

## Research Synthesis:

### Response of Birds to Thinning Young Douglas-Fir Forests

As a result of recent fire history and decades of even-aged forest management, a large proportion of coniferous forests in western Oregon are comprised of young (20-50 yrs), densely stocked Douglas-fir stands. Frequently, these stands are structurally simple, consist of a single canopy layer with one or two overstory tree species, and have a relatively sparse understory. The lack of structural complexity typically found in these stands may limit the availability of key habitat components for several species of vertebrates, including several species of birds. Thinning may increase stand

structural diversity by reducing competition among overstory trees and increasing the amount of sunlight reaching the forest floor, thereby increasing development of understory vegetation. As existing old-growth forests may have developed under lower densities than is typical of contemporary plantations, thinning also may be a tool for accelerating the development of late-successional habitat in some circumstances. In addition to the potential increases in structural and biological diversity,

thinning frequently is used to optimize wood fiber production and to generate timber revenue.

Because of the potential ecological and economic benefits, thinning is underway or planned for hundreds of thousands of acres of forest in western Oregon. However, there are few studies documenting the implications of commercial thinning to wildlife populations. As

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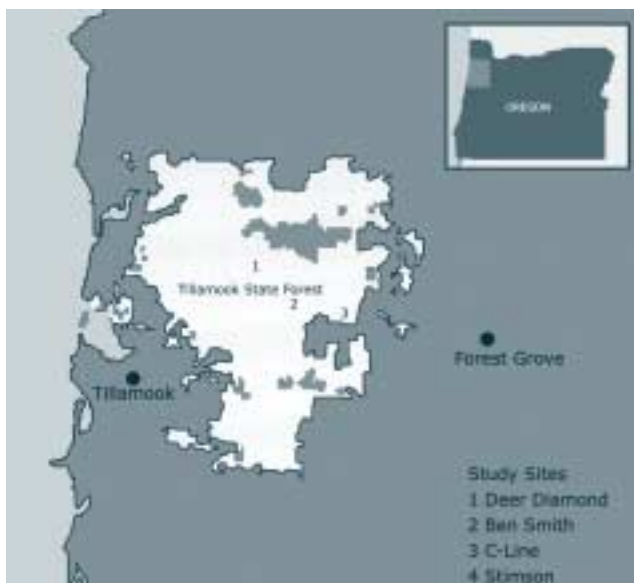


Figure 1. Map of Tillamook study sites.

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# RESEARCH SYNTHESIS



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part of a larger research program examining the influence of thinning on vegetation and wildlife, Dr. John Hayes, Jennifer Weikel, and Manuela Huso evaluated the response of breeding birds to thinning in the northern Oregon Coast Range. Their objectives were to determine:

- if abundance of breeding birds was influenced by thinning,
- if influences varied with thinning intensity, and
- if effects varied in time during the first 6 years following thinning.

Their study was conducted in the northern Oregon Coast Range in an area known as the “Tillamook Burn,” named for the series of intense fires that burned through the region between 1933 and 1951. As a result of intensive replanting and seeding efforts between 1949 and 1970, today these lands primarily consist of

large tracts of contiguous, even-aged Douglas-fir forest. Three replicate areas on the Tillamook State Forest and one on lands managed by the Stimson Lumber Company consisting of three 65- to 100-acre stands of 35-45 year-old forest were selected for study (Figure 1). Each stand within a replicate was randomly assigned to one of three treatments: no thinning (control), moderate thinning (thinning to a relative density (RD) of 35, or roughly 100 to 130 tpa), or heavy thinning (RD 20, or roughly 60 to 85 tpa). The moderate thinning treatment was designed to emulate operational commercial thinning that is typically used in the area to achieve wood fiber production goals. The heavy thinning treatment was designed to increase size of canopy openings, accelerate growth of overstory trees, stimulate understory development, and enhance structural complexity of the stands. The thinning treatments were performed between 1994 and 1995.

To sample bird abundance, five

point-count stations were established in each of the 12 stands. Each stand was visited seven times during the year prior to treatment (1994) and during each of the 6 years immediately following treatment (1995-2000). Observers recorded all birds seen or heard within 80 m of each point-count station during an 8-minute observation period.

Information-theoretic approaches (Burnham and Anderson 1998, Model Selection and Inference: a Practical Information Theoretic Approach. Springer-Verlag. 353 pp.) were used to construct a set of conceptual models describing the response of birds to thinning. The models were based on four possible scenarios for mean treatment differences:  $C=M=H$ ;  $C=M \neq H$ ;  $C \neq M=H$  and  $C \neq M \neq H$ , where C, M, and H represent the mean index of bird abundance or temporal trend in the control, moderately thinned, and heavily thinned stands. The strength of the individual models to fit the data were based on Akaike’s Information Criterion (AIC; Burnham and Anderson 1998).

