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Accelerating Development of Late-Successional Conditions in Young Managed Douglas-Fir Stands: A Simulation Study

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Abstract

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The goal of this simulation study was to provide information for defining thinning regimes for young Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) stands in the Central Cascades Adaptive Management Area, located in west-central Oregon. Specifically, this study used the ZELIG.PNW (3.0) gap model to evaluate effects of experimental thinning treatments on the development of late-successional attributes and on extracted merchantable volume. Sixty-four thinning treatments were simulated for four rotation intervals (260, 180, 100, and 80 years) starting with a 40-year-old managed Douglas-fir stand. The amount of time for five late-successional attributes to reach defined threshold levels, long-term developmental trends of these attributes, and amount of extracted merchantable volume were recorded for each treatment. Stand conditions of selected treatments were used in a subsequent harvest rotation in which 64 additional experimental thinning treatments were applied and evaluated. A total of 1,744 thinning treatments was evaluated in this study.

Results of this study confirm previous recommendations for accelerating development of late-successional attributes in young managed stands. Additionally, results show the potential for a range of thinning treatments to attain late-successional conditions in about the same amount of time, but with different tradeoffs in terms of merchantable volume and long-term stand conditions. In general, heavy thinning of existing stands at ages 40 and 60 years promoted rapid development of large boles, vertical diversity, and tree-species diversity, but provided the least amount of extracted volume and required artificial creation of dead wood. Treatments that retained more than 40 percent of the original overstory and thinned to 99 trees per hectare at age 60 delayed attainment of late-successional conditions by 10 to 30 years but provided 12 to 20 percent more extracted volume, resulted in higher levels of most late-successional attributes at the end of a rotation, and required less artificial creation of dead wood. Treatments providing the fastest development of late-successional conditions in subsequent rotations varied with the amount of canopy cover retained at the end of the first rotation. For stands starting with ≥30 percent canopy cover, delaying the first commercial thin for 40 years promoted the most rapid development of vertical structure and shade-tolerant stems. Lower canopy-retention levels required heavy or light thins in subsequent entries, depending on the rotation interval, for rapid development of late-successional attributes.

Keywords: Forest management, alternative thinning strategies, late-successional development, simulation modeling.

Contents

Introduction

Managing forested stands for attributes other than maximum timber production is of increasing interest to federal land managers in the Pacific Northwest. This is especially topical for current, young (<80 years old) stands that originated after clearcut harvesting and are managed for optimal timber production. Specific goals for these young stands differ by federal land allocation (e.g., see USDA and USDI 1994), but an underlying objective is to accelerate the development of diverse ecological conditions. An additional concern for stands within timber-harvesting allocations is balancing ecological diversity with timber production over the current and future rotations.

Of the land allocations created in the Northwest Forest Plan (NWFP), the Central Cascades Adaptive Management Area (CCAMA), located in west-central Oregon, is mandated to evaluate various management options for young stands to meet multiple objectives (FEMAT 1993). To this end, the managers of the CCAMA have proposed the use of five general, long-term harvest strategies spanning a gradient of potential management intensities and frequencies as a framework for the development and evaluation of young-stand management strategies (Blue River watershed landscape study) (CCAMA 1998, USDA FS 1997). This framework only specifies rotation intervals and rotation-harvest retention levels; thinning treatments within a rotation need to be defined. Use of field-based studies to define these thinning treatments is currently not possible because ongoing studies are not completed or are too limited in scope. Assessment of thinning regimes with computer simulation modeling was considered a viable alternative.

The goal of this simulation study was to provide information for defining thinning regimes for the young-stand management framework of the CCAMA. Specifically, this study evaluated the potential effects of an incremental range of thinning treatments on the development of stand attributes characteristic of late-successional forests and on extracted merchantable volume. Treatments evaluated in this study were selected to include a reasonable range of thinning options for young Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) stands but do not include the full spectrum of possible thinning regimes. The range of treatments evaluated in this study, however, was intended to illustrate not only performance of specific thinning regimes but also fundamental dynamics of managed stands. Information revealed in this study can guide selection of thinning regimes that meet specific management goals as well as the design of thinning treatments for further testing.

Methods

Simulation Model

We used the ZELIG.PNW (3.0) gap model to simulate thinning-treatment effects on stand dynamics. Descriptions of model logic, empirically based enhancements for the Pacific Northwest (PNW) region, and model corroboration can be found in Garman and others (1992), Hansen and others (1995), Urban (1993), and Urban and others (1993). In short, ZELIG simulates the annual establishment, diameter growth, and mortality (ambient and stress-related) of individual stems on a small model plot (0.04 ha), the size of which corresponds to the zone of influence of a canopy-dominant stem. Dynamics are based on species' maximum potential rates of demographic processes (i.e., growth, regeneration), which are subsequently reduced as current light conditions (due to shading), soil moisture, ambient temperature, and soil fertility deviate from optimum levels. Unlike typical growth-and-yield models, the gap model considers two forms of stem mortality, both of which are implemented as stochastic processes. Stress-related mortality results from resource limitations (i.e., shading, drought). Stems with limited diameter growth for 3 consecutive years have an increased probability of stress mortality. Ambient mortality is independent of tree

density and resource conditions and accounts for tree death resulting from small-scale disturbances such as windthrow and disease. However, ambient mortality processes are not modeled in an explicit manner; e.g., windfirmness of stems and disease susceptibility are not explicitly considered in determining mortality potential of a stem. Instead, ambient mortality is based on the maximum physiological longevity of a species. Thus, all stems of a species, regardless of size and growth potential, have an equal probability of dying each annual time step. Ambient mortality rates currently used in the model correspond to observed median values of older Douglas-fir stands.[1] Coarse woody debris (CWD—i.e., snags and logs) dynamics are also a unique feature of the PNW version of the model and were based on field observations by Graham (1982). When a tree dies, it converts immediately to either a log (based on a probability of falling) or a snag, which later can break and create log pieces. Over time, each CWD piece is advanced through the standard decay classes (Cline and others 1980) by using a probability function based on maximum residence time (which differs by orientation, decay resistance, and stem size) and actual residence time in a decay class. The mass, diameter at breast height (d.b.h.) or large-end diameter, height or length, and decay class are tracked for each CWD piece. Spatial pattern of a forested stand is simulated by using a grid of interacting model plots, where the stature of trees on neighboring plots is considered in calculating light levels on each model plot. Yearly weather conditions affecting live-tree dynamics are generated within the model by using observed, long-term monthly values of precipitation, temperature, and solar radiation for a site. Because weather, certain demographic processes, and CWD dynamics are simulated as a stochastic process, replicates of simulations are used to derive an average trajectory of forest dynamics. When representing a stand with ≥64 model plots, eight replications of a simulated thinning treatment are sufficient for convergence (in the sense of Bugmann and others 1996) of modeled responses.

An additional feature of the ZELIG.PNW (3.0) gap model is a forest-management event scheduler. This module interprets user-specified commands designating management actions such as retention, removal, creation of snags and logs from live stems, and artificial regeneration. Various arguments associated with each command specify the method of retention or removal (e.g., above, below, proportional to the existing size-class distribution), target levels (in terms of basal area, density, volume, and percentage of canopy cover), species composition, and diameter and age limits.

Emulating reasonable levels of natural regeneration is paramount when simulating long-term dynamics of forest stands. For this study, ingrowth rates of shade-tolerant species were fine-tuned by comparing simulated tree-understory conditions over various overstory densities to observed conditions in naturally regenerated Douglas-fir stands in the Oregon Cascade Range (Garman and others 1999). Substrate conditions were considered to be limiting in modeled scenarios for shade-intolerant species. Thus, ingrowth of these species was constrained to relatively low levels.

Simulation Experiments

The framework of the CCAMA young-stand management assessment strategy consists of five rotation strategies and five developmental stages (i.e., initial conditions). Only the early stem-exclusion developmental stage for the five rotation strategies is considered in this study. The initial condition used for all five rotation strategies was a site-class 3, 40-year-old Douglas-fir stand (table 1) of the young-stand thinning

[1] Steve Acker. Personal communication. 1998. Assistant professor, Oregon State University, Department of Forest Science, Corvallis, OR 97331.

Table 1—Attributes of the initial stand used in all first-rotation simulation experiments

Stand development stage	Total density	Total basal area	Shade-tolerant basal area	Mean d.b.h.[a]—standard deviation
	Number per hectare	*Square meters - - - per hectare - - -*		*Centimeters*
40-year-old managed Douglas-fir	648	42.3	1.85	27.5–8.6

[a] d.b.h. = diameter at breast height.

and diversity study (Cascade Center for Ecosystem Management 1993). Stems of the observed stand were evenly distributed over an initial 2.56-ha model stand (8 by 8 model plots). Environmental parameters (i.e., monthly mean temperature, precipitation, and solar radiation) used in all simulations corresponded to midelevation (ca. 800 m) conditions of the Blue River Watershed on the Willamette National Forest. Each simulation experiment was replicated eight times with different random-number seed values.

Rotation strategies considered in this study included a 260-year rotation with 15-percent canopy retention at the rotation harvest (i.e., stand age 260 years), a 180-year rotation with 30-percent canopy retention, a 100-year rotation with 50-percent canopy retention, and an 80-year rotation with 15-percent canopy retention (standard matrix-allocation prescription) (tables 2 through 5). The rotation harvest in all rotation strategies also included the artificial creation of 10 snags per hectare greater than 50 cm d.b.h. from live stems and a mixed-species underplanting. Snags were created from the largest stems prior to the live-canopy retention. Additionally, a no-harvest or late-successional reserve strategy was indirectly considered by evaluating treatment effects of the longer rotation strategies (≥180 years).

Simulated thinning experiments for each rotation strategy consisted of variable entry times, thinning densities, and thinning methods prior to the rotation harvest (tables 2 through 5). Experimental entry times and thinning densities were based on recommendations of field personnel[2] and preliminary assessments. Additionally, a no-entry treatment was used for each entry time, meaning that the thinning entry was skipped. For all rotation strategies, simulation experiments consisted of up to three entry times and four thinning densities (commercial thins). Thinning from below (i.e., removal from below) in the first entry was generally used to increase the developmental rate of large boles. Thinning proportionally with an upper diameter limit of 60 cm in subsequent entries balanced the development of vertical diversity and shade-tolerant stem densities with that of large boles (see tables 2 through 5, first-rotation experiments). The proportional thinning method essentially reduced stem density while preserving the existing species' size-class distributions. In each thinning entry, all stems <10 cm d.b.h. were eliminated to emulate mechanical disturbance of a thinning operation regardless of the simulated thinning intensity.

[2] Jim Mayo. Personal communication. 1999. Silviculturist, Central Cascades Adaptive Management Area and Cascade Center for Ecosystem Management, Blue River Ranger District, P.O. Box 199, Blue River, OR 97413.

Table 2—Simulated silvicultural experiments for the 260-year rotation strategy

Stand age (years since last rotation harvest)	Thinning method	Diameter limit	Target thinning[a] densities or retention level[b]	Artificial creation of dead wood		Reforestation
				Snags	Logs	
		Cm		*No./ha*	*Mg/ha*	*No./ha*
			First-rotation experiment			
40	Below[c]	NA	136, 272, 408, all	0	0	NA
60	Proportional[d]	≥10–≤60	99, 198, 297, all	0, 2, 4	0, 5, 10	NA
80	Proportional	≥10–≤60	62, 124, 186, all	0, 2, 4	0, 5, 10	NA
260	Below	NA	15% (95% si, 5% st)[e]	10	0	988 (75% si, 25% st)[e]
			Second-rotation experiment			
12	Below	NA	494	0	0	NA
40	Below	NA	136, 272, 408, all	0	0	NA
60	Proportional	≥10–≤60	99, 198, 297, all	0, 2, 4	0, 5, 10	NA
80	Proportional	≥10–≤60	62, 124, 186, all	0, 2, 4	0, 5, 10	NA
260	Below	NA	15% (95% si, 5% st)[e]	10	0	988 (75% si, 25% st)[e]

NA = not applicable.
[a] Target thinning density is the number of stems per hectare remaining in a thinning entry.
[b] Retention level is the percentage of canopy cover retained in the rotation harvest.
[c] Refers to removal from below.
[d] Refers to removal of stems while preserving species' size-class distributions.
[e] si = shade-intolerant species (mostly Douglas-fir); st = shade-tolerant species (mostly western hemlock).

Table 3—Simulated silvicultural experiments for the 180-year rotation strategy

Stand age (years since last rotation harvest)	Thinning method	Diameter limit	Target thinning[a] densities or retention level[b]	Artificial creation of dead wood		Reforestation
				Snags	Logs	
		Cm		*No./ha*	*Mg/ha*	*No./ha*
			First-rotation experiment			
40	Below[c]	NA	136, 272, 408, all	0	0	NA
60	Proportional[d]	≥10–≤60	99, 198, 297, all	0, 2, 4	0, 5, 10	NA
80	Proportional	≥10–≤60	62, 124, 186, all	0, 2, 4	0, 5, 10	NA
180	Below	NA	30% (80% si, 20% st)[e]	10	0	741 (60% si, 40% st)[e]
			Second-rotation experiment			
12	Below	NA	494	0		NA
40	Below	NA	136, 272, 408, all	0	0	NA
60	Proportional	≥10–≤60	99, 198, 297, all	0, 2, 4	0, 5, 10	NA
80	Proportional	≥10–≤60	62, 124, 186, all	0, 2, 4	0, 5, 10	NA
180	Below	NA	30% (80% si, 20% st)[e]	10	0	741 (60% si, 40% st)[e]

NA = not applicable.
[a] Target thinning density is the number of stems per hectare remaining in a thinning entry.
[b] Retention level is the percentage of canopy cover retained in the rotation harvest.
[c] Refers to removal from below.
[d] Refers to removal of stems while preserving species' size-class distributions.
[e] si = shade-intolerant species (mostly Douglas-fir); st = shade-tolerant species (mostly western hemlock).

Table 4—Simulated silvicultural experiments for the 100-year rotation strategy

Stand age (years since last rotation harvest)	Thinning method	Diameter limit	Target thinning[a] densities or retention level[b]	Artificial creation of dead wood		Reforestation
				Snags	Logs	
		Cm		*No./ha*	*Mg/ha*	*No./ha*
			First-rotation experiment			
40	Below[c]	NA	136, 272, 408, all	0	0	NA
60	Proportional[d]	≥10–≤60	99, 198, 297, all	0, 2, 4	0, 5, 10	NA
80	Proportional	≥10–≤60	62, 124, 186, all	0, 2, 4	0, 5, 10	NA
100	Proportional	NA	50% (40% si, 60% st)[e]	10	0	494 (65% si, 35% st)[e]
			Second-rotation experiment			
12	Proportional	NA	494	0	0	NA
40	Proportional	NA	136, 272, 408, all	0	0	NA
60	Proportional	≥10–≤60	99, 198, 297, all	0, 2, 4	0, 5, 10	NA
80	Proportional	≥10–≤60	62, 124, 186, all	0, 2, 4	0, 5, 10	NA
100	Proportional	NA	50% (40% si, 60% st)[e]	10	0	494 (65% si, 35% st)[e]

NA = not applicable.
[a] Target thinning density is the number of stems per hectare remaining in a thinning entry.
[b] Retention level is the percentage of canopy cover retained in the rotation harvest.
[c] Refers to removal from below.
[d] Refers to removal of stems while preserving species' size-class distributions.
[e] si = shade-intolerant species (mostly Douglas-fir); st = shade-tolerant species (mostly western hemlock).

Table 5—Simulated silvicultural experiments for the 80-year rotation strategy

Stand age (years since last rotation harvest)	Thinning method	Diameter limit	Target thinning[a] densities or retention level[b]	Artificial creation of dead wood		Reforestation
				Snags	Logs	
		Cm		*No./ha*	*Mg/ha*	*No./ha*
			First-rotation experiment			
40	Below[c]	NA	136, 272, 408, all	0	0	NA
60	Proportional[d]	≥10–≤60	99, 198, 297, all	0, 2, 4	0, 5, 10	NA
80	Proportional	NA	15% (95% si, 5% st)[e]	10	0	988 (75% si, 25% st)[e]
			Second-rotation experiment			
12	Proportional	NA	494	0	0	NA
20	Proportional	NA	136, 272, 408, all	0	0	NA
40	Proportional	≥10–≤60	99, 198, 297, all	0, 2, 4	0, 5, 10	NA
60	Proportional	≥10–≤60	62, 124, 186, all	0, 2, 4	0, 5, 10	NA
80	Proportional	NA	15% (95% si, 5% st)[e]	10	0	988 (75% si, 25% st)[e]

NA = not applicable.
[a] Target thinning density is the number of stems per hectare remaining in a thinning entry.
[b] Retention level is the percentage of canopy cover retained in the rotation harvest.
[c] Refers to removal from below.
[d] Refers to removal of stems while preserving species' size-class distributions.
[e] si = shade-intolerant species (mostly Douglas-fir); st = shade-tolerant species (mostly western hemlock).

Simulation experiments consisted of a two-step process. Starting with the 40-year-old stand, a full-factorial design (i.e., all possible combinations of thinning densities by entry time) was used to evaluate treatment effects on rate of attainment of late-successional conditions (described below) and merchantable volume. This initial assessment is referred to as the first rotation. Six of these treatments were then selected for an additional assessment over a subsequent rotation, which collectively are referred to as the second-rotation experiments. These six treatments included the two with the fastest development of late-successional conditions, the two producing the most extracted merchantable volume, and the two with the highest combined rank of extracted merchantable volume and rate of attainment of late-successional conditions. For each of the six treatments, the postharvest conditions at the end of the first rotation were used as the initial condition of the second rotation. Thinning treatments examined in the second rotation were similar to those of the first rotation with the exception of a nonvariable, precommercial thin 12 years after the start of the second rotation (tables 2 through 5). Also, a proportional-thin method was used in the precommercial and all commercial thins in the 100- and 80-year rotation strategies to facilitate vertical differentiation of the canopy. Additionally, three thinning entries 20 years apart were examined in the 80-year second-rotation experiments instead of just the two used in the first-rotation experiments (table 5).

The importance of artificially creating snags and logs was additionally evaluated in both the first- and second-rotation experiments. Up to four snags per hectare and 10 Mg/ha of logs were created from stems otherwise selected for harvest in the latter two thinning entries (tables 2 through 5). The largest boles designated for harvest were retained as snags or logs. Each artificially created snag and log piece was tracked separately inside the model, which allowed evaluating the effects of different levels and combinations of artificially created dead wood (e.g., log creation with and without snag creation) in a single simulation run. The simulation model lacks feedback between dead wood and live stems. Thus, emulating different levels of dead-wood creation within a simulation had no effect on the dynamics of live attributes. Merchantable volume of each artificially created dead-wood piece was recorded separately and used to adjust total extracted volume in postprocessing examinations of different dead-wood retention strategies.

For context, the first-rotation assessment of each rotation strategy consisted of 64 experiments (four thinning densities by three thinning entries or four cubed) except for the 80-year rotation, which only had 16 unique experiments. The second-rotation assessment consisted of 384 experiments (four thinning densities by three thinning entries by six initial conditions). Combined across all rotation strategies and rotations, a total of 1,744 different simulation experiments were performed in this study.

Analyses

Treatment effects examined in this study included the stand age at which threshold values of late-successional conditions (table 6) were attained, values of attributes just prior to the rotation harvest, and amount of extracted merchantable volume. Attributes and threshold levels were derived from recommendations by Franklin and Spies (1991) and the USDA Forest Service Region 6 *Interim Old-Growth Definitions for the Western Hemlock Series, Site Class 3* (USDA FS 1993). Vertical heterogeneity is an important characteristic of late-successional stands, but exact methods for measuring this attribute are lacking in federal guidelines. As a measure of multilayer condition, the canopy height diversity index (CHDI) developed by Spies and Cohen (1992) was used. This index considers the relative volume of space occupied by tree crowns in

Table 6—Attributes and threshold values characteristic of late-successional forest conditions for the western hemlock series[a]

Attribute	Threshold value
Density of large boles (>100 centimeters d.b.h.[b])	10 per hectare
Canopy height diversity index	8.0
Density of shade-tolerant species >40 centimeters d.b.h.[b]	10 per hectare
Density of snags >50 centimeters d.b.h.[b], >5 meters tall	10 per hectare
Log mass ≥10 centimeters large-end diameter	30 megagrams per hectare

[a] Modified from Franklin and Spies (1991) and USDA Forest Service (1993).
[b] d.b.h. = diameter at breast height.

five different height classes (e.g., 0 to 16 m, 17 to 32 m, 33 to 48 m, 49 to 64 m, and >64 m) and has been shown to be sensitive to vertical development in natural Douglas-fir stands ranging in age from 30 to 750 years. In the current implementation of this metric, crown diameter of stems is estimated from d.b.h. with regional, species-specific allometric equations (Means and others 1994). The CHDI criterion of 8.0 corresponds to conditions of 200-year-old, naturally regenerated Douglas-fir stands.

Values of each late-successional attribute and measures of stand structure and composition were recorded every 5 years during a simulation. Also, d.b.h., age, and species of harvested stems were recorded for assessment of extracted merchantable volume. The stand age at which the threshold level of a late-successional attribute was satisfied and sustained over the course of a simulation was determined from the time traces. Overall developmental rate of live, late-successional conditions was based on the minimum stand age at which large bole, CHDI, and shade-tolerant stem density criteria were satisfied. For dead-wood attributes, stand age at which criteria were satisfied was analyzed for different combinations of natural recruitment and artificial levels.

A modified version of the HARVEST model (Harmon and others 1996) was used to estimate merchantable volume of removed stems. This model takes into account species-specific decay and breakage rates, and timber utilization standards in calculating biomass of stems. It was modified to output merchantable volume instead of biomass for current timber utilization standards of 18 cm minimum d.b.h., 10 cm minimum top diameter, and a stump height of 45 cm.

A late-successional index (LSI) was used to compare treatment effects when rotation intervals were too short for threshold levels of live criteria to be satisfied:

$$LSI = ((BI + SQRT(STI \times CHI))/2.0) * 100 ,$$

where

BI = 0.02 + (1-EXP(-0.5 × no. of large boles/ha)),

STI = (No. of shade-tolerant stems >40 cm d.b.h./ha)/10.0, and

$CHI = CHDI/8.0$.

The large bole (BI), shade-tolerant density (STI), and CHDI (CHI) components of the LSI were constrained to a maximum of 1.0. Large boles had a greater influence on the LSI than on the other two attributes. The LSI values range from 0 (least similar to late-successional conditions) to 100 (threshold values of all three criteria are met).

Simulation results are shown in graphs to illustrate values of responses and trends among thinning level-thinning entry combinations. Interpreting these graphs can be difficult given the number of dimensions (i.e., three entries by four thinning levels). An annotated example of the graph format is provided to aid in interpretation and should be reviewed prior to reading the results section (fig. 1). Simulated mean values shown in these graphs plus additional related information are presented in tables in the appendix to facilitate numerical comparisons among treatments.

