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INSIDE

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"Science affects the way we think together."

Lewis Thomas

Forests, People, Fire: Integrating the Sciences to Build Capacity for an "All Lands" Approach to Forest Restoration

Tom Spies

Management of fire-prone forests was the topic of this public field trip to the Deschutes National Forest, Oregon.

"If a problem cannot be solved, enlarge it."

– Dwight D. Eisenhower

Forests on the eastern slopes of the Oregon Cascade Range are naturally fire prone. A century of fire suppression, logging, and grazing has altered the forest structure, however, leading to conditions that with a strike of lightning could produce fires larger and more damaging than what burned in the 1800s and earlier. The challenge today, at least on federal land, is to restore these dry forest landscapes so that beneficial wildfire can be sustained as part of the ecosystem while uncharacteristically severe wildfires are avoided.

Central Oregon is more than national forests, though, and the land is not owned or managed by a single entity. Homes, communities, ranches, and commercial timberland are all present as well. The land and its resources are used and valued by many people for many different purposes.

Management choices on any particular piece of land—including the choice to do no management—can substantially affect other lands

IN SUMMARY

Interest in landscape-scale approaches to fire management and forest restoration is growing with the realization that these approaches are critical to maintaining healthy forests and protecting nearby communities. However, coordinated planning and action across multiple ownerships have been elusive because of differing goals and forest management styles among landowners. Scientists with the Pacific Northwest Research Station and their colleagues recognized that working at the landscape scale requires integrating the biophysical, social, and economic dimensions of the problem, and this necessitates collecting new types of information and inventing new tools.

To accomplish this, the study team included widely diverse expertise and worked closely with stakeholders in central Oregon throughout the process. The team gathered information from private, state, federal, and tribal landowners about their current forest and fire management practices and then built a computer model that can be used to facilitate collaborative decisionmaking about forest management in fire-prone environments. The model allows stakeholders to compare alternative management scenarios to see how various approaches affect wildfire behavior, risk, and the associated delivery of valued ecosystem services. The model is now being used with two forest collaborative groups in central Oregon to help stakeholders understand the potential tradeoffs associated with management options.

within a watershed or region. Consequently, many forest landowners are concerned about what their neighbors are doing or not doing on nearby properties to minimize wildfire risk. Piecemeal approaches, at best, have a localized effect, but at worst can lead to conflict or political standoffs that stymie attempts to grow and maintain healthy, resilient forests across the larger landscape.

When many landowners begin working with a common vision, the combined efforts have far greater potential than any one individual's. The Forest Service has been seeking ways to encourage different landowners and stakeholders within shared landscapes to work together to restore forests, using an "all lands" approach. Timber, wildlife habitat, and other forest conditions that took decades to grow can be drastically changed in one afternoon of severe wildfires. The risk of losses to wildfire is a motivating factor that is bringing stakeholders to the discussion table. But despite a shared desire of what should be avoided, we are humans, each influenced by our own experiences, values, and social networks. As the saying goes, coming together is one thing; working together is another.

"Most environmental problems are human problems," says Tom Spies, a research forester and landscape ecologist with the Pacific Northwest (PNW) Research Station. "We have an urgent need to integrate biophysical, social, and economic sciences to better understand the aggregate social-ecological effects of wildland fire management, and the tradeoffs associated with different landscape management strategies."

To tackle this problem, a multidisciplinary team of scientists came together to develop a model that would help them and stakeholders explore potential futures for forests in central Oregon. Supported by a $1.5 million grant to Oregon State University (OSU) from the National Science Foundation's Dynamics of Coupled Natural and Human Systems program, Spies and OSU's John Bolte gathered experts in sociology, anthropology, economics, environmental history, fire science, forest ecology, wildlife ecology, landscape ecology, and computer science, and launched a 5-year study to use modeling and other scientific methods to better understand decisionmaking and fire management outcomes in central Oregon.

