Communique

JULY 2001

CASCADE CENTER FOR ECOSYSTEM MANAGEMENT

MANAGEMENT IN YOUNG FORESTS

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In 1993 the Cascade Center for Ecosystem Management published a communiqué titled “Young Managed Stands” (Hunter 1993) that offered perspectives on management in young forests, summaries of current studies, and contact information to promote communication among those interested in the topic. At that time, the eyes of many were turning away from the harvest of old-growth forest, the focus of many decades, to management and research in young managed stands, which had become abundant on private and public lands (currently about 25% of forested land on the Willamette NF). While silvicultural knowledge of even-aged stands managed for timber volume had been well-established, little was known in regard to biodiversity values and purposeful management of those values in young managed forests. Numerous studies were initiated in young stands in the Douglas-fir region to try and learn more about management of young forests. In this communiqué we highlight some new developments in young stand management and research since 1993, take a look at possible pathways to the future, and offer some resources for connecting with other folks who are also learning more about management in young forests.

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THE LAST DECADE

The Northwest Forest Plan (NFP), authorized in 1994, promoted maintenance and restoration of late-successional and aquatic habitats and associated species, and a lower but potentially sustainable level of wood production on National Forest System (NFS) and Bureau of Land Management (BLM) administered lands in the range of the northern spotted owl in the Pacific Northwest. The plan drastically reduced harvest of late-seral habitat, identified reserves of various kinds, established adaptive management areas, and encouraged restoration of forests and watersheds affected by previous management.

Many resource managers began to focus on young managed forests. Silviculturists, wildlife biologists, and others began taking steps to incorporate characteristics of older forests, e.g., diverse spacings, broadleaf trees, snags, and understory regeneration (McComb et al. 1993, Hunter 1993, Carey 1995, Carey and Johnson 1995, Carey 1996, Hayes et al. 1997) into young managed stands based on available information. Such practices were explicitly called for in the NFP (e.g., p. B-6), and several research efforts began examining impacts of these practices (see studies listed in this communiqué). Another significant change was an increase in planning and analysis at larger scales (e.g., watershed analyses, Late-Successional Reserve assessments), and it has become commonplace to see stand-level prescriptions and restoration activities based these analyses.

In keeping with this rapid change in forest management on public lands, loggers have become increasingly knowledgeable about what is needed for operational planning and layout so that they can meet an increasing list of important forest resource management objectives. An increasing number of loggers have gained expertise in use of a variety of equipment for harvesting young stands: helicopters, small skyline yarders, slack-pulling carriages, harvesters and forwarders. Experience with different prescriptions under a wide variety of logging system scenarios has been key to meeting multiple objectives on federal lands.

Nevertheless, preparation of watershed analyses and Late-Successional Reserve (LSR) assessments delayed young stand management several years in many areas. Surveys for "Survey and Manage" (S&M) species required additional time before stands could be treated, and subsequent protection of sites where S&M species were found reduced the land base where thinning could be conducted. In addition, wood markets have been variable, litigation continual, and philosophical battles common. All these factors have combined to slow management of young stands in many areas,

"On the district, we have applied 'non-traditional' techniques in young stands for over a decade. In riparian reserves and Late Successional Reserve (LSR) stands, we've implemented commercial and precommercial thinning which uses variable spacing, releasing individual trees to emphasize 'wolfy' large tree characteristics, girdling, leave areas and fingers, and leaving hardwoods. On matrix lands, primarily in commercial thinning, we have used small holes (1/4 to 1/2 acre) with thinning around them or no thinning, leave islands, protecting all snags, down logs, residual trees, leaving minor species and selectively leaving wildlife trees (forked, cull, wolf, etc). We've also done heavy thins with understory planting."

Jeanne Rice, District Silviculturist, Clackamas River RD, Mt. Hood NF

"We have begun to incorporate a long-term view of the role of the young stand in landscape analysis for a watershed. We have gained experience with new layout designs and marking guidelines. We have seen innovative contracting language, which may help modify the way we do business."

Al Baumann, Forester
North Umpqua RD, Umpqua NF

and have raised concern over the fate of these young stands. For example, on the BLM Coos Bay District, Davis (2001) estimated that about 97% of LSR stands <30 yrs old were at densities >150 trees per acre (tpa). Many believe that thinning such dense stands is necessary to rapidly develop late-successional characteristics and to promote biological diversity. Many BLM and Forest Service units are considering thinning of similarly dense stands in LSRs.

NEW KNOWLEDGE

Meanwhile, research on management of young stands has greatly expanded over the past decade in many areas, including: tree growth and regeneration, uneven-aged silviculture, vertebrate diversity, lichen and bryophyte ecology, trophic interactions, wood quality, logging systems, public perceptions, etc. A synthesis of all new information is beyond the scope of this communiqué, but many studies, publications, and web sites are provided to encourage further inquiry. In this section we highlight just a few of many recent developments of importance to management of young stands.

Perhaps one of the most influential studies in the 1990s was that of Tappeiner et al. (1997). Using tree-ring analysis of stumps in ten clearcuts (25-74 ac in size) on BLM land in the Oregon Coast Range, this study examined diameter growth rates of trees in former Douglas-fir old-growth stands and nearby young-growth stands (trees 50-70 yrs old) that had regenerated naturally after logging. Growth rates in the young stands (even of the largest trees) were significantly lower than in the old-growth trees at comparable ages. Tappeiner et al. (1997) presented strong evidence that the higher growth rates at early ages in the old-growth trees were the result of low tree densities at early ages. Further, age ranges of dominant Douglas-fir in the old-growth stands spanned a minimum of 66 yrs, up to a maximum of 364 yrs (mean 150 yrs), suggesting that periodic disturbance initiated multiple understory regeneration events. Given this evidence, the authors suggested "When the objective of forest management is to grow stands with old-growth characteristics, it appears that density management (e.g., one or more thinnings to low densities) will be required."

In contrast to the above study, Winter (2000) examined a single, 8-ac old-growth stand in the western Washington Cascades using very detailed stand reconstruction techniques. Winter found that the stand appeared to have established over a relatively short period of time (21 yrs), and at a relatively high density (~324 tpa at 70 yrs), similar to the young-growth stands examined by Tappeiner et al. (1997). Winter's study indicated that old-growth forests can develop, at least in small patches, at higher densities than those examined by Tappeiner et al. (1997), but left unknown the commonness of such forests.

More recently, Poage (2001) expanded the work of Tappeiner et al. (1997) with an additional 28 stands (most >40 ac) on BLM land in the Oregon Cascade and Coast Ranges. The stands examined showed a mean age range in old-growth Douglas-fir trees of 174 yrs. Even in 0.25-ac plots the mean age range was 73 yrs, notably higher than in Winter's (2000) stand. Similar to Tappeiner et al. (1997), Poage observed rapid growth during young ages of the larger diameter old-growth trees, indicating that the contemporary old-growth trees he examined began at low densities compared to contemporary young-growth stands. However, the applicability of these findings to other forests in western Oregon and Washington remains unknown.

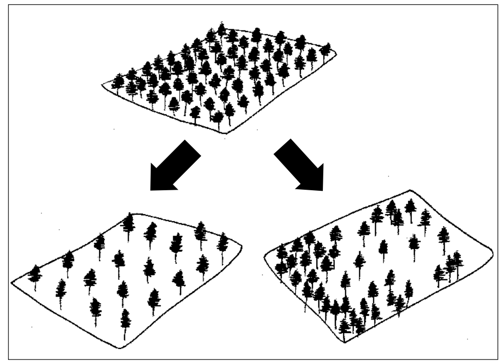
In young-growth stands, Wilson and Oliver (2000) examined height:diameter (H:D) ratios, which are affected by the density of trees during early stages of growth. Tree shape is crucial to tree stability and related to the physical structure and appearance of forests. This work determined that H:D ratios established by the time a tree is about 33 ft tall strongly determine the H:D ratio of the tree for at least 80-100 ft of additional height growth. Similarly, Poage (2001) found diameter of old-growth trees at 100-300 yrs was strongly related to their diameter and basal area growth at age 50 yrs. Both of these studies indicated that tree and stand characteristics at early stages had profound effects on the character of trees and stands at later stages.

"Both of these studies indicated that tree and stand characteristics at early stages had profound effects on the character of trees and stands at later stages."

In an extensive modeling experiment, Garman (1999b) simulated up to 64 different thinning treatments for each of four rotation lengths (80, 100, 180, and 260 yrs) for a managed Douglas-fir stand beginning at age 40 yrs, 262 trees per acre (tpa), and 10.8 inches average diameter at breast height (dbh), which is typical of many older plantations on west-side NFS and BLM lands. In each treatment, the amount of time to reach five late-successional attributes (Franklin and Spies 1991a) was recorded, as were long-term developmental trends of these attributes and amount of extractable merchantable volume.

Garman's (1999b) results suggested "heavy thinning early on in stand development is the key to accelerating the development of late-successional conditions in young managed Douglas-fir stands." One particular sequence of three commercial thins met the live subset of late-successional conditions (live stem and canopy characteristics, but not snags and logs) by age 117, compared to 220 yrs without thinning. However, Garman pointed out that "treatments which promote the most rapid development of an attribute will not necessarily produce the highest levels of that attribute over the long term…. Also, treatments providing similar rapid developmental rates of late-successional conditions can lead to different long-term structures." Other factors having strong influence on structural development were overstory retention (for second rotations), seed source and subsequent abundance of shade tolerant species, and the type of thinning (e.g., from above, from below, or proportional).

In a related effort, Busing and Garman (2001) used simulations of different rotation lengths (40, 80, 150, and 260 yrs) and several silvicultural regimes over long time periods to explore the consequences for wood production, wood quality, and ecological attributes of forest stands. Thinning from below promoted the fastest development of large boles, increased the potential number of large snags and logs recruited, and increased volume of high-quality (mature, clear) wood in all trials. Proportional thinning (removing equal portions of all size classes) accelerated the ingrowth of shade tolerant species. Under a clearcutting regime with replanted Douglas-fir, good yields of high quality wood were obtained with rotations as short as 80 yrs; however, most old-growth-related ecological objectives required more time to develop. Longer rotations met more goals of all types—wood production, wood quality, and ecological attributes—than shorter rotations.



Heavy, even-spaced thinning produces different habitat structure than variable-density thinning.

A component of forest structure not often considered in modeling is horizontal diversity. Andy Carey (USFS PNW Res. Sta., Olympia, WA) warns that calls for heavy thinning are often translated to mean wide, *even-spaced* thinnings in the minds of hearers and practitioners. Even-spaced thinnings often do not promote patchy, diverse understories that foster development of late-seral forest characteristics. Why? Because these stands often lack the biological legacies that natural stands retained after catastrophic stand-regenerating disturbance: large live trees, huge amounts of coarse woody debris (which produces patchy regeneration), and a diversity of shrubs, deciduous trees, and conifer species (Carey et al. 1996, 1999a, b, Carey and Harrington 2001). Thus, Carey et al. (1999a) suggested variable-density thinning, multiple thinning entries, underplanting, and coarse woody debris and snag augmentation tailored to on-site conditions in order to promote diversity in forest development.

