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INSIDE

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"Science affects the way we think together."
Lewis Thomas

FOREST BIODIVERSITY POLICIES: WHERE ARE THEY LEADING US? ARE WE GOING WHERE WE EXPECTED TO GO?

Logging in the Coast Range has created a mosaic of forest age classes and habitat conditions. Changes in forest policies can impact landscape-scale habitat conditions in addition to affecting economic activity generated from logging.

IN SUMMARY

Policies to achieve biodiversity goals have been implemented across many different forest ownerships in the last 10 years. Surprisingly, little research has been done to examine how well those policies might achieve their goals, how they might change landscapes in the future, and how the policies affecting different owners add up to a total picture of forest biodiversity in a large multiowner landscape.

To fill this void, the Coastal Landscape Analysis and Modeling Study (CLAMS), a multidisciplinary research project centered at the Pacific Northwest (PNW) Research Station in Corvallis, Oregon, recently completed a set of different analyses that paint a picture of how forests of the Oregon Coast Range look today, how they might change over the next 100 years, and what the implications are to forest biodiversity and forest management.

Assuming a continuation of the current suite of forest policies, CLAMS scientists project that disparate management priorities between public and private landowners will amplify contrasts in forests structure. Future timber harvest will occur predominantly on forest industry lands. Habitat area for spotted owls, low-dispersal lichens, and marbled murrlets is projected to increase dramatically on federal lands over the next 100 years. Alternative conservation policies, such as increased retention of large trees after harvest, could be implemented to increase wildlife habitat, but these would come at substantial cost to private landowners.

"To the extent that philosophical positions both confuse us and close doors to further inquiry, they are likely to be wrong."

—E.O. Wilson

Much has been written about the development of the Northwest Forest Plan and of President Clinton's Forest Summit in 1993. By now, most people who are interested in such things have heard the story about the team of Pacific Northwest scientists who developed the framework for the Plan in just 90 days, while sequestered in a Portland office tower.

No question, it is an amazing tale of how an ad hoc team of scientists collaborated under intense pressure to develop a sweeping policy designed to ensure the future viability of the spotted owl while also shoring-up the proverbial three-legged stool of rural sustainability across 24 million acres of federal forests. A less well-known, but equally compelling story, has been unfolding in the dozen years since the plan took effect: a subset of the very same scientists have been toiling in a slow-motion version of what they barreled through in 1993. In short, they wanted to make sure they got it right.

Essentially, they wanted an opportunity to rigorously integrate their expertise—ecology, forestry, sociology, economics, and others—to make informed projections regarding the long-term effects of policy. Will forest policies yield the landscapes we desire?

They selected the Oregon Coast Range as their test case. The region contains approximately 5 million acres of the most productive forests in the world. In fact, in addition to some well-known endangered species and immeasurable biological wealth, almost half of the state's timber supply originates from these forests, with an annual stumpage value in the hundreds of millions of dollars and providing a major source of logs for Oregon's mills. With the stakes of forest policies so high, the Coast Range encapsulates much of the debate that swirled through the spotted owl wars of the early 1990s.

The umbrella term for the group is the Coastal Landscape Analysis and Modeling Study (CLAMS); since its inception, it has included dozens of scientists, managers, and graduate students.

Having spent over $10 million in more than a decade working on CLAMS, the scientists have a laundry list of accomplishments to be proud of. They have developed state-of-the-art simulation models and high-resolution maps, published several dozen peer-reviewed papers, hosted symposiums for the public, watershed committees, and academic communities, and they've been invited to speak at conferences throughout the world. They are now able to simulate future landscape conditions across all ownership types in tremendous detail, using several hypothetical policy pathways, including several designed to conserve biodiversity.

Recently, they have completed the project that was first envisioned during the genesis of CLAMS: a single integrated analysis of the Coast Range's ecological and economic condition, followed by several indepth projections of expected landscape conditions over the next century.

"Given the long timeframes and wide range of spatial scales affected by forest policy and management, multiscale simulation analyses were needed to more completely understand the potential effects of alternative policies and practices," says Tom Spies, co-leader of CLAMS and a research ecologist at the PNW Research Station in Corvallis, Oregon.