The team produced a unique computer model that supports collaborative efforts to design landscape-scale fire management strategies to meet multiple objectives. It provides a holistic characterization of the social and ecological dimensions of wildfire risk, and the potential effects of various management strategies on wildfire risk and valued ecosystem services. Results from the study were published as special feature in a recent edition (volume 22) of *Ecology and Society*.

KEY FINDINGS

- Current forest management approaches differ widely within the central Oregon study area, leading to different outcomes in terms of fire risk reduction, timber harvest, carbon sequestration, and wildlife habitat.
- Current levels of restoration on federal lands slightly reduced the future occurrence of high-severity fire compared to no management, according to model projections. This indicates that significantly more landscape needs to be treated to really affect future fire behavior.
- Contrary to some expectations, national forests in the study area are currently more resilient to high-severity fire compared to other large forest ownerships in the study area.
- The level of forest restoration on the landscape changes the amounts of annual timber harvest, carbon sequestration, and wildlife habitat.

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To provide scientific information to people who make and influence decisions about managing land.

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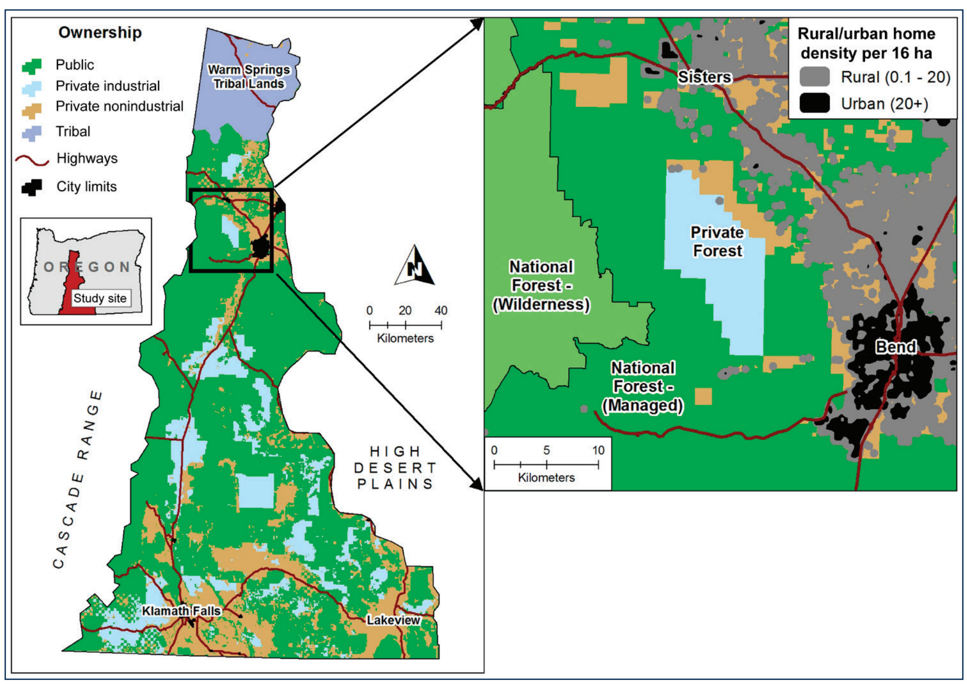


The study area in central Oregon encompasses multiple types of land ownerships: public, private industrial, tribal, as well as rural and urban residential.

The wildland-urban interface south of Sisters in central Oregon. Fires often originate in wilderness areas (e.g., the Three Sisters Wilderness in background) and can spread into areas where people live.

Beyond the Wildland-Urban Interface

The area of dry forest with uncharacteristic risk for severe fire far exceeds the government funding available to conduct fuel reduction treatments. Given this situation, in the 1990s and early 2000s, the bulk of these resources were spent on treatments in the wildland urban interface. This makes sense—conduct treatments where homes and lives are at risk. But today there is growing national recognition that tackling wildfire risk might be better served by addressing restoration and management at a landscape scale—beyond just the wildland-urban interface and beyond just federal land. A landscape approach includes the wildlands where many fires originate and cross-boundary partnerships involving stakeholders with a shared interest in a given landscape.