Based on numerous field studies in western Oregon and Washington in the 1980s and 1990s (Carey et al. 1991, Carey 1995, 2000, 2001, Carey and Johnson 1995, Carey et al. 1996, 1999a, b, c, Colgan et al. 1999, Carey and Wilson 2000, Hayeri and Carey 2000, Thysell and Carey 2000, Carey and Harrington 2000), Carey cautions that management strategies implementing only one or two tools (e.g., only legacy retention or conventional thinning), "can place stands on hard-to-alter trajectories characterized by incomplete or unbalanced biotic communities, truncated or misdirected developmental processes, invasion by exotic species, simplified vegetation structure, low capacity to support prey bases and predators, low resilience to perturbation, and high susceptibility to disease." Alternatively, Carey suggests managing for a variety of structures and stand types within landscapes. Further, Carey et al. (1999a) urge that *processes* be managed and encouraged, not just structures. Important processes include: crown-class differentiation, decadence, canopy stratification and understory development.

Synthesizing insights from many studies and discussions, Franklin et al. (2001) have articulated a new model of structural development in natural Douglas-fir/western hemlock stands. It greatly elaborates former models (e.g., Oliver 1981, Oliver and Larson 1990), which were primarily based on data from managed plantations (and still are appropriate for intensively managing even-aged stands for timber production). In contrast, this new model incorporates complex processes and structures involved in development of natural forests, and examines these aspects over a longer time period than former models. Franklin et al. (2001) describe nine structures, three spatial patterns, and 20 processes that are important during the successional development of forest stands. This new model may help managers better understand and incorporate aspects of natural forest development into management of young forests.

These and other recent studies have come at an opportune time, as managers consider what to do with the hundreds of thousands of acres of young stands previously on a trajectory guided by timber growth and yield objectives. Some argue that, if left alone, stands currently at high densities will not meet timber goals in matrix lands, and will not meet biodiversity goals in reserve lands. Others say "let nature take its course," and that natural disturbances will diversify the stands. Some of the issues involved in this debate are reviewed later in this communiqué (see The Path Ahead). The demand is high for solid information on young stand dynamics and late-successional habitat development, and field and simulation studies remain vital to help address these issues.

A Cooperative Research/Management Venture of the Cascade Center for Ecosystem Management.

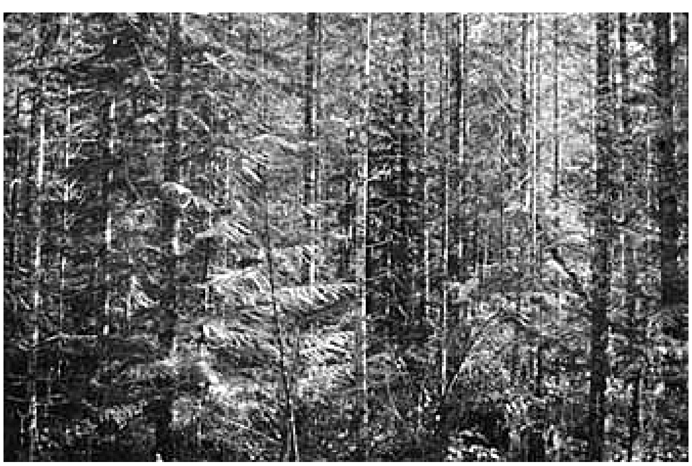
THE WILLAMETTE NATIONAL FOREST YOUNG STAND THINNING AND DIVERSITY STUDY: *THREE YEARS POST-TREATMENT*

Learning to manage young stands for late-successional habitat, biological diversity, and wood production

This study was conceived in the late 1980s by silviculturists and biologists on the Willamette National Forest working with scientists from Oregon State University: John Tappeiner, Loren Kellogg, and Bill McComb. The primary interest was to see if different thinning, underplanting, and snag creation treatments could accelerate development of old-growth characteristics in young managed forests, and to promote more biologically diverse young forests. The effort was one of the first of its kind to take an interdisciplinary look at the effects of alternative silvicultural treatments in young stands in the Douglas-fir region. By the time the first pre-treatment data were collected in 1991, the cooperative effort had grown to include an examination of tree growth, plant and animal diversity, logging systems, and would soon include examination of mushrooms (chanterelles), public perceptions, and forest floor woody detritus. Timber harvest treatments began November 1994 and were completed in 1996. Since harvest of the stands, arthropod diversity and snag creation components have been added to the study and intensive stand modeling has been accomplished. More information and publications from the study can be obtained at:www.fsl.orst.edu/ccem/yst/ystd.html.

STUDY DESIGN

Most components of the study have used the full study design, which is four treatments replicated in four blocks. The 16 stands were 35-45 yrs of age at the time of treatment, averaging about 11 inches dbh and 250 tpa. The stands were dominated by Douglas-fir, with varying amounts of other conifers and hardwoods present in the stands (Hunter 1993). Understories also varied among stands, with shrub cover ranging from very little to thick salal, rhododendron, or vine maple. Four themes (goals) guide the trajectory and silvicultural prescriptions in stands for future treatments.



Name Control

Initial Treatment None

Goals No treatment; baseline

Future Treatments None

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Name	Light thin
Initial Treatment	Thinned to 100-110 residual tpa
Goals	Timber production and wood quality
Future Treatments	When stands reach relative density (RD) of 50, thin to RD=30; thins expected every 15-20 yrs

Name	Light thin with gaps
Initial Treatment	Thinned to 100-110 residual tpa, with 20% in 1/2-ac openings with conifer plantings
Goals	Maximum horizontal and vertical heterogeneity
Future Treatments	Same as light thin with addition of 1/2-ac openings convering 20% of stand and planted with conifers. Gaps to be precommercially thinned and placed on trajectory similar to rest of stand

Name	Heavy thin
Initial Treatment	Thinned to ~50 residual tpa with conifer underplantings
Goals	Accelerate development of late-successional habitat
Future Treatments	When overstory reaches RD=50, thin to RD=20; thins expected every 25-30 yrs. One precommercial thin expected in understory; later treatments to understory uncertain at this time

STUDY COMPONENTS

Coordinators: Jim Mayo, Blue River Ranger District, Blue River, Oregon 97413, 541-822-1216, jmayo@fs.fed.us; John Cissel, Willamette NF, 541-822-1214, jcissel@fs.fed.us.

Component	Data-collection Completed	Data-collection Planned	Contact
Vegetation cover and growth (trees, shrubs, herbs, bryophytes)	2 yrs pre-, 2 yrs post-treatment (1997-1999)	Summer 2001, and every 5 yrs thereafter	Gabe Tucker, Jim Mayo (Blue River RD, Willamette NF)
Woody detritus (logs, limbs, needles, snags, stumps, duff)	1 yr post-treatment (1997)	Every 10 yrs	James Boyle (Dept. Forest Resources, OSU)
Mushrooms (chanterelle productivity)	1 yr pre- (1994), 3 yrs post-treatment (1996, 1997, 1999)	Fall 2001, and periodically thereafter	David Pilz (USFS PNW Res. Sta., Corvallis, OR)
Mammal (small ground-dwelling) and amphibian abundance and diversity	2 yrs pre- (1991-1992), 2 yrs post-treatment (1998-1999)	Fall 2001, and periodically thereafter	Steve Garman (Dept. Forest Science, OSU)
Bird (diurnal songbirds) abundance and diversity	2 yrs pre- (1992-1993), 3 yrs post-treatment (1997-1999)	Spring 2001, and periodically thereafter	Joan Hagar (Dept. Forest Science, OSU)
Snag creation	None	Snags will be created fall 2001; dynamics and use to be examined	Joan Hagar (Dept. Forest Science, OSU)
Arthropods on understory vine maple and hemlock, on the forest floor, and flying	Post-treatment Summer 2000	Post-treatment Summer 2001	Hoonbok Yi, Tim Schowalter (Dept. Entomology, OSU)
Logging systems (costs of various skyline, mechanical, and tractor harvest methods; soil compaction; stem damage)	1994-1997, during logging	Next entry, 10-20 yrs	Loren Kellogg (Dept. Forest Engineering, OSU)
Public perceptions	Pre-treatment photos 1994, post-treatment photos 1997	Spring 2001 and periodically thereafter	Robert Ribe (Dept. Landscape Architecture, UO)

RESULTS SO FAR, AND WHAT THEY MEAN

Vegetation. Post-treatment residual tree densities (all species >5 inches dbh) averaged 251 tpa for the control, 60 tpa for the heavy thin, 106 tpa for the light thin, and 86 tpa for the light thin with gaps (includes gaps with no trees in calculation). Corresponding basal area averages were 203 ft^2/ac, 72 ft^2/ac, 113 ft^2/ac, and 94 ft^2/ac, respectively. All treatments maintained hardwoods to promote stand diversity.

Although no statistically significant treatment effects to bryophytes were observed because of high variation within treatments, bryophyte ground cover (predominantly mosses) was positively correlated with overstory cover (and related measures, e.g., stem density, basal area) both pre- and post-treatment. Tucker et al. (undated) speculated that decreased canopy cover increased sunlight and wind movement, which may have dried out and killed bryophytes. Interestingly, Rambo and Muir (1998) found just the opposite in their study, and concluded that light may have been limiting in the stands they studied. Thus, more investigation is needed with regard to bryophytes over a range of light and moisture conditions.

Herb cover was negatively associated with overstory cover, likely due to associated light conditions and competition for water and nutrients. No responses have yet been observed from low shrubs. Tall shrubs appear to have been set back by logging damage during harvest operations, but are expected to rebound, particularly in stands where light is most available. Analysis of exotic plants, H:D ratios, and mortality of planted understory is not yet completed. Two to three years after harvest, limb development on retained trees had increased canopy cover an average of 4-8%.

Garman (2001b) simulated alternative silvicultural prescriptions for meeting long-term objectives for each of the study treatments and recommended future approaches for each treatment (see table under Study Design). He suggested that future thinnings and subsequent growth should be monitored in order to see how well the trajectories match simulated trends. Additionally, simulation models are expected to continually improve, allowing better predictions of forest dynamics and refinement of thinning prescriptions.

References: Bohac et al. (1997), Tucker et al. (undated), Garman (1999a), Garman (2001b).

Woody detritus. Dead and decaying wood, from small twigs, to branches, logs, snags and stumps, play an important role in forest ecosystems. These structures store water and nutrients on the site, contribute to soil organic matter, provide food for some fungi and microbes that in turn recycle nutrients to the soil, and provide cover and nesting habitat for many species of vertebrates and invertebrates. A single year of data was collected in 1997, after harvest of all stands. Detritus was categorized into six classes: forest floor (above mineral soil and <0.25 inches diameter); fine (0.25-1.0 inches diameter), medium (1-3 inches diameter), coarse (>3 inches), stumps, and snags. Total weight ranged 123-145 tons/ac and did not vary significantly among treatments. However, as might be expected, fine and moderate-sized detritus was greater in all treatments than the control due to recent slash from logging. Snag mass was significantly greater in the control than any of the thinned stands. In treated and control stands, wood >3 inches in diameter consistently comprised over half of the total woody detritus mass.

References: Boyle and Buford (1999).

Mushrooms (chanterelles). Mushrooms are the reproductive structures or "fruiting bodies" of certain fungi. Chanterelles, in particular, are the fruiting bodies of symbiotic fungi that form nutrient exchange structures called "mycorrhizae" on tree root tips; they assist Douglas-firs with taking up water and minerals from the soil and obtain carbohydrates in return. Fortuitously, chanterelles are also good to eat! Two species were common in these stands, *Cantherellus formosus* and *C. subalbidus*.

