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FINDINGS

INSIDE

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

BIODIVERSITY AND INTENTIONAL MANAGEMENT: A RENAISSANCE PATHWAY

A *Competitive exclusion. In the competitive exclusion stage, trees fully occupy the site and compete with one another for light, water, nutrients, and space such that most other vegetation and many trees become suppressed and die.*

IN SUMMARY

A project in western Washington tries to mimic natural disturbance to create forest structure similar to late-seral stages. A model was developed to identify pathways to achieve this structure with four indices: capacity to support vertebrate diversity, forest floor function, ecological productivity based on tree-using rodents, and production of deer and elk.

The study found that maximizing biodiversity through intentional forest management reached the goal of old-forest habitat more quickly than other timber-fiber strategies, and it produced significant economic benefit.

"If we can conserve biodiversity, we preserve options and maximize benefits for current and future generations," says Andrew Carey, team leader for the project. (See pages 2 and 3 for key findings and policy implications of this research.)

If you have comments on this or other issues of "PNW Science Findings," please let me know.

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"The whole of science is nothing more than a refinement of everyday thinking."
Ralph Waldo Emerson 1803-1882

If you synthesize the babble of issues emerging from clearcutting or roads or spotted owls or fish or board feet or natural disturbances and ravaged communities, what it all comes down to is, How can we manage our forests sustainably? In other words, so that they won't ever go away. This is the problem we have set for ourselves.

And Andrew Carey believes we can solve it. "If we can conserve biodiversity, we preserve options and maximize benefits for current and future generations," he says. It certainly sounds like a sustainable solution. "Our biggest challenges are not technical: we have the data and the modeling ability and even the will. Rather, our biggest challenge lies in our ability to grasp the complexity of the problem and then communicate clearly with each other about it."

Carey is a research biologist for the PNW Research Station and science team leader for the Washington Forest Landscape Management Project. The project is referred to as a pragmatic, ecological approach to small-landscape management and is based on the idea of biodiversity pathways.

"The approach of biodiversity pathways tries to mimic the natural disturbance process to create over time a forest structure similar to late-seral [big tree] stages," he says. In today's research context, this in itself is not so remarkable, but the overlay added by Carey and his colleagues is *intentional management.*

"By this term we mean we *intentionally* try to meet public needs of many kinds, paying full attention to all the research and theory and adapting the management system to local conditions, while using ecological principles and real world—empirical—data."

MANAGING FOR FOREST STRUCTURE

The Washington project was designed to offer flexibility in management options, not to create the next version of "the only way to do things," Carey says. The clearcutting-burning-replanting regime that dominated so much of forest management thinking in recent decades in the Pacific Northwest was for a time accepted as the norm. Promoting other forest values was incidental, not intentional.

Breaking out of that mold and crafting new perspectives on forest management has been a process fraught with animosity and clashing philosophies. Carey disparages the conflict and believes the time has come for a renaissance.

"If it is recognized that conservation of biodiversity is a foundation for sustainable forestry, artificial conflicts between conserving biodiversity and maintaining wood production disappear," he says. "Biodiversity pathways offer flexibility both in terms of what forest stands will look like at their end point and in generating revenues."

Forest ecosystem development can follow very different trajectories, he says, depending on conditions at initial establishment, subsequent silvicultural practices, and subsequent local, natural disturbances. Thus Carey's team assumed various endpoints were at all times possible.

"Active management designed to produce a desired mix of conditions can be far more effective and less costly than blanket attempts at 'preservation' that eliminate human intervention," he says. "Just setting something aside as a reserve doesn't mean it's going to function that way." The team focus, however, is not on old-growth reserves. It is on second-growth forests, many of which are currently of uniform age.

Indeed, his group believes the biodiversity-pathways approach can provide all the avowedly desirable outcomes sought from forests: forest products; recreation and spiritual opportunities; support for forest-dependent human communities; habitat for most, if not all, forest wildlife; healthy, resilient forest ecosystems; functional landscapes; and reconciliation of alternative agendas for forest land management.

The end result of such a management system, he explains, can be that people with diverse perspectives are able to see what they are looking for in managed forests, whether it be wildlife, the appearance of streams and landscape, or the quantities and species of wood harvested.

KEY FINDINGS

- **Maximizing biodiversity through intentional forest management achieved the goal of accruing old-forest habitat more quickly than other timber-fiber management strategies and produced significant economic benefits.**
- **Excluding management after a timber harvest seemed to delay forest development compared to thinning with other management techniques. Lack of management seemed to result in fragmentation of the remaining forest.**
- **Managing to maximize biodiversity met late-seral forest goals most quickly, produced 82 percent of maximum net present value of timber, and maximized long-term sustainable income. Maximizing net present value created no late-seral forest and resulted in many wildlife species being at risk.**

GRAPPLING WITH BIODIVERSITY

So if biodiversity holds all the solutions, what exactly is it?

It's the stuff splattered across your windshield on a summer evening. It's all the big critters and the little critters you find in a place. It's all the plants they eat and the soil they stomp on. It's the fungi. It's the soil web. It's all the trees and the way they breathe.

