1. **Project Title**
   Go Big or Go Home? Tools and Processes for Scaling up Collaborative Forest Restoration

2. **List of principal investigators and other key personnel names and affiliations**

| Role | Name (Last, First) | Affiliation |
|---|---|---|
| Lead PI | Davis, Emily Jane | COF FES and Extension |
| CoPI | White, Eric | PNW |
| CoPI | Bailey, John | COF FERM |
| CoPI | Spies, Tom | PNW Research Station |
| CoPI | Lindberg, Kreg | COF FES |
| CoPI | Leavell, Daniel | COF FES and Extension |
| CoPI | Merschel, Andrew | COF FES |

3. **Project starting and ending date**

| | |
|---|---|
| Start Date | 10/2015 |
| End Date | 12/2017 |
| Duration (months) | 27 |

4. **Total Project Costs**

| Year 1 | Year 2 | Year 3 | Total |
|---|---|---|---|
| $128,450 | $113,698 | $7,852 | $250,000 |

5. **Summary Abstract – 250 words**

Federal agencies, state government, collaborative groups, and businesses are under great pressure to increase the pace and scale of restoration in fire-adapted landscapes on Oregon's eastside to meet ecological and economic needs. However, forest collaboratives have thus far typically focused on identifying agreement and supporting the implementation of forest restoration projects at smaller-than-landscape scales. At the same time, Forest Service planning processes still do not reach landscape scales despite a stated Agency commitment to "all-lands" planning; managing across ownerships remains elusive. Meanwhile, scientists have been challenged to develop landscape tools that can be used in social-ecological systems to help address practical problems. The goal of this research is to analyze how forest collaboratives and Forest Service managers can successfully plan and manage at landscape scales, and determine how scientific research, participatory simulation modeling, and innovations in collaborative participation can contribute to the processes. Our primary research components are participatory landscape simulation with collaboratives, understanding how collaboratives and the Forest Service conceive of landscapes, and detailing how science can be more effectively engaged in collaborative landscape planning. Our research addresses three IWFL themes: Resilient Ecosystems, Healthy People and Communities, and Competitive and Innovative Products.

**Project Title**

Go Big or Go Home? Tools and Processes for Scaling up Collaborative Forest Restoration

## A. Project Description

### 1. Introduction and justification

Federal agencies, state and county governments, collaborative groups, and businesses are under great pressure to increase the pace and scale of restoration in fire-prone landscapes on Oregon's eastside to meet ecological and economic needs. The State of Oregon and Forest Service Region 6 have invested heavily in projects and efforts (e.g., the State Federal Forest Health Program and the Eastside Restoration Strategy) to increase the capacity of forest collaboratives. The Forest Service is attempting to work more rapidly and at larger spatial scales by 1) analyzing resource conditions and restoration needs at landscape levels, and 2) using collaborative groups that focus on landscape-level planning.

**IWFL Research Theme Connections**

**Resilient ecosystems**—We provide tools for active collaborative management that improve forest health and resilience of ecosystem services to disturbance and climate change while strengthening connections between landscapes and rural communities.

**Healthy people and communities**—Collaboratives aim to improve social and economic conditions in human communities through sustainable management of the ecological resources on which those communities rely. This research addresses the needs of collaboratives at a historic point as they plan landscape projects with more complex connections to human communities.

**Competitive and innovative products**—Collaborative projects generate sawlogs and biomass that keep eastside Oregon sawmills in operation and drive new value-added manufacturing. This project addresses the need to plan at landscape scales to sustain valuable infrastructure and foster innovation.

Forest landscapes are large heterogeneous land areas where complex interactions of human and ecological systems control forest conditions, processes, and the magnitude, type, and characteristics of forest goods and services (Franklin et al. 2014). Landscape attributes and associated ecological processes are often influenced by feedbacks from past disturbances or management, and external factors (e.g., forest policy and climate change) that cannot be controlled locally (Spies et al. 2014). Understanding and managing forests at landscape scales challenges managers and collaboratives to grapple with increased complexity, uncertainty, and risk. **Scientists are just beginning to respond to that challenge by developing knowledge and tools to understand social-ecological landscapes and find practical solutions to societal problems (Moritz et al. 2014).**

Forest collaboratives typically have focused on identifying agreement and supporting the implementation of forest restoration projects at smaller-than-landscape scales. Many participants build trust in the process and each other by using site-specific data, implementation and effectiveness monitoring at stand levels, and visual ground-truthing on local field tours of individual planning areas. Some groups are now attempting to develop resource- or issued-based agreements, such as for plant association groups, that could be applied more broadly, but Forest Service planning processes still do not reach the scale (e.g., >10,000 to 100,000 ha) needed to address key processes and interactions among planning units. Despite a stated Agency commitment to "all-lands" planning, managing across ownerships has yet to be implemented or even evaluated for real landscapes.