Chanterelles were found in all stands, though not in all years. Numbers ranged 0-422 per acre, and weight ranged 0-30 lbs per acre. Chanterelles were expected to be influenced by (1) food supplies for the fungus (density and health of host trees), (2) environmental conditions near the forest floor that affect fruiting (temperature, humidity, and light levels), and (3) soil conditions (compaction, summer and early autumn moisture levels, distribution of rotted wood and organic matter in the soil profile, litter layer thickness, slash burning, and microbial population shifts). Thus, Pilz hypothesized that chanterelle productivity would decline (but not be eliminated) after treatment, more so in heavier thinnings, and that productivity would then rebound to pre-thinning levels or higher as trees became more vigorous and fully re-occupied the habitat. Results so far have supported these hypotheses, although during the first four years following harvest, productivity has not yet rebounded to previous levels.

Pilz has also been examining sampling methods for mushrooms and mapping their spatial distribution in order to evaluate the response of individual colonies to thinning treatments. Long, narrow strip plots (300-1200 x 15 ft) worked well for estimating the stand-level productivity of these highly clustered mushrooms, but the total sample area needed to be large (approximately 1 ac) to generate useful estimates. Genetic analyses by cooperating Ph.D. student Susie Dunham revealed extensive diversity in seemingly homogenous patches of chanterelles, including a previously undescribed species of chanterelle!

References: www.fsl.orst.edu/mycology/youngstndthin/Yss.html.

Mammals and amphibians. Thinning had only a few detectable impacts on ground-dwelling populations of small mammals and amphibians so far. This is thought to be due to the variability in hardwoods, shrubs, and other microsite factors that may overshadow changes in overstory canopy cover and tree density for these ground-dwelling species. Deer mouse abundance increased in the light thin and light thin with gaps treatments, but no significant response was detected in the heavy thin treatment. A similar pattern was seen with the ensatina (salamander). Garman (2000b) speculated that the light thin treatments inflicted relatively minimal mechanical damage on the stands while allowing greater production in the understory, compared to the heavy thin stands which experienced more extensive mechanical disturbance of the understory. The strongest response observed was with the Trowbridge's shrew, which decreased in response to heavy thinning. Some differences among years possibly were due to weather conditions.

References: Garman (1998), Garman (2000a), Garman (2000b).

Numbers of mammals captured so far over the course of the study (pre- and post-treatment)	
Deer mouse	1591
Trowbridge's shrew	1202
Townsend's chipmunk	725
Pacific and fog shrews	256
Western red-backed vole	248
Northern flying squirrel	65
Creeping vole	53
Shrew-mole	20
Coast mole	11
Short-tailed weasel	5
Marsh shrew	3
Bushy-tailed woodrat	3
Douglas's squirrel	1
Western spotted skunk	1

Numbers of amphibians captured so far over the course of the study (pre- and post-treatment)	
Ensatina	129
Rough-skinned newt	19
Northwestern salamander	10
Pacific giant salamander	6
Red-legged frog	3
Clouded salamander	2
Dunn's salamander	1
Tailed frog	1
Western toad	1

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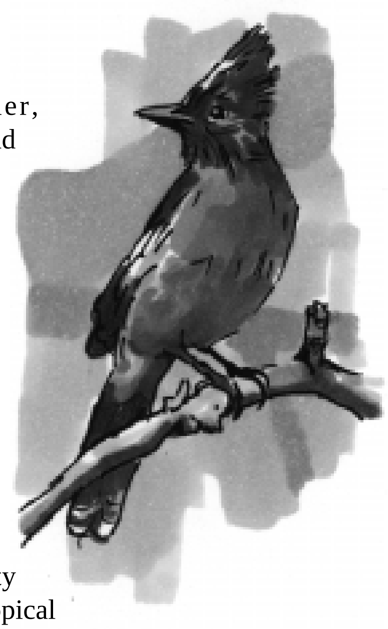
Birds. Approximately 72 species of birds have been recorded thus far. Bird species richness and diversity increased in all three thinning treatments relative to controls. Four species increased in abundance in at least one thinning treatment. Hammond's flycatcher and dark-eyed junco increased in all treatments, while MacGillivray's warblers and western tanagers increased in heavily thinned and gap treatments, but not in the lightly thinned treatment. Changes in abundance of each of these species are generally corroborated by a multi-study analysis of bird density over a range of tree densities in the western Cascades (Hansen et al. 1995). Hammond's flycatchers and dark-eyed juncos also have been documented as responding positively to thinning in the Oregon Coast Ranges (Hagar et al. 1996, Hayes and Weikel unpublished data). Several uncommon bird species were present in the stands after thinning, but were absent or nearly so before thinning: red-breasted sapsucker, western wood-pewee, olive-sided flycatcher, Townsend's solitaire, and brown-headed cowbird (Hagar and Howlin 2001).



Abundance of six species decreased after thinning, but none was eliminated (see table). Each of these species is common in the region and all are expected to persist in these stands. No change in abundance was detected for cavity nesters as a group, neotropical migrants as a group, or eight other species (see table).

References: Hagar (1999), Hagar and Howlin (2001).

Positive Response to Thinning	No Response Detected
Species Richness (number of species)	Cavity nesters[1]
Shannon Diversity (index of species diversity)	Gray jay
Hammond's flycatcher	Steller's jay
MacGillivray's warbler	Chestnut-backed chickadee
Western tanager	Red-breasted nuthatch
Dark-eyed junco	Varied thrush
	Hutton's vireo
Negative Response	American robin
Pacific-slope flycatcher	Neotropical migrants[2]
Winter wren	Black-throated gray warbler
Golden-crowned kinglet	Black-headed grosbeak
Swainson's thrush	Red crossbill
Hermit thrush	Evening grosbeak
Hermit warbler	

Comparison of post-treatment (3 yrs) to pre-treatment (2 yrs) bird abundance.

[1] Cavity nesting birds = black-capped chickadee, chestnut-backed chickadee, red-breasted nuthatch, brown creeper, house wren, red-breasted sapsucker, downy woodpecker, hairy woodpecker, northern flicker, and pileated woodpecker.

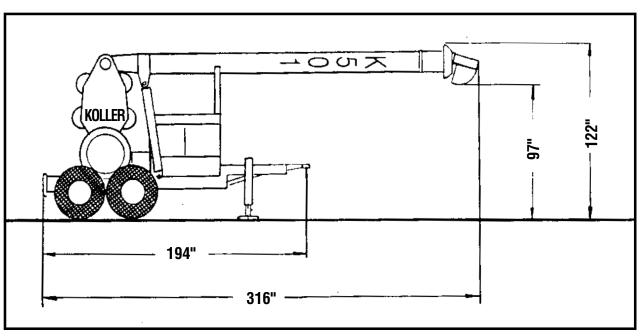
[2] Neotropical migrants = common nighthawk, rufous hummingbird, black-throated gray warbler, western wood-pewee, Pacific-slope flycatcher, Hammond's flycatcher, Swainson's thrush, hermit thrush, warbling vireo, hermit warbler, MacGillivray's warbler, Wilson's warbler, western tanager, and black-headed grosbeak.

Arthropods. Samples were collected in summer 2000 and are still being identified. Preliminary results are expected in 2001.

Logging systems. Compaction due to old skid trails (created 30-50 yrs previous) was examined in two units prior to experimental treatment in this study (Allen 1997). Mean bulk density (a measure of compaction) generally remained about 10% higher (within 8 inches depth) on old skid trails than in undisturbed soil, while some areas had higher levels and others showed virtually no difference. Approximately 4-10% of the stand area showed evidence of soil compaction prior to experimental treatment.

Harvester and forwarder traffic (examined in one stand) was found to increase bulk density an average of 11-12% on undisturbed soil (most attributed to the forwarder), but there was no evidence that harvester-forwarder traffic increased bulk density on old skid trails. It was estimated that new skid trails covered 26-29% of the harvested portion of the stand. This level of disturbance exceeds Forest Service regional standards. If this degree of disturbance is typical of this harvesting system, then use of the harvester-forwarder system may not be feasible on National Forests, or the standards would need to be reassessed.

Allen (1997) recommended that skid trails be accurately mapped and added to the known transportation network so that trails/roads can be used successively, reducing the area impacted. Allen recognized, however, the work involved, and the likelihood that changing equipment specifications may challenge the value of such mapping.



Planning and layout costs were not significantly different for the different treatment types. Contractor layout costs varied by the logging system used: the mechanized system had the lowest costs, followed by the tractor systems, and the skyline systems had the highest costs (Kellogg et al. 1998). For skyline systems, average production rates (ft^3/hr) and costs (\$\$/ft^3) did not differ among treatments because initial stocking levels varied widely among stands assigned the same treatment (e.g., light thin).

References: Kellogg and Reed (1998), Kellogg et al. (1998), Kellogg et al. (1999), Kellogg et al. (in press/a), Kellogg et al. (in press/b), Allen (1997), Allen et al. (1997), Han and Kellogg (2000a), Han and Kellogg (2000b), Han et al. (submitted), Han et al. (2000).

Public Perceptions. Photos of the study stands will be included in through-the-mail and live-group surveys. Questions are fashioned to gain insight into how citizens perceive different managed forest structural conditions, and how these perceptions change when information about the intentions of management are shared.

References: Ribe (2001).

VISION FOR THE FUTURE

This study was conceived with the hope that it would continue indefinitely, so long as expected benefits, synergistic partnerships, sufficient funding, and societal interest continued. Data from the study continue to shed light on aspects of young stand management and restoration of biodiversity in these stands. Stand conditions are changing rapidly following treatment; therefore, near-future scheduled measurements are expected to give insight to initial questions as stands continue to develop. As Mark Harmon (Oregon State University) said at an April 2000 workshop in Springfield, Oregon, "data are even more important the longer a study goes." Nevertheless, perhaps one of the most important outcomes of this study is the tremendous role it has served in promoting communication among forest managers, researchers, and public, not only folks directly involved with the study, but many others. Numerous field tours and workshops have been held annually since 1993, and are planned to continue (www.fsl.orst.edu/ccem). In these days of rapid societal transformation, such opportunities for communication are invaluable.

THE PATH AHEAD

"Although a new forest starts with many thousands of small trees to the acre, only a small proportion of these survive until the stand reaches maturity. At 10 years of age on reasonably good land there are about 900 trees to the acre, some of them 10 or 12 feet tall and clothed to the ground with living limbs. At 30 years of age at least one-half of these trees are dead, several of the survivors are more than 12 inches in diameter and 90 feet tall, and on all the surviving tees the lower branches, though they still hang on, dry and brittle, have been killed by the intense shade. When the forest is 100 years old there are only about 80 living trees to the acre, but most of them are now 2 or 3 feet in diameter. The larger trees are nearly 200 feet tall and have nearly attained their full height growth; dead branches have dropped off the trunks for at least half the total length; the bark has thickened greatly, become deeply furrowed, and turned a dark gray-brown. The ground is strewn with trees which have died, and the holes so made in the forest canopy admit enough light to permit the establishment of shrubby plants and occasional small hemlocks, cedars, and white firs."