To address concerns about fire-prone forests in central Oregon, the team identified a study area of more than 8 million acres that stretched along the eastern Cascades, from the Warm Springs Reservation in the north to the California border in the south, and encompasses the Deschutes and Fremont-Winema National Forests. Federal agencies (the Forest Service and the Bureau of Land Management) manage the bulk of the study area, but forest owners also include the Oregon Department of Forestry, several corporations, numerous small family forest owners, the Confederated Tribes of Warm Springs, the City of Bend, and several small communities of homeowners.

The team used several methods to collect data about the current management practices of different types of owners. They reviewed forest management plans, conducted paper surveys, and interviewed homeowners and managers face to face.

From its inception, the study was unusual for the Forest Service. "Past landscape modeling projects would typically emphasize ecological processes, and ecologists might need to do fieldwork to fill critical information gaps," says Spies. "In this case, the ecological processes were relatively well understood and the biggest information gaps were around social science, so it was the social scientists who needed to go out and fill the gaps with fieldwork. This was one of the more cutting-edge aspects to the whole study—it required strong social science focus to complete the picture of the coupled human and natural system."

In a parallel process, the computer scientists and ecological modelers built a new version of Envision, an existing landscape modeling system developed at Oregon State University. Envision simulates fire, forest succession, and forest management actions on hundreds of thousands of parcels of forest land to help users understand the effects of human decisionmaking in fire-prone forest landscapes.

"In this agent-based model, the agents are landowners," says Spies. For example, federal land managers are guided by a set of rules that helps them decide when and where to treat a forest to reduce fire risk through thinning or prescribed fire. That rule might be guided, let's say, by how close the forest is to an urban area, whether wildlife habitat is at risk, or the amount of time since the last fire or management activity. Those rules were coded into the model, and they collectively became the representation of a Forest Service manager.

"It's an attempt to use computers to help us understand how human decisions interact with the environment and lead to different outcomes—more fire, less fire, more habitat, less timber, and so forth—all the values we might consider related to a forest landscape," says Spies.

The model output helps stakeholders visualize how management decisions might affect the landscape over time. In the case of homeowners living on wooded acreage, for instance, one decision might pivot around the management actions they would consider taking as fire risk increases. As the forest gets denser, a real landowner and the simulated landowner may decide to clear underbrush to make their property more fire-resilient, so the model would adjust the condition of the forest accordingly.

Integrating the Sciences

Integrating the social and biophysical sciences made it possible to examine how management choices influenced the occurrence of, and resilience to, fire on the various landownerships in the study area.

"I would say that the key difference between the Forest Service and both the state and private corporate forest owners is that the Forest Service is moving toward a paradigm of living with wildfire," says Susan Charnley, a research social scientist with the PNW Research Station. Charnley led the effort to characterize management goals and behavior of large landowners.

In recent decades, the Forest Service has increased its use of thinning and prescribed fire to reduce fuel loads. In contrast, state and large corporate owners typically manage more intensively and try to keep fire out of their land holdings. "They engage in full wildfire suppression, and they don't use prescribed burns for fear that it could escape and damage the standing inventory of trees," says Charnley.

The research team was quite surprised at the differences in the projected outcomes of these two management styles. The model showed that federal forests currently are more resilient to high-severity fire than forest lands owned by other large ownership groups in the study area. The presence of large trees (with tall canopies) and the use of prescribed fire on federal lands appeared to be the key factors that mitigated fire risk.

Tom Spies

Fire exclusion has led to dense forest of old and young ponderosa pine and an accumulation of fuel on the forest floor. The old pines in this federal forest are at risk from intense fires that can consume canopies and roots.