Notation and Terminology

The term “target thinning density” refers to the thinning density specified in the experimental design and indicates the number of stems per hectare that remain following a thinning entry. For certain treatments, target densities may exceed the density of stems in a stand. Thus, modeled densities of a thinning entry will not exactly match that of the specified prescription. For all simulations, the target thinning densities and modeled densities by two size classes ($\leq$60 and >60 cm d.b.h.) are recorded in tables in the appendix so that actual, modeled stand structure can be determined. For ease of interpretation and convenience, however, reference to thinning treatments in the text and labels in the graphs of simulated results use the target densities specified in the experimental designs (e.g., tables 2 through 5). A target thinning density also has an implied diameter range as indicated in the experimental design in tables 2 through 5. When there is no diameter limit, the thinning density value specifies the total density of stems following an entry. Where a diameter limit is imposed, the target density value is the number of stems remaining following an entry within the specified diameter range.

Shorthand notation is used to reference thinning treatments and indicates target thinning densities by sequential stand entry. For example, 136-all-62 is the treatment where 136 trees per hectare (TPH) is the target density for the first and 62 TPH is the target density for the third thinning entry. The “all” indicates that all stems were retained in the second entry; i.e., the second entry was skipped. An “*” refers to all thinning densities of the experimental design. For example, 136-*-* indicates all thinning treatments with a target thinning density of 136 TPH in the first entry; *-198-* refers to all treatments with a second-entry target density of 198 TPH; 136-198-* refers to all treatments with target densities of 136 and 198 TPH in the first and second entry, respectively.

The term “stand age” refers to the amount of time since the last rotation harvest. This is especially important to remember for second-rotation experiments where entry times are referenced by the time since the end of the first-rotation harvest.

Unless otherwise noted, shorthand terms are used to refer to the late-successional attributes defined in table 6. Stems >100 cm d.b.h. are referred to as “large boles”; “snag density” refers to density of snags >50 cm d.b.h., >5 m tall; “log mass” pertains to downed stems with >10 cm large-end diameter; “shade-tolerant stems” refers to stems >40 cm d.b.h.

A nominal “Experiment no.” is associated with each treatment of a rotation strategy. It is mostly used in tables to aid in highlighting results of specific treatments. Results are presented in metric units. See “English Equivalents” section.

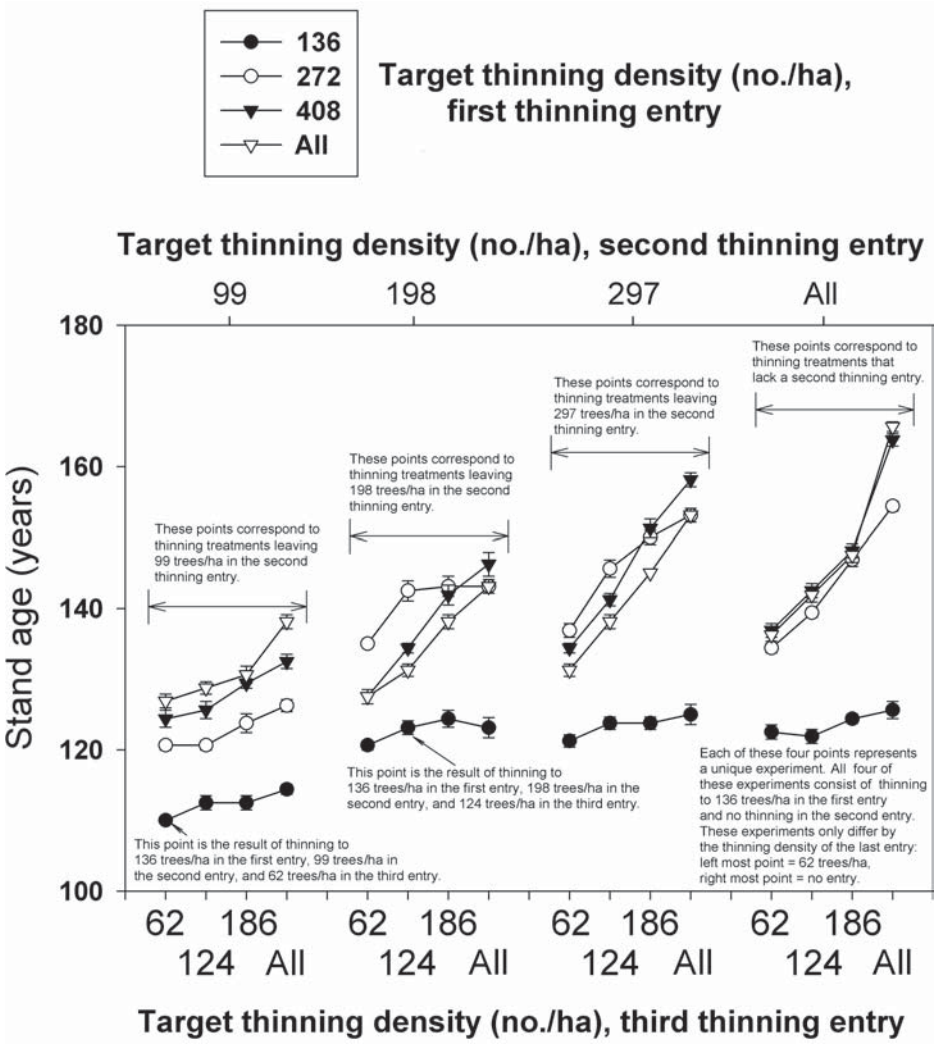

Figure 1—Example of the graphical scheme used to show results of simulation experiments. This example shows the stand age at which the large-bole criterion was satisfied for 64 different treatments. Thinning density of the first entry is represented by symbols (e.g., black dot, open dot, etc.). Thinning density of the second entry is noted across the top of the graph. Thinning density of the third entry is noted at the bottom of the graph. Points connected by a line represent similar thinning densities in the first and second entry, but each point corresponds to different thinning densities in the third entry. Each point is a mean (±1se) based on eight simulation replications.

Volume is presented in cubic meters. For context, approximate metric volume and Scribner board-foot (bd.-ft) equivalents for Douglas-fir are presented below:

50 cm d.b.h. = 2.5 m^3 or 380 bd. ft

100 cm d.b.h. = 15.5 m^3 or 2,730 bd. ft

150 cm d.b.h. = 41.9 m^3 or 7,450 bd. ft

Results

Two-Hundred-and-Sixty-Year Rotation Strategy

First-rotation experiments—

Live attributes—The amount of time to satisfy the large bole criterion was correlated with thinning densities of the first and last entry (fig. 2A). Thinning to 136 TPH at age 40 resulted in the development of 10 large boles per hectare 10 to 40 years sooner than other initial thinning densities. Accelerated development of large boles resulted from reduced competition among canopy and subcanopy stems. For instance, the 136-*-* treatments had 19-21 TPH >60 cm at stand age 60 compared to ca. 8, 5, and 4 for the 272-*-*, 408-*-*, and all-*-* treatments, respectively. By stand age 80, the 136-*-* treatments had up to twice the number of stems >60 cm d.b.h. compared to the other three initial thinning densities. Treatments starting with ≥272 TPH and thinning to similar densities at age 80 resulted in satisfying the large bole criterion at about the same time (fig. 2A). Regardless of initial thinning density, higher thinning densities in the second and third entries tended to increase the amount of time to satisfy the threshold level for large boles (fig. 2A).

Densities of large boles at the end of the rotation were generally related to thinning density of the first and last entries (fig. 2B). Initially thinning to 136 TPH promoted rapid development of large overstory stems (>100-cm d.b.h.), but over the long term, resulted in relatively lower densities of stems available to grow beyond 100-cm d.b.h. Initially thinning to 272 TPH favored growth of stems beyond the 60-cm diameter limit of subsequent thinning entries. The resulting density of stems >60 cm diameter led to slower development of large boles but afforded higher densities of stems exceeding 100 cm d.b.h. by age 260 compared to all other treatments (fig. 2B). Retaining more than 272 TPH in the initial entry restricted the number of stems exceeding the diameter limit of subsequent thins. This resulted in slower development of large boles and provided intermediate densities of stems available to exceed 100 cm d.b.h by age 260 compared to treatments starting with 136 and 272 TPH. Increasing the thinning density of the last entry generally decreased growth rates of stems but provided higher densities of stems exceeding 100 cm d.b.h. by age 260.

Developmental rate and long-term density of shade-tolerant stems exhibited a complex relation with thinning densities (figs. 2E and 2F). Thinning to 136 TPH at age 40 removed most of the existing shade-tolerant stems but promoted establishment and rapid development of species such as western hemlock (*Tsuga heterophylla* (Raf.) Sarg.), big-leaf maple (*Acer macrophyllum* Pursh), and western redcedar (*Thuja plicata* Donn ex D. Don). Initially thinning to ≥408 TPH retained more of the existing shade-tolerant stems that largely remained throughout the rotation. Treatments thinning to 272 TPH at age 40 retained fewer existing shade-tolerant stems compared to higher initial thinning densities and afforded lower recruitment rates compared to the 136-*-* treatments. The net result was relatively longer amounts of time for the shade-tolerant criterion to be satisfied when initially thinning to 272 TPH compared to most other initial thinning densities. Treatment effects on the density of shade-tolerant stems at age 260 were similarly related to retention levels of existing shade-tolerant stems and the promotion of natural recruitment (fig. 2F).

The stand age at which the CHDI criterion was satisfied and the long-term values of this metric mirrored the trends of the shade-tolerant stem criterion. An important exception was the more rapid development of CHDI without thinning (i.e., all-all-all) compared to about half of the other treatments (fig. 2C). This resulted from the relatively diverse structure of the initial stand used in these simulations. Other exceptions were

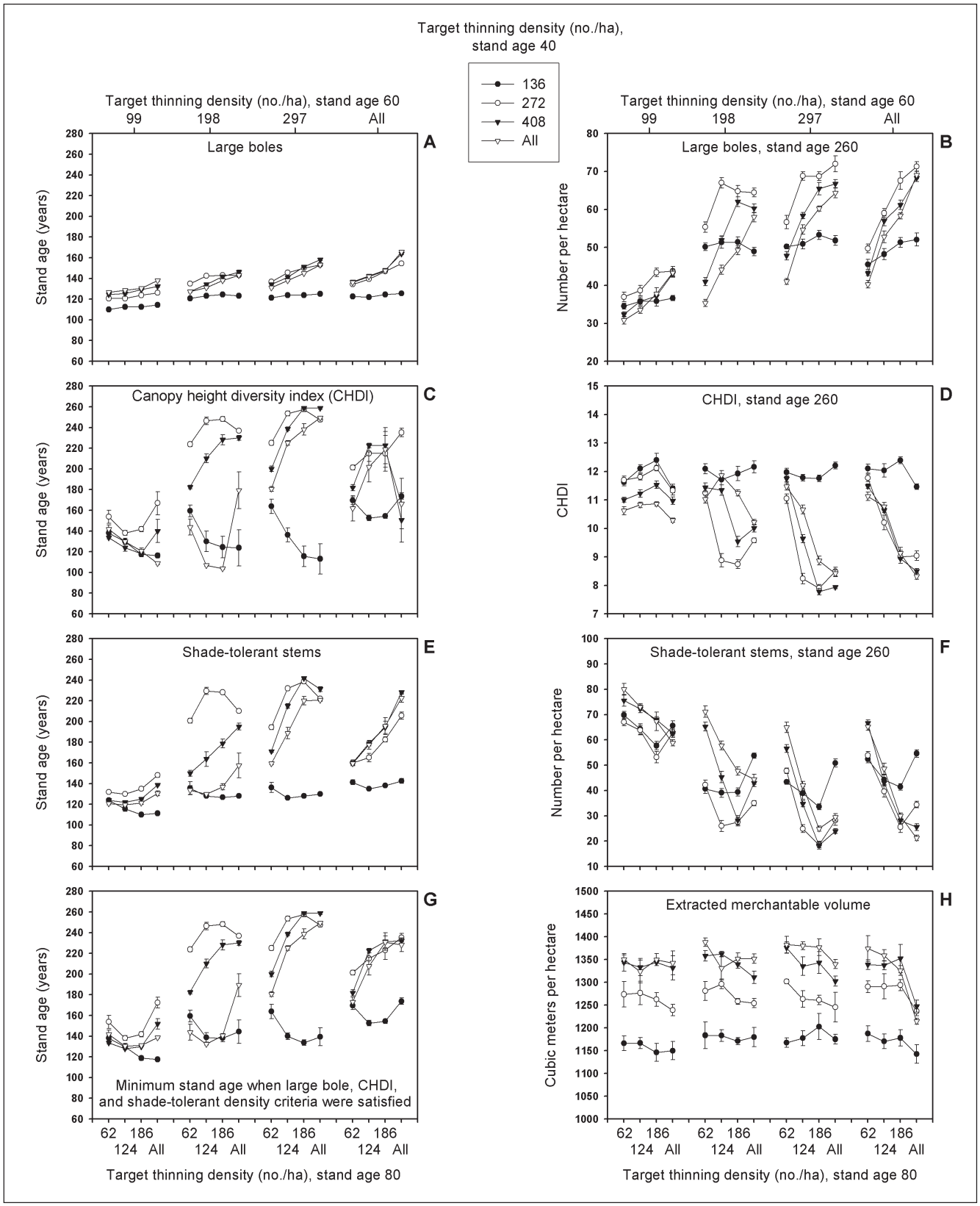

Figure 2—Stand age at which live, late-successional criteria were satisfied, extracted merchantable volume, and stand conditions at the end of the rotation for 64 experimental thinning treatments, 260-year rotation strategy (first rotation in table 2). Graphs on the left side show the mean (±1se) stand age when specific late-successional criteria were satisfied. Graphs on the right side show mean (±1se) values of criteria at age 260 prior to the rotation harvest; graph H is mean (±1se) merchantable volume extracted in thinning entries plus the rotation harvest at age 260. Graph I (on page 12) is mean (±1se) Douglas-fir basal area at age 260 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix table 9.

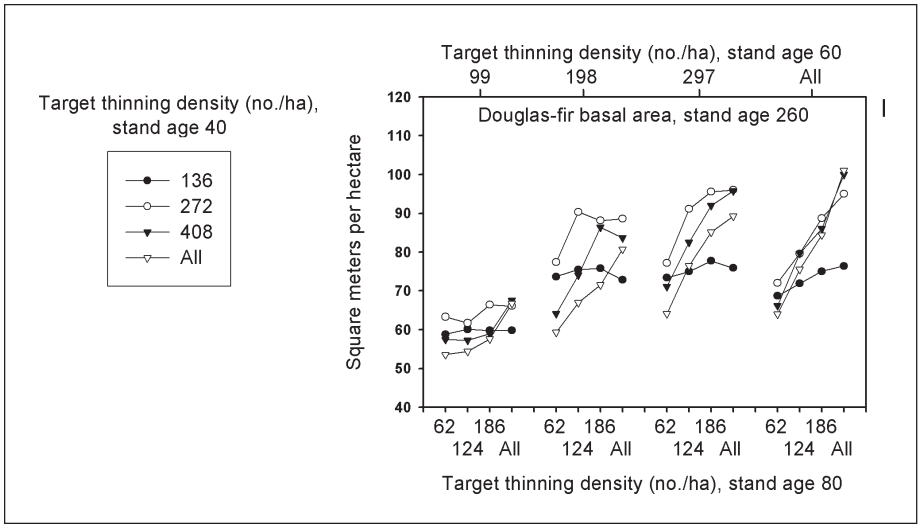

Figure 2 continued.

the tendency for the treatments initially thinning to 136 TPH to provide the highest CHDI value by stand age 260 and for all the treatments thinning to 62 TPH at age 80 to provide similar long-term values (fig. 2D).

Two general thinning strategies promoted rapid development of late-successional attributes. Strategies that satisfied live, late-successional conditions by age 117 to 120 created an open canopy at age 40, which facilitated development of large boles; intensively thinned at age 60, which increased growing space of the reinitiated tree understory; and limited thinning in the last entry, which preserved the existing vertical structure and species diversity (i.e., 136-99-186 and 136-99-all, fig. 2G). Attainment of live threshold levels by age 130 to 145 was achieved by retaining more than 40 percent of the original overstory density (≥272 TPH) and thinning to 99 TPH in the second entry and ≤186 TPH in the third entry (fig. 2G). Compared to not thinning at all (all-all-all, fig. 2G), these thinning strategies accelerated the development of live, late-successional criteria by about 100 years.

Extracted merchantable volume—Extracted merchantable volume increased with increasing thinning density in the first thinning entry but generally decreased with increasing thinning density at age 80 (fig. 2H). The 136-99-* treatments, which satisfied the live, late-successional criteria in the least amount of time, provided the least amount of extracted merchantable volume (fig. 2H). Treatments initially thinning to ≥272 TPH resulted in ca.100 to 200 m^3/ha more volume than treatments initially thinning to 136 TPH.

Dead wood—Natural recruitment of snags was related to thinning densities (fig. 3A). In general, the amount of time to satisfy the snag criterion decreased with decreasing thinning densities in the first entry. This was due to faster development of large boles at lower stem densities and thus a greater potential for recruitment of large snags. Also, the amount of time to satisfy this criterion decreased with increasing thinning densities in both the second and third entry. This simply reflected the tendency for more stems to die with increasing stem densities. Compared to the minimum time to satisfy the live, late-successional criteria, snags were a limiting factor only for the 408-99-62 and all-99-62 treatments. However, for these treatments, artificially creating

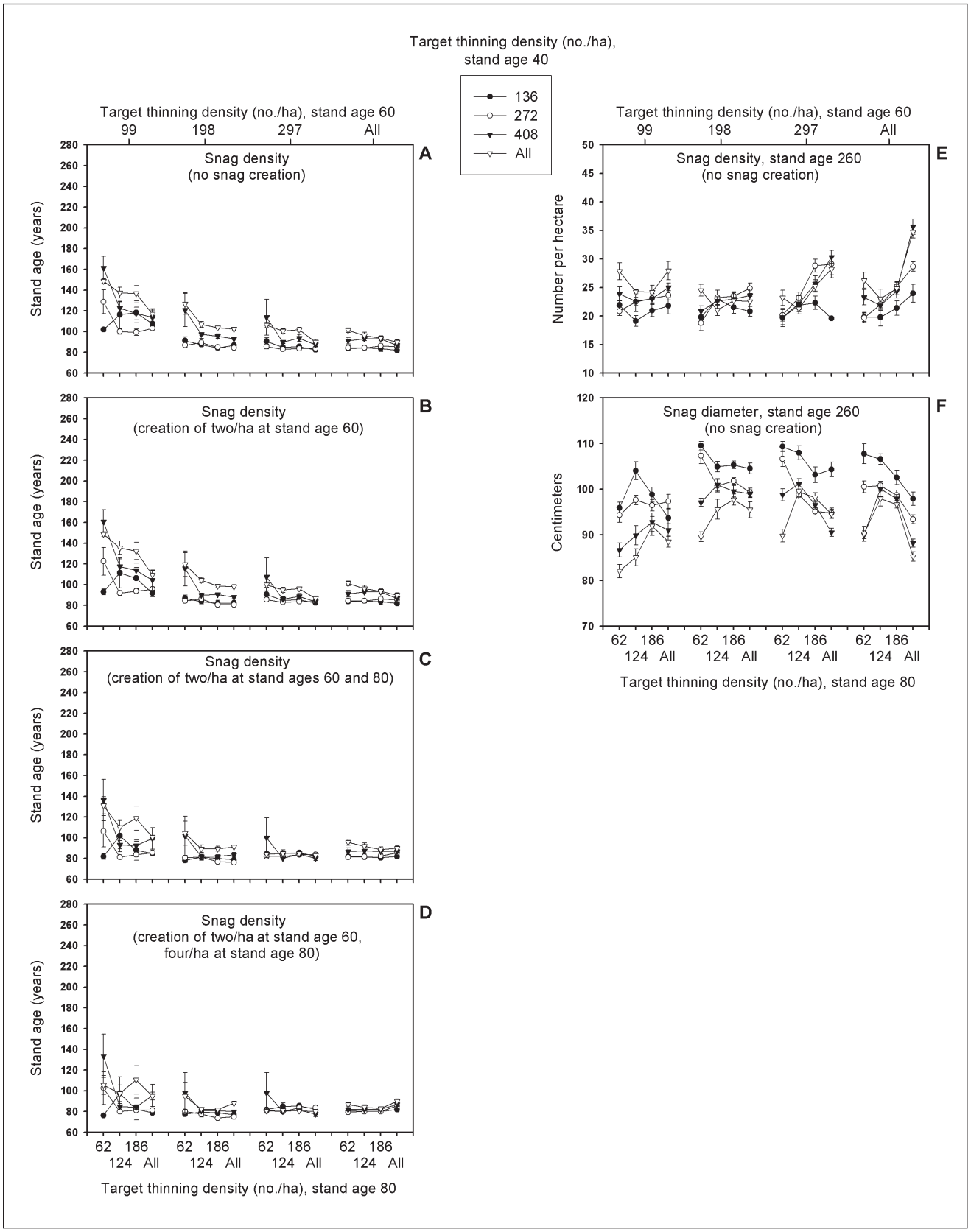

Figure 3—Stand age at which the snag criterion was satisfied, and density and size of snags (>50 centimeters diameter at breast height, >5 meters tall) at the end of the rotation for 64 experimental thinning treatments, 260-year rotation strategy (first rotation in table 2). Graphs on the left side show the mean (±1se) stand age when the snag criterion was satisfied for four different snag-creation scenarios. Snag density (E) and size (F) are means (±1se) at age 260 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix table 10.

two snags per hectare in the second and in the third entry was sufficient to satisfy the snag criterion (fig. 3C) at about the same time as the live criteria (fig. 2G). Enhancing snag densities only reduced extracted volume by 10 m^3/ha. Snag density at stand age 260 generally increased with increasing thinning density in the first entry and somewhat with increasing thinning density in the subsequent two thinning entries. This reflected the greater source of potential snags with increasing stem density. Artificially created snags had decayed or were <5 m tall owing to breakage by age 260. Thus, snag-creation schemes had little to no effect on density and mean d.b.h. of snags at least by the end of the rotation. Mean d.b.h. of snags at age 260 (fig. 3F) was inversely related to snag density (fig. 3E).

Developmental trends for log mass (fig. 4) were similar to those for snag density. Leaving fewer stems in the first entry but more subcanopy stems in the second and third entries generally resulted in faster accumulation of log mass (fig. 4A). Mean mass and large-end diameter of logs at age 260 varied little among the different snag-log creation strategies owing to decay and the long rotation interval. In general, mean log mass (fig. 4E) and log size (fig. 4F) at age 260 increased with increasing thinning density in the last entry.

Second-rotation experiments—Initial conditions for this rotation were derived from the 136-99-186 and 136-99-all first-rotation treatments, which provided the fastest development of late-successional attributes; the all-198-62 and all-297-124, which were the two top volume-producing treatments; and the 408-99-62 and 408-99-186 treatments, which had the highest combined rank for extracted volume and rate of attainment of late-successional conditions. Temporal trends of late-successional attributes for these six treatments are shown in figure 5. Stand conditions of five of these six treatments exhibited a high degree of convergence just prior to the end of the rotation. The exception was the all-297-124 treatment, which produced more large Douglas-fir boles and fewer shade-tolerant stems. Rotation-harvest treatments further homogenized stand conditions. The similarity among the six stands resulted in nearly identical thinning-treatment effects in the second rotation. The minimum time to satisfy the large bole, shade-tolerant, and CHDI criteria varied at most by 6 to 7 years for identical thinning treatments among the six initial stands; extracted volume only varied by 20 to 40 m^3/ha. Only treatment effects starting with stand conditions produced by the 136-99-186 first-rotation experiment are presented below (figs. 6 through 8).