McArdle et al. (1961), describing Douglas-fir forests naturally regenerated after fires or logging.

Recent studies, modeling efforts, and current thought provide rich resources from which to draw in considering options for management of young managed forests. However, sometimes the most difficult task is asking the right questions. Following is an attempt to raise pertinent questions and to provide jump-off points for further discussion.

First, there are two questions that deserve careful attention by researchers and managers. Answers to these questions will give valuable perspective to other questions (following) that address management of young forests.

If the conclusions of Tappeiner et al. (1997) and Poage (2001) are correct—that contemporary, natural, young-growth forests are developing at higher densities than did many contemporary old-growth forests in some areas of western Oregon—why are the establishment patterns different, and what are the implications for present-day management of young forests? Citing Isaac (1938, 1940), Tappeiner et al. (1997) speculated that a low supply of seed and a dense cover of shrubs and herbs may have limited conifer establishment after intense fires. Similarly, Phil Jaspers (Willamette NF) suggests that many of our contemporary late-successional forests may have developed subsequent to huge, intense fires that burned five or more centuries ago. Such fires may have created the seed and regeneration conditions that Tappeiner et al. (1997) suggested, with widely spaced forest patches, robust shrub and herb cover, and incremental invasion of conifers. In contrast today, ubiquitous forest cover provides abundant seed to many relatively small stand-replacing disturbances in a relatively short amount of time. The observations of McArdle et al. (1961, see side bar), although likely biased to fully stocked acres, nevertheless support the hypothesis that many forests in the past two centuries have developed at fairly high densities. They noted "these young forests as a rule are even aged, the larger trees in any one forest seldom varying by more than a few years."

Others speculate that contemporary old-growth forests did start at high densities, but were "thinned" by repeated low-intensity burns, whereas such repeat burns have not occurred (i.e., were suppressed) in the young-growth forests of today. But would low-intensity burns thin out young stands or would they just create patches of newer regeneration among dense, older regeneration? Or would fires destroy dense patches of regeneration, leaving patches of more widely spaced trees unharmed?

If present-day young stands are growing on a natural trajectory toward a new type of late-successional habitat, should that trajectory be thwarted? On the other hand, if fire suppression during the last two centuries has altered the developmental trajectories of forests, should this be remedied by thinning? A better understanding of long-term trends in forest distribution patterns, establishment processes, and the effect of fire at different ages would give helpful perspective to these questions, and could shape future management direction in young forests.

How transferable are the findings from western Oregon BLM lands (Tappeiner et al. 1997, Poage 2001) to forests in western Washington and at higher elevations (e.g., NFS lands) in the western Cascades? Jerry Franklin (University of Washington) notes "there are several younger age classes of natural forest, including the approximately 300-yr-old stands so common in the Breitenbush and Clackamas drainages and many of the stands that originated following the 1845 burn that have much more even-aged stand characteristics. That is, the Douglas-fir came in in a relatively short period of time (25-40 yrs) and quit, just as Linda Winter observed in her 500-yr-old stand" (see Franklin and Hemstrom 1981). Could it be that forests in higher precipitation zones at the north end of the Douglas-fir region and at higher elevations may naturally regenerate at higher densities and experience fewer fires than at southern locations and lower elevations? Further, might similar relationships apply to stand establishment and early growth during wetter climates versus drier climates? It would be valuable to conduct investigations similar to Tappeiner et al. (1997), Winter (2000), and Poage (2001) throughout a wider range of precipitation and forest zones in western Oregon and Washington in order to gain a broader perspective of regional variation in these processes.

What are the desired conditions of future late-successional forests? The previous two questions expressed broad temporal and spatial uncertainties that remain with regard to developmental trajectories of natural forests in western Oregon and Washington. Answers to these questions would provide guidance as to whether or not the structure, composition, and function of contemporary old-growth forests should be the target for future old-growth forests. In the mean time, using knowledge of composition, structure, and processes of contemporary late-successional forests (e.g., Carey et al. 1999a, b, Franklin et al. 2001) to guide current forest management is probably the best approach we have, and will be pursued in further discussion.

> ***"…management of old growth in western Oregon and Washington should be sensitive to the regional diversity of old-growth condition."***
> ***Spies and Franklin (1991)***

If existing late-successional forests will be used as templates for management activities leading to future late-successional forests, we need to better understand and describe the variation in structural attributes of late-successional forests across various environmental and geographic gradients. Some characterization of regional variation in old-growth forests has already taken place. Juday (1976) described some regional variation in the composition and structure of old-growth forests in the Oregon Coast Range. Spies and Franklin (1991) gave detailed descriptions of regional and site (e.g., moisture) differences in old-growth forests in western Oregon and Washington. One of the predominant geographic differences in habitat among old forests in the region was basal area of shade tolerant trees. Poage (2001) used BLM 100% inventory data from 91 sites (generally >40 ac) in western Oregon to examine species composition and structure of old-growth stands. He also found that most of the regional variation in structure among stands was due to non-Douglas-fir components (e.g., basal areas of western hemlock, grand fir, cedars, and hardwoods). Poage is currently expanding some of his work throughout BLM land in western Oregon and will include analysis of snags and horizontal diversity in former old forests.

How quickly do we want certain late-successional characteristics developed in these stands? Having described our vision of future late-successional forests, we are faced with the matter of timing. Findings from several sources (e.g., Tappeiner et al. 1997, Carey et al. 1999b, Garman 1999b, Poage 2001, Busing and Garman 2001) support the idea that development of late-successional attributes in young stands can be accelerated with various thinning practices (Franklin and Spies 1991b). However, there does not seem to be agreement on how quickly we want these young stands to attain these characteristics. Some call for expediting development of late-successional characteristics in order to provide for associated species, while others prefer a hands-off approach suggesting that human intervention is not necessary, or even desired. Regardless, Linda Winter (University of Washington) observes "while it may be possible to accelerate some attributes such as large trees and greater variability in species and spacing in some stands, other attributes such as huge branches, thick bark, and deep organic soil may require much time and cannot be rushed."

"Desired future condition refers to the structure and composition of the biotic communities in the ecosystem, not only the trees."

Andy Carey, Research Team Leader, USFS PNW Research Station, Olympia.

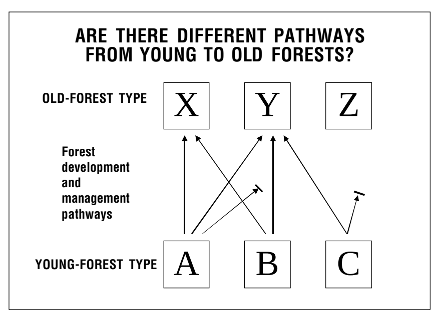
"…existing old-growth forests are, at least to some degree, unique products of historical events; they are thus not completely reproducible."

Franklin and Spies (1991b)

"We hypothesize, based on the high structural variability in old-growth Douglas-fir forests, multiple developmental or successional routes to old-growth-like forests."

Franklin and Spies (1991a)

How do we get there? The variable composition and structure of contemporary old-growth forests (Franklin and Spies 1991a, Poage 2001), variability in early establishment of contemporary and historical forests (Tappeiner et al. 1997, Winter et al. 2000, Poage 2001, McArdle et al. 1961, Isaac 1938), and lessons from extensive simulation experiments (Garman 1999b, Busing and Garman 2001), all suggest the possibility of multiple pathways to forests with old-growth characteristics. Further, the likelihood of differing structural and temporal objectives for different regions, ownerships, and landscapes suggests the need to understand and map out multiple pathways to late-successional habitat. Reconstructions, as recently have been attempted to some degree by Tappeiner et al. (1997), Winter (2000), and Poage (2001), offer insight into developmental routes of some stands. Experimental studies using specific silvicultural and habitat modifications (e.g., Carey et al. 1996, 1999c, Carey 2000, 2001, Carey and Wilson 2001, Haveri and Carey 2000, and many others) also give insight into the effects of specific treatments on aspects of biodiversity. But simulation models based on a synthesis of knowledge from multiple sources (e.g., Carey et al. 1999b, Garman 1999b, Busing and Garman 2001) will likely give the greatest flexibility in determining feasible pathways to desired forest conditions and in assessing ecological services provided by different pathways. Such models should be developed for more



common use by forest managers and supported by ongoing research.

Carey et al. (e.g., 1999a) have done extensive work to determine ecosystem processes important in fostering biodiversity and late-successional habitat in managed forests, and offer much guidance on incorporating these processes and structures into management of young stands. Garman (1999b) concluded from his modeling experiments “Given the uncertainty in how well thinning treatments will actually perform in terms of stand development, volume production, and habitat quality, it is prudent to manage for a diversity of stand trajectories. A mixture of treatments which provide rapid attainment of late-successional conditions, the highest economic return, and an array of long-term conditions should be considered for implementation over a watershed or landscape.” Perhaps the most basic principle to grab hold of is that we should not attempt to implement single prescriptions, no matter how diverse in themselves, in a blanket way across landscapes.

How long do we have to decide? While we consider the long-term ramifications of today’s decisions on future forests, some warn that we are limiting future options by not thinning dense stands. It is well-known that some extremely dense stands with severely reduced crowns, when thinned, show little growth response and are highly susceptible to blowdown. John Tappeiner (Oregon State University) advises “Thinning of dense stands will broaden the options for future trajectories of these stands, allowing time for discussion of long-term objectives, but options for many densely stocked stands will be limited if they are not thinned soon. Carefully manage and see where we are in 40-50 yrs.” Certainly all young stands are not dense, and thinning would not be required on every acre. Probably a variety of thinning practices (including no thinning) would be prudent while considering future options.

What is the role of natural disturbance in development of young forests, past, present, and future? Some speak of natural disturbances (e.g., root rot, snow and ice breakage, windthrow, bear damage, drought stress, beetle kill, etc.) as contributing to formation of late-successional characteristics in developing young stands, thus lessening the need for thinning. Others suggest that, having removed frequent fire from the ecosystem, we are now required to implement a diverse array of silvicultural manipulations to emulate some aspects of lost ecological processes. Still others warn of the destruction or ruin of young stands that may come about through natural disturbance (windthrow or disease), thus the need to thin to promote healthy, stable stands. It is likely that truth can be found in all these statements. However, the probability and effects of these disturbances likely vary across the region, and even within landscapes. Thus, these topics deserve further discussion and testing through simulation and field experiments.