Research on integrated social and ecological systems at landscape scales has been increasing as knowledge of landscape ecology has grown, computing power has increased to accommodate complex landscape models, and funding (e.g., NSF Coupled Natural Human System—CNHS—projects) of interdisciplinary projects has become a priority (Liu et al. 2007). Research is now focusing on understanding the interaction of social and ecological processes at landscape levels, feedbacks over space and time, tipping points that lead to dramatic changes in conditions, and the influence on system dynamics and outcomes of external influences such as climate change and policy (Spies et al. 2014; Halofsky et al. 2014).

Science has long played a pivotal role in collaborative restoration in Oregon, and the need for "best available science" is invoked even more frequently as collaboratives attempt to scale up their work. Science-based restoration has been enshrined in programs such as the Collaborative Forest Landscape Restoration Program and increased group use of scientific guides and studies (e.g., *Restoration of Dry Forests in Eastern Oregon: A Field Guide*). Stakeholders frequently call on scientific experts to define departure from expected ecological conditions and identify possible ecological and socioeconomic outcomes from management decisions, expecting objective truths that can guide collaborative decision-making. But integrating collaborative processes and scientific information can be challenging (Raymond et al. 2010). Collaborative landscape-scale analysis and planning demands even more specialized and complex forms of expertise as tools (especially simulations and visualizations) are now being piloted to conceptualize how management activities play out, and interact, over large areas. **Although there is research about the role of science and scientists in policy-making, less is known about their roles in multi-party collaborative processes and participatory research, particularly when the focus is landscapes and coupled-human and natural systems.** Stakeholders, particularly those who are newer or from non-natural-resource backgrounds, often struggle to participate given the complexity of concepts and approaches used by landscape collaboratives. Members from conservation groups sometimes express that the pace and scale of restoration is exceeding their comfort zones and ability to monitor and understand what is being proposed. Moreover, the idea that managing across ownerships and involving private landowners in federal forest collaboratives can lead to better social and ecological outcomes remains an untested hypothesis. **Our goal is to analyze how forest collaboratives and Forest Service managers can successfully plan and manage at landscape scales, and determine how scientific research, participatory simulation modeling, and innovations in collaborative participation can contribute to the process.** Our research addresses the following questions:

- How do collaboratives and land managers conceive of landscapes and landscape-level planning?
- How does use of landscape science concepts in collaborative planning affect collaborative dialogue, inclusivity, participation, and perceptions of success?
- How well do collaboratively-defined, landscape-level management plans achieve desired landscape outcomes for fuels reduction, ecological conditions, and social and economic effects?
- What is the state of knowledge for effective integration of ecological and social sciences in collaborative planning to truly improve social-ecological system resiliency?

## 2. Research location and methods

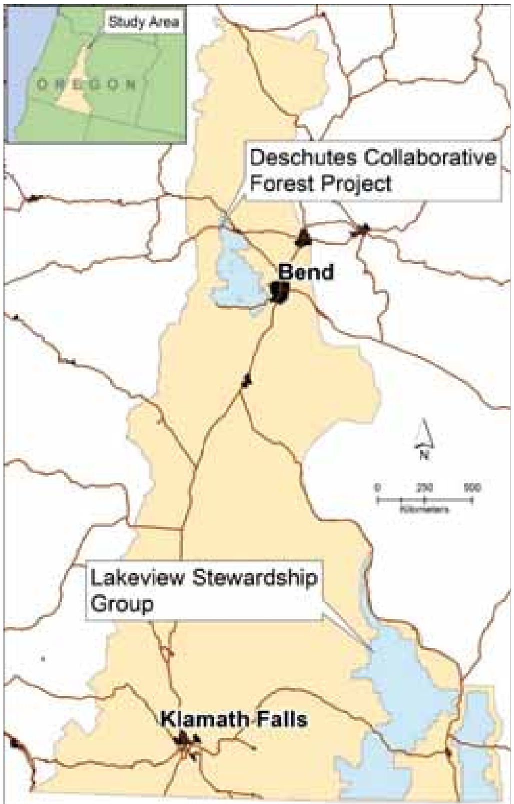



Figure 1—The 3.3 million ha project study area covers much of central and southern Oregon