Live attributes—Trends in treatment effects were generally similar between the two rotations. Thinning to 136 TPH in the first entry of the second rotation provided the most rapid development of large boles, vertical diversity, and shade-tolerant stem density (figs. 6A, 6C, and 6E). Thinning to 272-408 TPH in the first entry delayed the development of vertical structure and shade-tolerant stem density (figs. 6C and 6E). Not thinning until the second entry delayed development of large boles but resulted in satisfying the other live, late-successional criteria at about the same time as comparable 136-*-* treatments (figs. 6A, 6C, and 6E).

Developmental rates and long-term values of live attributes, however, differed between the first- and second-rotation simulations. For similar treatments, vertical structure and density of shade-tolerant stem criteria were satisfied sooner in the second rotation (compare figs. 2C and 2E with figs. 6C and 6E). Also, values of these attributes at the end of the second rotation were higher for most treatments (compare figs. 2D and 2F with figs. 6D and 6F). The retained canopy cover delayed development of large boles

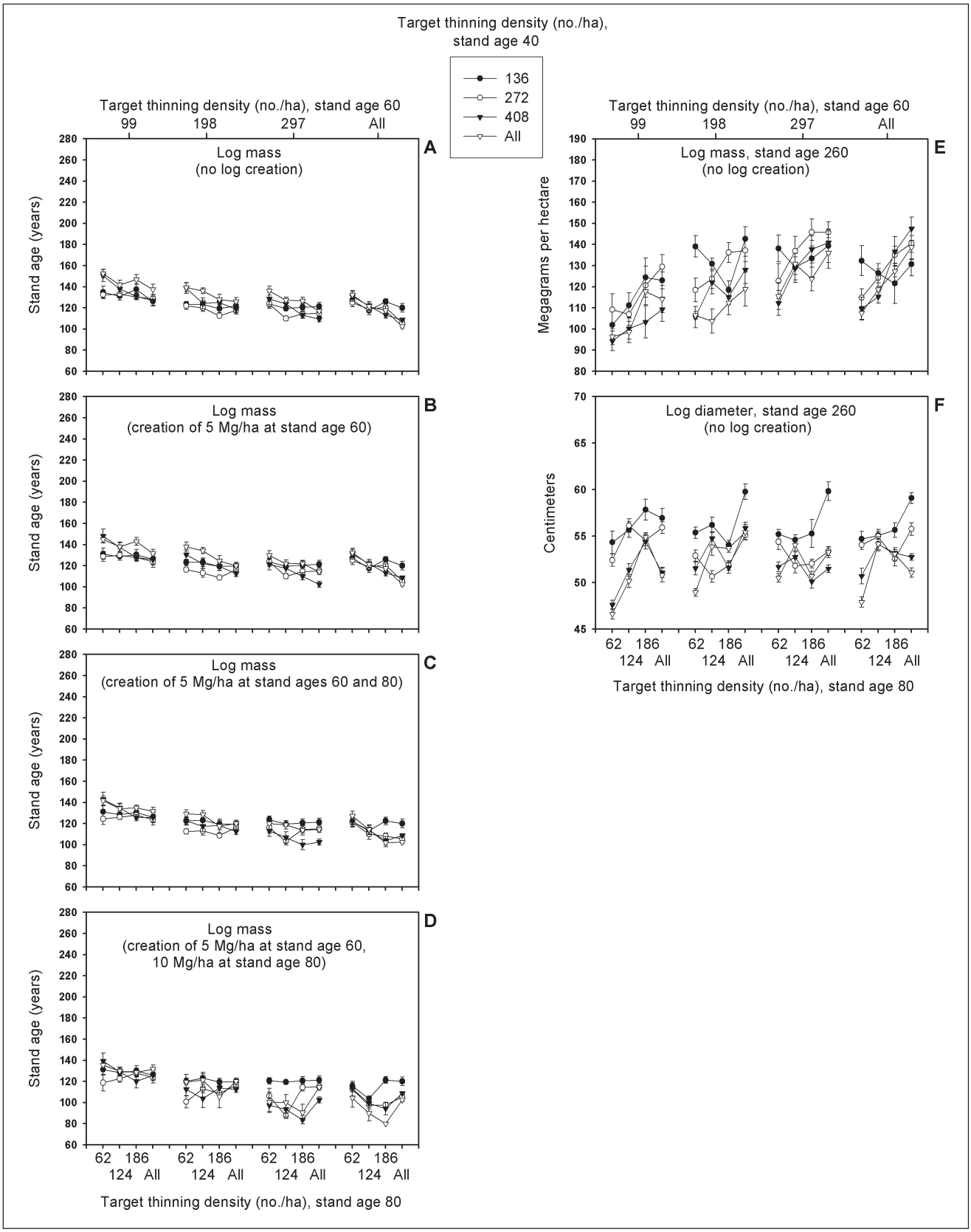

Figure 4—Stand age at which the log-mass criterion was satisfied, and mass and size of logs (>10 centimeters large-end diameter) at the end of the rotation for 64 experimental thinning treatments, 260-year rotation strategy (first rotation in table 2). Graphs on the left side show the mean (±1se) stand age when the log-mass criterion was satisfied for four different log-creation scenarios. Log mass (E) and size (F) are means (±1se) at age 260 prior to the rotation harvest. All values are based on scenarios without artificial creation of snags. Means are based on eight simulation replications. Data also are presented in appendix table 11.

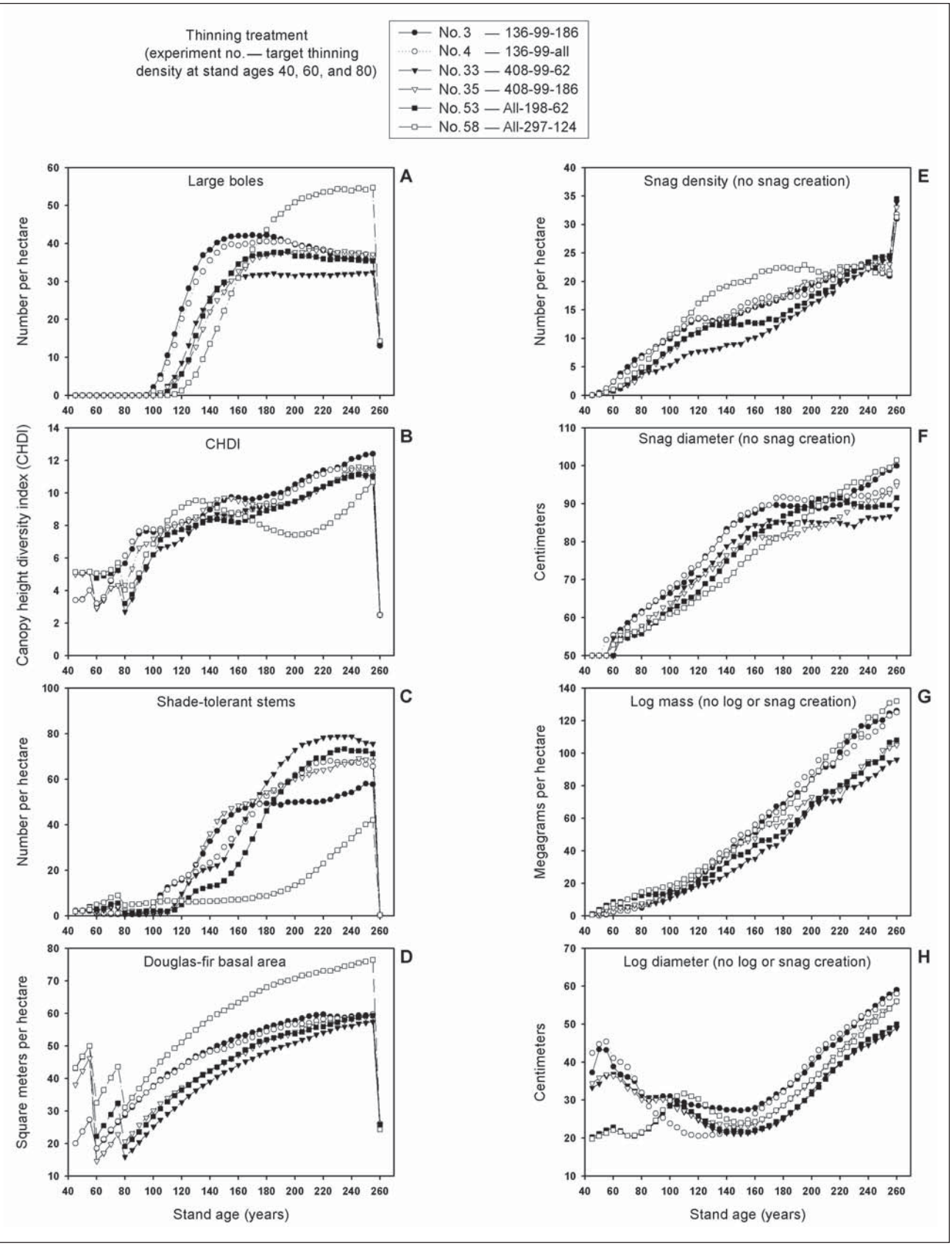

Figure 5—Temporal trends of selected attributes for the two thinning treatments providing the fastest development of late-successional attributes (experiment nos. 3 and 4), the two top volume producing treatments (experiment nos. 53 and 58), and the two treatments with the highest combined rank for rate of attainment of late-successional conditions and extracted volume (exp. nos. 33 and 35); 260-year rotation strategy (first rotation in table 2). All values are means based on eight simulation replications.

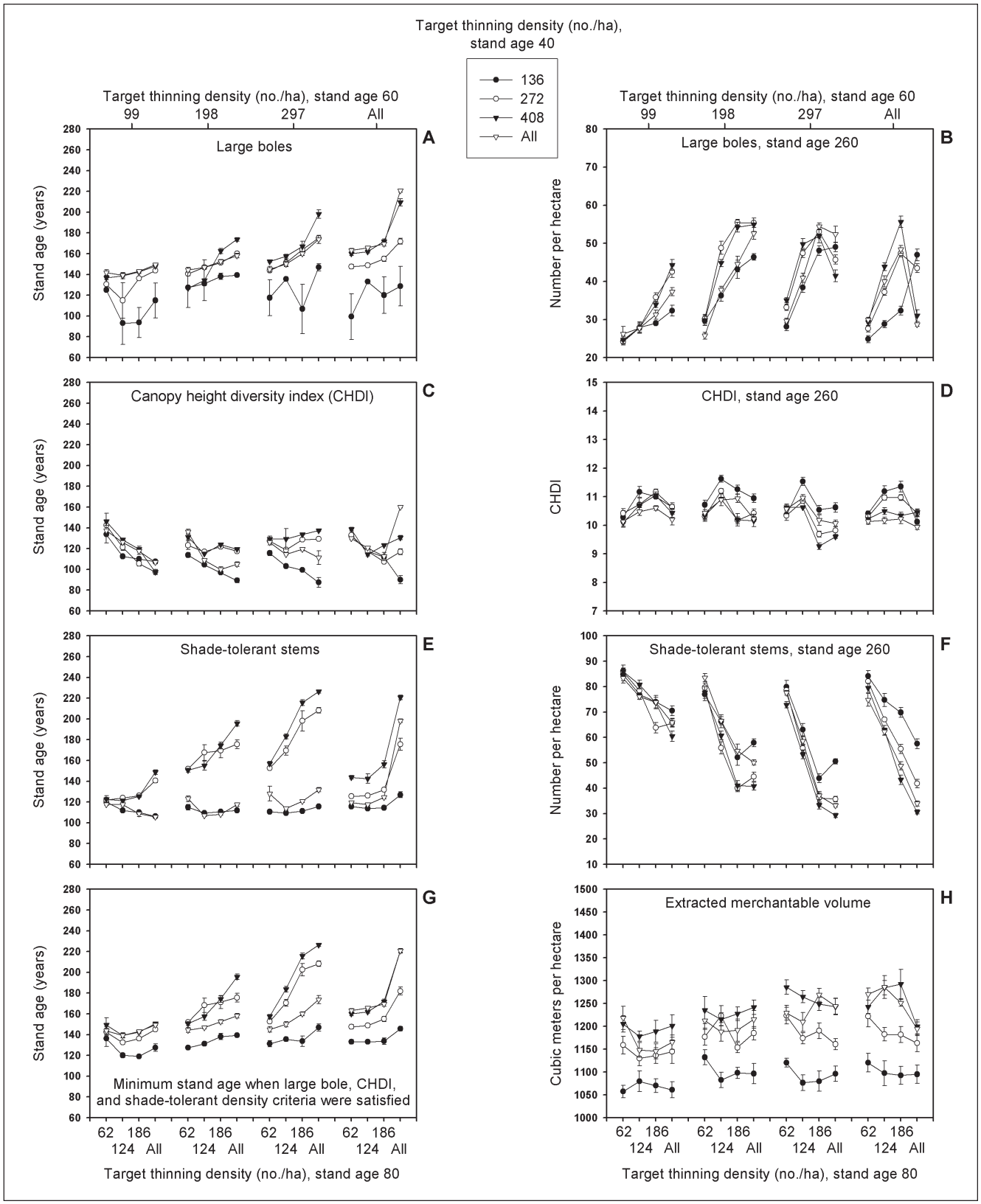

Figure 6—Stand age at which live, late-successional criteria were satisfied, extracted merchantable volume, and stand conditions at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 260-year rotation strategy (second rotation in table 2). Graphs on the left side show the mean (±1se) stand age when specific late-successional criteria were satisfied. Graphs on the right side show mean (±1se) values of criteria at age 260 prior to the rotation harvest; graph H is mean (±1se) merchantable volume extracted in thinning entries plus the rotation harvest at age 260. Graph I (on page 18) is mean (±1se) Douglas-fir basal area at age 260 prior to the final harvest. Means are based on eight simulation replications. Data also are presented in appendix table 12.

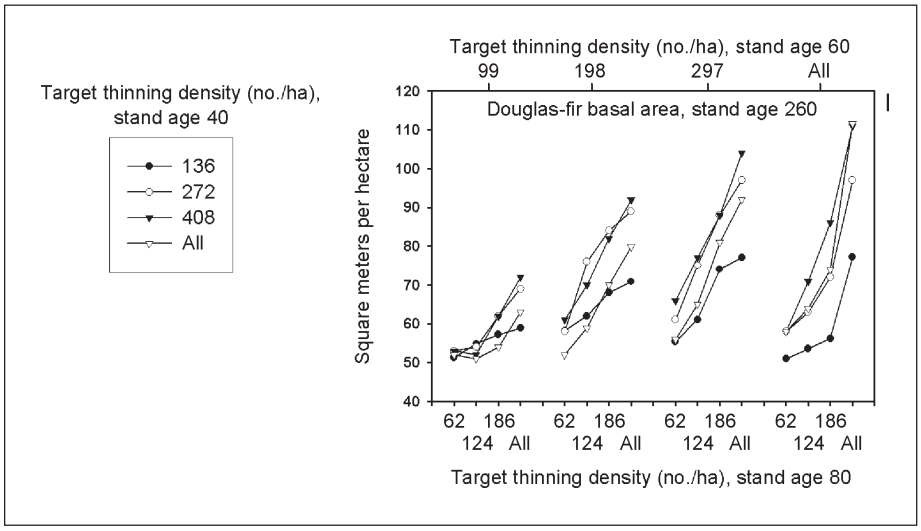

Figure 6 continued.

in all treatments except for most of the 136-*-* treatments (compare fig. 2A with fig. 6A). Densities of large boles at the end of the second rotation were lower compared to the first rotation (compare fig. 2B with fig. 6B). Despite these differences, thinning to 136 TPH in the first entry, 99 TPH in the second entry, and 124-186 TPH in the last entry provided the fastest attainment of live, late-successional threshold levels in both rotations (figs. 2G and 6G).

Extracted merchantable volume—Similar to the first-rotation experiments, extracted volume increased with increasing thinning density in the first and second entries, and somewhat decreased with increasing thinning density in the last entry (fig. 6H). For similar target thinning densities, extracted volumes, however, were about 100 to 150 m^3/ha lower in the second rotation compared to the first rotation (compare fig. 2H to fig. 6H). This reduction in volume reflected reduced growth rates and stem sizes owing to the residual overstory of the initial stand.

Dead wood—The stand age at which the snag density criterion was satisfied was more variable in the second (fig. 7) than in the first rotation (fig. 3). Although the initial stands of the second rotation had 30 to 40 snags per hectare, breakage and decay substantially reduced the density of the residual cohort over the long term. Artificial snag recruitment was important for maintaining snag densities when thinning to 62 TPH in the last entry or 99 TPH in the second entry (fig. 7A). These thinning treatments resulted in lower rates of natural mortality of large boles and required the artificial creation of two to four snags per hectare (figs. 7B through 7D) to satisfy the snag criterion at about the same time as live criteria (fig. 6G). Trends in long-term density and mean size of snags among treatments were, however, somewhat similar to those of the first rotation (compare figs. 3E and 3F with figs. 7E and 7F).

Log mass at the beginning and throughout the second rotation exceeded the corresponding threshold level (fig. 8A). Mass and mean large-end diameter of logs at the end of the rotation generally increased with increasing thinning density in the last entry (figs. 8B and 8C), reflecting higher mortality rates with increasing stem densities.

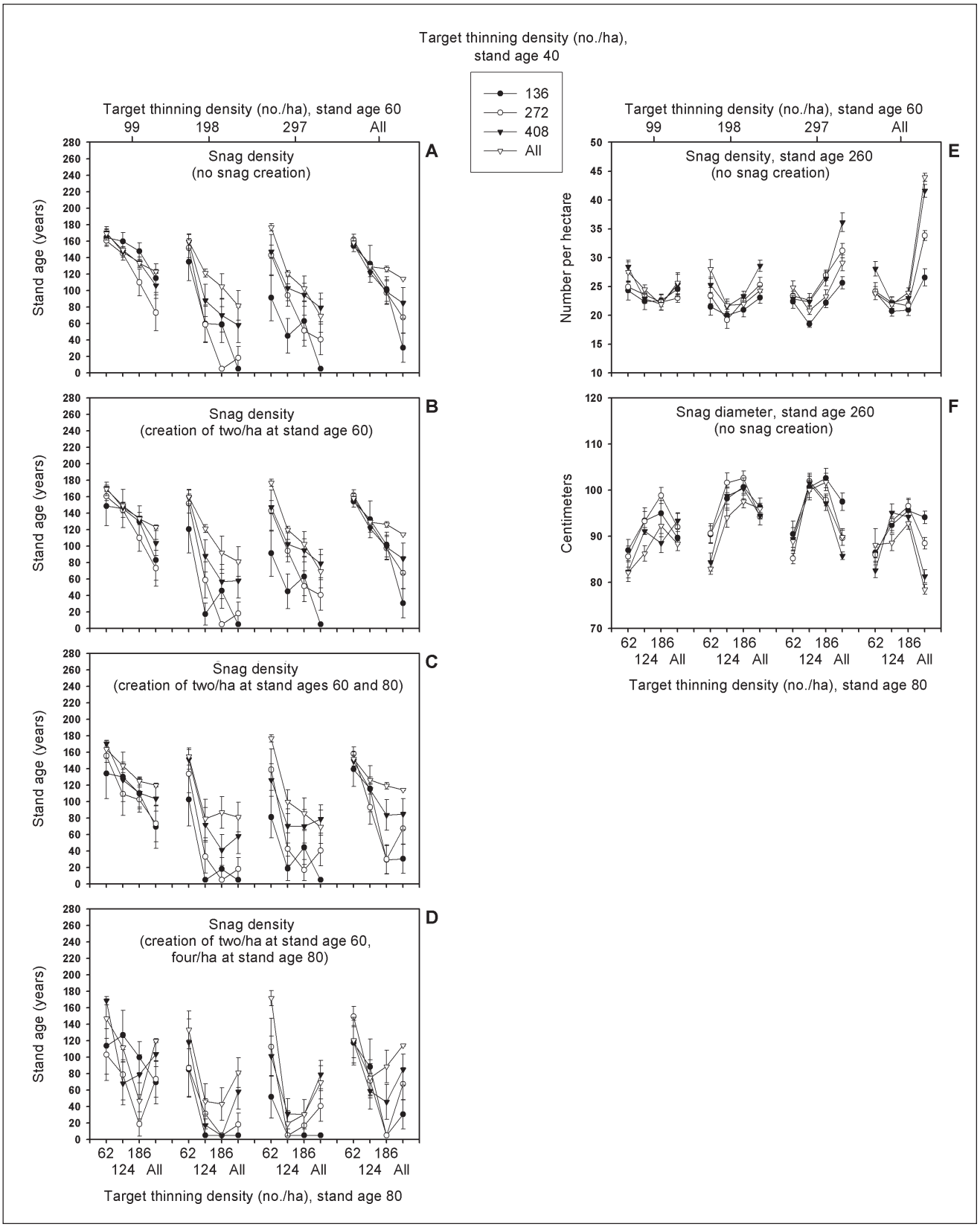

Figure 7—Stand age at which the snag criterion was satisfied, and density and size of snags (>50 centimeters d.b.h., >5 meters tall) at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 260-year rotation strategy (second rotation in table 2). Graphs on the left side show the mean (±1se) stand age when the snag criterion was satisfied for four snag-creation scenarios. Snag density (E) and size (F) are means (±1se) at age 260 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix table 13.