"Many of the large-scale assessments of forest policy done in the past have focused on commercial timber supply, typically seeking a sustained yield or even flow of wood fiber over time. The CLAMS models retain the capability to analyze commodity production while also incorporating a suite of ecological indicators. In many ways, the CLAMS approach is the logical intersection of two streams of thought on how to analyze policies for large multi-owner landscapes—a fairly old approach from economists and a fairly young approach from ecologists," says Norm Johnson, the other co-leader of CLAMS, and Distinguished Professor of Forest Policy at Oregon State University (OSU).

KEY FINDINGS

- The area of Coast Range forests dominated by mature and old-growth conifers and species associated with those habitats, such as the northern spotted owl and canopy lichens, are projected to increase.
- The area of biologically diverse hardwood and heterogeneous open forests (recently disturbed forests with remnant trees and shrub dominance) is projected to decline.
- Overall landscape diversity is projected to decline somewhat, whereas diversity within ownerships will decline strongly. Landscape diversity within individual ownerships declines more strongly than across ownerships as different dominant-use policies take effect.
- The lands of the forest industry will provide most of the timber harvest in the future; existing harvest levels could generally be sustained with intensive management on industrial lands offsetting losses to development on nonindustrial lands.

SEEING THE FOREST AND THE TREES

Increasingly, new strategies to conserve biodiversity are being codified into forest policy. Troubling, however, is the fact that biodiversity is exceedingly difficult to measure and track over time. "As a result, very little research has been done to examine how well [the strategies] might achieve the goals, how they might change landscapes in the future, and how the policies of different owners add up to a total picture of a region," says Spies.

Evaluating the efficacy of conservation policies is one primary challenge for CLAMS scientists. They have developed a host of measures that include habitat quality indices for several focal species of fish, wildlife, and plants, in addition to numerous measures of overall ecosystem condition, which are based primarily on forest structure.

Habitat suitability for many forest-dwelling species is best assessed through a detailed accounting of the species, size, and structure of trees, in addition to the amount of standing and down wood. "For this reason, most previous analyses of forest management effects on biodiversity have been based on empirical studies of stands or small landscapes," explains Spies.

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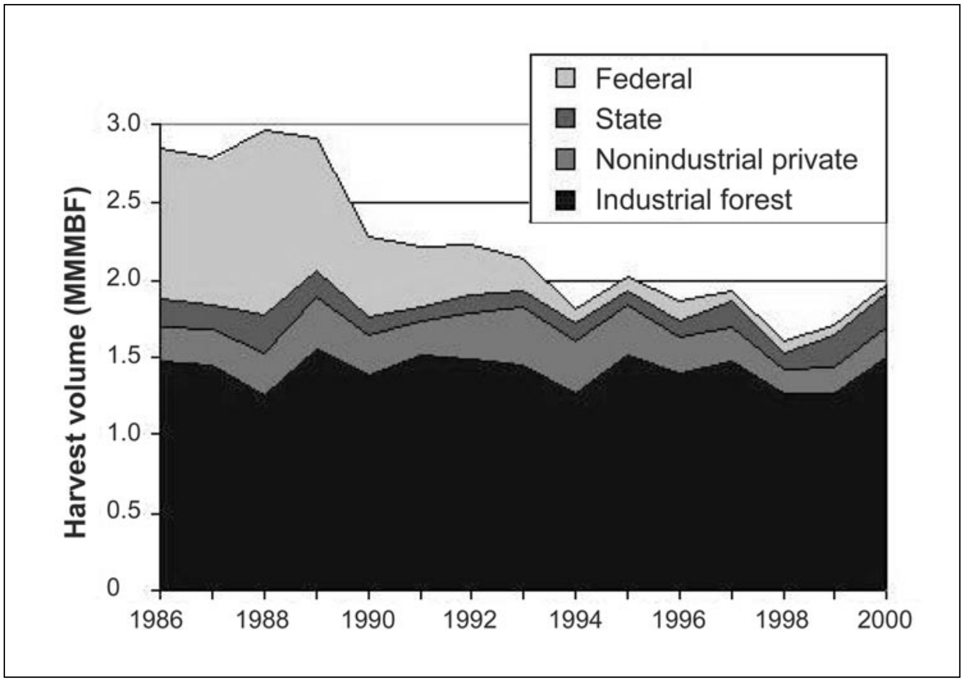
Scaling up to a landscape or region to assess habitat has typically required researchers to forgo this level of spatial and ecological detail and instead uses coarse-scale information based on aggregations and averages. CLAMS scientists rejected this tradeoff; they knew that to adequately assess future forest policies, they'd need an estimate of detailed habitat information for every piece of ground across the entire region. Fortunately, CLAMS came together with the expertise at the same time that computing power and other requisite technologies were first coming online.