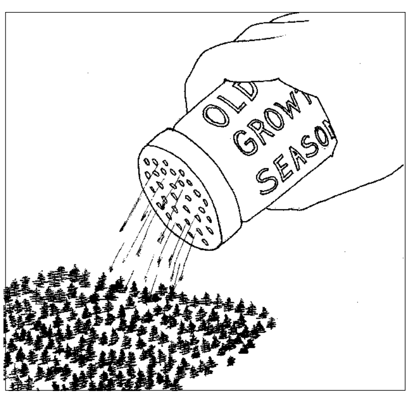
Saving a little money. Keith Murray (Presale, Sweet Home RD, Willamette NF) and others recently refined a method of designating trees for cutting without actually marking the timber prior to sale (called “Designation by Description” or DxD). Basically it involves leaving the largest tree and cutting all the trees within a given distance of that tree. In its simplest form it results in an evenly spaced thinning with dominant and co-dominant trees

> ***“It would be unfortunate if a blanket silvicultural prescription of heavily thinning young stands were adopted across the region.”***
>
> **Poage (2001)**
>
> ***“How long do we have before we lose the option of creating old-growth structure in these dense stands that were originally managed for timber production?”***
>
> **Nathan Poage, USGS Forest and Rangeland Ecosystem Sciences Center, Corvallis**
>
> ***“Is there some way to prioritize stands for treatment, i.e., which stands will differentiate naturally and which will stagnate without treatment?”***
>
> **Tom Rottman, Forestry Technician, Clackamas RD, Mt. Hood NF**

being left most of the time. Since this approach does not look at crowns, broken- or multi-top trees are sometimes retained. Other variables can be added to increase species diversity and quality (e.g., altering diameter or radius limits for particular species). It has been successfully used on several thinning sales (weight scale) at Sweet Home RD. The purchaser is responsible for compliance with the designation provision of the contract (C2.35#). The provision is monitored beginning with the purchaser designating the trees, and through falling and logging. Final acceptance by the USFS comes after logging is completed. You can go back to any stump or any live tree and determine if it should have been cut. This method is approved by the USFS Region 6 Office and has significantly decreased the cost for marking thinnings. The Sale Administrator does have to spend more time at the beginning of the sale making sure that the purchaser gets started correctly.

Encouraging diversity in young stands. Numerous methods for encouraging diversity in young stands have been implemented throughout western Oregon and Washington, and are mentioned throughout this communiqué and in the previous one on this topic (Hunter 1993); these include variable-spacing thinning, hardwood retention, snag creation, plantings, underburning, etc. Studies of the impacts of these actions to birds, mammals, and overall vertebrate diversity have generally shown positive effects positive effects for some species and negatives effects to others (e.g., Hagar and Howlin 2001, Carey 1996, 1999c, 2000, 2001, Wilson and Carey 2000, Hayeri and Carey 2000).

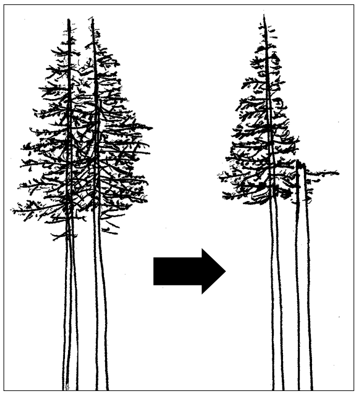
Several additional tools may be useful for increasing diversity and/or late-successional attributes in young stands. Manual sculpturing of trees to create hiding and nesting or denning cover for various animals is an intensive practice used in stands with little or no remnant large tree, snag, or log structure. It involves using chainsaws to carve artificial lightning strikes into trees, cut slits or holes for bats and other cavity-nesters, and create dens in down logs.



Can we "season" or "seed" young forests with components of biodiversity from old forests?

An idea not yet attempted is to "shred" the foliage of a single old-growth tree, including all the lichens, bryophytes, arthropods (in a way that many would survive), and perhaps mix in chunks of limb and bark, and then fly the material over several 10s or 100s of acres of young forest. Dispersal of some epiphytic lichens (and probably other old-forest canopy species) is dependent on windfall or animal transport. Thus, this approach may be able to "seed" large expanses of young forest with certain components of late-successional-forest canopy diversity in areas where no live remnant trees or forests occur nearby.

Variable-spaced thinnings are being implemented in many areas to promote diversity in stand structure. In a demonstration project on the Clackamas RD, Mt. Hood NF, John Wells (Wildlife Biologist) and Bruce Holmson (Silviculturist) have experimented with what they call "site-adapted, structure-based thinning." In this approach the species contributing the most to stand density is the one targeted for thinning, and less common species and some structurally imperfect trees are retained. One of the most interesting aspects of this effort is their hypothesis regarding the development and importance of lop-sided crowns. While evenly spaced trees generally develop symmetrical crowns, trees growing within a few feet of each other often develop asymmetrical crowns.



Wells and Holmson hypothesize that the presence of lop-sided crowns may increase the likelihood of top breakage from snow or ice accumulation, thus increasing natural snag habitat and/or unusual top structures.

Biodiversity questions. While we know a fair amount about a few common vertebrate species with small home ranges, we know little about uncommon and rare species within these and other taxonomic groups (e.g., arthropods, mollusks, some rare plants and fungi). Most immediately, there is a need to understand effects of thinning on "Survey and Manage" species (e.g., red tree voles, and rare ground-dwelling taxa). Do some persist through thinning? Are some lost? Do remnant structures or patches maintain these species in young stands? If any are lost through thinning, do they immigrate from nearby populations? How rapidly do they disperse and colonize? And, when do young stands become productive habitat for species associated with old-forest habitats?

"How do we get a 52-inch dbh hollow live tree on the managed landscape in 2125? How do we grow a "candelabra" or "bayonet" tree? ...One thing is clear to me: we'll have to plan to produce desired habitat features just as carefully as we plan to produce certain quantities of wood volume per unit area."

John Wells, Wildlife Biologist, Hood River RD, Mt. Hood NF

"I think that managing height to diameter ratios in our Late-Successional Reserve plantations is a simple way for silviculturists to attain a major characteristic we want in our old-growth stands."

Jeff Davis, District Silviculturist, Coos Bay BLM

Spatial and temporal scales. There is an increasing need to carefully consider and to articulate the spatial scales at which we measure, manage, and express value for aspects of biodiversity. Most studies of managed forests have examined species with home ranges occurring within study stands of less than 50 ac. We know little about the interaction of multiple stands in landscapes, or the activities of animals with larger home ranges. Similarly, most policy regarding Survey and Manage species is directed at site-level or stand-level activities. However, we have little understanding of how populations of these species operate at the landscape level. Further, societal values of biodiversity (which are not even universal in themselves) are typically ambiguous and not measurable. There is a need for clarity in the expression of biodiversity values at different scales. At what spatial scale do we assess biodiversity? Similarly, at what spatial scale is it important to have species persist? Every tree? Every stand? Every drainage? Every watershed? Biodiversity may not be quantifiable in such a way that all will agree, but without such information, it makes it difficult to attempt to manage such a value, and leaves up to the researcher what measurements will be taken (and at what scale) in research efforts.

There is a similar need to consider more long-term consequences of our actions, and to articulate the temporal relevance of scientific results. Charlie Halpern (Forest Ecologist, University of Washington) asks "What are the effects of multiple rotations on sustainability, plant diversity, understory composition, and site productivity." Similarly, what are the cumulative effects of compaction and soil disturbance from different logging systems to site productivity, soil hydrologic properties, soil organisms, plants, burrowing animals, etc., over several harvest entries or rotations?

Large multi-disciplinary studies

Most of these larger studies are examined in more detail in Monserud and Peterson (in review).

1. THE FOREST ECOSYSTEM STUDY. This study was initiated to address development of spotted owl habitat through manipulation of young managed forests. Four treatments were replicated in 4 blocks in 50- to 70-yr old, stem-exclusion-stage, Douglas-fir plantations on Ft. Lewis Military Reservation, Washington. Treatments were: control, variable-density thinning with underplanting, den augmentation (primarily for flying squirrels), and a combination of the 2nd and 3rd treatments. Response variables were extensive, including diversity and abundance of small mammals, arboreal rodents, winter and spring birds, hypogeous fungi, certain soil microbial communities, vegetation measurements, predator encounters, and several others. Pre-treatment data were collected for some components as early as 1991, stands treated in 1993, and post-treatment data collection continues. Refs: Carey et al. (1999c)—Andy Carey (USFS PNW Res. Sta., Olympia, WA)

2. DEMONSTRATION OF ECOSYSTEM MANAGEMENT OPTIONS (DEMO) STUDY. A long-term, interdisciplinary study of ecological and silvicultural effects of timber harvest with alternative levels and patterns of canopy retention. Consists of 6 treatments representing several patterns and levels of overstory retention: 100% retention, 75% aggregated retention, 40% dispersed retention, 40% aggregated retention, 15% dispersed retention, 15% aggregated retention. Treatments are replicated in 4 blocks in southwest Washington and 4 in southwest Oregon. Areas of investigation include vegetation, wildlife, fungi, invertebrates, hydrology, social perceptions, harvest costs, and several others. Refs: Northwest Science (v. 73 Special Issue, 1999), www.fs.fed.us/pnw/demo—Charles B. Halpern (Div. Ecosystem Sciences, UW) and Keith Aubry (USFS PNW Res. Sta., Olympia, WA) lead contacts

3. SILVICULTURAL OPTIONS FOR HARVESTING YOUNG-GROWTH PRODUCTION FORESTS (CAPITOL FOREST STUDY). Six silvicultural treatments are replicated in 3 blocks on the Capitol State Forest, western Washington: clearcut, retained overstory, small patch cutting, group selection, and extended rotation with and without thinning; all openings >=0.1 ac are planted. Examining tree growth and stand development, economics, stand damage, soil disturbance, visual quality and public response, songbird and wildlife tree response. First block was installed in 1998, second to be installed in 2002, and third in 2004. Refs: www.fs.fed.us/pnw/olympia/silv/wsothome.htm—David Marshall (USFS PNW Res. Sta., Olympia, WA)

4. DENSITY MANAGEMENT STUDIES. A set of studies being installed by the U.S. Bureau of Land Management in western Oregon to test whether density management thinning can be used in 40-70 yr-old Douglas-fir forests to accelerate the development of late-successional habitat characteristics while producing significant wood volume. Three treatments and a control (about 50 ac each) are replicated in seven blocks: high density (120 tpa with leave islands), moderate density (80 tpa with leave islands and patch openings), and variable density (mosaic of areas with 40, 80, &120 tpa, with leave islands and patch openings). Leave islands and patch openings range in size from 1/4 to 1 acre. All patch openings were planted, and one-acre areas of 40, 80, & 120 tpa, and the control were underplanted. Harvesting is 95 % complete, and permanent vegetation monitoring plots (1/4 acre) are being installed. The response of all vascular plants in the overstory and understory will be tracked. Companion studies at some sites by USFS & OSU scientists will address the response of other taxa to density management. The USFS riparian buffer study will assess the effects of thinning in riparian reserves on aquatic vertebrate diversity (Deanna Olson, USFS PNW Res. Sta., Corvallis, OR) and associated microhabitats and microclimate gradients (Samuel Chan, USFS PNW Res. Sta., Corvallis, OR). Web site under development—John Tappeiner (Dept. Forest Science, OSU) and Charley Thompson (BLM, Salem, OR)

5. THE VALUE OF LEAVE ISLANDS WITH OLD FOREST REMNANTS AS REFUGIA FOR SENSITIVE PLANT AND ANIMAL SPECIES IN MANAGED FORESTS. As a component of the BLM Density Management Studies, this northwest Oregon study will examine the relative abundance and diversity of vascular plants, lichens, bryophytes, amphibians, small mammals, terrestrial mollusks, and possibly arthropods in 3 young forest treatments: 1) leave islands (1/4, 1/2 and 1 ac) containing old-forest remnants such as wolf trees, large wood, or a priori diversity "hotspots" within a thinned forest matrix; 2) thinned young forest matrix surrounding the leave islands (40, 80, and 120 trees per acre, 30 to 70 yr old); and 3) a matched unmanaged young forest control (of same age as pretreatment stands). Site selection and initial data collection are expected Spring 2001. Collaborators are being sought to extend study scope to private, industrial, state, and federal forest lands—Deanna H. Olson (USFS PNW Res. Sta., Corvallis, OR)