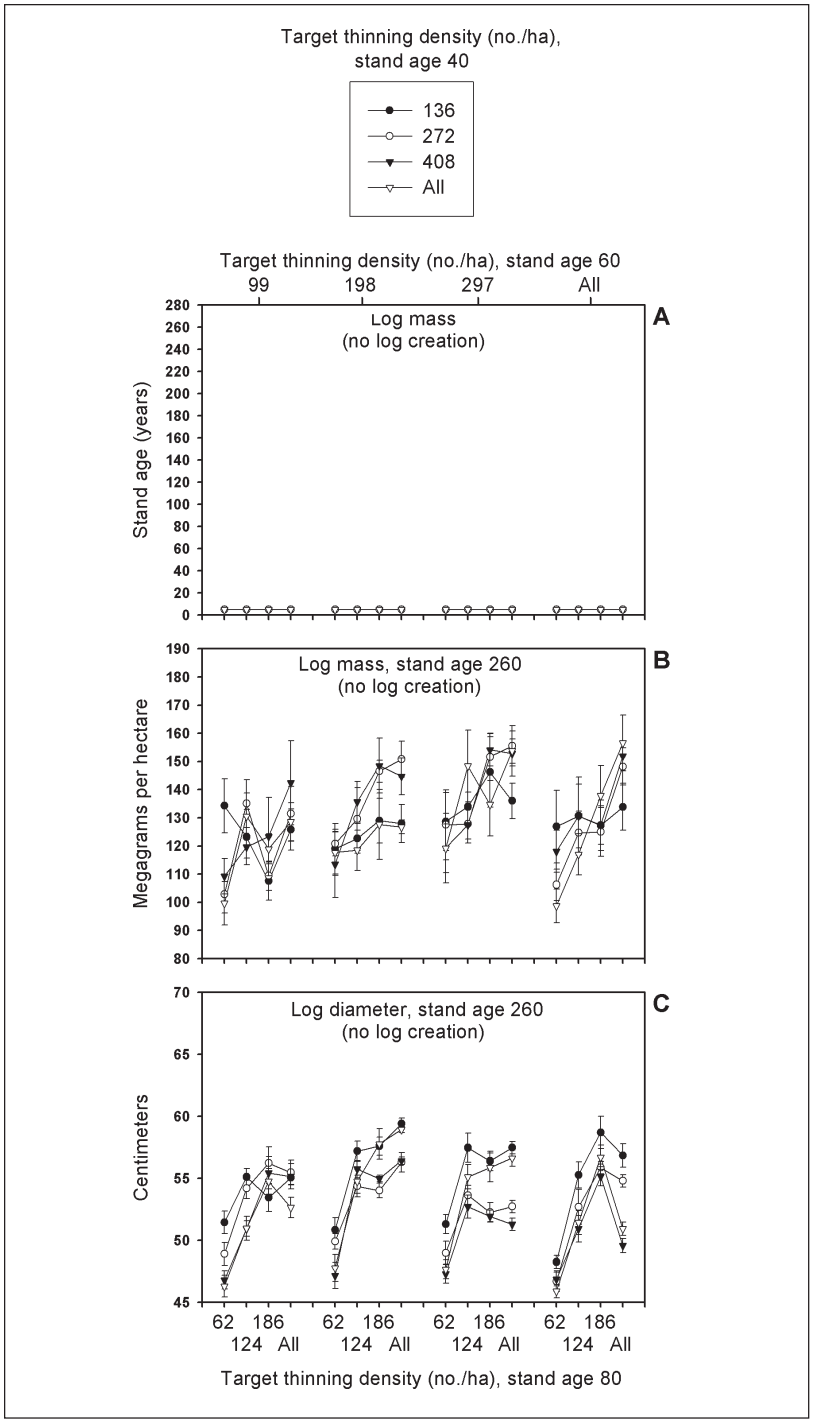

Figure 8—Stand age at which the log-mass criterion was satisfied, and mass and size of logs (>10 centimeters large-end diameter) at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 260-year rotation strategy (second rotation in table 2). Graph A is stand age when log-mass criterion was satisfied. Log mass (B) and size (C) are means (±1se) at age 260 prior to the rotation harvest. All values are based on scenarios without artificial creation of snags. Means are based on eight simulation replications. Data also are presented in appendix table 14.

One-Hundred-and-Eighty-Year Rotation Strategy

First-rotation experiments—

Live attributes—Developmental rates of live, late-successional attributes were identical to the experiments of the 260-year rotation (see figs. 2A, 2C, 2E, and 2G). However, given the shorter rotation, half of the treatments failed to satisfy the live criteria by the end of the 180-year rotation (fig. 9E), owing to insufficient vertical diversity (fig. 9B) or density of shade-tolerant stems (fig. 9C). Treatments satisfying the live criteria by the end of the rotation were those that initially thinned to 136 TPH or thinned to 99 TPH in the second entry (fig. 2G).

Extracted merchantable volume—Similar to extracted volume in the 260-year first-rotation experiments, initially thinning to 136 TPH produced 100 to 150 m^3/ha less volume than treatments initiated with more stems (fig. 9F). However, volume generally increased with increasing thinning density. Also, similar levels of extracted volume were produced among treatments initially thinning to ≥272 TPH and with similar thinning densities at age 80.

Dead wood—Treatment effects on snag and log attributes were similar to those for the 260-year experiments (compare figs. 3E and 3F and figs. 10A and 10B; figs. 4E and 4F and figs.10C and 10D). However, mean snag density and log mass were up to one-half as much at the end of the 180-year rotation compared to the 260-year rotation experiments.

Second-rotation experiments—Initial conditions for this rotation were derived from the 136-99-186 and 136-99-all first-rotation treatments, which provided the fastest development of late-successional attributes; the 408-297-186 and all-297-186 treatments, which were the two top volume-producing treatments; and the all-198-186 and 408-99-186 treatments, which had the highest combined rank for extracted volume and rate of attainment of late-successional conditions. Temporal traces of attributes for these six treatments are shown in figure 11. The six stands used as initial conditions in the second rotation were fairly similar owing to the homogenizing effect of the canopy-retention treatment of the rotation harvest. Because of this similarity, treatment effects were almost identical among the six stands. Only the results for the stand created from the all-297-186 first-rotation treatment are illustrated (figs. 12 and 13).

Live attributes—The retention of 30-percent canopy cover at the end of the first rotation substantially influenced thinning-treatment effects. The density of large boles retained at the end of the first rotation and the continual recruitment of large boles from the residual cohort resulted in satisfying the large-bole criterion over the course of the second rotation (fig. 12A). Densities of large boles at the end of the second rotation were similar among treatments (fig. 12B) and generally considerably lower than corresponding treatments in the first rotation (compare to fig. 9A). This reflected decreased growth rates owing to the residual overstory. The residual overstory, however, favored rapid development of shade-tolerant stems (compare figs. 2E and 12E) and vertical structure (compare figs. 2C and 12C). The most rapid attainment of threshold levels of live attributes was about 30 years sooner in the second- than in the first-rotation experiments (compare figs. 9E and 12G); however, treatments providing this rapid development differed. With exceptions, treatments of the second-rotation experiments that delayed thinning until the second entry satisfied the live, late-successional criteria in the shortest amount of time (fig. 12G). Skipping the first thinning entry essentially allowed a greater proportion of existing shade-tolerant stems to exceed the 60-cm diameter limit and led to higher densities of these species (fig. 12E).

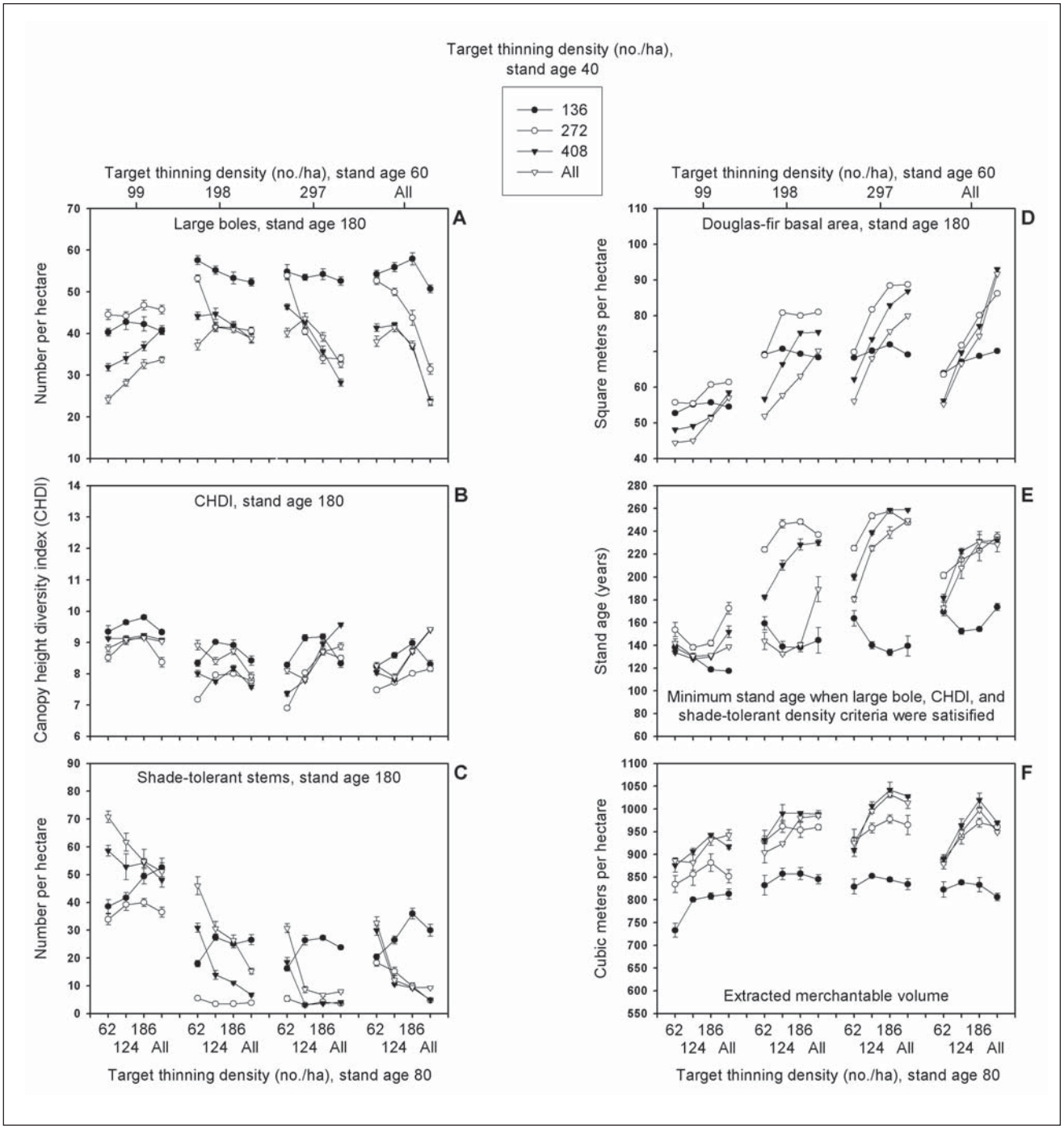

Figure 9—Stand conditions and extracted merchantable volume at the end of the rotation for 64 experimental thinning treatments, 180-year rotation strategy (first rotation in table 3). Graphs A through C are means (±1se) of late-successional attributes at age 180 prior to the rotation harvest. Graph D is mean (±1se) Douglas-fir basal area at age 180 prior to the rotation harvest. Graph E is the stand age at which all three live, late-successional criteria were satisfied and is from the 260-year rotation experiments (fig. 2H). Values >180 years indicate that criteria were not satisfied by the end of the 180-year rotation. Graph F is the mean (±1se) merchantable volume extracted in thinning entries plus the rotation harvest at age 180. Means are based on eight simulation replications. Data also are presented in appendix table 15.

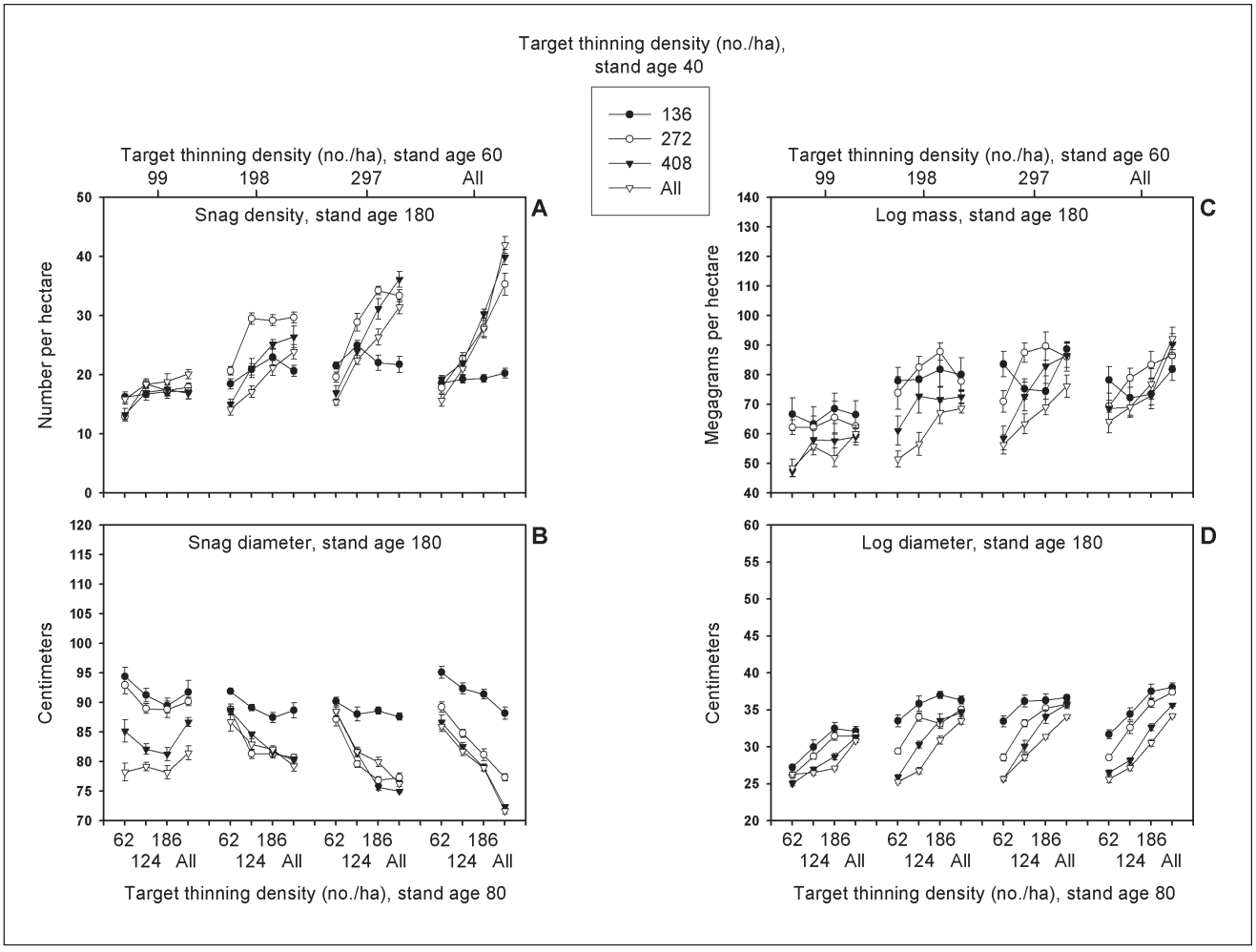

Figure 10—Density and size of snags (>50 centimeters d.b.h., >5 meters tall), and mass and size of logs (>10 centimeter large-end diameter) at the end of the rotation for 64 experimental thinning treatments, 180-year rotation strategy (first rotation in table 3). Snag and log measures are means (±1se) of naturally recruited dead wood at age 180 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix tables 16 and 17.

Extracted merchantable volume—Similar to the first rotation, thinning to 136 TPH at age 40 provided the least amount of volume (fig. 12H). Lower growth rates under the residual canopy resulted in ca. 100 to 300 m^3/ha less volume in the second (fig. 12H) compared to the first rotation (fig. 9F) for similar thinning treatments.

Dead wood—Treatments providing the most rapid attainment of live, late-successional conditions (i.e., all-≤297-≥186) required artificial creation of up to six snags per hectare to satisfy the snag criterion at about the same time as the live criteria (figs. 13A through 13D). Thinning to 99 TPH at stand age 60 or to 62 TPH at age 80 tended to delay the development of large snags (figs. 13A through 13D). Mean density and d.b.h. of snags at the end of the second rotation were linearly related to thinning density. Increasing thinning density resulted in more but smaller snags (figs. 13E and 13F).

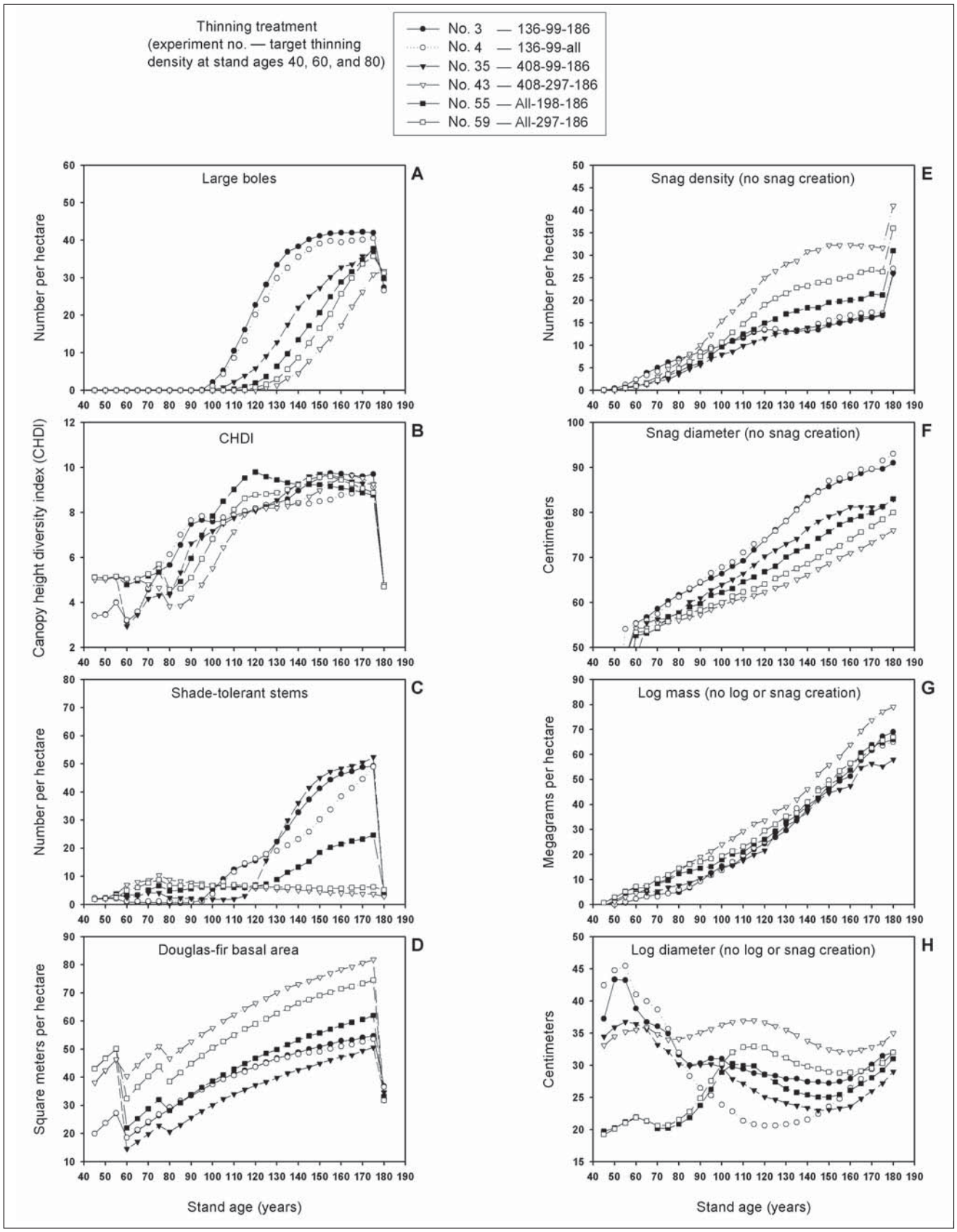

Figure 11—Temporal trends of selected attributes for the two thinning treatments providing the fastest development of late-successional attributes (experiment nos. 3 and 4), the two top volume producing treatments (exp. nos. 43 and 59), and the two treatments with the highest combined rank for rate of attainment of late-successional conditions and extracted volume (experiment nos. 35 and 55), 180-year rotation strategy (first rotation in table 3). All values are means based on eight simulation replications.

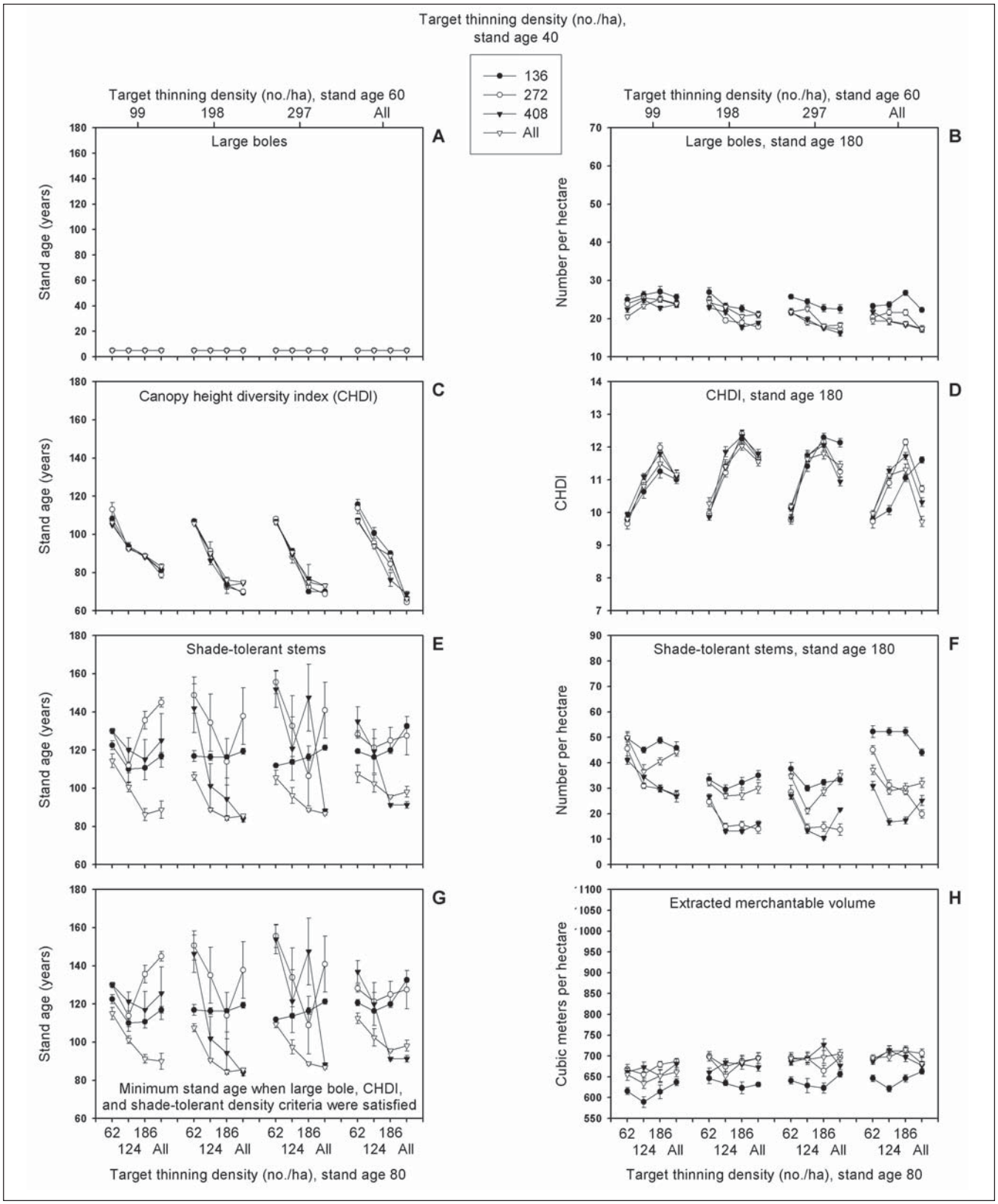

Figure 12—Stand age at which live, late-successional criteria were satisfied, extracted merchantable volume, and stand conditions at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the all-297-186 first-rotation treatment, 180-year rotation strategy (second rotation in table 3). Graphs on the left side show the mean (±1se) stand age when specific late-successional criteria were satisfied. Graphs on the right side show mean (±1se) values of criteria at age 180 prior to the rotation harvest; graph H is the mean (±1se) merchantable volume extracted in thinning entries plus the rotation harvest at age 180. Graph I is mean (±1se) Douglas-fir basal area at age 180 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix table 18.