Our study area encompasses the ecological, social, and economic diversity that represents many of the challenges of moving forest collaboration to the landscape scale. We focus on landscapes covered by the Deschutes Collaborative Forest Project (DCFP) and the Lakeview Stewardship Group (LSG) (Figure 1). This 3.3 million ha region at the focus of our study lies on the east slope of the Cascade Range. This ecologically diverse region spans cold, wet subalpine forest types to very dry shrub-steppe. The dominant forest type is ponderosa pine (*Pinus ponderosa*), which covers 1/3 of the area. Collaborative efforts in eastern Oregon typically focus on trying to treat landscapes to reduce the potential for high severity fire by returning forest systems to their historical fire regime. Fire regimes of the area are diverse, ranging from frequent low-severity fires (4-11 years) in the ponderosa pine type to infrequent (250 years) high-severity fires in the mountain hemlock type (Bork 1984). Historically, the mixed-conifer forest types probably had low- to-moderate-severity fires at intervals of 5-25 years (Agee 1998). **Coming to agreement on how to manage dry and moist mixed conifer forests is a significant challenge to collaborative groups being asked to increase the pace and scale of restoration treatments (Stine et al. 2014)**. Large, severe wildfires are common in the study area and account for most of the burned acres. Fire frequency and loss of old-growth forest has been especially high in this region in recent decades (Spies et al. 2006).

Biological diversity is rich within the region. The region contains habitat for the federally-protected Northern Spotted Owl (*Strix occidentalis caurina*), the sensitive-listed White-headed woodpecker (*Picoides albolavartus*), and the at-risk Northern Goshawk (*Acciptiter gentilis*). Mule deer (*Odocoileus hemionus*) occur throughout the study area and are a popular game animal. Fuel treatments can help to conserve protected-species habitat from high-severity fire but can also have deleterious effects on habitat when thinning reduces hiding cover and winter range.

The Bend/Sisters region (DCFP collaborative) epitomizes the “new West” (Hansen et al. 2002) in Oregon with declines in natural resource extractive industries and increased tourism, outdoor recreation, and amenity-based in-migration. Despite declines in traditional timber industries, a number of businesses within the Bend/Sisters region do forest restoration work or make products out of small wood removed during forest restoration. Among eastern Oregon collaboratives, DCFP is a large collaborative and viewed as one of the most productive collaborative groups. The Lakeview region (LSG collaborative), in contrast, has experienced limited population growth and the economy remains centered on resource use and extraction. The single sawmill in Lake County processes the majority of the timber harvested on public and private lands within the County. The area has experienced increased poverty and a slowing economy as timber harvesting activity and mining has slowed in recent decades. Local logging operators who have historically operated on public and private land are having difficulties capturing work under the new restoration economy centered on forest fuels reduction and restoration of fire-adapted ecosystems on federal lands (White et al. 2015). Many public and private forests in the area were damaged in the 93,000 acre Barry Point fire of 2012. A biorefinery that would require annual feedstock inputs of about 130,000 dry tons of wood is currently proposed for Lakeview.

Both collaborative groups included in this project are participating in Forest Service Collaborative Forest Landscape Restoration (CFLR) projects. The central goal of the CFLR Program is to apply science-based, collaboratively-developed restoration management plans at landscape scales to achieve desired ecological, social, and economic outcomes from fuels reduction. These competitively-awarded projects provide funds ($1 million plus annually for multiple years) to implement and monitor fuels treatments across large landscape areas. The CFLR projects within our study area incorporate private forest lands adjacent to federal ownership for a holistic effort at all-lands management.

**Methods**

We will use an integrated, mixed methods approach to address our research questions. Our research team is comprised of biophysical and social scientists with expertise in applying quantitative and qualitative approaches in integrated research efforts. Multidisciplinary groups of scientists will contribute to each of our three research components (**conceiving of landscapes, participatory landscape modeling, and science engagement with collaboration**). Key activities/outcomes within each research component will **cross-cut** (arrows in figure below) to inform activities in the other research components (Figure 2).