6. OLYMPIC HABITAT DEVELOPMENT STUDY. Eight blocks in 30-70-yr-old stands on Olympic National Forest, Olympic Peninsula, each with a control and 3-4 thinning treatments which include: combinations of gaps, unthinned patches, coarse woody debris supplementation, and underplanting. Responses being measured include tree growth, stand structure, understory composition, small mammal and arboreal rodent communities, amphibian composition, and coarse woody debris. Pre-treatment surveys began 1994, first thinnings 1997, 4 blocks thinned to date. Refs: Carey and Harrington 2001, www.fs.fed.us/pnw/olympia/silv/wsonstud.htm, www.fs.fed.us/r6/olympic/ecomgt/research/habitat.htm—Connie Harrington and Andy Carey (both USFS PNW Res. Sta., Olympia, WA)

Tree and other vegetation studies

7. RIPARIAN SILVICULTURAL TRIALS IN WASHINGTON STATE. Examines the effectiveness of different conifer reforestation techniques in alder-dominated riparian areas of the central Cascades and western Olympic Peninsula of Washington. A suite of treatments are replicated 3 times; treatments include 0-50% retention, spruce and cedar planting, dispersed and aggregated planting patterns; planting density constant at 200 tpa. Overstory measurements include species, condition, vigor, damage growth, age; seedling measurements include species and growth. Pre-treatment data collected and stands treated at one site, others still to be sampled and treated—Dean Rae Berg (Silvicultural Engineering, Edmonds, WA), Sono Hashisaki (Springwood Assoc., Seattle, WA), Pat Stevenson (Stilliguamish Tribe, Arlington, WA)

8. ALTERNATIVE SILVICULTURAL TREATMENTS FOR YOUNG PLANTATIONS IN THE PACIFIC NORTH-WEST. Five silvicultural treatments in 10-20-yr-old stands replicated 5 times on the Gifford Pinchot NF, 1 on Willamette NF, and 5 on Olympic Division, Washington DNR. Treatments are control, uniform thin, thinning with 1 size of gap and planting, thinning with 3 sizes of gaps, thinning with 3 sizes of gaps and planting. Measuring tree growth, stand structure, and understory plant composition and cover. Gifford Pinchot NF replications treated and measured in 1995, remeasured twice. Other areas treated but not yet remeasured. Refs: www.fs.fed.us/pnw/olympia/silv/poster.htm, www.fsl.orst.edu/ccem/pdf/veryyss.pdf—Connie Harrington (USFS PNW Res. Sta., Olympia, WA)

9. OAK RELEASE STUDY. Three treatments in 5 Oregon white oak stands at Fort Lewis (near Olympia, WA) to determine the effectiveness of releasing overtopped oaks from conifer (mostly Douglas-fir) suppression. The treatments are: no release, _ release (cutting all conifers within a radius circle equal to _ subject tree height), and full release (cutting all conifers within a circle with a radius equal to the subject tree's height). Responses being measured are: tree growth, epicormic branching, crown expansion, acorn production, understory composition, and microclimate. Treatments being implemented spring 2001—Connie Harrington (USFS PNW Res. Sta., Olympia, WA)

10. THE H.J. ANDREWS UNEVEN-AGED MANAGEMENT PROJECT. This study is examining different ways to convert young, even-aged forest into uneven-aged forest. Consists of 3 treatments plus controls, replicated 4 times. Treatments include a series of thinnings and plantings to produce alternative target uneven-aged structures: multi-storied stand (relative density maintained 20-40), single tree selection (relative density maintained 30-50), and group selection (small gaps created and regenerated). Different thinning approaches are also applied (e.g., from below, crown thinning, etc.). Pre-treatment vegetation data collected 1997-1998. Logging almost all done. Refs: Tucker (1999)—Gabe Tucker (Evergreen State College, WA)

11. COMMERCIAL THINNING FOR DIVERSITY. Three replications of a control and 3 treatments in 30-yr-old plantations in Oregon Coast Range: 100, 60, and 30 residual tpa, unmanaged controls left at 200-400 tpa. Begun in 1992, multiple aspects of study at different stages: skyline harvesting techniques and cost—Loren D. Kellogg (Dept. Forest Engineering, OSU); overstory growth and yield—Bill Emmingham (Dept. Forest Science, OSU), Kathleen Maas (OSU), and Stuart Johnston (Siuslaw NF); underplanting in the growth and yield plots and operational underplanting—Peyton Owston (USFS PNW Res. Sta., Corvallis, OR), and Sam Chan (USFS PNW Res. Sta., Corvallis, OR); understory vegetation dynamics—Don Minore (USFS PNW Res. Sta., Corvallis, OR), Peyton Owston, and Sam Chan); forest microsite response (Sam Chan); underplanting species trials (Bill Emmingham). Refs: COPE Report, August 1996, Vo. 9, No. 2&3.

12. THE HIGH-LOW THINNING STUDY. Three replications of adjacent "thin-from-above" and "thin-from-below" treatments in conifer forests of Oregon Coast Range. Data on tree growth available for 10-15 yrs—Bill Emmingham (Dept. Forest Science, OSU)

13. ANALYSIS OF SHORT-TERM CONSEQUENCES OF THINNNING. Eight stands in western Oregon include one one or more treatments: clearcut, control, thin from below, thin for diversity. Measuring volume, growth, wood value. Post-treatment data for 10 yrs so far—Bill Emmingham (Dept. Forest Science, OSU)

14. PRUNING AND FERTILIZING PRECOMMERCIALLY THINNED DOUGLAS-FIR STANDS IN THE OREGON COAST RANGE. Investigating the interactions of fertilizing, pruning, and precommercially thinning young Douglas-fir stands in the Oregon Coast Range, Coos County. Experiment began in 1994 when plantations were 10 yrs old. Six treatments replicated at 4 locations. Intent is to carry out study through to full rotation. Refs: COPE Report v. 8 n. 3, September 1995—Bill Emmingham (Dept. Forest Science, OSU), Kathleen Maas (Dept. Forest Science, OSU), Ralph Duddles (Forestry Ext. Agent, Coos Co., OR), and Ronald Durham (Menasha Corporation, North Bend, OR)

15. THINNING FROM ABOVE TO CONVERT EVEN-AGED DOUGLAS-FIR STANDS TO UNEVEN-AGED STRUCTURES. An intensive retrospective and reconstructive study of 4 stands in the western Cascades and Coast Range that had been thinned from above with several commercial thinning entries, and which had diverse vertical stand structure. Refs: Miller and Emmingham (2001)—Mark Miller (ITS Management, Portland, OR) and Bill Emmingham (Dept. Forest Science, OSU)

16. COMPETITION AND GROWTH IN PRECOMMERCIAL HEMLOCK AND ALDER STANDS. Examining affects of salmonberry and associated shrubs and herbs, along with alder/hemlock ratios ranging from pure hemlock to pure alder on excellent sites in Oregon Coast Range. Spacings in Nelder arrangement from 11.8x11.8 inches to 118x118 inches. Present age of stands is 14 yrs. Competing cover, size, and growth of 12,000 trees has been measured for 6 yrs so far. Continuing through 2017—Mike Newton and Liz Cole (both Dept. Forest Science, OSU)

17. INTRASPECIFIC COMPETITION DOUGLAS-FIR AND MIXED DOUGLAS-FIR/GRAND FIR. Height, dbh, basal diameter, and height to live crown taken on ~4000 trees 6 times over 19-21 yrs in Oregon Coast Range. Spacings range 3 to 800 ft^2/tree in square and rectangular configurations, initially kept weed-free. Continuing through 2017—Mike Newton and Liz Cole (both Dept. Forest Science, OSU)

18. OVERSTORY GROWTH AS A FUNCTION OF RESIDUAL STAND BASAL AREA. In Oregon Coast Range, 50-yr-old Douglas-fir stands thinned to 75, 100, 125, and 140 ft^2/ac basal area; underplanted with Douglas-fir, western hemlock, grand fir, and western redcedar; three levels of understory vegetation treatment. Currently 7 yrs understory growth measurements, seedling growth, animal damage; 3 measurements of 9000 overstory trees. Continuing through 2017—Mike Newton and Liz Cole (both Dept. Forest Science, OSU)

19. SWISS NEEDLE CAST COOPERATIVE: NUMEROUS STUDIES. Began in 1997. Involves over 20 private, county, state, and federal organizations interested in managing this native disease of Douglas-fir which primarily affects plantations. Studies involve aerial and ground survey, growth impact studies, tree physiology, infection biology, tree genetics, alternative fungicides, precommercial thinning, and fertilizer and vegetation control. Refs: www.cof.orst.edu/coops/sncc/index.sht—Greg Philip (Dept. Forest Science, OSU), coordinator

20. INFLUENCE OF CANOPY TYPE ON BIODIVERSITY OF EPIPHYTIC LICHENS AND BRYOPHYTES IN RIPARIAN FORESTS. Seven riparian stand types in 6 blocks (total 42 stands) in western Oregon. Examining if different riparian forest types host different lichen and bryophyte communities, and the potential effect of forest canopy alterations on these communities. Refs: www.fsl.orst.edu/cfer—Bruce McCune (Dept. Botany and Plant Pathology, OSU), and Andrea Ruchty

21. THE ECOLOGY OF RARE PLANTS. Includes effects of thinning and ground disturbance on growth and reproduction of the clustered lady's slipper *Cypripedium fasciculatum*. Stands located in southwest Oregon. Refs: www.fsl.orst.edu/cfer—Penelope Latham and John Tappeiner (Dept. Forest Science, OSU)

22. OLD-GROWTH STAND DEVELOPMENT. Stumps of over 900 former old-growth trees were measured in clearcuts of western Oregon in 1997 and 1998; an additional data set from over 1260 previously measured stumps is also being used in analyses. Xylem rings are counted and measured in order to determine ages, sizes, and growth rates of former old-growth trees, and these data will be compared to similar measurements for nearby young-growth trees. Field work is complete, data analysis is under way. Refs: Poage (2001), www.fsl.orst.edu/cfer—John C. Tappeiner (Dept. Forest Science, OSU), Nathan Poage (USGS, FRESC, Corvallis, OR), Tom Sensenig (Medford District, BLM)

Wildlife studies

23. SPOTTED OWL RESPONSES TO EXPERIMENTAL THINNING AND SELECTION HARVESTS. Currently radio-tracking 8-10 owl pairs in each of 7 study areas composed of young Douglas-fir stands in western Oregon and mixed-age stands in mixed-conifer forests in southwest Oregon and northern California. Silvicultural treatments may

occur on as much as 20% of core areas (1000-ac areas). Standard and variable-density thinnings may occur in Oregon. Half of each study area to remain untreated for control. Home range size and habitat selection will be examined before, during, and after the treatments. Some areas already treated, some treated 2001—Larry Irwin (NCASI, Stevensville, MT) and Dennis Rock (Eugene District BLM)