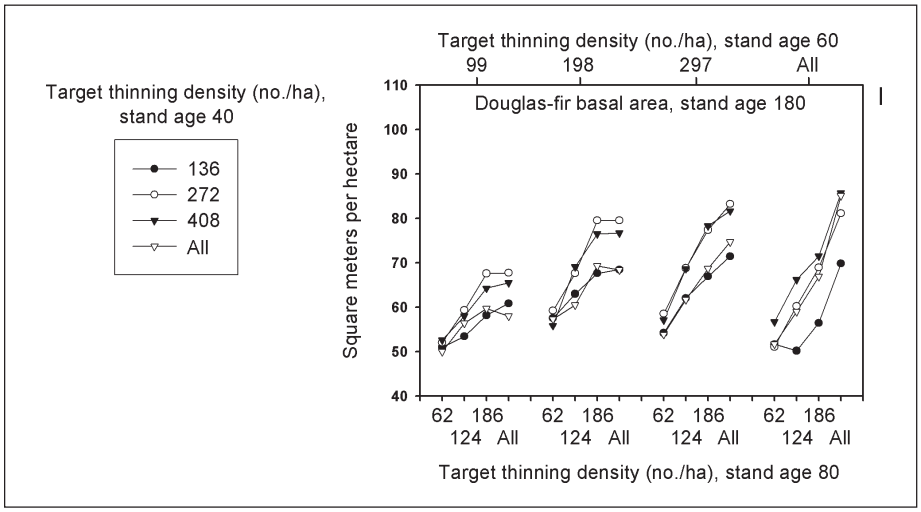

Figure 12 continued.

The log-mass criterion was satisfied from the start of the second rotation, owing to high log densities at the end of the first rotation and continued recruitment throughout the second rotation (fig. 14A). Mean log mass at the end of the second rotation was fairly similar among treatments (fig. 14B), but mean log size slightly increased with increasing thinning densities (fig. 14C).

One-Hundred-Year-Rotation Strategy

First-rotation experiments—

Live attributes—The relatively short rotation limited the attainment of late-successional conditions. Only the 136-99-* treatments resulted in an appreciable number of large boles by age 100 (fig. 15A). Thinning to 136 TPH in the first entry promoted vertical differentiation (fig. 15B) but at the expense of shade-tolerant stem densities (fig. 15C). Increasing thinning densities in the last entry generally decreased development of vertical layers but increased shade-tolerant stem densities. No treatments satisfied all the live late-successional criteria by stand age 100 (fig. 15E). The 136-99-* treatments resulted in the highest LSI owing to the heavier weighting of large boles (fig. 15E). For all other treatments, the LSI score increased with increasing thinning densities in the last entry owing to increasing densities of shade-tolerant stems.

Extracted merchantable volume—Trends in extracted merchantable volume among treatments (fig. 15F) were analogous to those of the 180-year first-rotation experiments (fig. 9F). The 136-*-* treatments provided the least amount; other treatments resulted in similar amounts of extracted volume.

Dead wood—Most treatments required some artificial creation of snags to satisfy the snag criterion by age 100 (figs. 16A through 16D). However, the snag creation for the 136-99-* treatments, which produced the highest LSI values, generally was satisfied by age 100 without artificial supplements (fig. 16A). Mean snag size at age 100 decreased with increasing thinning density (fig. 16E). Log mass tended to be limiting (fig. 17A). Even with the addition of 15 Mg/ha of logs, the log-mass threshold level could not be satisfied by age 100 in the heavy thinning regimes (e.g., 136-*-* and *-99-* treatments) (fig. 17D).

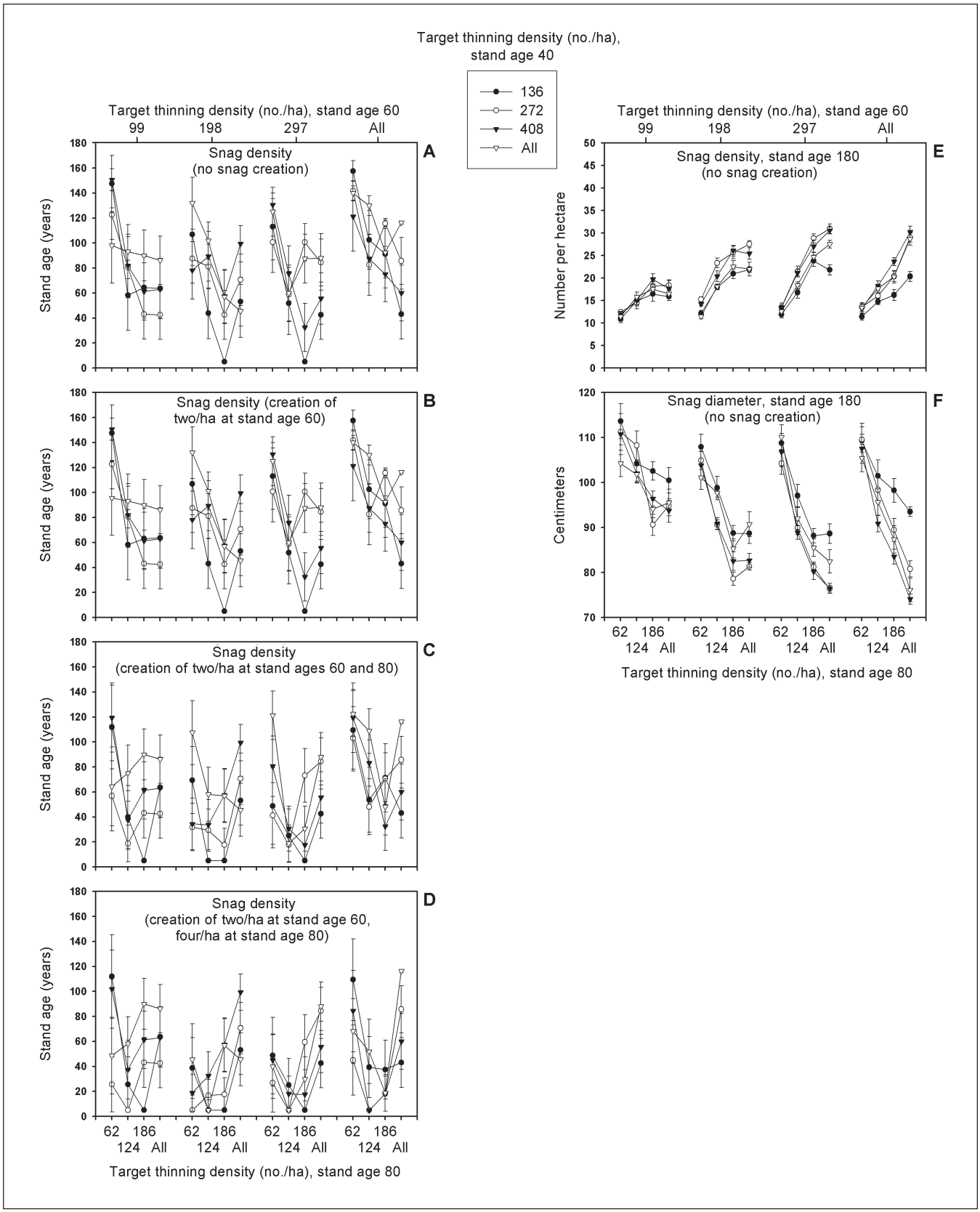

Figure 13—Stand age at which the snag criterion was satisfied, and density and size of snags (>50 centimeters d.b.h., >5 meters tall) at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the all-297-186 first-rotation treatment, 180-year rotation strategy (second rotation in table 3). Graphs on the left side show the mean (±1se) stand age when the snag criterion was satisfied for four snag-creation scenarios. Snag density (E) and size (F) are means (±1se) at age 180 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix table 19.

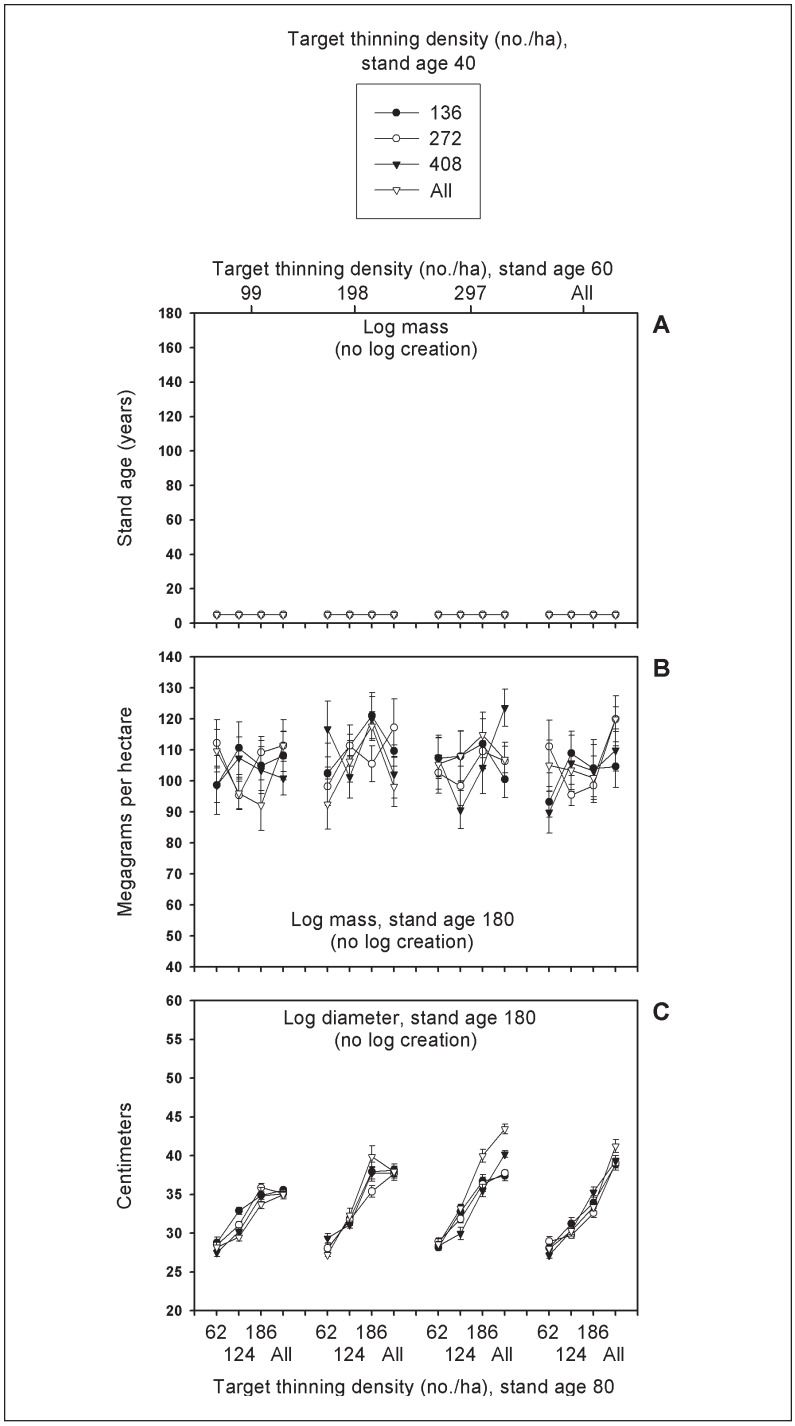

Figure 14—Stand age at which the log-mass criterion was satisfied, and mass and size of logs (>10 centimeter large-end diameter) at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the all-297-186 first-rotation treatment, 180-year rotation strategy (second rotation in table 3). Graph A is stand age when log-mass criterion was satisfied. Log mass (B) and size (C) are means (±1se) at age 180 prior to the rotation harvest. All values are based on scenarios without artificial creation of snags. Means are based on eight simulation replications. Data also are presented in appendix table 20.

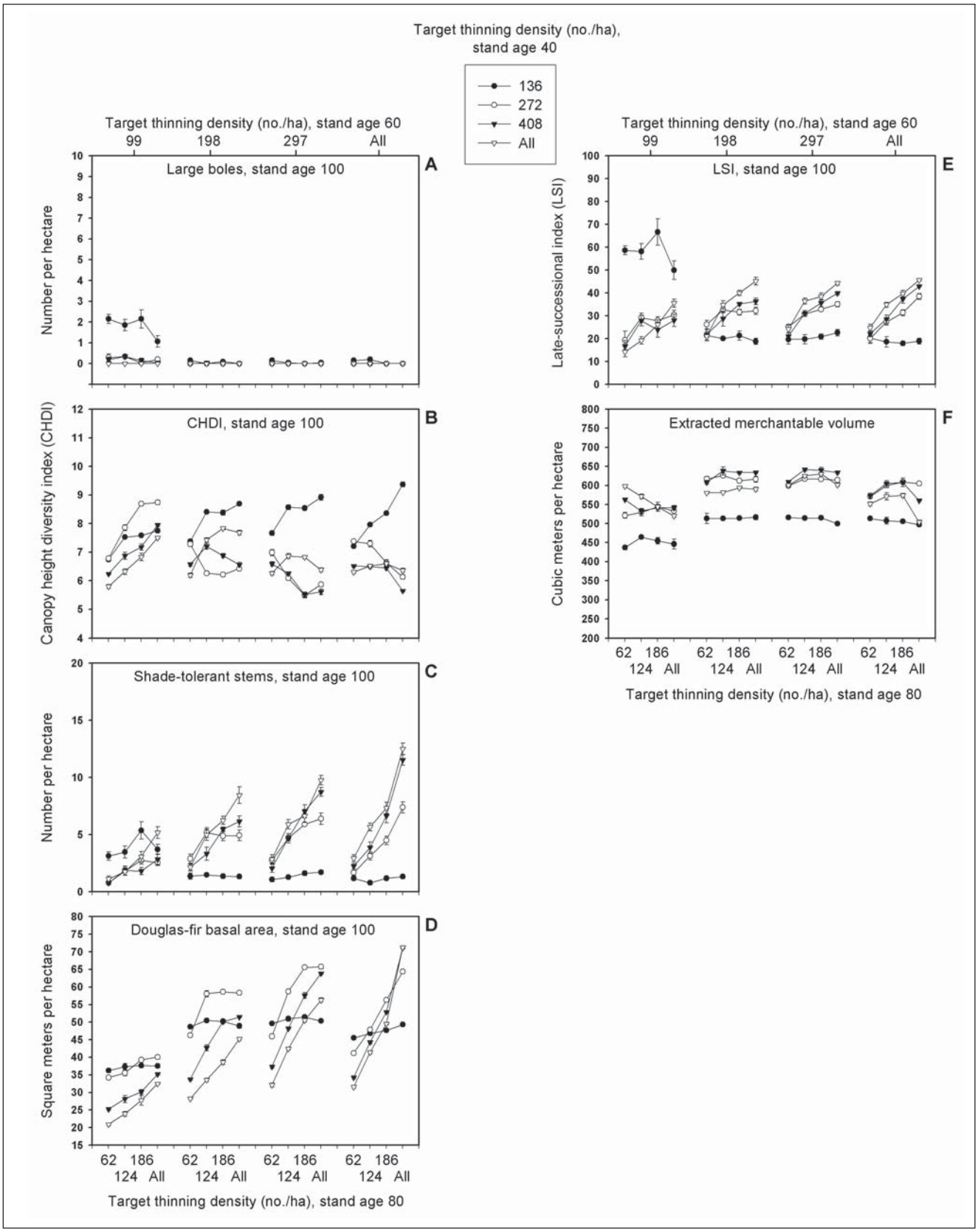

Figure 15—Stand conditions and extracted merchantable volume at the end of the rotation for 64 experimental thinning treatments, 100-year rotation strategy (first rotation in table 4). Graphs A through C are means (±1se) of late-successional criteria at age 100 prior to the rotation harvest. Graph D is mean (±1se) Douglas-fir basal area at age 100 prior to the rotation harvest. Graph E is mean (±1se) late-successional index at age 100 prior to the rotation harvest. Graph F is mean (±1se) merchantable volume extracted in thinning entries plus the rotation harvest at age 100. Means are based on eight simulation replications. Data also are presented in appendix table 21.

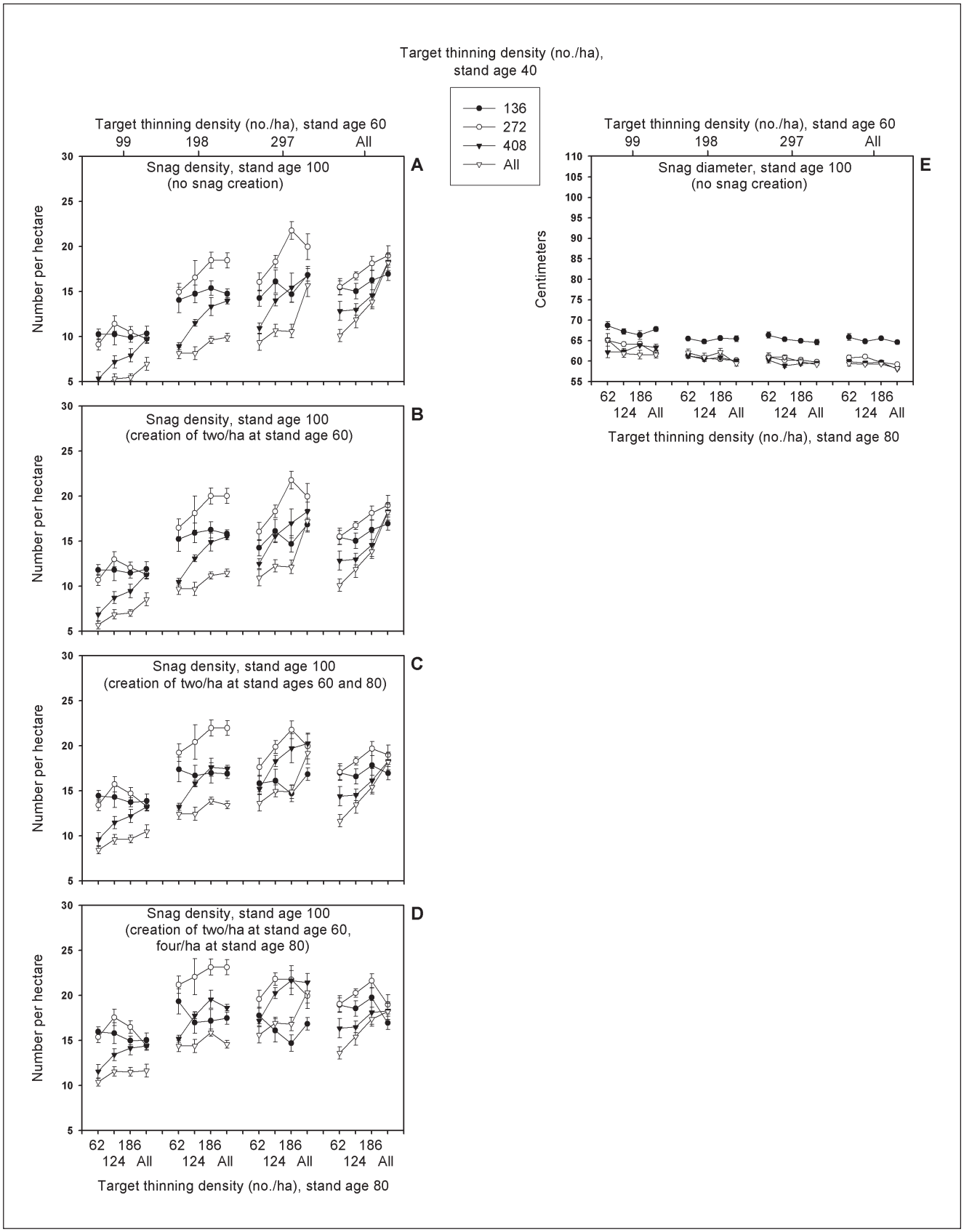

Figure 16—Density and size of snags (>50 centimeters d.b.h., >5 meters tall) at the end of the rotation for 64 experimental thinning treatments, 100-year rotation strategy (first rotation in table 4). Graphs A through D are mean (±1se) densities at age 100 prior to the rotation harvest for four snag-creation scenarios. Graph E is mean (±1se) size of snags at age 100 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix table 22.

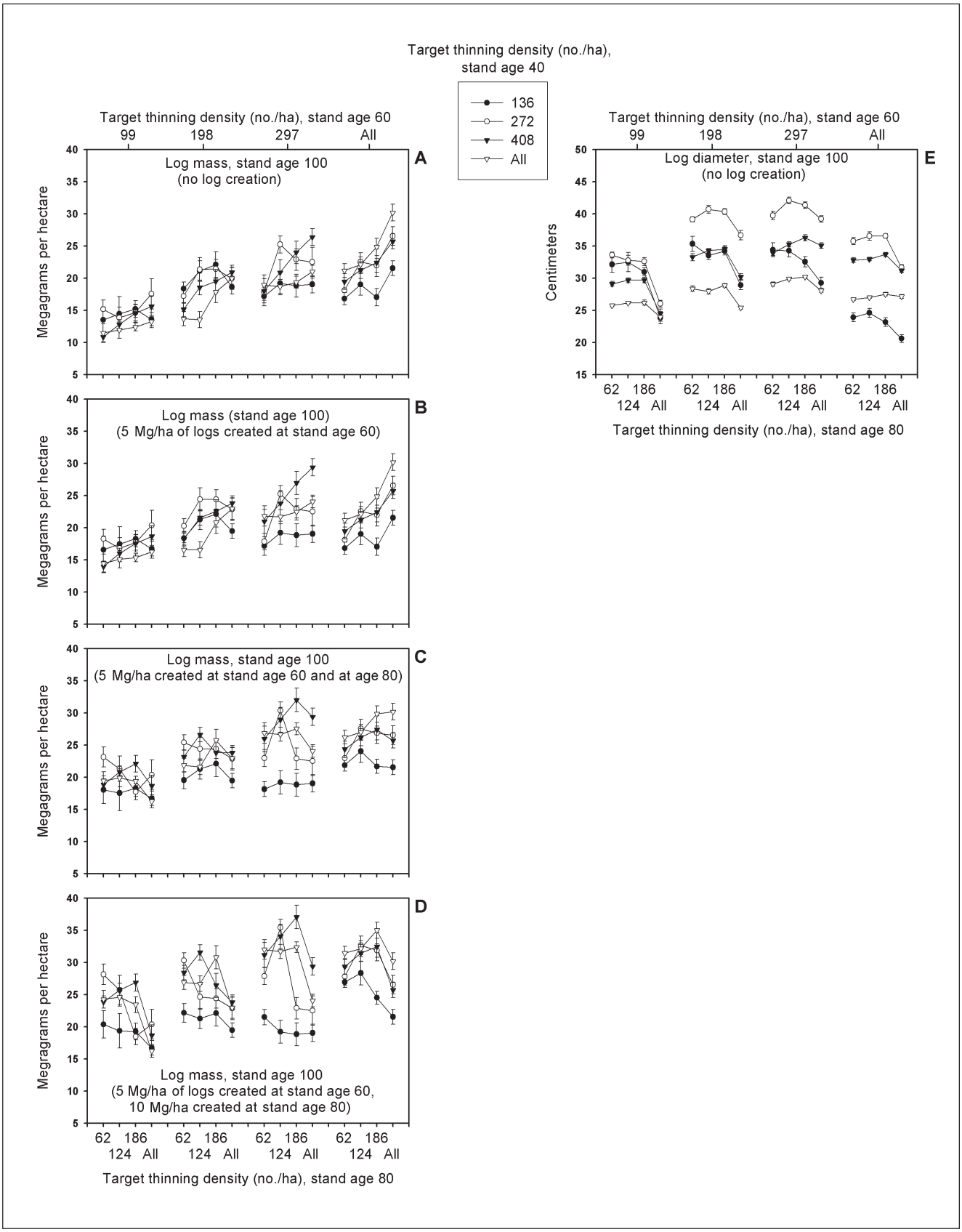

Figure 17—Mass and size of logs (>10 centimeters large-end diameter) at the end of the rotation for 64 experimental thinning treatments, 100-year rotation strategy (first rotation in table 4). Graphs A through D are mean (±1se) mass at age 100 prior to the rotation harvest for four log-creation scenarios. Graph E is mean (±1se) size of logs at age 100 prior to the rotation harvest. All values are based on scenarios without artificial creation of snags. Means are based on eight simulation replications. Data also are presented in appendix table 23.