In the buildup to these most recent analyses, Janet Ohmann, a research ecologist at the PNW Research Station in Corvallis, Oregon, and Matt Gregory, an OSU senior research assistant, combined satellite imagery, environmental data, and several hundred field plots in a novel way to construct a detailed vegetation map of the Coast Range. The map is unique in that every one of the more than 50-million pixels contains an inventory of the species, size, and arrangement of trees predicted to be found in that very spot.



Federal timber harvests have declined during the past several decades. In the future, most harvest volume will come from forest industry lands.

"The map had to have sufficient fine-scale heterogeneity to support the models of habitat capability for focal wildlife and plant species being used in CLAMS," says Ohmann.

"The resolution allowed us to examine several biodiversity elements for the first time at a regional scale," she says. "In fact, the detailed tree-, stand-, and species-level data in the vegetation maps revealed regional trends that would be masked in traditional coarse-filter regional assessments. For example, although young forests are abundant in the region—in the form of plantations—they mostly lack the structural elements of natural young forests, such as snags and down wood."

In addition, the multiownership perspective revealed biodiversity concerns and benefits not readily visible in single-ownership analyses. The Coast Range is a mosaic of public and private ownerships; disparate management priorities characterize each owner group and this has manifested itself in distinct forest patterns.

"Federal lands provide most of the late-successional and old-growth forest," says Ohmann. "State lands contain a range of forest ages and structures, including diverse young forest, large amounts of legacy dead wood, and a large component of high-elevation true fir forests. Non-industrial private lands contain diverse young forest and the greatest abundance of hardwood trees. Forest industry land encompasses much early-successional forest, most of the mixed hardwood-conifer forest, and large amounts of legacy down wood."

PROJECTING A CENTURY OF HABITAT AVAILABILITY

Not only did the map allow CLAMS scientists to evaluate the current condition of the Coast Range, it also provided the foundation for a grand simulation model designed to project the natural rate of growth and death of forest vegetation in conjunction with anticipated timber harvest and land use change over the next century. Development of the model, termed the Landscape Management and Policy Simulator (LAMPS), was spearheaded by Johnson and Pete Bettinger, a professor of forestry now at the University of Georgia who did the work as a faculty member in the College of Forestry, OSU.

LAMPS updates the high-resolution map in 5-year intervals after accounting for predicted changes. This allows the trajectory of timber harvest and habitat quality to be projected 100 years in the future.

Spies and Brenda McComb, a wildlife biology professor from the University of Massachusetts, led an evaluation of habitat availability and capability for seven focal species representing different ecosystem roles and life histories. This required Spies and McComb to quantify the specific needs of four species of birds: the northern spotted owl, marbled murrelet, western bluebird, and olive-sided flycatcher; one mammal: the red tree vole; and two lichens: one with low-dispersal ability and one with moderate dispersal abilities. Together, the habitat needs for these species are thought to overlap with those of many of the other species found in the Coast Range.

They began by simulating the fate of the landscape under the existing suite of forest policies: The Northwest Forest Plan on federal lands, State Management Plans for state-owned land, and the Oregon Forest Practices Act on private lands.