24. BIRD RESPONSE TO THINNING. Control (~200 tpa), moderate thin (100 tpa), and heavy thin (80 tpa), at each of 4 sites in the northern Oregon Coast Range. Diurnal breeding songbirds. Pre-treatment data collected 1994-1995, post-treatment 1996-2000 and continuing every 5-10 yrs. Refs: Weikel (1997, Weikel and Hayes (1999), www.fsl.orst.edu/cfer—John P. Hayes (Dept. Forest Science, OSU) and Jennifer Weikel

25. MONITORING AVIAN RESPONSE TO DENSITY MANAGEMENT. This study is monitoring bird abundance in stands of different thinning treatments to demonstrate the range of responses that can occur. High retention (120 tpa), moderate retention (80-110 tpa), variable retention (40, 80, and 120 tpa in the same stand), and a control were implemented at a series of sites in the Oregon Coast Range. Pre-treatment data collected 1998 and/or 1999; post-treatment in 1999 and/or 2000 depending on site; post-treatment counts scheduled again for 2005. Refs: www.fsl.orst.edu/cfer—W. Daniel Edge (Dept. Fisheries and Wildlife, OSU) and Jennifer M. Weikel

26. SMALL MAMMAL RESPONSE TO THINNING. Northern Oregon Coast Range, Tillamook Burn area. Investigating the effects of different levels of thinning on small mammal communities at the microsite and stand levels. Study located in previously treated stands—control (200 tpa), moderate thin (100 tpa), heavy thin (80 tpa)—replicated in three blocks. Data collected 1999 and 2000, analysis to be completed 2001. Refs: www.fsl.orst.edu/cfer—John P. Hayes (Dept. Forest Science) and David Larson

27. TROPHIC RELATIONS AMONG BIRDS, ARTHROPODS, AND SHRUBS. This study focuses on the role of understory vegetation in providing arthropod food sources to birds, in 2 mature/old-growth stands and 5 managed stands in the central Oregon Coast Range. Observations are made of foraging habits, arthropod abundance and plant associates, and bird diets. Field data collection complete; data analysis to be completed soon. Refs: www.fsl.orst.edu/cfer—Edward Starkey (USGS, FRESC, Corvallis, OR) and Joan Hagar (Dept. Forest Science, OSU)

28. INFLUENCE OF COARSE WOOD ON SMALL MAMMALS IN THE OREGON COAST RANGE. On the McDonald-Dunn Research Forest at the eastern edge of the Coast Range. This study will determine the influence of coarse wood and other habitat variables on population demographics (e.g., abundance, survival, age and sex ratios, reproductive condition) of small mammals. Two stands of four silvicultural treatments (clearcut, patch-cut, two-story, and control) in three blocks. Wood was added to randomly selected clearcuts and patch cuts in each block. Stands were 90-130 yrs old prior to treatment in 1989-1991. Small and medium-sized mammals were sampled in 1999 and 2000 prior to addition of logs (winter 2000-2001), and mammals will be sampled in 2001 and 2002. Refs: www.fsl.orst.edu/cfer—John P. Hayes (Dept. Forest Science, OSU) and David L. Waldien (Dept. Fisheries and Wildlife, OSU)

29. RESPONSE OF SMALL MAMMALS TO FUELS MANAGEMENT IN SOUTHWEST OREGON. This study will examine and compare short-term population and community responses of small mammals to different methods of slash management in commercially thinned Douglas-fir forests. Three thinned stands were identified as blocks, within which three methods of slash treatment were executed: lop and scatter, pile, and pile and burn. Blocks were thinned in April 1999 and slash was treated in October 1999. Pre-treatment data were collected in summer 1999, and post-treatment data in summer 2000. Data being analyzed. Refs: www.fsl.orst.edu/cfer—W. Daniel Edge (Dept. Fisheries and Wildlife, OSU) and Jeff Manning

30. VALIDATION OF SONGBIRD HABITAT MODELS. This study is testing the efficacy of logistic regression habitat-relationship models developed by Weyerhaeuser biologists for 15 forest birds. Fifty stands on Weyerhaeuser and BLM lands in the western Cascades near Cottage Grove were used for validation. Results from field sampling were compared with model predictions. Analysis continuing. Refs: www.fsl.orst.edu/cfer—W. Daniel Edge (Dept. Fisheries and Wildlife, OSU) and Dodie Wilson

31. INFLUENCE OF LANDSCAPE CHARACTERISTICS ON ABUNDANCE AND USE OF HABITAT BY BAT COMMUNITIES IN THE CENTRAL OREGON CASCADES. Located over several federal and private ownerships in the lower McKenzie and North Umpqua basis, western Oregon Cascades. This study is investigating the influence of roost availability on richness of bat communities and abundance of bats. Bats are equipped with radio transmitters and followed to identify day roosts, which may be in a number of stand types. Data collected 1999 and 2000, will continue in 2001, after which data will be analyzed. Refs: www.fsl.orst.edu/cfer—John P. Hayes (Dept. Forest Science, OSU) and Ed Arnett

LITERATURE CITED

There are hundreds of recent publications on young forests in the Pacific Northwest. Only those cited in this communiqué are included here. A larger, but still partial list can be viewed at the Cascade Center for Ecosystem Management website: www.fsl.orst.edu/ccem.

Allen, M.M., P.W. Adams, and L.D. Kellogg. 1997. **Soil bulk density and penetrometer measurements after harvester and forwarder traffic over different slash depths in the Oregon Cascades**, research project completion report, June 30, 1997. For. Engin. Dept., Oreg. State Univ. 87 pp.

Allen, M.M. 1997. **Soil compaction and disturbance following commercial thinning with cable and cut-to-length systems in the Oregon Cascades.** M.F. Thesis. For. Engin. Dept., Oreg. State Univ. 105 pp.

Bohac, S.A., Lattig, M.D., and Tucker, G.F. 1997. **Initial vegetative response to alternative thinning treatments in second growth Douglas-fir stands of the Central Oregon Cascades.** The Evergreen State College. 47 pp.

Boyle, James R., and T.L. Buford. 1999. **Young Stand Thinning and Diversity Study (YSTDS) post-treatment woody detritus inventory final report.** Dept. of For. Res., College of Forestry, Oreg. State Univ. 9pp.

Busing, R.T., and S.L. Garman. 2001. **Promoting old-growth characteristics and long-term wood production in Douglas-fir forests.** For. Ecol. Manage. [in press].

Carey, A.B. 1995. **Sciurids in managed and old-growth forests in the Pacific Northwest.** Ecol. Appl. 5(3): 648-661.

Carey, A.B. 1996. I**nteractions of northwest forest canopies and arboreal mammals.** Northwest Sci. 69(special issue): 72-78.

Carey, A.B. 2000. **Effects of new forest management strategies on squirrel populations.** Ecol. Appl. 10(1):248-257.

Carey, A.B. 2001. **Experimental manipulation of spatial heterogeneity in Douglas-fir forests: effects on squirrels.** For. Ecol. and Manage. [in press].

Carey, A.B., M.M. Hardt, S.P. Horton, and B.L. Biswell. 1991. **Spring bird communities in the Oregon Coast Range.** Pages 122-142 *in* L.F. Ruggiero, K.A. Aubry, A.B. Carey, and M.H. Huff (tech. eds.). **Wildlife and vegetation of unmanaged Douglas-fir forests.** USDA For. Serv., Pacific Northwest Res. Sta. Gen. Tech. Rept. PNW-GTR-285, Portland, OR.

Carey, A.B., and C.A. Harrington. 2001. **Small mammals in young forests: implications for sustainability.** For. Ecol. Manage. [in press].

Carey, A.B., and M.H. Johnson. 1995. **Small mammals in managed, naturally young, and old-growth forests.** Ecol. Appl. 5(2): 336-352.

Carey, A.B., J.K. Kershner, B.L. Biswell, and L.D. de Toledo. 1999*a*. **Ecological scale and forest development: squirrels, dietary fungi, and vascular plants in managed and unmanaged forests.** Wildl. Monog. 142:1-71.

Carey, A.B., B.R. Lippke, and J. Sessions. 1999b. **Intentional systems management: managing forests for biodiversity.** J. Sust. For. 9(3/4):83-125.

Carey, A.B., D.R. Thysell, and A. Brodie. 1999*c*. **The Forest Ecosystem Study: background, rationale, implementation, baseline conditions, and silvicultural assessment.** USDA For. Serv. Gen. Tech. Rep. PNW-GTR-457. 129 p.

Carey, A.B., D.R. Thysell, L.J. Villa, T.M. Wilson, S.M. Wilson, J.M. Trappe, E.R. Ingham, M. Holmes, and W. Colgan. 1996. **Foundations of biodiversity in managed Douglas-fir stands.** Pages 68-82 in D.L. Peterson and C.V. Klimas, eds. The role of restoration in ecosystem management. Society for Ecological Restoration, Madison, Wisconsin.

Carey, A.B., and S.M. Wilson. 2001. **Induced spatial heterogeneity in Douglas-fir canopies: responses of small mammals.** J. Wildl. Manage. [in press].

Colgan, W. III, A.B. Carey, J.M. Trappe, R. Molina, and D. Thysell. 1999. **Diversity and productivity of hypogeous fungal sporocarps in a variably thinned Douglas-fir forest.** Can. J. For. Res. 29:1259-1268.

Davis, J. 2001. [Untitled issue paper dated February 20, 2001]. Coos Bay District, Bureau of Land Management. 5 pp.

Franklin, J.F., and M. Hemstrom. 1981. **Aspects of succession in the coniferous forests of the Pacific Northwest.** p. 212-229 in D. C. West, H. H. Shugart, and D. B. Botkin, Forest succession concepts and application. Springer Verlag: New York.

Franklin, J.F., and T.A. Spies. 1991a. **Ecological definitions of old-growth Douglas-fir forests.** Pp. 61-69 *in* L.F. Ruggiero, K.A. Aubry, A.B. Carey, and M.H. Huff (tech. eds.). **Wildlife and vegetation of unmanaged Douglas-fir forests.** USDA For. Serv., Pacific Northwest Res. Sta. Gen. Tech. Rept. PNW-GTR-285, Portland, OR.

Franklin, J.F., and T.A. Spies. 1991b. **Composition, function, and structure of old-growth Douglas-fir forests.** Pp. 71-80 *in* L.F. Ruggiero, K.A. Aubry, A.B. Carey, and M.H. Huff (tech. eds.). **Wildlife and vegetation of unmanaged Douglas-fir**

forests. USDA For. Serv., Pacific Northwest Res. Sta. Gen. Tech. Rept. PNW-GTR-285, Portland, OR.

Franklin, J.F., T.A. Spies, R. Van Pelt, A.B. Carey, D.A. Thornburgh, D.R. Berg, D.B. Lindenmayer, M.E. Harmon, W.S. Keeton, D.C. Shaw, K. Bible, J. Chen. 2001. **Disturbances and structural development of natural forest ecosystems with silvicultural implications, using Douglas-fir forests as an example.** For. Ecol. Manage. [in press].

Garman, S.L. 1998. **Young Stand Thinning and Diversity Study: Post-treatment assessment of ground-dwelling vertebrates.** Interim report. Oreg. State Univ. 13pp.

Garman, S.L. 1999a. **Assessing potential development of snags: Young Stand Thinning and Diversity Study**. Oreg. State Univ. 34 pp.