Table 7—Stand structure after the rotation harvest of the 6 first-rotation treatments used in the second-rotation experiments, 100-year rotation strategy

Thinning treatment	Density (no./ha) by d.b.h.[a] class		Quadratic mean diameter by d.b.h.[a] class		Basal area
	≤ 60 cm	*> 60 cm*	*≤ 60 cm*	*> 60 cm*	*Square meters per hectare*
136-99-62	213.4	45.4	11.9	86.8	29.2
136-99-186	183.6	43.4	15.5	85.4	28.4
408-297-124	264.4	39.5	18.3	72.3	23.2
408-297-186	270.0	34.3	20.6	70.1	22.3
408-297-all	210.6	30.4	24.6	70.7	22.0
All-297-186	235.9	40.3	19.5	71.6	23.3

[a] d.b.h. = diameter at breast height.

Second-rotation experiments—Initial conditions for this rotation were derived from the 136-99-62 and 136-99-186 first-rotation treatments, which had the highest LSI values; the 408-297-124 and 408-297-186 treatments, which were the top two volume-producing treatments; and the 408-297-all and all-297-186 treatments, which had the highest combined rank for extracted volume and rate of attainment of late-successional conditions. Temporal traces of attributes for these six treatments are shown in figure 18. The two treatments initiated with 136 TPH had higher large-bole densities (fig. 18A) and vertical diversity (fig. 18B) in the latter part of the first rotation, and higher mean snag d.b.h. (fig. 18F) and lower shade-tolerant stem density (fig. 18C) and log mass (fig. 18G) throughout the rotation compared to the other four treatments. Retaining 50-percent canopy cover at age 100 somewhat homogenized stand conditions, but there were important structural differences among sets of treatments. The 136-99-62 and 136-99-186 thinning treatments had slightly more and larger stems in the canopy (i.e., >60 cm d.b.h.) and a subcanopy composed of slightly smaller stems compared to the other four treatments (table 7). Results for experiments starting with the 136-99-186 and 408-297-all first-rotation treatments are compared below.

Live attributes—Initial stand conditions of the second rotation influenced treatment effects. The overstory structure of the initial stands derived from the 136-99-62 and 136-99-186 first-rotation treatments led to more rapid development of live attributes compared to treatments starting with the other four initial stands (e.g., compare figs. 19A and 20A, figs. 19C and 20C, figs. 19E and 20E, and figs. 19G and 20G). Trends in long-term values of attributes were variable, but vertical diversity was noticeably higher at age 100 when starting with the 136-*-* first-rotation stands (compare figs. 19D and 20D).

There were subtle differences among second-rotation treatments that were independent of initial stand conditions. Thinning to 136 TPH in the first entry limited the development of vertical layers compared to other initial thinning densities (fig. 19D). This was due to the removal of much of the tree understory compounded by suppression effects of the large-canopy stems. Shade-tolerant stem densities at the end of the rotation increased with increasing density in the last entry and somewhat with decreasing initial thinning density (fig. 19F). Treatments providing the most rapid attainment of live, late-successional conditions were those that skipped the first entry, and thinned to ≥297 TPH in the second and to ≥124 TPH in the third entry (figs. 19G and 20G).

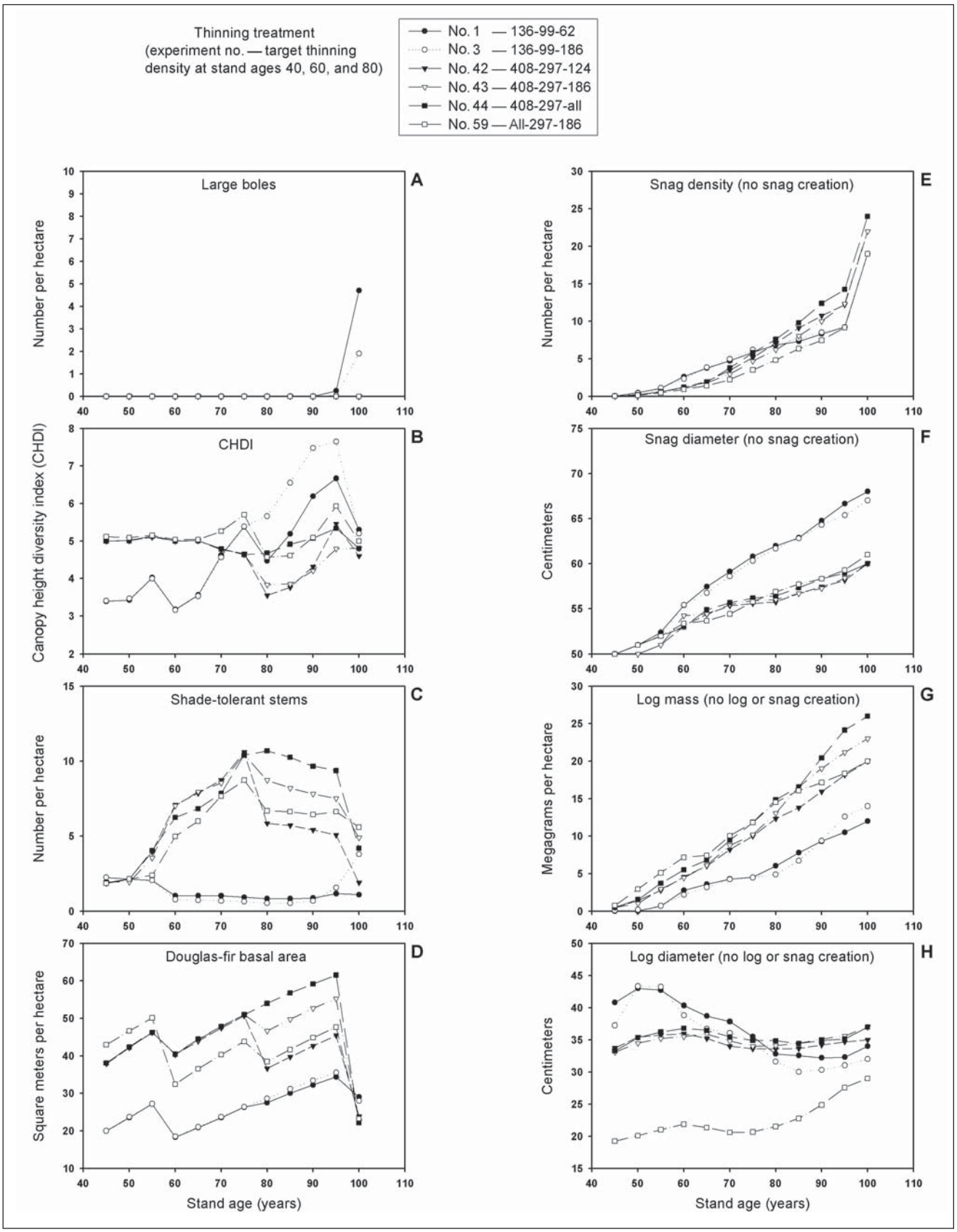

Figure 18—Temporal trends of selected attributes for the two thinning treatments providing the fastest development of late-successional attributes (experiment nos. 1 and 3), the two top volume-producing treatments (experiment nos. 42 and 43), and the two treatments with the highest combined rank for rate of development of late-successional conditions and extracted volume (exp. nos. 44 and 59), 100-year rotation strategy (first rotation in table 4). All values are means based on eight simulation replications.

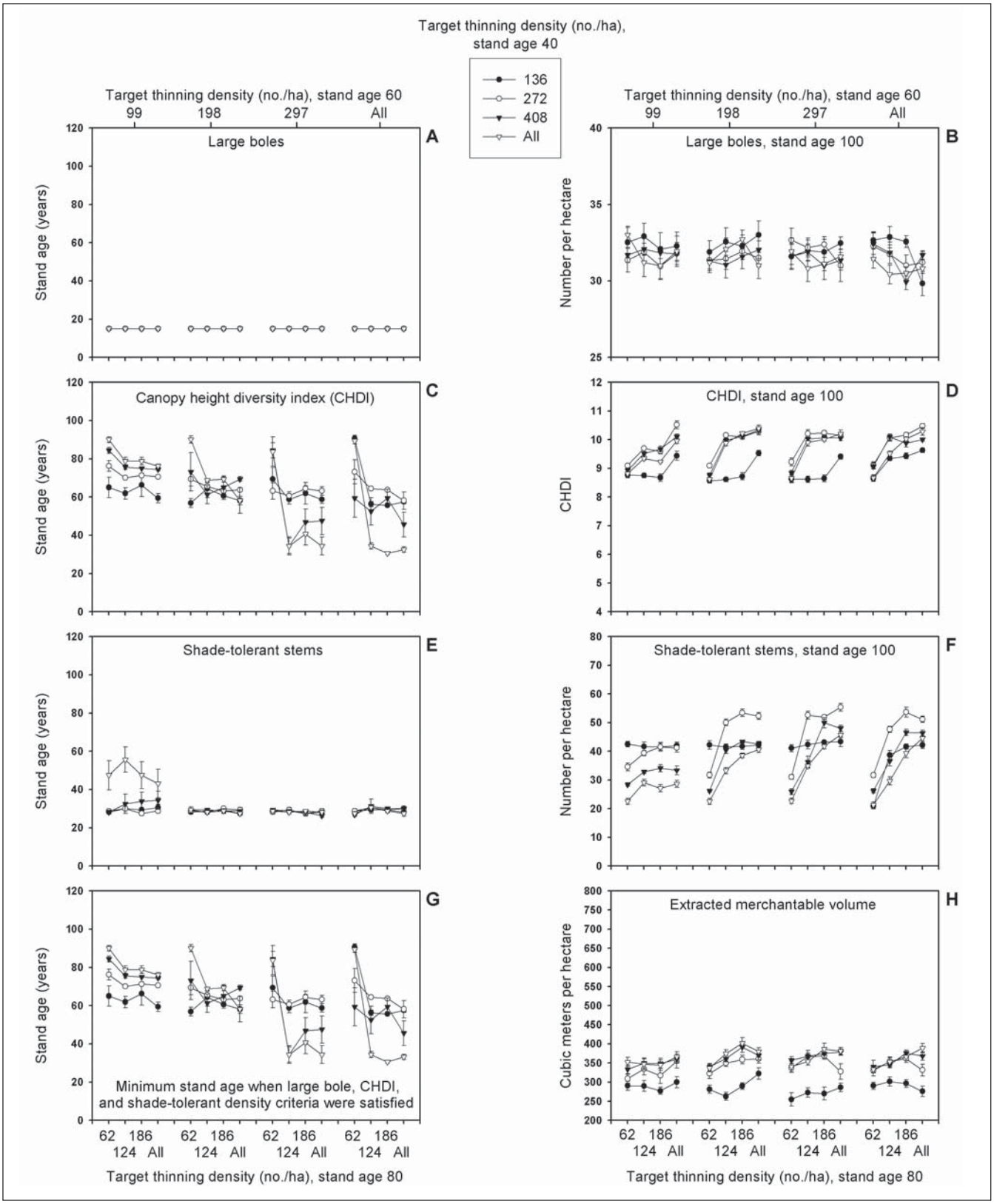

Figure 19—Stand age at which live, late-successional criteria were satisfied, extracted merchantable volume, and stand conditions at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 100-year rotation strategy (second rotation in table 4). Graphs on the left side show the mean (±1se) stand age when specific late-successional criteria were satisfied. Graphs on the right side show mean (±1se) values of criteria at age 100 prior to the rotation harvest; graph H is the mean (±1se) merchantable volume extracted in thinning entries plus the rotation harvest at age 100. Graph I (on page 35) is mean (±1se) Douglas-fir basal area at age 100 prior to the final harvest. Means are based on eight simulation replications. Data also are presented in appendix table 24.

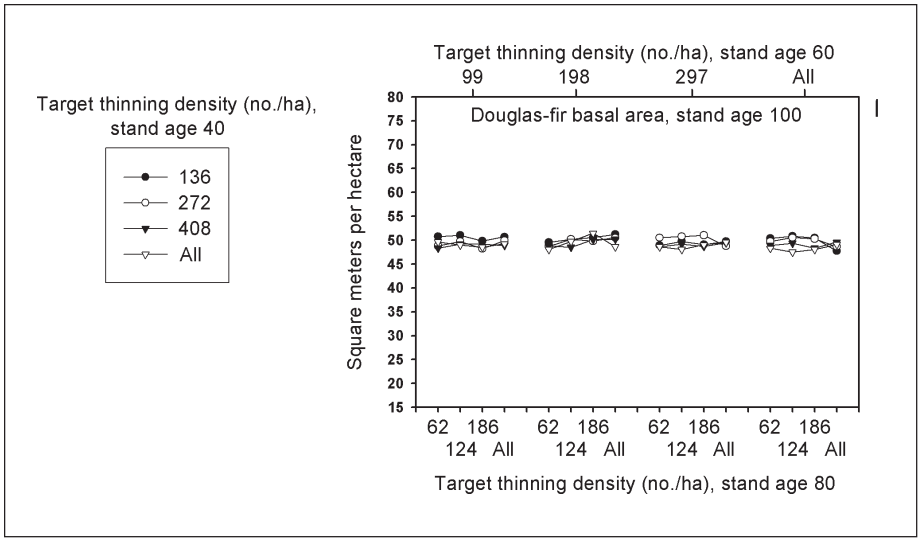

Figure 19 continued.

Extracted merchantable volume—Treatments applied to the 136-99-62 and 136-99-186 first-rotation stands resulted in 100 to 150 m^3/ha less extracted volume compared to similar treatments applied to the other four initial stands (e.g., compare figs. 19H and 20H). Independent of initial conditions, treatments that retained 136 TPH in the first thinning entry generally produced less extracted volume compared to other thinning treatments) (figs. 19H and 20H). Among treatments, extracted volume somewhat increased with increasing thinning density in especially the third entry.

Dead wood—Snags were not a limiting factor in any treatment regardless of the initial stand conditions (figs. 21A and 22A). This was due to the high density of snags at the end of the first rotation. Long-term density and snag size, however, were correlated with initial conditions. Initial stands with fewer but larger boles resulted in fewer but larger snags at the end of the rotation (e.g., compare figs. 21B and 22B and figs. 21C and 22C). The stand age when the log-mass criterion was satisfied also differed among initial stand conditions. Starting with fewer but larger canopy stems delayed satisfying the log-mass criterion by up to two decades (compare figs. 23A and 24A) but resulted in up to 20 Mg/ha more log mass (compare figs. 23B and 24B) and slightly larger logs (compare figs. 23C and 24C) by the end of the 100-year rotation.

Eighty-Year Rotation Strategy

First-rotation experiments—

Live attributes—The short duration of this strategy limited the attainment of threshold levels of late-successional attributes (figs. 25E and 25G). Thinning regimes did not produce boles >100 cm d.b.h. by the end of the 80-year rotation. Only three treatments (i.e., 408-297, 408-all, and all-all) satisfied the shade-tolerant stem-density criterion by age 80 (fig. 25B). The CHDI threshold level was not achieved by any treatment. However, initially thinning heavily (e.g., 136-*), delaying thinning until age 60 (i.e., all-*), or thinning lightly and skipping the last thinning entry (i.e., 408-all) favored the development of vertical diversity by age 80 (fig. 25A). Although each of these strategies provided comparable CHDI values, they had different effects on species composition. The vertical structure resulting from the heavy initial thinning (i.e., 136-*) comprised regenerated Douglas-fir (fig. 25C) and few shade-tolerant stems (fig. 25B).

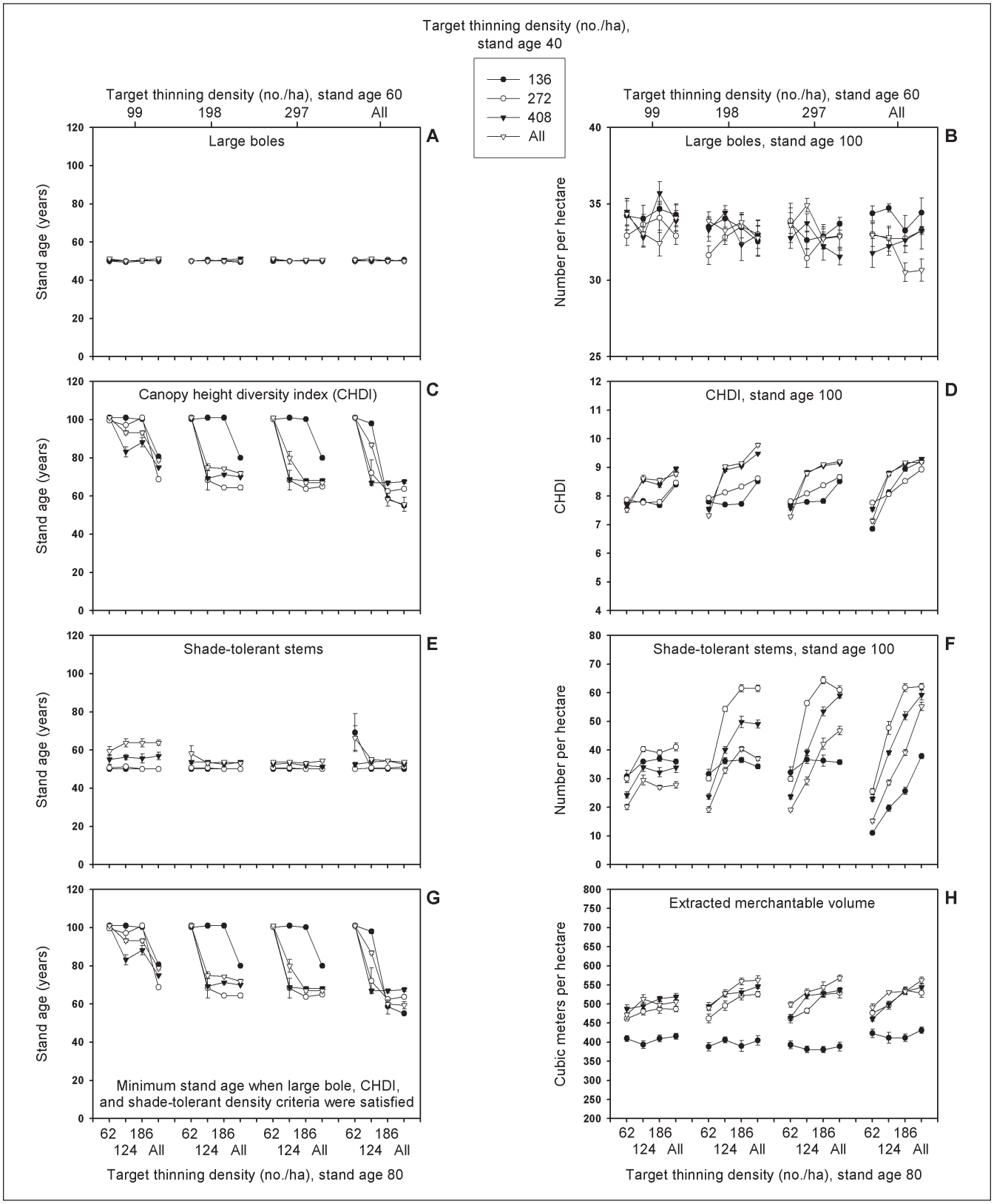

Figure 20—Stand age at which live, late-successional criteria were satisfied, extracted merchantable volume, and stand conditions at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 408-297-all first-rotation treatment, 100-year rotation strategy (second rotation in table 4). Graphs on the left side show the mean (±1se) stand age when specific late-successional criteria were satisfied. Graphs on the right side show mean (±1se) values of criteria at age 100 prior to the rotation harvest; graph H is the mean (±1se) merchantable volume extracted in thinning entries plus the rotation harvest at age 100. Graph I is mean (±1se) Douglas-fir basal area at age 100 prior to the final harvest. Means are based on eight simulation replications. Data also are presented in appendix table 25.

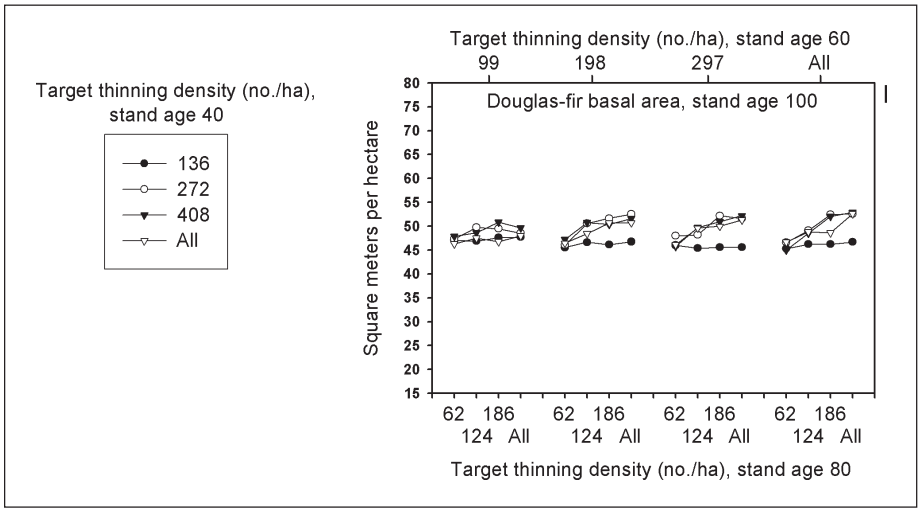

Figure 20 continued.

Higher thinning densities (e.g., ≥408) retained more of the existing shade-intolerant and shade-tolerant stems in the first entry. This effectively allowed more stems to grow beyond the 60-cm diameter limit of the subsequent thinning entry and resulted in a more even mixture of shade-intolerant and shade-tolerant stems by age 80 (figs. 25B and 25C).

Based on the standard LSI, similarity to late-successional conditions increased with increasing thinning density in the first and second entry (fig. 25E). This primarily reflected trends in the density of shade-tolerant stems (fig. 25B). Using boles >80 cm d.b.h. in the calculation of the LSI (fig. 25F), however, resulted in the 136-* and 272-99 treatments exhibiting the greater similarity to older stand conditions than other treatments by age 80 (fig. 25G).

Extracted merchantable volume—Extracted volume only differed by ca. 100 to 150 m^3/ha among treatments (fig. 25D). Treatments initially thinning to 272 TPH generally provided slightly more volume than other thinning treatments.

Dead wood—Natural snag and log recruitment were insufficient to satisfy the corresponding criterion by the end of the rotation. Even when artificially creating four snags per hectare, only treatments with a heavy thin in the first entry (≤272 TPH) and thinning to ≥198 TPH in the last entry promoted the development of ≥10 snags per hectare by the end of the rotation (fig. 26C). Artificial supplements of 10 Mg/ha of logs at age 60 were insufficient to satisfy the log-mass criterion by the end of the rotation (figs. 26E and 26G).