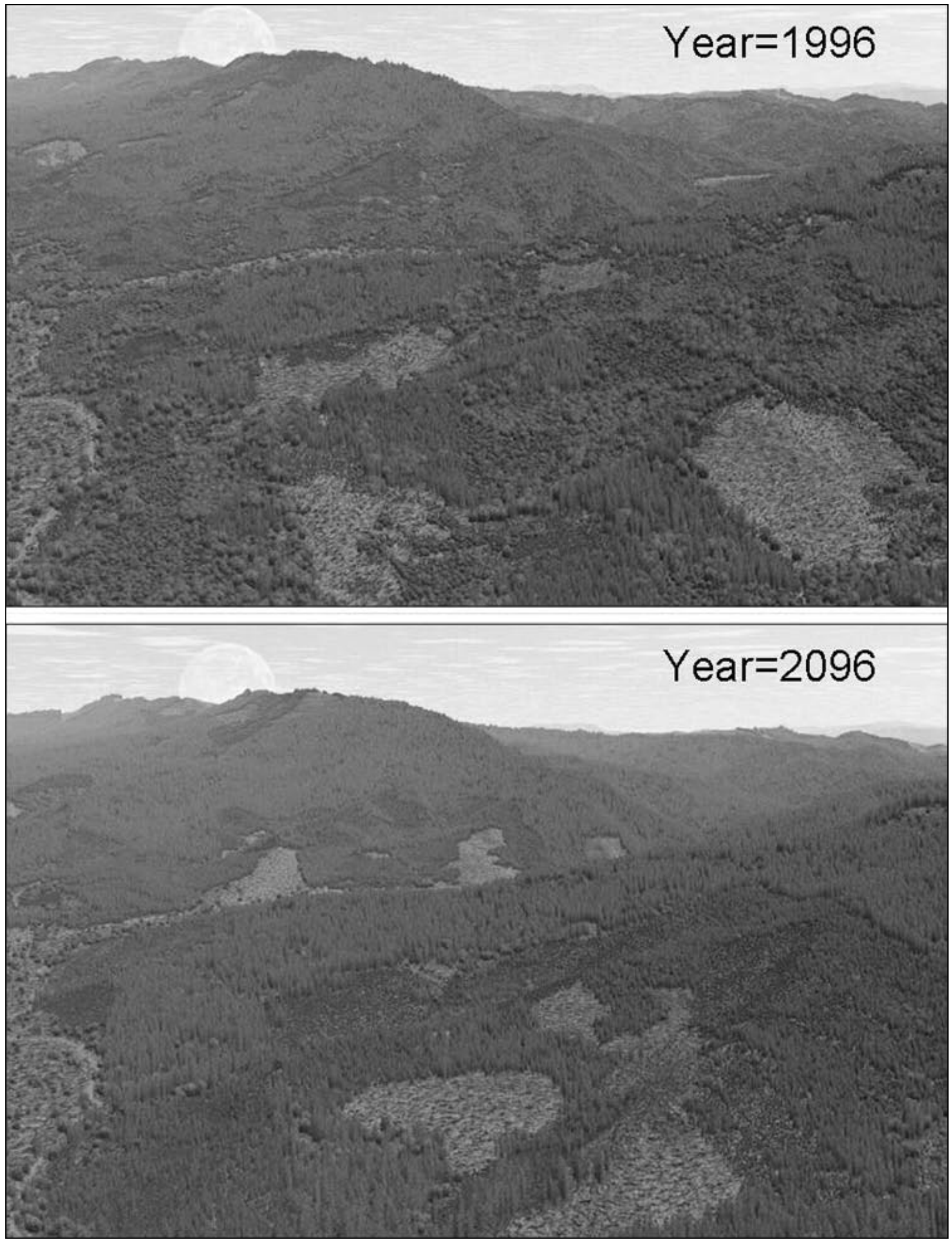
"Under current land management policies, habitat area for spotted owls, low-dispersal lichens, and marbled murrelets was projected to increase dramatically over the next hundred years. Habitat for western bluebirds was projected to decline slightly, and the habitat for moderate dispersal lichens will decline, then stabilize. Olive-sided flycatcher habitat is projected to decrease at first then increase later in the century. Red tree vole habitat was projected to remain stable throughout the simulation period," says Spies.

One of the really exciting things about LAMPS is that it allows users to test hypotheses about conservation policies. In one example, CLAMS simulated a hypothetical change in the Oregon Forest Practices Act that would require private landowners to retain five large live trees per acre. This is frequently cited as a way to retain wildlife habitat after a harvest. They then reevaluated the habitat of the focal species.

"Green tree retention reduced the discrepancy between private and public forests and benefited several of the species we examined," says Spies. "The policy was particularly effective at increasing habitat availability for red tree voles, western bluebirds, and moderate mobility lichens." It would, though, require that landowners leave valuable trees in the woods.