More technically, biodiversity includes all the building blocks of the living world: genes, organisms, populations, communities, ecosystems, the ecological and evolutionary processes that incorporate these blocks, and the resulting ecological and economic goods and services.

All very well, but how do you measure it?

"For the Washington project, we developed a new set of biotic indices of forest ecosystem health. These measures developed out of the mechanics of our modeling approach. We needed a quantitative way to express the alternative scenarios we were projecting," says Carey. "We also needed credibility with other scientists, interested and informed stakeholders (conservation, land managers, and the timber industry), and empirical evidence to show this is a good way to look at forest function."

Purpose of PNW Science Findings

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

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The team compared biotic communities in old-growth, young natural, and managed forests to develop the four new indices: capacity to support vertebrate diversity, forest floor function as illustrated by the integrity of the forest floor mammal community, ecological productivity as shown by the abundance of the arboreal (tree-using) rodent community, and production of deer and elk.

Carey notes that as the research data accumulate—from all available data, not just his own—these indices are so far testing out as strong and appropriate measurement tools.

"If there is any lesson from the recent past, it is that targeting individual species and designing management around them can be extremely disruptive and expensive," he says. "It cannot be done for each of the myriad existing species." Instead, he posits, *webs of life*, *functions of ecosystems*, *interactions* of organisms, *legacies* of undisturbed forests—these are the living dynamics that must be understood and preserved.

POLICY IMPLICATIONS

- **Guidelines for conservation of biodiversity on intensively managed lands need to be developed, available to be implemented across multiple ownerships.**
- **Sustainability needs to be considered with respect to economic, social, environmental, and policy factors. If any one of these elements is not sustainable, none of the others will be either.**
- **Biotic indices based on ecosystem processes are more comprehensive and effective measurements of ecosystem health than monitoring individual species.**
- **Biodiversity pathways provides a management paradigm that can promote reconciliation of the diverse groups using Pacific Northwest forests.**

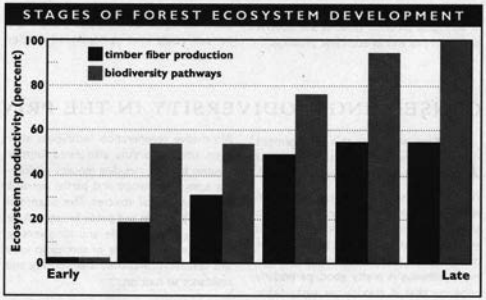
MANAGEMENT AND BIODIVERSITY: MODEL ASSUMPTIONS

The basis for the biodiversity-pathways model included some key assumptions. *Conserving specific biodiversity legacies*—examples are coarse woody debris, pieces of intact forest floor including understory plants, and live old trees—during harvest and regeneration can "jump start" the rebuilding of a healthy, diverse forest, Carey says. *Minimal site preparation* disturbs fewer forest ecosystem processes and leaves more of them intact after harvest.

Minimizing time in the stem-exclusion stage[1] of stand development, which is most competitive and therefore most devastating to the most species, encourages development of complex, mixed-age forests. *Repeated variable density thinnings* contribute here, Carey notes, by developing the understory, thereby creating small openings that influence forest floor characteristics and, along the way, producing a sustained flow of wood products and revenue.

Managing for coarse woody debris, producing logs, cavity trees, and structural complexity in streams, maintains crucial fish and wildlife habitat functions. And *extending rotations* into the range of 90 to 130+ years versus 40 to 50 years on a significant part of the land base allows development of a wide range of age classes and tree sizes. According to Carey, this would help decrease the proportion of now-common competitive-exclusion stage forests.

Although empirical data form the foundation of the modeling assumptions used in the Washington project, Carey emphasizes that the results are as yet based on some untested hypotheses. Research is underway to establish the robustness of the model and its assumptions.



[1] ***Stem-exclusion stage or competitive exclusion***—*Trees fully occupy the site and compete with one another for light, water, nutrients, and space such that most other vegetation and many trees become suppressed and die.*

THE BIODIVERSITY PATHWAY SO FAR

Where does the biodiversity pathway, as delineated by running the model, lead?

"Maximizing biodiversity through intentional forest management achieved the goal of accruing old-forest habitat more quickly than other timber-fiber management strategies, and it produced significant economic benefit," Carey says.

This type of forest management achieved the highest level of ecosystem health across the four indices. Not only this, the combination of biodiversity legacies, minimal site preparation, variable density thinnings, and management for coarse woody debris, produced a larger variety, higher quality, and greater volumes of wood products than more conventional timber-fiber production pathways, he notes.

"The biodiversity pathway seemed to be the best option for producing a sustainable flow of ecological products (species and ecosystem health) as well as economic products."

Specifically looking at economic products, maximizing biodiversity produced 82 percent of maximum net present value of timber,[2] and maximized long-term sustainable income. Turning the objectives around, managing instead to maximize net present value of timber indeed resulted in the highest short-term economic value but posed the most risk to species and reduced sustainable income.