Second-rotation experiments—Initial conditions for this rotation were derived from the 272-99 first-rotation treatments, which had the highest modified LSI; the 136-99 treatment, which produced the most boles >80 cm d.b.h. by age 80 (fig. 25F); the 272-198 and 272-297 treatments, which provided the most extracted volume; and the 408-198 and 136-all treatments, which had the highest combined rank for extracted volume and modified LSI. The three treatments that thinned to 136 TPH at age 40 or to 99 TPH in the last entry produced more boles >80 cm d.b.h. (fig. 27A), higher vertical diversity (fig. 27B), but substantially fewer shade-tolerant stems (fig. 27C) over the first rotation compared to the other treatments. These three treatments also resulted

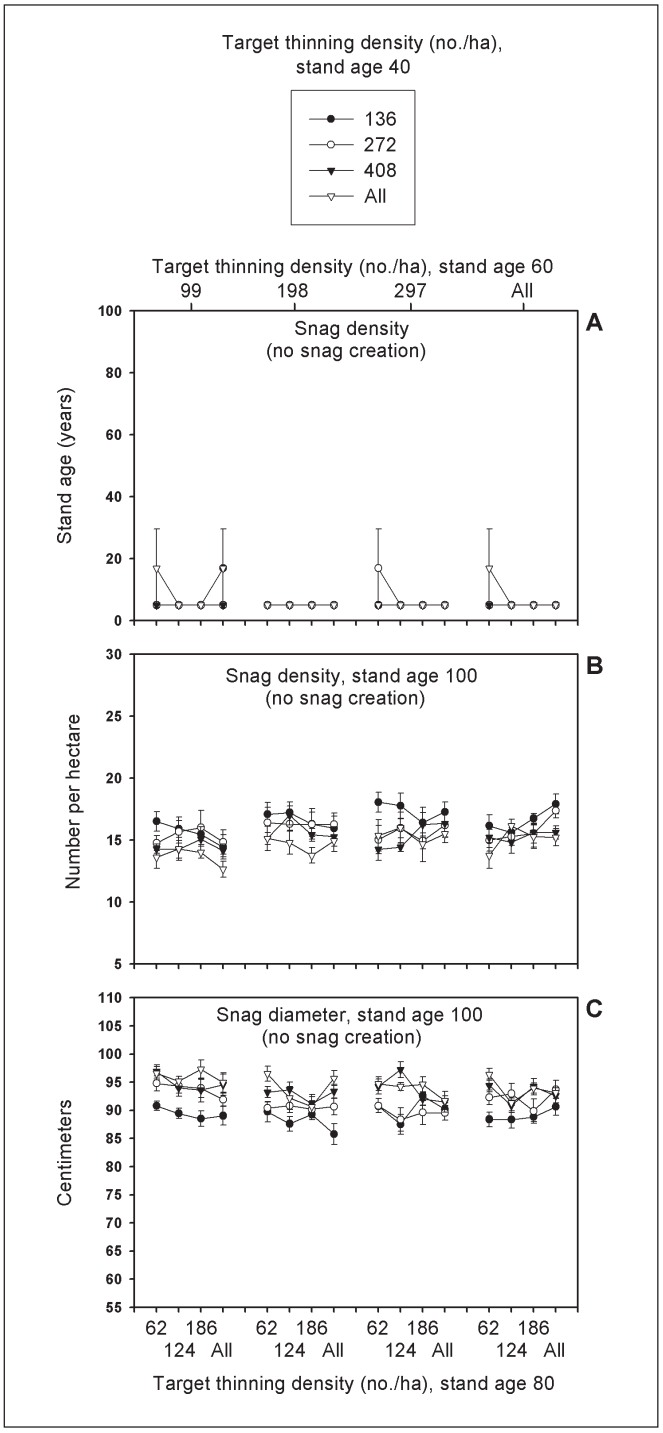

Figure 21—Stand age at which the snag criterion was satisfied, and density and size of snags (>50 centimeters d.b.h., >5 meters tall) at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 100-year rotation strategy (second rotation in table 4). Graph A is stand age when the snag criterion was satisfied. Snag density (B) and size (C) are means (±1se) at age 100 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix table 26.

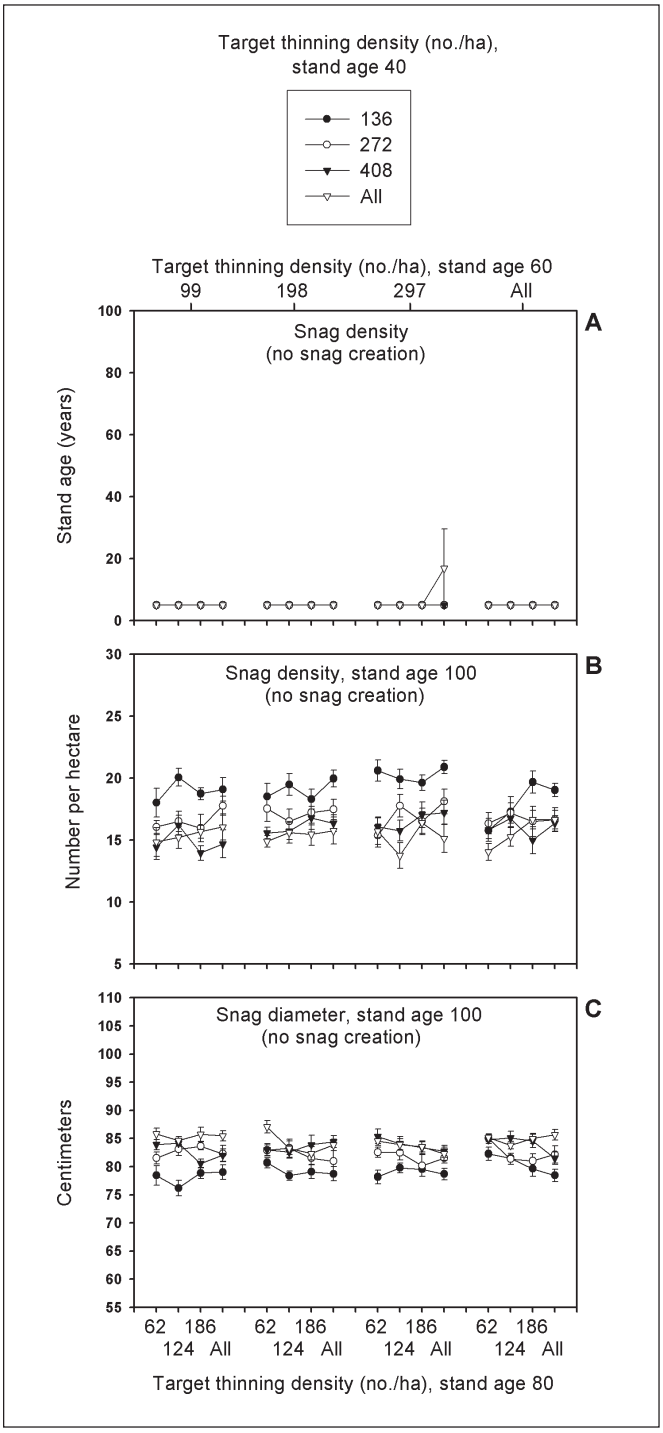

Figure 22—Stand age at which the snag criterion was satisfied, and density and size of snags (>50 centimeters d.b.h., >5 meters tall) at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 408-297-all first-rotation treatment, 100-year rotation strategy (second rotation in table 4). Graph A is stand age when the snag criterion was satisfied. Snag density (B) and size (C) are means (±1se) at age 100 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix table 27.

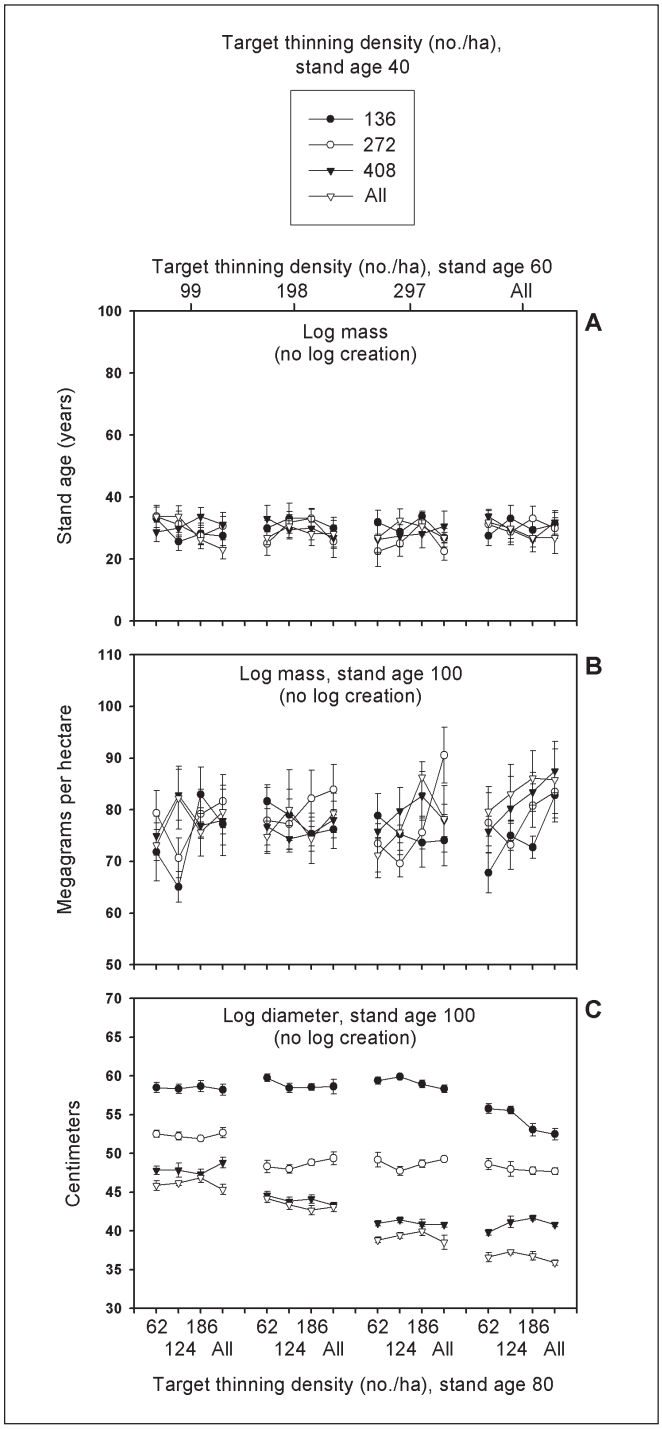

Figure 23—Stand age at which the log-mass criterion was satisfied, and mass and size of logs (>10 centimeters large-end diameter) at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 100-year rotation strategy (second rotation in table 4). Graph A is stand age when the log-mass criterion was satisfied. Log mass (B) and size (C) are means (±1se) at age 100 prior to the rotation harvest. All values are based on scenarios without artificial creation of snags. Means are based on eight simulation replications. Data also are presented in appendix table 28.

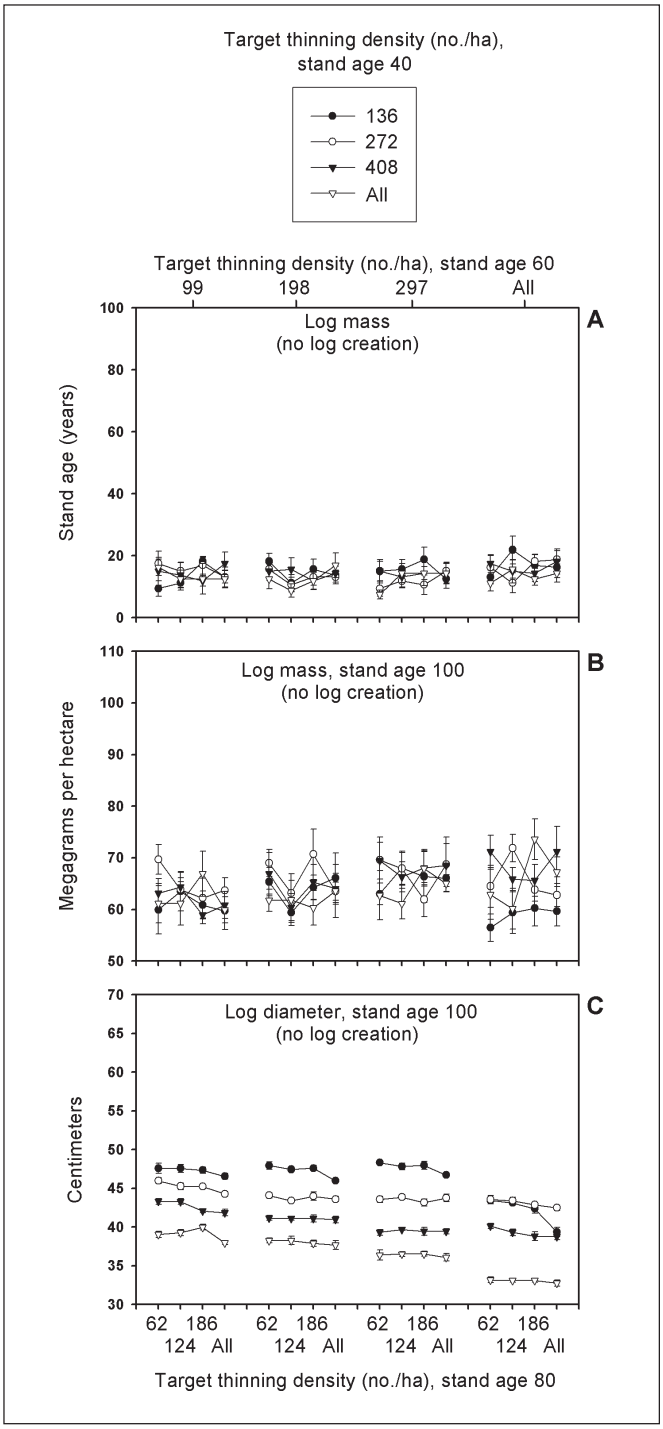

Figure 24—Stand age at which the log-mass criterion was satisfied, and mass and size of logs (>10 centimeters large-end diameter) at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 408-297-all first-rotation treatment, 100-year rotation strategy (second rotation in table 4). Graph A is stand age when the log-mass criterion was satisfied. Log mass (B) and size (C) are means (±1se) at age 100 prior to the rotation harvest. All values are based on scenarios without artificial creation of snags. Means are based on eight simulation replications. Data also are presented in appendix table 29.

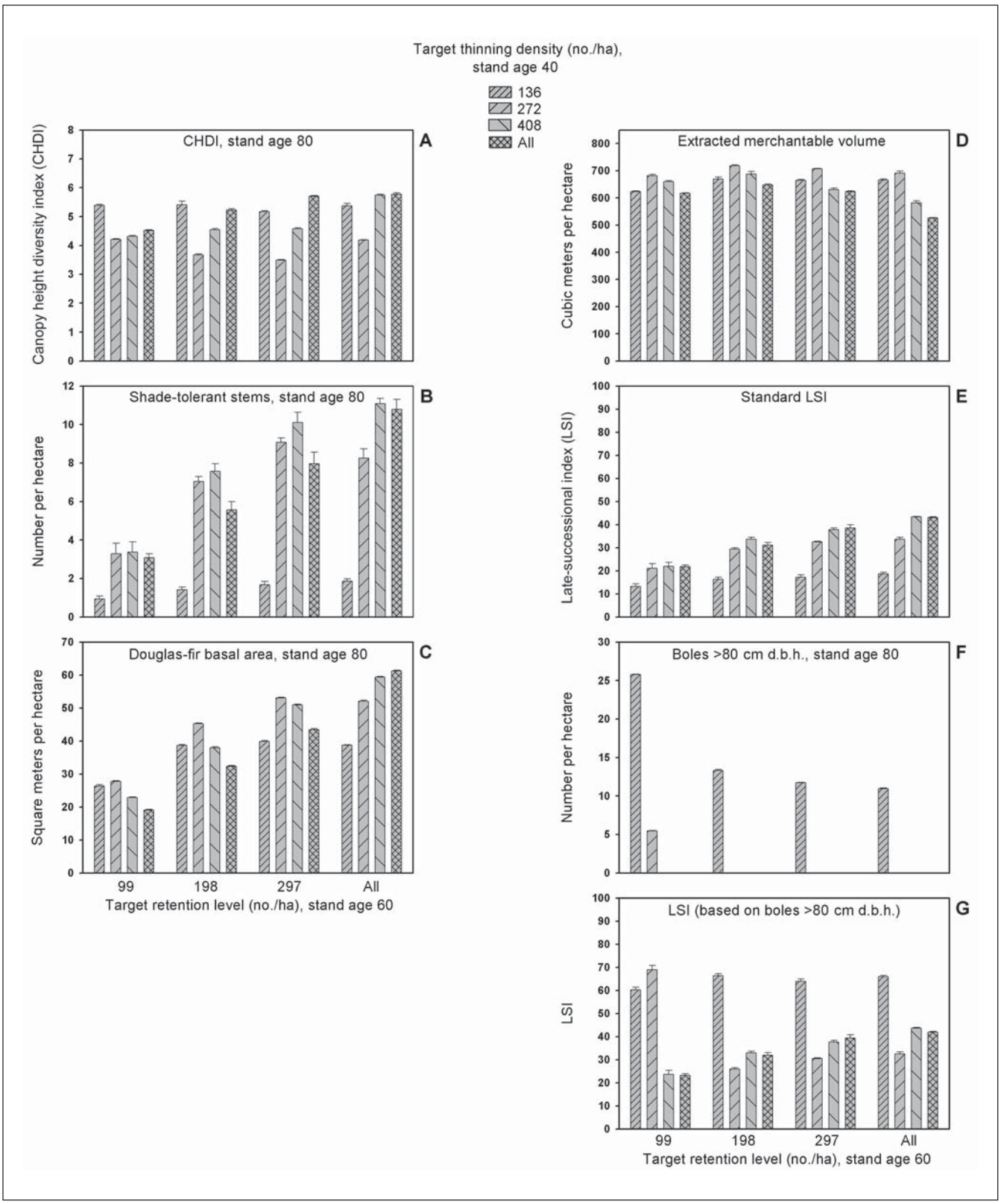

Figure 25—Stand conditions and extracted merchantable volume at the end of the rotation for 16 experimental thinning treatments, 80-year rotation strategy (first rotation in table 5). Graphs A and B are means (±1se) of late-successional attributes at age 80 prior to the rotation harvest. Graph C is mean (±1se) Douglas-fir basal area at age 80 prior to the rotation harvest. Graph D is the mean (±1se) merchantable volume extracted in thinning entries plus the rotation harvest at age 80. Graph E is the mean (±1se) standard late-successional index (LSI); G is the mean (±1se) modified LSI using boles >80 cm d.b.h. (F). Means are based on eight simulation replications. Data also are presented in appendix table 30.

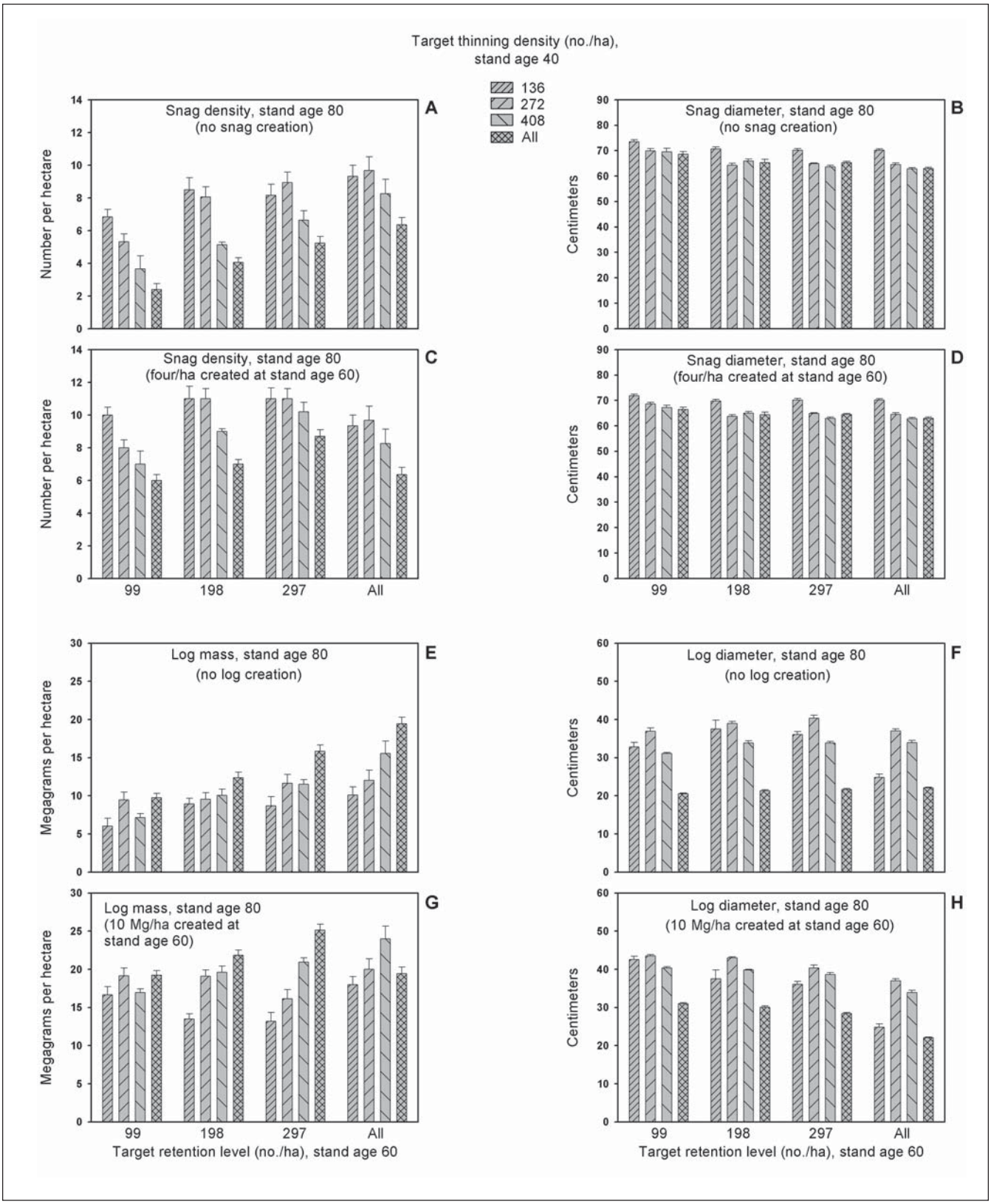

Figure 26—Mean (±1se) density and size of snags (>50 centimeters d.b.h., >5 meters tall), and mean mass and size of logs (>10 centimeters large-end diameter) at the end of the rotation for 16 experimental thinning treatments, 80-year rotation strategy (first rotation in table 5). Graphs A through D pertain to two snag-creation scenarios. Log measures in E through H are from the scenario without artificial snag creation. All values are at age 80 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix table 31.