Garman, S.L. 1999b. **Accelerating development of late-successional conditions in young managed Douglas-fir stands: a simulation study.** Oreg. State Univ. 196 pp. [submitted to USDA For. Service as PNW Gen. Tech. Rept.].

Garman, S.L. 2000a. **Biodiversity of thinned stands: Young Stand Thinning and Diversity Study.** Oreg. State Univ. 31pp.

Garman, S.L. 2000b. **Response of ground-dwelling vertebrates to thinning young stands: The Young Stand Thinning and Diversity Study. Interim report.** Oreg. State Univ. 35 pp.

Garman, S.L. 2001b. **Simulated future thinning prescriptions: young stand thinning and diversity study.** Oreg. State Univ. 52 pp.

Hagar, J. 1999. **Songbird community response to thinning of young Douglas-fir stands in the Oregon Cascades. Second year post-treatment results for the Willamette NF Young Stand Study.** Oreg. State Univ. 7pp. [available in PDF at www.fsl.orst.edu/ccem/yst/ystd.html]

Hagar, J.C., and S. Howlin. 2001. **Songbird Community Response to Thinning of Young Douglas-fir Stands in the Oregon Cascades - Third Year Post-treatment Results for the Willamette N.F., Young Stand Thinning and Diversity Study.** Report prepared for USDA For. Service, Willamette N.F. [available in PDF at www.fsl.orst.edu/ccem/yst/ystd.html].

Hagar, J.C., W.C. McComb, and W.H. Emmingham. 1996. **Bird communities in commercially thinned and unthinned Douglas-fir stands of western Oregon.** Wildl. Soc. Bull. 24:353-366.

Han, H.-S. and L.D. Kellogg. 2000a. **A comparison of sampling methods for measuring residual stand damage from commercial thinning.** J. of For. Engin.. 11(1):63-71.

Han, H.-S. and L.D. Kellogg. 2000b. **Damage characteristics in young Douglas-fir stands from commercial thinning with four timber harvesting systems.** West. J. Appl. For. 15(1):27-33.

Han, H.-S., L.D. Kellogg, G.M. Filip, and T.D. Brown. 2000. **Scar closure and future timber value losses from thinning damage in western Oregon.** For. Prod. J. 50(1):36-42.

Han, H.-S., T.W. Steele, and L.D. Kellogg. [submitted]. **DamQuick: A new method for rapidly assessing residual stand damage during partial timber harvests.** Can. J. For. Resources.

Hann, D.W. 2001. **Stability and density management in Douglas-fir plantations.** Can. J. For. Res. 31(2):367-368.

Hansen, A.J., W.C. McComb, R. Vega, M.G. Raphael, and M.G. Hunter. 1995. **Bird habitat relationships in natural and managed forests in the west Cascades of Oregon.** Ecol. Appl. 5:555-569.

Haveri, B.A., and A.B. Carey. 2000. **Forest-management strategy, spatial heterogeneity, and winter birds in Washington.** Wildl. Soc. Bull. 28(3):643-653.

Hayes, J.P., S.S. Chan, W.H. Emmingham, J.C. Tappeiner, L.D. Kellogg, and J.D. Bailey. 1997. **Wildlife response to thinning young forests in the Pacific Northwest.** J. For. 95(8):28-33.

Hayes, J.P, and J. Weikel. Dept. of For. Science, Oreg. State Univ, Corvallis.

Hunter, M. 1993. **Young managed stands.** Communiqué published by the Cascade Center for Ecosystem Management, Blue River Ranger District, Willamette National Forest. 16 pp. [available in PDF format at www.fsl.orst.edu/ccem/yst/ystd.html].

Isaac, L.A. 1938. **Factors affecting the establishment of Douglas-fir seedlings.** U.S. Dep. Agric. Circ.

Isaac, L.A. 1940. **Vegetative succession following logging in the Douglas-fir region with special reference to fire.** J. For. 38:716-721.

Juday, G.P. 1976. **The location, composition, and structure of old-growth forests of the Oregon Coast Range.** PhD Thesis: Oreg. State Univ, Corvallis.

Kellogg, L., and M. Reed. 1998. **Thinning young stands.** Cat. No. 1089. Forestry Med. Ctr., College of Forestry, Oreg. State Univ. (31 min.). 541-737-4702.

Kellogg, L.D., G.V. Milota, and B. Stringham. 1998. **Logging planning and layout costs for thinning: experience from the Willamette Young Stand Project.** For. Res. Lab., Oreg. State Univ. Res. Contrib. 20. 20 pp.

Kellogg, L.D., M. Miller, Jr., and E.D. Olsen. 1999. **Skyline thinning production and costs: experience from the Willamette Young Stand Project.** For. Res. Lab., Oreg. State Univ. Res. Contrib. 21. 33 pp.

Kellogg, L.D., G.V. Milota, and M. Miller Jr. [in press/a]. **Tractor thinning production and costs. Experience from the Willamette Young Stand Project.** For. Res. Lab., Oreg. State Univ.

Kellogg, L.D., M.M. Hossain, and E.D. Olsen. [in press/b]. **Mechanized thinning production and costs. Experience from the Willamette Young Stand Project.** For. Res. Lab., Oreg. State Univ.

McArdle, R.E., W.H. Meyer, and D. Bruce. 1961. **The yield of Douglas fir in the Pacific Northwest.** Tech. Bull. No. 201, USDA, Wash., D. C.

McComb, W.C., T.A. Spies, and W.H. Emmingham. 1993. **Douglas-fir forests: managing for timber and mature-forest habitat.** J. For. 91(12):31-42.

Miller, M., and W. Emmingham. 2001. **Can selection thinning convert even-aged Douglas-fir stands to uneven-age structures?** West. J. Appl. For. 16(1):35-43.

Monserud, R.A., and C.E. Peterson. [in review]. **Large-scale management experiments in the moist maritime forests of the Pacific Northwest.** [Unpublished manuscript on file at the Portland For. Sciences Lab, USDA For. Service, PNW, Portland, submitted to Landscape and Urban Plannning, 2001.]

Oliver, C.D. 1981. **Forest development in North America following major disturbances.** For. Ecol. Manage. XX:153-168.

Oliver, C.D., and B.C. Larson. 1990. **Forest stand dynamics.** McGraw-Hill, New York, 467 pp.

Poage, N.J. 2001. **Structure and development of old-growth Douglas-fir in central western Oregon.** PhD Thesis, Oreg. State, Univ., Corvallis.

Rambo, T.R., and P.S. Muir. 1998. **Forest floor bryophytes of Pseudotsuga menziesii-Tsuga heterophylla stands in Oregon: influences of substrate and overstory.** Bryologist 101: 116-130.

Ribe, R. 2001. **Public perceptions of alternative forest management practices: testing alternative stand treatments.** Cascade Center for Ecosystem Management. 2 pp. [http://www.fsl.orst.edu/ccem/pdf/social.pdf].

Spies, T.A., and J.F. Franklin. 1991. **The structure of natural young, mature, and old-growth forests in Oregon and Washington.** Pp. 91-109 *in* L.F. Ruggiero, K.A. Aubry, A.B. Carey, and M.H. Huff (tech. eds.). Wildlife and vegetation of unmanaged Douglas-fir forests. USDA For. Serv., Pacific Northwest Res. Sta. Gen. Tech. Rept. PNW-GTR-285, Portland, OR.

Tappeiner, J.C., D. Huffman, D. Marshall, T.A. Spies, and J.D. Bailey. 1997. **Density, ages, and growth rates in old-growth and young-growth forests in coastal Oregon.** Can. J. For. Res. 27:638-648.

Thysell, D.R., and A.B. Carey. 2000. **Effects of forest management on forest understory and overstory vegetation: a retrospective study.** USDA For. Serv. Gen. Tech. Rep. PNW-GTR-488. 41 p.

Tucker, G. 1999. **The H.J. Andrews uneven-aged management project: managing young stands.** Cascade Center for Ecosystem Management. 2pp. [http://www.fsl.orst.edu/ccem/pdf/uneven.pdf].

Tucker, G., M. Duane, J. Mayo, and L. Skiels. Undated. **Response of vegetation to alternative silvicultural thinning in the central Oregon Cascades: analysis of third-year post-harvest data from Willamette National Forest young stand thinning and diversity study.** Unpublished report to Blue River Ranger District.

Weikel, J.M. 1997. **Habitat use by cavity-nesting birds in young thinned and unthinned Douglas-fir forests of western Oregon.** MS Thesis, Oreg. State Univ. 102 pp.

Weikel, J.M., and J.P. Hayes. 1999. **The foraging ecology of cavity-nesting birds in young forests of the northern Coast Range of Oregon.** Condor 101:58-66.

Wilson, J.S., and C.D. Oliver. 2000. **Stability and density management in Douglas-fir plantations.** Can. J. For. Res. 30:910-920. [See Hann (2001) for a correction to the organon analysis.]

Wilson, S.M., and A.B. Carey. 2000. **Legacy retention versus thinning: influences on small mammals.** Northwest Sci. 74:131-145.

Winter, L.E. 2000. **Five centuries of structural development in an old-growth Douglas-fir stand in the Pacific Northwest: a reconstruction from tree-ring records.** Ph.D. Thesis. Univ. Wash., Seattle. 134 pp.

WANT TO KNOW MORE?

Web sites

Cascade Center for Ecosystem Management (www.fsl.orst.edu/ccem)

Cooperative Forest Ecosystem Research (www.fsl.orst.edu/cfer)

Stand Management Cooperative (www.cfr.washington.edu/research.smc/)

Swiss Needle Cast Cooperative (www.cof.orst.edu/coops/sncc/index.sht)

Contacts

The following information is given to assist you in contacting folks mentioned in this communique. Check the affiliation of the person and look up their contact information on the web, or call the appropriate office.

Oregon State University information: 541-737-0123

Oregon State University web site: www.orst.edu, click on “find someone”

University of Oregon information: 541-346-1000

University of Oregon web site: www.uoregon.edu, type in name at “Search UO”

University of Washington information: 206-543-2100

University of Washington web site: www.washington.edu, click on “Search” and use the directory of interest.

U.S.D.A. Forest Service, PNW Research Station, Corvallis: 541-750-7255

U.S.D.A. Forest Service, PNW Research Station, Olympia: 360-956-2345

U.S.D.A. Forest Service web site: www.fs.fed.us, click on “contacts”

U.S.D.I. Bureau of Land Management information: 503-952-6002

U.S.D.I. Bureau of Land Management web site: www.blm.gov/orwadir.htm

U.S. Geological Survey information (Corvallis): 541-750-7307

U.S. Geological Survey web site: www.usgs.gov/bio/USGS/ph.html

Upcoming events

For upcoming events related to young stands see www.fsl.orst.edu/ccem

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The Cascade Center for Ecosystem Management is a research and management partnership between Oregon State University, the Pacific Northwest Research Station, and the Willamette National Forest. It evolved from the longstanding relationships centered on the H.J. Andrews Experimental Forest. The mission of the Center is to develop information about how ecosystems function, integrate that information into management strategies that meet social goals, and develop effective mediums to communicate information to the natural resource community. This Communique represents one outreach effort.

Comments and input for future issues on this or other topics are appreciated, and should be directed to: jcissel@fs.fed.us or (541) 822-1214.

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