Bluntly speaking, Carey says, maximizing net present value created no late-seral forest and resulted in many wildlife species being at risk.

Another alternative explored was the option of excluding management after a timber harvest.

"What we saw was delayed forest development, compared to thinning with other management techniques," Carey says. "Long periods of greatly reduced species diversity occur during forest maturation, and these periods could lead to continued species extirpation."

All wildlife species did better under the biodiversity-pathway management scenario. The Washington project team created a classification of forest development incorporating eight stages, to reflect accurately the longevity, structure, and organization of Pacific Northwest forests. Carey believes that if management takes into account the biodiversity value of each stage, it can work intentionally towards providing the needs of late-successional wildlife.

This is where the four ecosystem health indices come into play as measurement tools. "All indices are higher in the biodiversity pathway than in other management scenarios at all eight stages of ecosystem development," Carey says.

CONSERVING BIODIVERSITY IN THE PRIVATE-OWNER WORLD

How well does this management pathway sell in the world of short-rotation net present values?

"We've had very positive responses from state forest managers to date. It's harder to tell with the corporations. While you and I might think that achieving 82 percent of net present value under biodiversity-management pathways is pretty good, particularly knowing that it maximizes sustainable revenues over time, they do have immediate return, or even cash flow, to think about, and they do like complete freedom of decision," says Carey. Family owned corporations, large or small, have a view to a sustainable future and take an intergenerational responsibility that clearly matches the goal of conserving biodiversity, he adds.

He readily acknowledges there are difficult considerations in this approach for any timber company. Foremost is the short-term timber supply problem during transition to longer rotations. This could be partly offset by increases in thinning, he suggests, and by possible reduction of pressures for withdrawal of land from the timber base.

Alternative regeneration techniques after even small clearcuts also need further creative thought, including mosaics of different ages, shelterwood and partial removal, and mixtures of species. The potential payoffs for private and public forests include advantages for wildlife and biodiversity, aesthetics, the matching of species to local site conditions, improved stem quality, and resistance to root rot.

And finally, there are the plantations. Millions of acres of young plantations in western Oregon, Washington, and British Columbia are fast approaching commercial thinning age.

"The choice between harvesting now with continued short-rotation management versus repeated thinning on long rotations will have major effects on long-term productivity of all forest values, the nature of the future forest, and future land use conflicts," says Carey. "This is a major management question of the near future."

Probable factors in the question are publicly induced private landowner incentives, he notes. These might take the form of carbon sequestration credits (a kind of carbon profit and loss table), tax incentives and publicly funded consulting foresters, conservation easements, and direct credits for putting blocks of land into biodiversity-pathway management.

WRITER'S PROFILE

Sally Duncan is a science communications planner and writer specializing in forest resource issues. She lives in Corvallis, Oregon.

[2] ***Net present value of timber***—*the present and future monetary value of the timber that would be produced by the land discounted to the present under some set of expectations (stumpage value and discount [interest] rate).*

ARE WE THERE YET?

Obviously, biodiversity pathways have yet to be accepted or tested on a large scale. Yet there seems to be an inherent logic to them, based on all that we have been learning the hard way, as well as the empirical way, in the past few decades.

As Carey puts it, "The extended rotation and biodiversity pathway options can be important in reducing the land use conflicts and economic and social disruption experienced in recent years. It's an opportunity to combine timber production with production of some of the ecological and amenity values many people associate with old forests. To manage intentionally for them." We have indeed set ourselves up to solve the problem.

But are we missing something in our enthusiasm for this most recent solution?

"Of course we are. We'll only learn what it is by rigorous monitoring and evaluation of these proposed management pathways," Carey says. "The quest to understand how to manage forests the best way possible will always provide us with a moving target. But that just emphasizes the need to set new goals in what we can achieve."

The number of tree-dwelling rodents found in a forest, such as the flying squirrel, is used as a measure of ecological productivity of a forest. Photo credit: Tom Iraci.

FOR FURTHER READING

Carey, A. [and others]. 1996. ***Washington Forest Landscape Management Project—a pragmatic, ecological approach to small landscape management.*** Rep. No. 2. Olympia, WA: Washington State Department of Natural Resources.

Carey, A.B.; Curtis, R.O. 1996. ***Conservation of biodiversity: a useful paradigm for forest ecosystem management.*** Wildlife Society Bulletin. 24(4): 610-620.

Curtis, R.O.; Carey, A.B. 1996. ***Timber supply in the Pacific Northwest: managing for economic and ecological values.*** Journal of Forestry. 94(9): 4-7, 35-37.

Carey, A.B. 1998. ***Dimensions of ecosystem management: a systems approach to policy formulation.*** In: Calhoun, J.M., ed. ***Forest policy: ready for renaissance.*** Contrib. 78. Pullman, WA: College of Forest Resources, University of Washington, Institute of Forest Resources.

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Photo credit: Tom Iraci

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WASHINGTON FOREST LANDSCAPE MANAGEMENT

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