Parallel to the analysis of terrestrial species, CLAMS scientists Kelly Burnett and Gordon Reeves, who are both fish biologists at the PNW Research Station in Corvallis, Oregon, led an assessment of salmon and trout habitat potential. Obviously, habitat requirements for fish are different than those for vegetation or wildlife; therefore, much of their effort in the early years of CLAMS was spent creating high-resolution stream maps of the Coast Range.

Fish habitat quality, like wildlife and tree habitat quality, is correlated with ownership. "Stream reaches best suited for steelhead trout occur predominately on publicly owned forest lands, whereas reaches best suited for coho salmon occur commonly on privately owned lands with various uses," explains Burnett. "Unlike wildlife, these patterns have more to do with differences in the gradients of the streams on public and private land than with management. Nonetheless, the best coho streams, which flow primarily through private lands—many of which are in agricultural uses—will be subject to higher intensity land management over the next century than will the best steelhead streams."



These photorealistic visualizations are generated from predictive models of vegetation cover, not actual tree data. The life-like rendering of future landscapes allows policymakers to envision outcomes of forest management decisions.

THE HUMAN ENVIRONMENT

CLAMS is truly a multidisciplinary effort focused as much on human systems as ecological ones. Therefore, in addition to habitat quality, the LAMPS simulations are used to simulate the impacts of future population growth and housing density as well as future timber supply and value under various policy scenarios.

"Simulations of the current forest policies suggest that development and land-use change over the next 100 years should leave intact the large majority of coastal forests," says Johnson.

Even so, human population growth will continue to chip away at the forests. Projections of land-use change correspond to an expected 60 percent increase in Oregon's population. Most of the growth will be located on the margins of the Willamette Valley, primarily around the cities of Portland and Salem. "Based on these projections we might see a 10 percent reduction in the industrial forests available for timber harvest and a 33 percent reduction in non-industrial forest over the next 100 years as development occurs," says Jeff Kline, a research economist at the PNW Research Station in Corvallis, Oregon.

According to Kline, the greatest unknown is the magnitude of future "speckling" of new homes throughout the remaining wildlands and forest.

Given a continuation of the current policy, most of the timber volume will come from private lands, which rely heavily on clearcutting and patch cutting. Public lands, in contrast, will produce little timber volume and perform the bulk of the thinning. Simulations suggest that harvest in the region could continue at its current rate over the next century.

If the conservation policy requiring retention of more trees after harvest are implemented, private landowners might experience a 5- to 7-percent reduction in harvest. Thus, such a policy would cost landowners many millions of dollars per year and reduce the wood available to Oregon mills." says Johnson.

LAND MANAGEMENT IMPLICATIONS

- Forest management policies can strongly affect biological diversity. The differences among the different ownerships are striking.

- Many of the projected changes are consistent with current federal and state policies and plans. For example, the increase in acreage of mature and old-growth forests is the desired outcome of the Northwest Forest Plan for federal lands. However, some changes may not have been widely known or anticipated when policies were developed. The increase in area of older conifer forest types is matched by a decline in area of other forest types that provide biologically diverse and unique habitat.

- Landscape-level, cross-ownership simulations are needed to assess the effects of forest management policies on biodiversity. Some trends such as decline of hardwoods and diverse early-successional stages may not be desirable.

BRINGING IT ALL TOGETHER

The CLAMS project has developed new approaches in the field of landscape ecology. It is also one of the best examples in the world of how interdisciplinary approaches can be used to evaluate forest management consequences in multiownership landscapes.

During the next year, Ecological Applications, a prestigious academic journal, will be highlighting the work of CLAMS in a special issue. This assemblage of papers will be the first time that the full breadth of CLAMS research will be published in one place.

Spending the time to write and assemble these papers gave the scientists a chance to reflect on what they've accomplished. "The project is one of the most integrated research efforts in the history of the PNW Research Station," says Spies. "It has involved vegetation ecologists, fish biologists, wildlife ecologists, economists, policy experts, and social scientists. The project has also involved both researchers and management agency personnel."

"The CLAMS approach requires a belief that you can take on a whole forest system in all its complexity and messiness and, if not tame it, at least not be overwhelmed by it," says Johnson.

"To achieve our objective of conserving the vast majority of biological diversity, it is critical that we plan and assess at the level of landscapes and regions as well as ecosystems."

—J.F. Franklin

FOR FURTHER READING

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The CLAMS team conducts many field trips for researchers, managers, and students.

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