Tom Spies

This dense forest of young trees and shrubs is growing on private land with a history of clearcutting. Its current conditions put it at risk to loss from high-severity fire.

The study also concluded that current Forest Service management practices slightly reduced projected high-severity fire occurrence but strongly reduced landscape-scale risk (e.g., fuel conditions) compared to no management. The beneficial effect of management on areas of high-severity fire was largest in years with extreme fire weather, which has implications as air temperatures warm and precipitation patterns change, resulting in more frequent or prolonged droughts.

Assuming the continuation of current management practices, Forest Service lands are expected to become increasingly resilient to high-severity fire over a 50-year period, while forests on other large ownership types will not follow suit under the assumptions used in the model.

"This is because, based on current practices on private, corporate, and state ownerships, the trees will remain relatively small," Spies says. "And the mechanical methods used on private lands did not reduce surface fuels as much as prescribed fire did on federal lands. There is some variation within ownership categories, however."

Gaining clarity on the most effective wildfire management practices is useful, but the reality is that social and economic forces come into play and tend to drive decisionmaking. Charnley points out that many timber producers, for example, are constrained by market forces when it comes to thinning small-diameter wood because of volatile or nonexistent chip and biomass markets.

"The study makes it clear that there's a real problem on the landscape, particularly for some owners who aren't traditionally paid attention to, like private corporate owners," she says. Lack of a reliable chip market affects many forest landowners who have budget limitations and depend on timber revenues for management operations.

Tradeoffs between fire-risk reduction and other management goals, such as timber production, carbon sequestration, or wildlife habitat, were evident in the modeling. For example, scenarios with fewer fuels reduction treatment yielded more carbon and habitat for wildlife species that live in dense forest such as the northern spotted owl, but carbon and late-successional forests increased in all scenarios.

The research team refers to their model as a "discussion support model," rather than a "decision support model," because it provides a structured framework for discussing these kinds of tradeoffs and management options. The model does not predict the future but, rather, is a tool for exploring possible futures.

Working With Forest Collaboratives

Many of the forest restoration projects on federal forests in Oregon are planned with input from formal forest collaborative groups. These collaboratives bring together individuals and organizations with a range of interests and perspectives to identify common values and a shared vision of forest management. Now that the agent-based model is available, researchers are working with two collaborators to use the model. Eric White, a research social scientist with the PNW Research Station, is co-leading this next phase of the project with OSU researchers.

The Deschutes Collaborative Forest Project and the Lakeview Stewardship Group are working with researchers in this next phase, which is intended to facilitate dialog about tradeoffs associated with potential management options and help groups develop landscape-scale forest plans that meet multiple objectives.

The Deschutes collaborative came up with eight very different scenarios that ranged from doing almost no treatment to doubling or tripling the treatments on federal lands. Over a period of several months, the modeling team ran each scenario, shared the results with the group and federal land managers, and revised the scenarios several times based on their input.

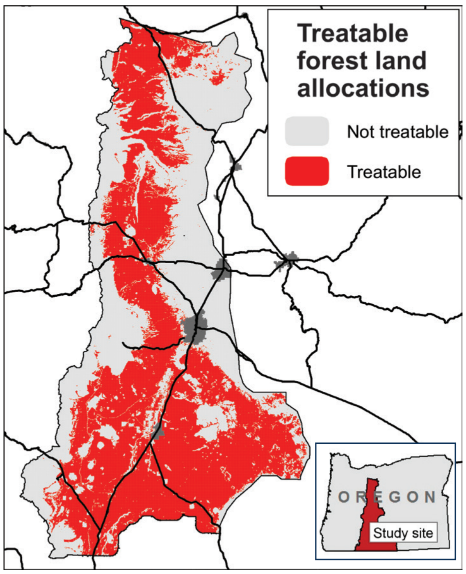
Although many of the management strategies had varying levels and types of treatment, the landscape conditions over many decades often looked fairly similar, although White cautions against jumping to conclusions about what this might mean.

