any given point in time. Data were sorted and summarized across state, ownership type, forest type, geographical region within state, and fire risk. The results provide a comparison of fire and carbon impacts by treatment type for the forest and for the product stream that comes from the forest under a given management regime. The CORRIM life cycle carbon-modeling framework was used to characterize outputs from treatments including products, and carbon offsets. Based on these analyses and summaries there are many forest types that can be expected to experience declining carbon stores from wildfire. Treatments can mitigate losses in forest carbon under some conditions. Treatments that produce long-lived products provide mitigation outside the forest, but do not necessarily reduce fire risk. Trade-offs between these goals will be discussed using representative examples from the databases generated using this decision support tool.

West Wide Wildfire Risk Assessment
Janet Hoyta,b

Wildfire risk in the western US is increasing and becoming a more complex challenge that warrants coordinated assessment, planning and response. Sanborn is currently leading the West Wide Wildfire Risk Assessment (WWA), a wildfire risk assessment of all lands for the 17 western states and selected Pacific Islands. The WWA documents the risk from wildfire by quantifying the magnitude of the current wildland fire problem in the West. The WWA is unique because it assesses all lands across the west using consistent data and methods, therefore providing information to support planning and decision making at national, regional, state and local scales. The project uses one standard method to model and summarize wildfire threat, fire effects and wildfire risk. The project has been completed in collaboration with the states, with state input and feedback provided throughout the project. With the first phase of the assessment expected to be completed in the spring of 2012, this project will result in a wealth of data being delivered to the states. These WWA results will provide a foundation for coordinating policy and baseline data for state and county level planning in the West, especially for those states with limited resources. Sanborn will provide an overview of the assessment and its results, highlight some of the data that was developed for the project, and discuss possible applications of the WWA.

Fuel Moisture Dynamics across Developmental Stages of Northern Rockies Forests
Michael Battaglia,a,b Paula Fornwalt, b Terrie Jain, c Andrew Hudak, c Russ Parsons, d and Russ Graham c

Fuel moisture plays an important role in determining fire behavior. Herbaceous, shrub, and woody fuel moisture influence surface fire behavior by determining if these fuels will act as a heat sink or source. Foliar moisture influences the amount of heat energy required to initiate a crown fire. Forests of different developmental stages consist of various combinations of tree species, densities, and canopy openings. These different developmental stages in turn influence the types and arrangement of fuels available to burn and the fuel moisture of these fuels. A better understanding of how forest structure and composition influence fuel moisture dynamics can inform managers of potential fuel complexes that can maintain higher fuel moistures later into the fire season. In this study, we monitored moisture of tree seedlings, shrubs, herbaceous plants, woody fuels, litter, dust, and soils over the 2011 growing season in various developmental stages of mixed conifer forests of the Northern Rockies at the Priest River Experimental Forest. Our intent is to quantify the temporal changes in fuel moisture for each fuel strata in relation to the forest developmental stage. This information will be linked with concurrent studies that are currently quantifying heterogeneity from the site to landscape with the ultimate goal of investigating the role that landscape heterogeneity of forests can enhance landscape resiliency to wildfire.

Postfire Succession in a Sagebrush Steppe and Western Juniper Community in Northeastern California
Sara Hannc,a,b and Ken Fulghamb

The sagebrush steppe ecosystem of the Intermountain West has experienced a decline over 150 years due to changing fire regimes, invasive species and conifer encroachment. One species of concern is western juniper (Juniperus occidentalis), whose distribution and density has expanded dramatically. Additionally the invasion of exotic annual grasses like cheatgrass (Bromus tectorum) have led to reduced productivity, biodiversity and increased high severity fires. Prescribed fire is an effective management tool in the restoration of sagebrush habitats. We examined the long-term, post-fire vegetation dynamics of a sagebrush steppe and western juniper community at two study sites located in Modoc County California. The immediate post-fire plant communities at 10 years were dramatically different than those measured nearly thirty years after the fire. While invasive annual grasses dominated the area in the years immediately following fire, native perennial grasses and forbs began recovering after 10 post-fire growing seasons. Following nearly 30 growing seasons, perennial grass and forb cover and productivity were still greater than pre-fire levels. Sagebrush cover had also recovered to pre-fire levels, although decidedly slower than herbaceous recovery. Evidence of post-fire western juniper establishment was evident. There were significant differences in the post-fire vegetation between the sampling sites, confirming that the heterogeneity of sagebrush plant communities leads to differences in predicting post-fire succession.
The Implementation of Technology to Promote the Application of Fire Science

Chet Buell*a,b

Funded by the Joint Fire Science Program (JFSP) the Southern Fire Exchange (SFE) is filling a relatively new role in the promotion of prescribed burning throughout the Southeastern United States. Historically, promotion has been through the individual State Forest Departments and Prescribed Fire Councils, the US Forest Service and a variety of other organizations. The unique role played by SFE, and other JFSP consortia across the country, is increasing the visibility, accessibility, and application of fire science in both prescribed fire and wildfire management. To be most effective in this activity, the SFE is actively using social media, websites, and discussion forums to help wildland fire professionals and the public interact, and learn how research is answering questions and solving problems for them. This paper explores the successes and challenges we have experienced in tackling the rapid dissemination of fire science and research into practical applications.