Of the 22 bird species statistically analyzed, detections of nine species decreased and eight species increased relative to controls following thinning, and there was no strong evidence that thinning influenced abundance of five species (Table 1, Figure 2). Of the 17 species that responded to thinning, the magnitude of response of eight species varied with thinning intensity. Numbers of Pacific-slope flycatchers (Figure 2A),

**Table 1.** Response of species to thinning treatments.

Declined in response to thinning	No evidence of change in response to thinning	Increased in response to thinning
Pacific-slope flycatcher	Chestnut-backed chickadee	Dark-eyed junco
Hutton’s vireo	Winter wren	Warbling vireo
Hermit warbler	Gray jay	American robin
Golden-crowned kinglet	Wilson’s warbler	Hairy woodpecker
Steller’s jay	Red-breasted nuthatch	Townsend’s solitaire
Swainson’s thrush		Evening grosbeak
Brown creeper		Western tanager
Black-throated gray warbler		Hammond’s flycatcher
Varied thrush		

Hutton's vireos, and brown creepers decreased more in heavily thinned stands than in moderately thinned stands, and numbers of dark-eyed juncos (Figure 2B) and hairy woodpeckers increased more in heavily thinned stands than in moderately thinned stands. Two species, the Steller's jay and varied thrush, appeared to decrease only in the heavily thinned stands, and warbling vireos increased only in the heavily thinned stands.

Although no species was extirpated from stands following thinning, detections of Hutton's vireos, golden-crowned kinglets, brown creepers, black-throated gray warblers, and varied thrushes in one or more of the thinning treatments were 50 percent or less than detections in controls, suggesting thinning significantly impacts their numbers. In contrast, American robins, Townsend's solitaires, and Hammond's flycatchers were rare or absent in controls but regularly present in thinned stands, and detections of western tanagers, evening grosbeaks, and hairy woodpeckers increased by three-fold or more in thinned stands relative to controls.

Only Pacific-slope flycatchers, warbling vireos, and western tanagers showed strong evidence of temporal trends in response to thinning. For these three species, differences between numbers in controls and thinned stands became more extreme through time.

These results, in combination with other recent studies, demonstrate that thinning influences abundances of several species of wildlife during the first few years following thinning. As neither thinned nor unthinned stands provide optimal habitat for all species, it may be beneficial to retain some densely stocked, unthinned patches in landscapes dominated by younger stands to provide refugia for species that are negatively impacted by thin-

ning. However, because the short-term consequences of thinning for many species of wildlife are positive, neutral, or of minor negative impact, most wildlife populations in landscapes dominated by young, densely stocked plantations should benefit from thinning over a large proportion of the landscape if done in conjunction with management and retention of legacy structures and dead wood, and other conservation measures. □

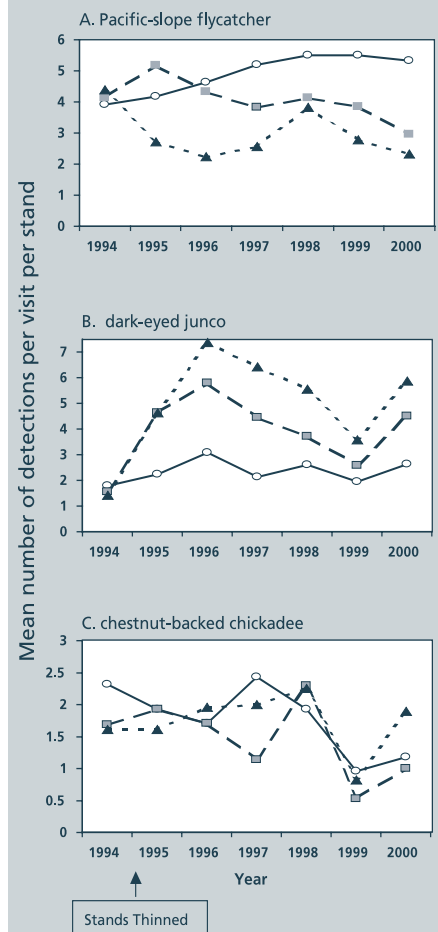
*Dr. John P. Hayes is program coordinator and a wildlife ecologist for the CFER program. He also serves as an associate professor in the Department of Forest Science at Oregon State University.*

*Jennifer Weikel ended her appointment with CFER in 2001 to accept a position as a Wildlife Ecologist for Pacific Wildlife Research Inc., a consulting firm based out of Corvallis, OR. During her time with CFER, Jennifer served as a research assistant in wildlife ecology and was involved in research examining effects of commercial thinning young Douglas-fir stands on songbirds.*

*Manuela Huso is a senior faculty research assistant with the Department of Forest Science at Oregon State University. She serves as a consulting statistician to members of the department and its collaborative research partners including the USDA Forest Service PNW Research Station and USDI Forest and Rangeland Ecosystem Science Center in Corvallis.*