"We'll model some management activity that may reduce the density of forest, but over time the model is growing that forest back," White says. "So 20 years after a treatment, the forest may look exactly the same as it did before you treated it. You have to continually come back and do more treatments—that's the dynamic nature of the forest. It takes a tremendous amount of effort to move the needle. Maybe this result suggests that we need to find a more middle-of-the-road scenario, and incorporate items from each of our scenarios."

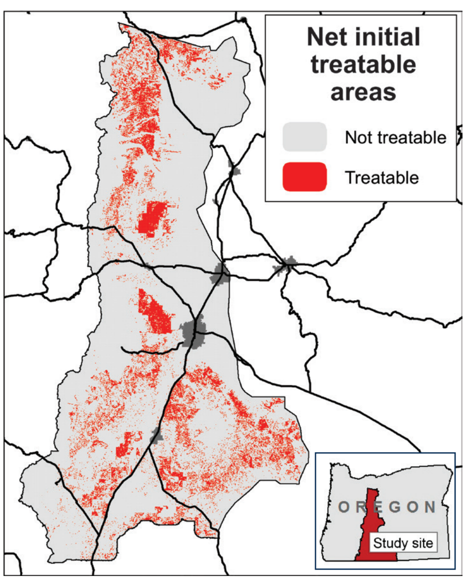
The model doesn't recommend management options, but offers science-based simulations of their outcomes to facilitate collaborative decisionmaking. "The Deschutes group used our model in the way we'd hoped, which was to create a basis for discussion and give them a chance to come up with some ideas of their own," White says.

Reflection

It was challenging to translate knowledge developed from the social science field work to the decision rules in the model. This translation, however, was the mechanism for enabling the social data to be considered along with the data on forest structure, fuel levels, and fire behavior in the model. It required that scientists with disparate disciplinary backgrounds work together to find common language and conceptual frameworks. The back-and-forth among team members and other stakeholders as the model was developed was invaluable to creating shared understanding.



Forest area, excluding designated wilderness, which could be treated with mechanical methods or prescribed fire to reduce fire risk.



Remaining area of forest that could be treated after adding additional constraints to the decision process—for example, no fuel reduction treatments in areas where spotted owls nest or roost, and only treating forest stands with trees of certain ages or sizes.

LAND MANAGEMENT IMPLICATIONS

- The landscape simulation model and the method for stakeholder interaction provide a holistic framework for characterizing the social and ecological dimensions of wildfire risk, and discussing the potential effects of different management strategies on risk and delivery of valued ecosystem services.
- The model and method can facilitate an all-lands approach to wildland fire management planning and implementation in central Oregon.
- Two forest collaborative groups are using the model to explore potential futures that result from collaboratively developed restoration strategies.
- Knowledge about the potential tradeoffs among wildfire risk, timber, carbon, and wildlife habitat associated with different management options can be used in developing forest plans that meet multiple objectives.

"It was challenging for some of the social scientists to think about reducing human behavior to a limited set of assumptions, or decision rules, for the modeling," says Jeff Kline, a research forester and economist with the PNW Research Station. But this translation of social data to model programming was pivotal for the integration of information from different disciplines.

Charnley, for instance, is primarily a qualitative researcher. "I'm not a modeler, and don't really understand modeling, but I was interested in being able to use the model outcomes as a way of getting information about the environmental consequences of how people are managing their land," she says.

The team did make progress in integrating the sciences to achieve their objectives, and one part of Kline's contribution was to spearhead an effort to document the knowledge they gained as they found new ways of working together.

"In the past, we've done these types of projects and we never really took the time to reflect on how that went," he says. "In this project, we did do that, and we came away with some broader lessons about how we conduct interdisciplinary research." These lessons will benefit ongoing efforts to understand the complex interactions between human societies and ecological processes.

"Alone we can do so little;
together we can do so much."
–Helen Keller

For Further Reading

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