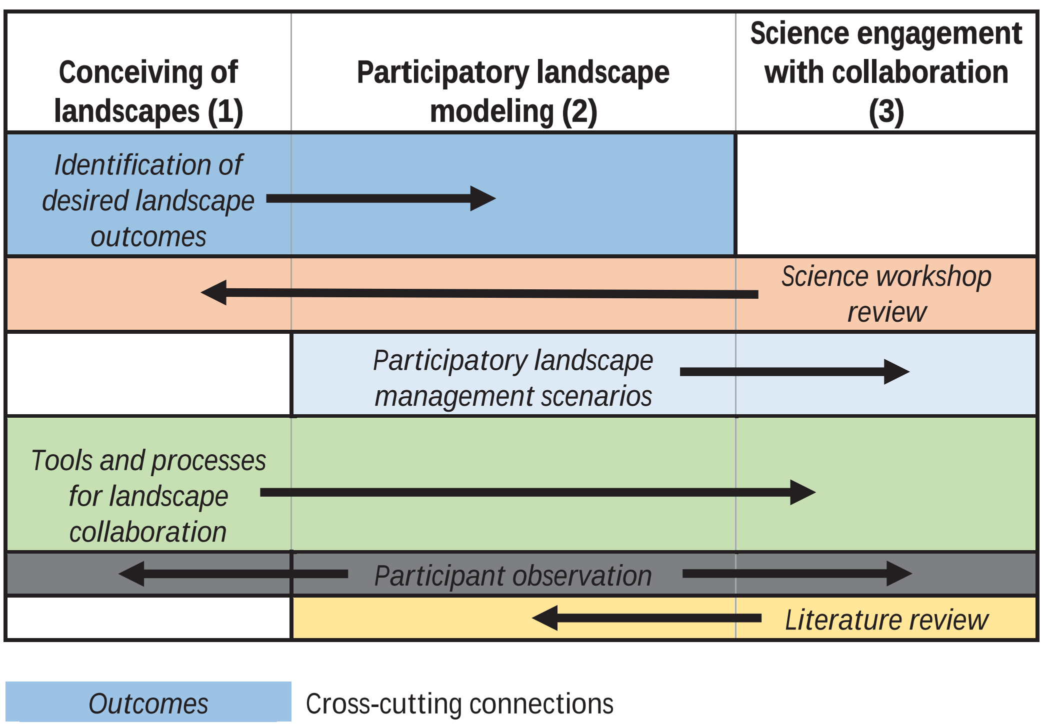



Figure 2—Key activities and outcomes will cross-cut through our research components

(1) Conceiving of landscapes and landscape-level planning
We will use document review and surveys and focus groups of collaborative participants and Forest Service managers to generate new knowledge about **how collaboratives and land managers conceive of landscapes and landscape-level planning**, and **how use of science in collaborative planning at landscape scales affects collaborative dialogue, inclusivity, participation, and perceptions of success**. We will generate new knowledge about 1) key outcomes desired by collaboratives when completing landscape-level management (**cross-cutting**), 2) the challenges and opportunities for collaborating for landscape-level management, and 3) how current collaborative tools (e.g., zones of agreement, field tours, multiparty monitoring) could be adapted for landscape-scale collaboration (**cross-cutting**).

Document review will focus on examining a sample of Forest Service project planning documents completed after 2008 for fuel treatment on the Deschutes and Fremont-Winema national forests. We will identify planning documents from the Forest Service Projects, Appeals, and Litigation (PALs) database which contains listings of all National Forest projects. Projects within PALs that relate to fuel treatments will be identified following the approach used by Summers (2014). Content analysis will be completed on documents to assess the degree to which Forest Service planning documents incorporate concepts related to landscape-level social-ecological systems (e.g., connections between systems, feedbacks, scale-dependent processes, tipping points, and external influence), place proposed treatments in a landscape context, and use landscape-planning tools (e.g., fire modeling, fuel treatment simulators) to inform decision-making. We will pursue opportunities to work with students in the Master of Natural Resources and Master of Public Policy programs for review of Forest Service documents.