*Funding for this research was provided by the Coastal Oregon Productivity Enhancement (COPE) program, College of Forestry, Oregon State University, and by funding to the Cooperative Forest Ecosystem Research (CFER) program by the USGS Forest and Rangeland Ecosystem Science Center, the Bureau of Land Management, and the Oregon Department of Forestry.*

**Figure 2.** Examples of responses of birds that decreased in numbers in response to thinning (Pacific-slope flycatcher, Figure 2A), increased in numbers in response to thinning (dark-eyed junco, Figure 2B), and showed no strong evidence of change in response to thinning (chestnut-backed chickadee, Figure 2C). Symbols represent mean response of all replicates combined for control stands (open circles), moderately thinned stands (shaded squares), and heavily thinned stands (solid triangles).



# UP CLOSE:

## A Census of Red Alder and Douglas-fir Along Unlogged Headwater Streams in Western Oregon

by Jeff Shatford and David E. Hibbs

The explosion of research on riparian ecosystems over the past two decades has generated a broad spectrum of information as well as controversy regarding the management of forest and fishery resources in Oregon. Much of this work has highlighted the physical and biotic contributions trees make to streams, including shading, litter-fall, and large wood. This knowledge has in turn guided the development of streamside protection areas for the maintenance of water quality and fisheries.

Many decisions, however, have been based on a limited knowledge of the historical conditions of riparian forest communities in the region. What information exists has been collected from a limited number of watersheds, primarily in the

Coast Range and central Cascades. Today, few intact unmanaged riparian forests remain, making those few that do remain a valuable storehouse of information. Over the last several years, CFER has been collecting data from such areas to describe the character and natural range of variability inherent to these systems.

With the help of agency personnel, unmanaged stream networks that had a minimal history of human disturbance (i.e., no evidence of logging, mining, or farming) were identified. Data collection was stratified among first- through third-order streams in four sub-regions west of the Cascade crest: the coastal fog belt, Coast Range, Cascade Mountains, and Klamath area. We recorded the size, species, and distance of all trees within 50 m (160 ft) of the stream edge. Here, we limit our discussion to two species, Douglas-fir and red alder.

We addressed two main questions:

- What is the relative contribution of each species to the total population of trees in each of the four sub-regions?

- How does the proportion of Douglas-fir and alder change between first- and third-order streams, and between valley slope and stream bank?

**Table 1.** Proportion of Douglas-fir and red alder stems ( $\pm 95\%$  confidence limits) in streamside and upslope plots from unmanaged riparian forests in four sub-regions of western Oregon. The streamside plots were immediately adjacent to the stream (0-10 m, 0-33 ft) and upslope plots were 20-30 m (66-100 ft) from the stream.

	Streamside	Upslope
<b>Douglas-fir</b>		
Klamath	0.44 $\pm$ 0.07	0.45 $\pm$ 0.07
Cascade	0.19 $\pm$ 0.06	0.38 $\pm$ 0.08
Coast	0.15 $\pm$ 0.09	0.25 $\pm$ 0.11
Fog-belt	0.00 —	0.02 $\pm$ 0.03
<b>Red alder</b>		
Klamath	0.05 $\pm$ 0.03	0.00 —
Cascade	0.13 $\pm$ 0.05	0.03 $\pm$ 0.03
Coast	0.50 $\pm$ 0.14	0.37 $\pm$ 0.12
Fog-belt	0.48 $\pm$ 0.14	0.21 $\pm$ 0.11

To measure changes along the slope, we delineated two arbitrary 10-m microsites within our 10 x 50 m sampling quadrats; a streamside plot immediately adjacent to the stream (0-10 m, 0-33 ft) and an upslope plot 20-30 m (66-100 ft) from the stream. Tree-species abundance was recorded as the average proportion of that species in a given sample (i.e., 46% or 0.46 indicates that on average, 46 of a 100 trees sampled were of the species of interest).

Combined, Douglas-fir and alder comprised 40-60% of all trees in riparian forests throughout the region. It has been repeatedly observed and reported that in the Coast Range, alder, and hardwoods in general, increase in abundance with increasing stream order or size. This general pattern was consistent with results from three of the four sub-regions we surveyed, but not with results from the coastal fog-belt. Alder comprised 0, 4, and 42% of the trees along first-order streams in the Klamath, Cascade, and Coast sub-regions, respectively, increasing to 7, 15, and 50% along third-order streams. The downstream increase in hardwood abundance reflects the related increase in floodplain width and disturbance patterns, which favor alder colonization.

The pattern was reversed in the fog-belt; alder comprised as much as 50% of the trees on first-order streams, but only 24% of trees on third-order streams. Because the third-order streams are more likely to be near the coast, the decrease in alder abun-

dance may be a reflection of the increasing dominance of Sitka spruce.