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Modeling the Consequences of Escaped Large Wildland Fires

Matthew Thompson,a,b Michael Hand,b and Darek Nalleb

Land management agencies face uncertain tradeoffs regarding investments in preparedness and fuels management versus future suppression costs and impacts to valued resources and assets. The expected suppression costs and impacts of fire are not equal across landscapes or across regions, suggesting opportunities for efficiency gains by prioritizing funding where net wildfire management costs and detrimental impacts are lowest. It is critical, therefore, to have the ability to estimate the likely socio-economic and ecological consequences of escaped large wildland fires. We present an approach to quantify likely consequences by sampling from a set of simulated empirical distributions. The foundation of this approach is the simulation of escaped large wildland fire occurrence and growth across the landscape of interest. With this dataset we can estimate likely suppression costs on a per-fire basis, based on historical fire cost data and characteristics associated with each event. We can also estimate likely impacts of wildfire, by overlaying simulated fire perimeters with geospatial maps of valued resources and assets. Using bootstrap sampling techniques we can then estimate the consequences of any given number of escapes in any given location. Through a case study on the Deschutes National Forest, we illustrate how our approach can be coupled with information on initial attack success and fuel treatment effectiveness to analyze investments across the wildfire management spectrum.

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Applying Wildfire Risk Assessment to Inform Strategic Fuel Treatment Prioritization

Matthew Thompsona,b and Dave Calkinb

In recent years policymakers and managers have increasingly turned to the field of risk analysis to better manage wildfires, and to mitigate losses to highly valued resources and assets (HVRAs). This trend is evident, for instance, in the design and delivery of spatial risk assessment tools embedded within the Wildland Fire Decision Support System, and in the establishment of comparative risk assessment as the scientific basis for the National Cohesive Wildland Fire Management Strategy. An emerging wildfire risk assessment framework includes three primary components: wildfire simulation modeling outputs quantifying likely fire behavior, geospatial identification of HVRAs, and the characterization of fire effects to HVRAs. Key strengths of this framework include the spatial identification and quantification of expected wildfire-related benefits and losses across the landscape, the ability to formally incorporate expert judgment and local expertise, and the consistency of the framework across planning scales. Results of risk assessments can be incorporated with information regarding management objectives, priorities, and treatment opportunities, to inform strategic fuel treatment prioritization. In this presentation we highlight application of the risk assessment framework to inform fuel treatment prioritization at the forest and regional level. Specifically we present results from recent efforts on the Lewis and Clark National Forest in Montana, and across the Forest Service Rocky Mountain Region. We describe opportunities for current and future application of the framework, and identify additional research needs.

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Characteristics of National Large Airtanker Use in Federal Fire Suppression

Crystal Stonestifer,a,b Dave Calkin,b Matthew Thompson,b and Darek Nalleb

Large airtankers have been widely used in fire suppression operations on federal lands in the United States. Due to aging aircraft and strict airworthiness requirements, the current fleet of airtankers has declined from a high of 43 planes in 2000, to 11 in 2011. At the same time, maintenance costs and exposure risks associated with flying aging aircraft increase each year. The US Forest Service now faces imminent decisions that will shape the airtanker fleet of the future. Moving forward, the large airtanker program must maintain economic viability while simultaneously sustain a fleet of sufficient size to meet suppression demand during periods of critical national fire preparedness. Understanding the characteristics of large airtanker usage in federal fire suppression operations is key to successfully meeting these objectives, yet no dataset currently exists which comprehensively documents these pattern of use or the strategic objectives at play. In this, we present a novel effort at comprehensive integration of spatial airtanker drop data with resource orders and spatial and contextual fire information. Onboard Load and Monitoring System (OLMS) retardant delivery data are matched to Resource Order and Status System (ROSS) large airtanker requests and spatial fire information to track precise locations of airtanker retardant drops on federal lands. The resulting dataset provides a national picture of the majority of large airtanker use in 2010 and 2011. These types of data analyses should help to define the specifics of future large airtanker contracts and direct the parameters of potential federal aircraft acquisitions.

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Persistent Questions about Wildfire Economics
Wallace Covington

The Ecological Restoration Institute at Northern Arizona University was asked by the Department of Interior to conduct a third-party analysis to answer persistent questions about the economic efficacy of fuels reduction treatments. The ERI-NAU organized a writing workshop with leaders in the field of fire and natural resource economics to conduct the analysis. In this technical session we will present the results of the workshop.

• Introduction/opening remark by Wally Covington.
• Legacy of Hazardous Fuels Reduction Treatments by Yeon-Su Kim.
• County-level effects of fuel treatments on wildfire suppression costs by Jonathan Yoder (tentative).

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Individual and Organizational Influences to the Use of Fire Science
Vita Wright

Insights into the science delivery and application process in the context of land management can be gained from scientific literature on human behavior, communication, and organizations. Using social science theory and methods, I studied individual and organizational influences to the use of science by federal fire managers and decision-makers. Results supported the 25-year-old Technology Acceptance Model, which showed beliefs about usefulness to be better predictors of use than beliefs about ease of use. Beliefs and attitudes toward research were diverse, with National Park Service managers, fire ecologists, and those with graduate education showing more positive attitudes toward research, more use of research, and more frequent relationships with scientists. Survey respondents were separated into early and late adopters, allowing the Diffusion of Innovation theory to be used to develop communication strategies to shorten the time to diffusion. During a second study found differences in the communication networks of decisionmakers, program managers, and staff specialists; this study further contributes to science delivery strategies. In addition, perspectives on organizational culture and process for innovation and learning varied by pay grade level. The following characteristics of learning organizations showed the most room for improvement: time for reflection, appreciation of differences, and analysis of assumptions. Recommendations are provided for scientists, science communicators, and upper-level land managers interested in bridging the gap between science and decisionmaking by fire managers. These concepts are also relevant to other forest management disciplines.

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