We will complete a survey and follow-up focus groups of collaborative group participants (which include Forest Service managers) to understand desired landscape outcomes, challenges and opportunities, and potential tools for moving to landscape-scale collaboration. Participants in the survey and focus groups will be identified from rosters of collaborative group participants and Forest Service personnel who participate in collaborative group meetings. We will use studies of current forest collaborative processes in Oregon (Davis) as a frame to identify how collaborative processes may evolve beyond current approaches when moving to landscape-scale projects. Focus groups and survey development will be led by project social scientists (Davis/Lindberg) but will also include project biophysical scientists.

For quantitative analyses, survey data will be analyzed using SPSS. Samples will be large enough to apply relevant descriptive and inferential statistics. Qualitative analysis of focus groups will be conducted through coding and analysis of transcribed audio for key themes that were articulated in our frame as well as unanticipated emergent factors (Berg et al. 2004).

(2) Participatory landscape modeling
We will engage in participatory landscape simulation modeling with collaborative group participants to determine **how well collaboratively-agreed upon landscape-scale management strategies achieve desired landscape outcomes for fuels reduction, ecological conditions, and social and economic effects**. This research effort will also contribute to answering **how use of landscape science concepts in collaborative planning affects collaborative dialogue, inclusivity, participation, and perceptions of success.**

Participatory modeling workshops will include project ecologists (Spies, Bailey, Leavell, Merschel) and social scientists (White, Davis, Lindberg) working with forest collaborative participants and Forest Service managers. The first workshops will focus on computer model visualization of current landscape conditions that participants identify as of interest and parameterizing models to represent collaboratively-developed landscape management scenarios. In these initial workshops, participants will work alongside project scientists to map out collaboratively-developed landscape management scenarios (**cross-cutting**) for simulation (see below). Follow-up workshops with participants will focus on reviewing landscape simulation model output of projected landscape ecological conditions and economic outcomes based on 50-year model runs with and without anticipated climate change. To gain insight into some of the social implications of landscape management, we will report projected smoke generation from wildfire and prescribed fire and the extent to which thinning, prescribed fire, and wildfire affect Forest Service recreation sites, trails and roads.

Co-PI Davis will use participant observation (**cross-cutting**) during the workshops to help answer how **use of landscape science concepts in collaborative planning affects collaborative dialogue, inclusivity, participation, and perceptions of success**. She will audio record and transcribe workshops, build a framework of factors from her studies of current forest collaborative processes in Oregon, and use this framework to code data for evidence of how each collaborative interacts when considering new scientific information.

Agent-based models, such as the one used in this project, are particularly useful in participatory efforts involving stakeholders because such models correspond well to the ways that stakeholders think 1) about decision-making and 2) interactions of system components (Matthews and Gilbert 2007). This consistency facilitates the process of stakeholders providing feedback on model operation and in developing model scenarios. Parker et al. (2003) identify three levels of participatory model development and application: 1) stakeholders are involved in all stages of model development; 2) stakeholders run the developed model with scientists to address a practical application; and 3) stakeholders run models and change model parameters to test policies. In the previously completed portions of this research, we have involved stakeholders in developing an agent-based model. The currently proposed research applies the second and third approaches to participatory modeling.