A comparison of alder populations between streamside and upslope plots provides some insight into limitations on alder abundance. In the Klamath sub-region, alder was not recorded in upslope plots. Rather, it was limited to a narrow band immediately adjacent to the stream bank. In the Cascade sub-region, alder was rarely found upslope (<1% of all stems), but comprised 13% of stems in streamside plots. By comparison, in the Coastal sub-region, alder comprised 37% of the trees in upslope plots, increasing to 50% in streamside plots.

This pattern of decreasing alder abundance from the coast to the Klamath parallels and is regulated by the regional moisture gradient. In the Klamath sub-region, relatively arid and open forests exist, even near streams, allowing oaks and other xerophytic species to play a role. Due to the limited effects of summer drought in the humid Coastal sub-region, alder is able to colonize the side-slope as well as the stream bank.

The pattern of Douglas-fir abundance was generally the opposite of that observed for alder. Moving from first- to third-



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order streams, Douglas-fir decreased slightly from 50 to 36% of the total tree population along streams in the Klamath area and from 32 to 27% in the Cascade sub-region. The decrease was more pronounced in the Coast Range where Douglas-fir dropped from 44% of the trees on first-order streams to only 8% of the trees on third-order streams. Its occurrence in the fog-belt, aptly called the Sitka spruce zone, was extremely low (<2% of all stems).

A comparison of microsites in the Coast Range and Cascade Mountains indicates that Douglas-fir was less abundant near streams compared to upslope (Table 1). This did not hold true for the Klamath region, however, where the proportion of Douglas-fir was equally high in both microsites.

The likelihood that a tree will provide shade, litterfall, or large woody debris to a stream is a function of tree size, species, and distance away from the stream. Our initial analysis suggests that there are predictable changes in the composition of riparian forests moving from headwaters to downstream and laterally from side-slope to streambank. This implies that the amount and type of woody debris entering a stream will vary according to location within the stream network and among the regions. More subtle variation in shading due to changes in hardwood/conifer proportion is also likely.

Each of the four sub-regions is unique in terms of the two species we considered. The observed differences in tree abundance are predictable given the moisture gradient across the region. The strength and direction of the shift from Douglas-fir to alder abundance along the downstream and side-slope gradient is also unique to each sub-region and follows a characteristic and predictable pattern. One cannot assume or impose a single common vegetation composition over all of western Oregon. If we wish to mimic unmanaged riparian forests to any degree, we must recognize the unique character inherent to each area and find ways to incorporate this natural variation into management plans. □

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# PROGRAM ANNOUNCEMENTS

## Publication Highlight

In the Pacific Northwest, the maintenance of old-growth trees is often emphasized because of the structural diversity and unique habitats they provide. Over the past century, however, fire suppression, especially in the southern part of this region, has resulted in increased understory tree density. Increased stand density potentially makes these forests susceptible to stand-replacing fires and insect-related mortality due to increased water stress. Reducing stand density in existing old-growth stands may increase resistance to wildfire, improve tree and stand vigor, and increase resistance to insects and pathogens. Yet, density reduction is seldom considered in old-growth forests because of the assumption that large old trees are incapable of responding to increased growing space.

Penny Latham, a research assistant and plant ecologist for the CFER program, and John C. Tappeiner, a recently retired USGS scientist and

former member of the CFER science team, recently co-authored a publication in which the growth response of 271 old-growth Douglas-fir, ponderosa pine, and sugar pine trees (158-650 years) was examined 20-50 years following density reduction. Results indicate that density reduction did not harm and often benefited old trees.

Growth increased by 10% or more for 68% of the trees in thinned stands, and the greatest growth response to density reduction often occurred 20 to 25 years after treatment. Latham and Tappeiner's results have important implications not only for the basic biology of aging forests, but for silvicultural practices in forests with old-growth trees.

More details on this study and its results are provided in: Latham, P., and J. Tappeiner. 2002. Response of old-growth conifers to reduction in stand density in western Oregon forests. *Tree Physiology* 22:137-146. □

## Congratulations

Congratulations to CFER-affiliated graduate student Dodie Wilson on completion of her M.S. thesis entitled "Validating Songbird Habitat Relationship Models".

Abstracts of student theses and dissertations are available on our Web site (<http://www.fsl.orst.edu/cfer/research/pubs/pubs.html>).

## Awards

David Waldien, a Ph.D. student in the Department of Fisheries and Wildlife, has been awarded the following scholarships:

- The Thomas G. Scott Grant Scholarship
- The P.F. Yerex and Nellie Buck Yerex Graduate Fellowship, and
- The Advanced Graduate Student Scholarship, Oregon Chapter of The Wildlife Society



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our Web site at  
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to learn more about  
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## Credits

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