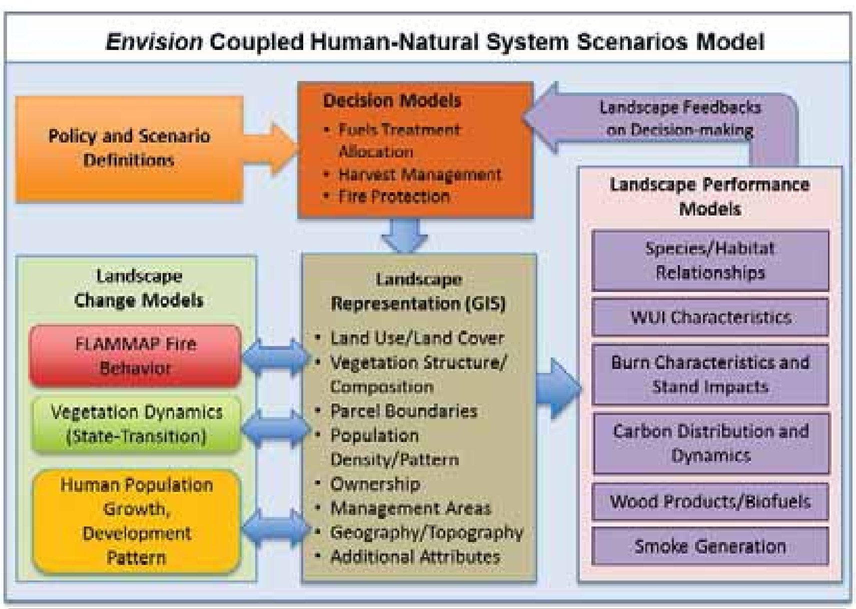
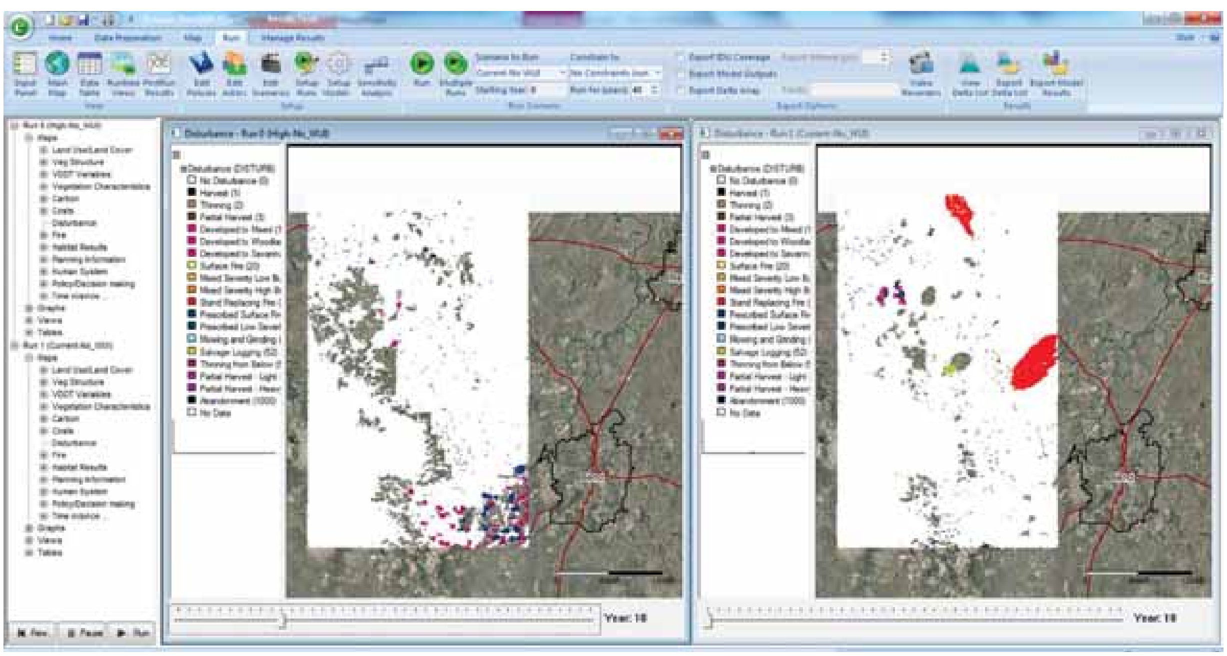



Figure 3—Conceptual diagram of our agent-based model parameterized for use in this study

Participatory scenario modeling will involve application of our existing agent-based landscape simulation model parameterized for our study area and developed in the Forests, People, Fire (FPF) Project (NSF CNHS award number: 1013296) (Spies et al. 2014). Our stochastic landscape simulation model uses the Envision modeling framework (partner Bolte) (Bolte et al. 2007) and simulates landscape conditions in our study area under alternative management regimes for multi-decade model runs with an annual timestep at a spatial resolution of about 3 ha. The FPF model was designed to represent the interactive feedbacks of coupled natural human systems in a spatially explicit, scenario-driven, policy-centric framework (Figure 3). The model integrates existing fire models (partner Ager) and state and transition vegetation models that are used, and were developed, by managers and ecologists. The model can be run with anticipated future climate change effects on fire frequency and severity. Model output at each timestep includes a comprehensive suite of tabular and spatially-explicit landscape outcomes including fire severity, forest structure and composition, timber harvest volume, habitat for focal animal species, exposure of homes and private lands to wildfire, losses of timber to wildfire, and carbon storage. An additional module that estimates the economic impacts to local communities from alternative federal management activities is being developed and will be available for this research (14-JV-11261952-037).

The FPF model allows for statistical comparison of landscape outcomes under alternative management scenarios (Figure 4). We will compare the landscape outcomes from 1) Forest Service business-as-usual management (already parameterized within the model), 2) collaboratively-agreed upon management scenarios developed in the participatory workshops in this research, and 3) landscape outcomes under very high rates of fuel treatment as determined from model runs completed by partner Ager (JFSP project number 14-1-01-22). Comparisons will center on the key landscape outcomes identified in collaborative focus groups (see previous) and include area and occurrence of high severity fire and acres of high fuel loading. Statistical comparisons will be completed for model runs with and without anticipated climate change. We will use climate change scenarios based on representative concentration pathways RCP 4.5 and 8.5 and different GCMs following Stavros et al. (2014). We will run multiple replications of each scenario and conduct sensitivity analysis of key variables in the model (e.g., amount, type and spatial pattern of fuel treatments).



Accelerated management: 5% of landscape/year

Current management: 1% of landscape/year

Figure 4—Graphical and statistical comparison of landscape outcomes under alternative management regimes using our agent-based model

**(3)** Science engagement with collaboration

We will gather peer-reviewed literature, review outcomes from recent science workshops provided to collaboratives in Oregon and Washington, and use information from focus groups of collaborative members in our study area to **determine the state of knowledge for effective integration of ecological and social sciences in collaborative planning to truly improve social-ecological system resiliency**. Scientific literature on engagement of science with multi-stakeholder decision-making groups (**cross-cutting**) will be identified using standard literature search databases and discussion with other scientists. We will use our project team's knowledge and existing networks of scientists and practitioners to identify science engagement workshops held since 2012 for collaborative groups within Oregon and Washington. We will contact workshop organizers and gather any proceedings documents to identify perceived outcomes and successful and unsuccessful aspects of those workshops (**cross-cutting**). We will use part of the focus groups detailed above to understand how collaborative members and managers can use science most effectively. We will pursue opportunities to work with students in the Master of Natural Resources and Master of Public Policy programs for the science engagement literature synthesis.

We will also generate knowledge of how collaborative members can most effectively receive and use science from 1) participant observation during the landscape scenario modeling workshops and 2) ongoing work of project co-PI Merschel (14-JV-11261952-037) with the Nature Conservancy and DCFP to explore ecological processes and fire history in mixed-conifer forests. Further, our synthesis will build on a technical guide currently being completed by Project co-PI Davis with an OSU Master of Public Policy graduate student (Davis and Hughes, forthcoming) identifying best practices for collaborative science engagement.

## 3. Anticipated outcomes

1. New knowledge of how managers and the involved public conceive of landscapes as coupled, fire-prone social-ecological systems, and how those groups can develop adaptive management strategies that improve resiliency at landscape scales.
2. Greater understanding of social-ecological science and how to implement science-based objectives in collaborative planning.
3. Advance emerging field of participatory systems modeling.
4. Improved capacity of two eastern Oregon collaboratives for landscape-scale restoration planning.
5. Provide tools and knowledge for other collaborative groups in Oregon.
6. Contribute to IWFL themes of Resilient Ecosystems, Healthy People and Communities, and Competitive and Innovative Products.

Deliverables: participatory simulation modeling workshops for DCFP and LSG, one MS thesis, three peer-reviewed publications (effectiveness of collaborative-management plans at achieving desired outcomes, participatory agent-based systems modeling workshops, science-practitioner engagement), two scientific presentations, two practitioner presentations, one webinar, two community presentations.

## 4. Outreach activities

Our team has worked extensively with the project partners and has existing connections with the collaboratives and national forests through the FPF project and Davis's and Leavell's Extension roles. Outreach will consist of participatory landscape modeling sessions, a webinar, two technical publications, presentations to practitioner and community audiences, and an active web presence. OSU Extension field agent Daniel Leavell will assist with participatory simulation modeling sessions, the webinar, other outreach activities, and the research generally. We will host a webinar for practitioner audiences outside our study area focused on using science knowledge for landscape-scale management. We will complete two project-related presentations at practitioner workshops and meetings such as the Central Oregon Fire Science Symposium and the Federal Forest Working Group. We will also present our project at its mid-term point to reach community audiences beyond the collaboratives in each location. These presentations will focus on sharing results to date and obtaining feedback. We anticipate holding one meeting with Bend 2030, a land use planning effort that includes an emphasis on the wildland-urban interface. We will identify a similar suitable community effort at which to present in Lake County. We will establish a project website and contribute to social media (e.g., Twitter, blog postings with regional partners such as Sustainable Northwest and the Northwest Fire Science Consortium). Finally, we will maintain communication with the partners listed in Section 7 through quarterly conference calls.

## 5. Timeline

| **Activity (Component)** | **Year (project months)** | | | | |
|---|---|---|---|---|---|
| | 2015 (1-3) | 2016 (4-9) | 2016 (10-15) | 2017 (16-21) | 2017 (24-27) |
| Partner communication and outreach (1,2,3) | | | | | |
| Planning document review (1) | | | | | |
| Interviews/focus groups (1,3) | | | | | |
| Participatory modeling workshops (2) | | | | | |
| Science workshop review (3) | | | | | |
| Science engagement literature synthesis (3) | | | | | |
| Outreach: practitioner presentations (1,2), community presentations | | | | | |
| Outreach: webinar (1,2) | | | | | |
| Articles, presentations, theses (1,2,3) | | | | | |

## 6. Integration

Integration occurs throughout the three components: the coupled human and natural systems model (Envision), which is already parameterized and running for the study area; engagement of scientists and stakeholders in joint learning about landscape application of science for planning; and regular meetings of the research team to ensure integration of component parts. Each of our project components will be addressed by both biophysical and social scientists. Our project addresses three IWFL themes (Figure 5). Our research integrates across those themes by 1) identifying the desired landscape outcomes (i.e., social and economic outcomes, landscape resiliency, and traditional and innovative wood products) from collaborative groups 2) projecting how landscape-level management affects a suite of outcomes consistent with those themes, and 3) how science in each of the themes can be incorporated most effectively in collaborative management efforts.

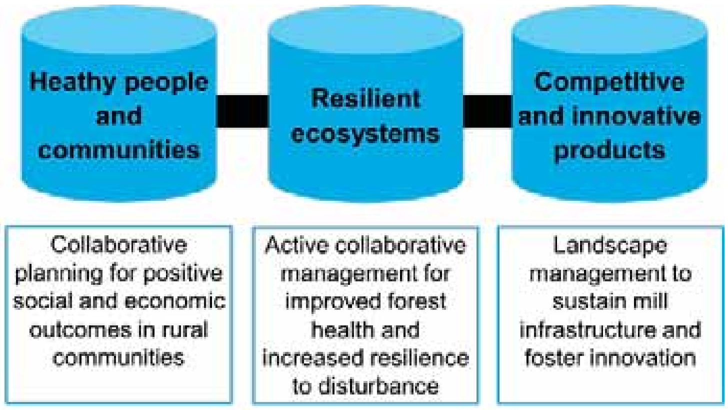



Figure 5—We address three IWFL themes using integrative methods

### 7. Partner linkages and support

External partners John Bolte (Biological & Ecological Engineering/ANR Extension, OSU—Envision model) and Alan Ager (Western Wildland Environmental Threat Assessment Center, U.S. Forest Service—Fire simulator) were primary contributors to the FPF project and will provide consultation, as needed, in this project and will engage in research implementation and project reporting, as appropriate. The LSG and DCFP will participate in this project. See attached letters of support from The Nature Conservancy and Lake County Resources Initiative. Our project team has longstanding relationships, through the FPF project and other research, with the Deschutes National Forest and Fremont-Winema National Forest. Our project uses the agent-based landscape simulation model constructed with funding from the National Science Foundation (NSF CNHS award number: 1013296). Finally, this project will leverage over $100k of Forest Service funding (14-JV-11261952-037) to extend the capacities of the model and improve the user interface.

### 8. Interaction with IWFL Board members

We contacted Lee Miller, Tom Spies, Diane Daggett, and Russ Hoeflich regarding this proposal. We received feedback from Spies, Daggett, and Hoeflich. Spies provided information that informed our description of the study area and the methods for participatory modeling. Daggett provided information to help us make the language around the role of collaborative members and stakeholders in the project more clear and helped us identify some additional outreach opportunities. Hoeflich provided us information about the need for landscape-level planning to address restoration needs and the role of landscape models in science engagement.