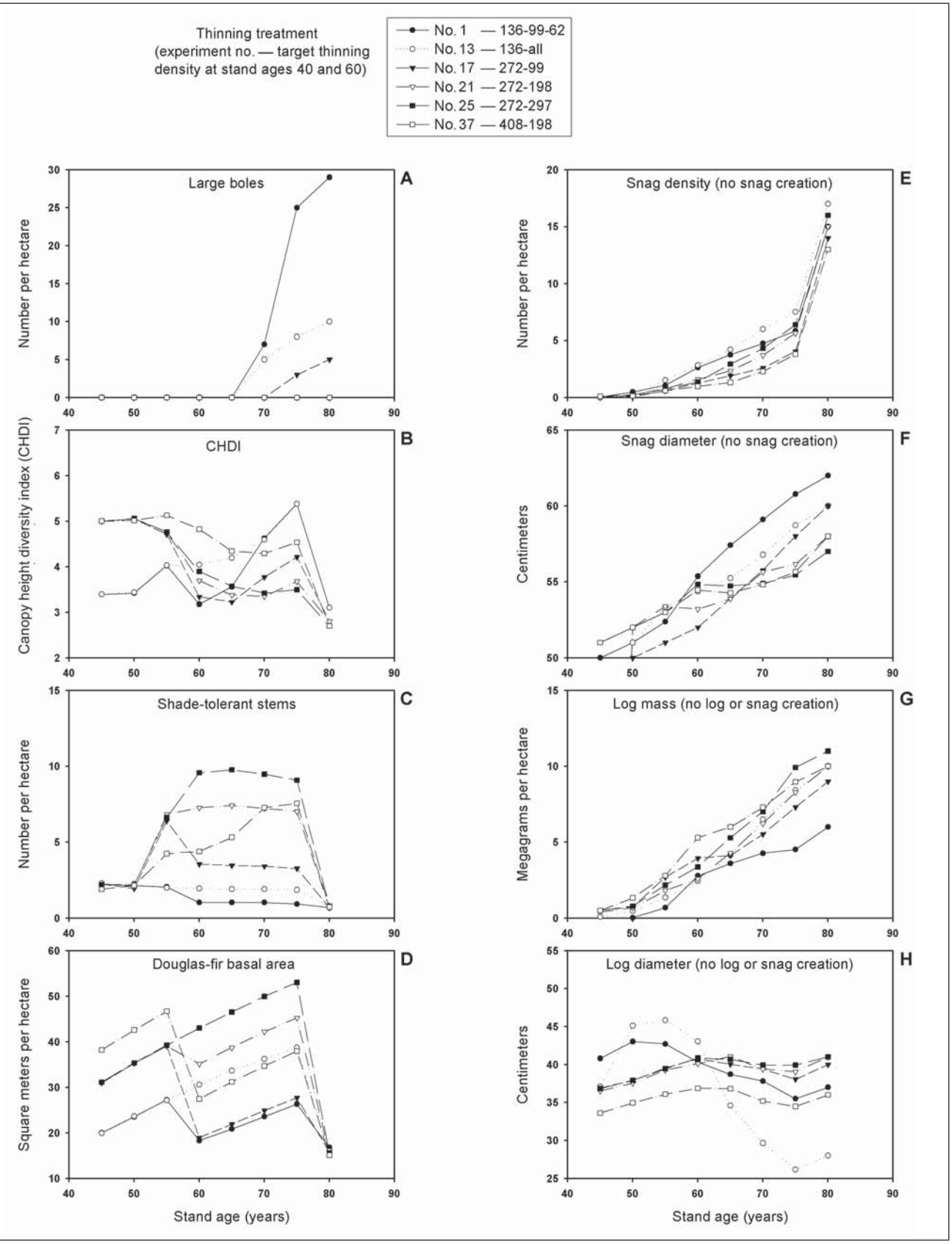

Figure 27—Temporal trends of selected attributes for the two thinning treatments providing the fastest development of late-successional attributes (experiment nos. 1 and 17), the two top volume-producing treatments (exp. nos. 21 and 25), and the two treatments with the highest combined rank for rate of attainment of late-successional conditions and extracted volume (experiment nos. 13 and 37), 80-year rotation strategy (first rotation in table 5). All values are means based on eight simulation replications.

Table 8—Stand structure after the rotation harvest of the 6 first-rotation treatments used in the second-rotation experiments, 80-year rotation strategy

Thinning treatment	Density (No./ha) by d.b.h.[a] class		Quadratic mean diameter by d.b.h.[a] class		Basal area
	≤ 60 cm	*> 60 cm*	*≤ 60 cm*	*> 60 cm*	*Square meters per hectare*
136-99	51.6	26.6	5.0	78.6	12.9
136-all	13.3	27.4	5.0	76.2	12.5
272-99	51.6	28.9	5.0	72.2	11.9
272-198	30.9	28.9	7.9	70.7	11.5
272-297	26.2	28.9	10.8	69.9	11.3
408-198	43.4	29.3	7.3	68.7	11.0

[a] d.b.h. = diameter at breast height.

in larger overstory and smaller understory stems after the first-rotation harvest compared to the other treatments (table 8). Results for the 136-all and 272-297 treatments are compared below.

Live attributes—Initial conditions of the second rotation had little influence on rate of attainment of threshold levels (e.g., compare corresponding attributes in figs. 28 and 29). An exception was the rate of attainment of the large-bole criterion. Starting with larger overstory stems resulted in more rapid attainment of this criterion when thinning to ≥272 TPH in the first commercial entry of the second rotation (e.g., figs. 28A and 29A).

Relative effects of treatments were generally similar among the six initial stand conditions. Thinning to 136 TPH in the first entry delayed satisfying the large-bole criterion (figs. 28A and 29A) and limited densities at the end of the rotation (figs. 28B and 29B). Thinning to ≥272 TPH in the first commercial thinning entry of the second rotation affected development of vertical structure (fig. 28C) and of shade-tolerant stems (fig. 28E). Long-term trends of both attributes generally increased with increasing thinning density especially in the third entry (figs. 28D and 28F).

Extracted merchantable volume—Initial stand conditions had little effect on amount of extracted volume produced by a treatment (figs. 28H and 29H). For all initial conditions, mean total extracted merchantable volume differed at most by 150 m^3/ha among treatments. Extracted volume only slightly increased with increasing thinning densities.

Dead wood—Snag and log dynamics were related to initial stand conditions. Starting with the three stands with relatively larger overstory stems (i.e., the first three in table 8), all second-rotation treatments resulted in higher rates of snag recruitment (compare figs. 30A through 30D with figs. 31A through 31D) but lower rates of log-mass accumulation (compare figs. 32A through 32D with figs. 33A through 33D) compared to treatments starting with smaller overstory stems. Regardless of initial stand conditions, natural or artificial recruitment of snags and logs was sufficient to satisfy the dead-wood criteria before or at about the same time as the live, late-successional criteria.

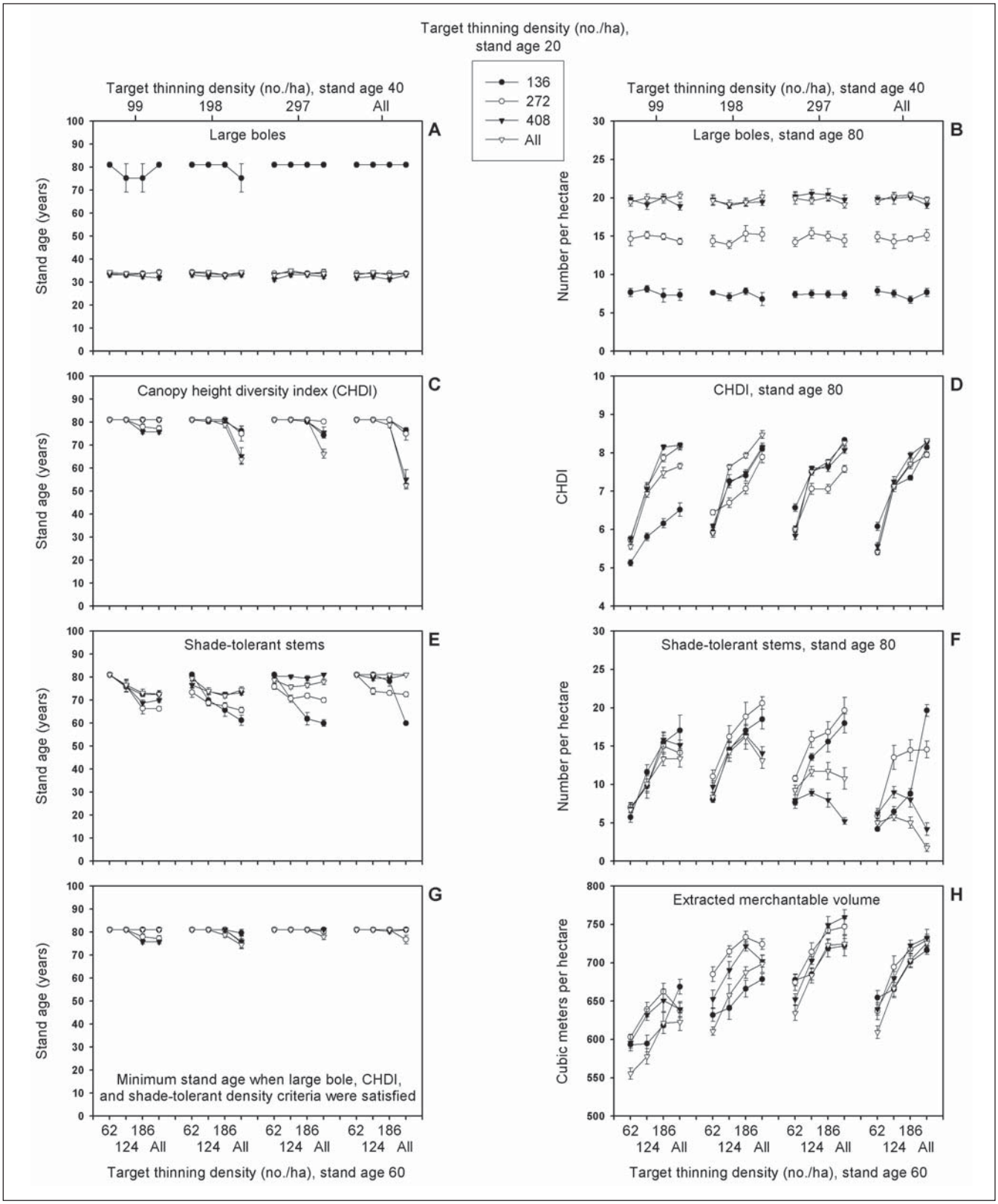

Figure 28—Stand age at which live, late-successional criteria were satisfied, extracted merchantable volume, and stand conditions at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 136-all first-rotation treatment; 80-year rotation strategy (second rotation in table 5). Graphs on the left side show the mean (±1se) stand age when specific late-successional criteria were satisfied. Graph I (on page 45) is the mean (±1se) late-succession index at age 80 prior to the rotation harvest. Graphs on the right side show mean (±1se) values of criteria at age 80 prior to the rotation harvest; graph H is the mean (±1se) merchantable volume extracted in thinning entries plus the rotation harvest at age 80. Graph J (on page 45) is mean (±1se) Douglas-fir basal area at age 80 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix table 32.

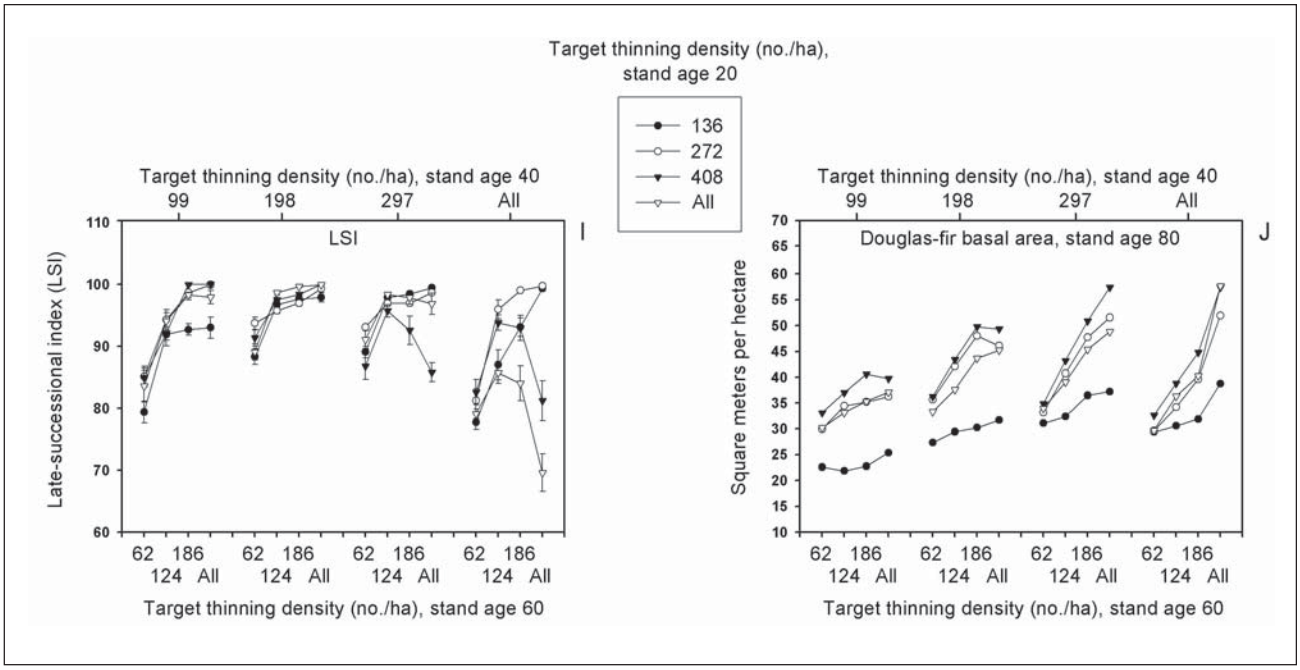

Figure 28 continued.

Discussion

First-Rotation Experiments

Stand characteristics—Previous studies have suggested the use of heavy thinning in young Douglas-fir stands to accelerate the development of late-successional attributes (Barbour and others 1997, McComb and others 1993, Tappeiner and others 1998). Results of this study support this general recommendation. Thinning to 136 TPH at age 40 followed by extensive reduction of the tree understory at age 60 and moderate to no reduction of stems at age 80 attained threshold levels of live, late-successional attributes by stand age 117, compared to age 220 without thinning. Even for rotations ≤100 years, creating a relatively sparse overstory and managing the tree understory to optimize vertical stratification were key to producing stand structures most similar to those of naturally regenerated 200-year-old Douglas-fir stands.

An important concept illustrated by this study was the potential for different thinning regimes to promote rapid development of late-successional attributes. In addition to the strategy noted above, treatments that thinned stems ≤60 cm d.b.h. to 99 TPH at age 60 and to ≤186 TPH at age 80 satisfied the live, late-successional criteria by stand age 120 to 140 (fig. 2G), or within 23 years of the fastest attainment rate revealed in this study. Similar developmental rates provided by these two strategies reflected convergence of stand structures. Regimes that thinned heavily at ages 40 and 60 reduced species diversity and vertical structure of the initial stand, but these attributes quickly recovered owing to the rapid development of the naturally regenerated tree understory. Treatments that delayed extensive reduction of the tree understory until the second entry allowed more stems to exceed the upper diameter limit of thinning treatments. This promoted development of vertical diversity but also relatively slower growth rates of trees owing to higher overall stem densities. Differences in stand dynamics were subtle enough between these two strategies that threshold levels of large boles, vertical structure, and shade-tolerant stem densities were attained at about the same time.

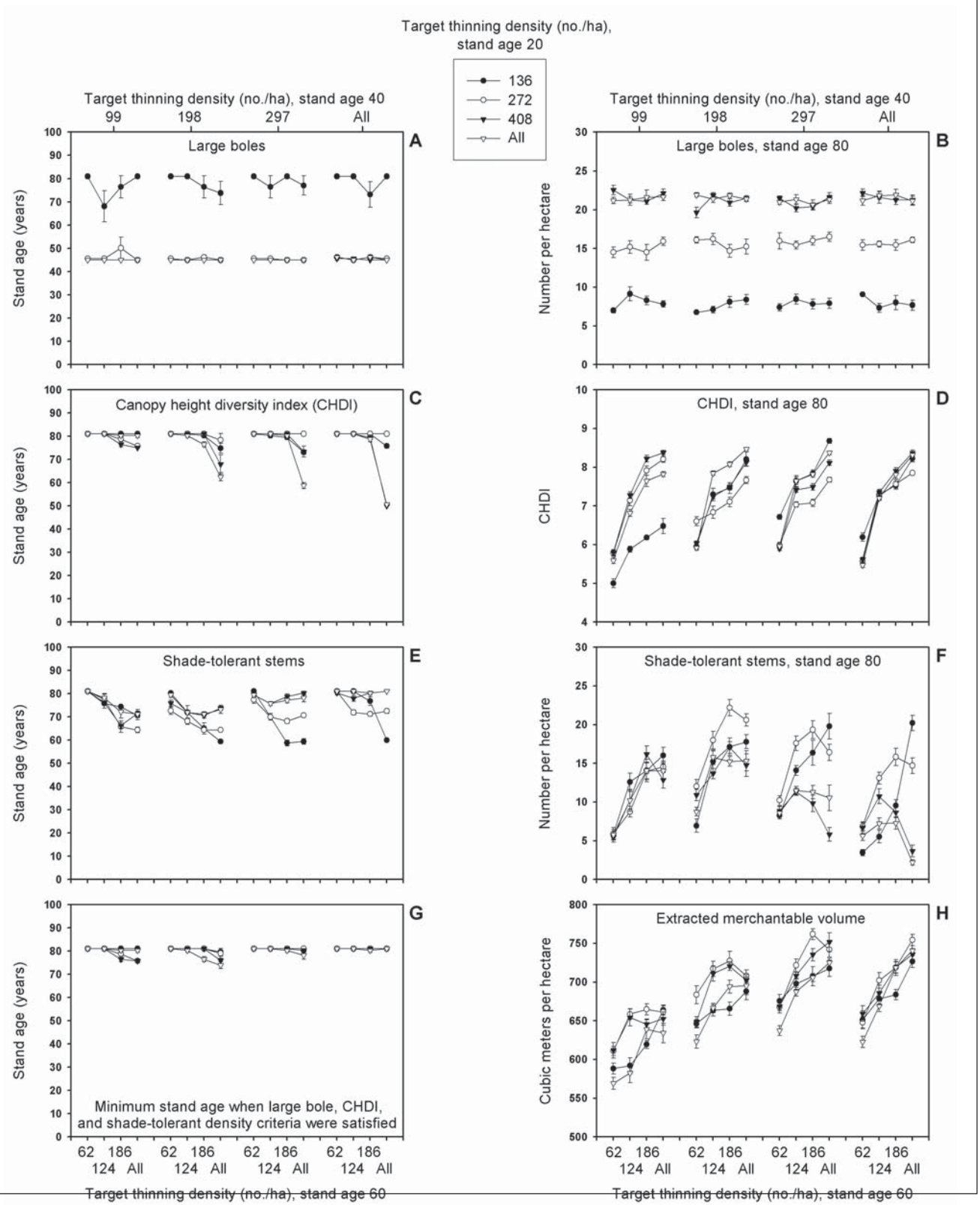

Figure 29—Stand age at which live, late-successional criteria were satisfied, extracted merchantable volume, and stand conditions at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 272-297 first-rotation treatment, 80-year rotation strategy (second rotation in table 5). Graphs on the left side show the mean (±1se) stand age when specific late-successional criteria were satisfied. Graph I (on page 47) is the mean (±1se) late-succession index at age 80 prior to the rotation harvest. Graphs on the right side show mean (±1se) values of criteria at age 80 prior to the rotation harvest; graph H is the mean (±1se) merchantable volume extracted in thinning entries plus the rotation harvest at age 80. Graph J (on page 47) is mean (±1se) Douglas-fir basal area at age 80 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix table 33.

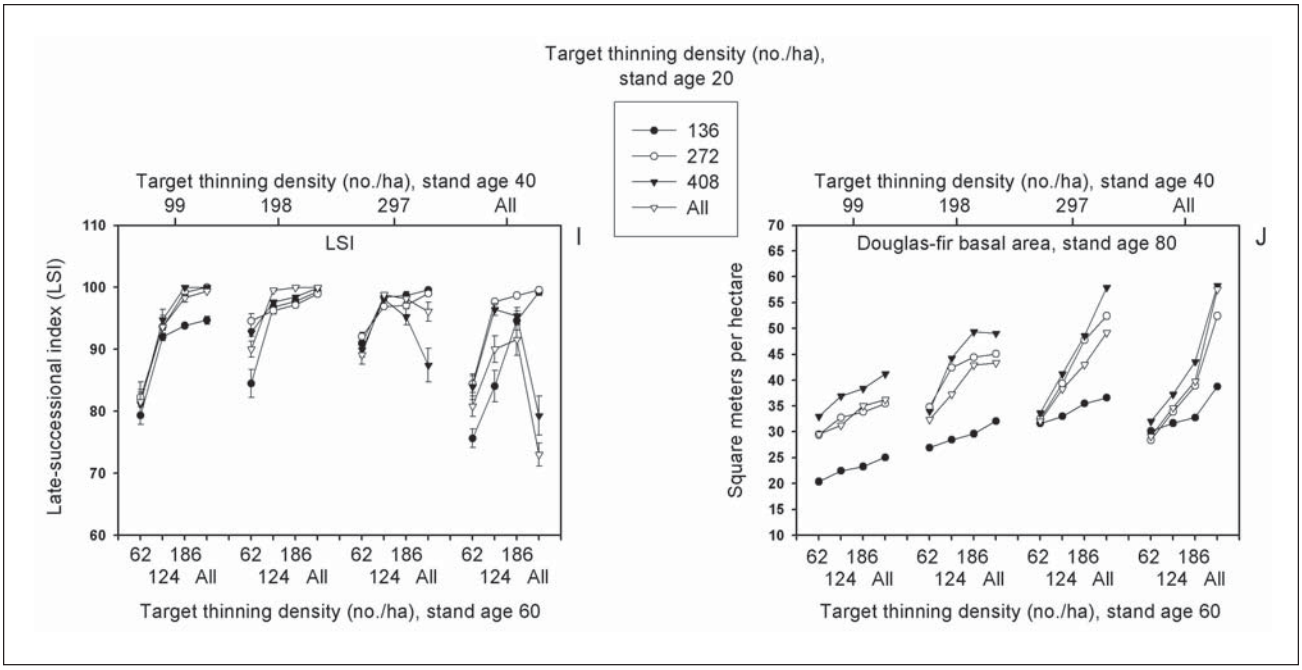

Figure 29 continued.

Barbour and others (1997) speculated that thinning treatments accelerating live, late-successional conditions would decrease recruitment rate of dead wood. Results of this study support this hypothesis. Treatments promoting rapid development of live, late-successional attributes limited overstory and understory densities over stand ages 120 to 140. This in turn limited natural recruitment of snags and logs owing to lower rates of stress-related mortality and lower numbers of large stems subjected to ambient mortality. For these treatments, only about two to four snags per hectare and 5 to 10 Mg/ha of log mass naturally developed by age 80. Over rotations ≥180 years, natural recruitment was sufficient to satisfy the dead-wood criteria at about the same time as live criteria. To achieve threshold levels of snags by age 80 to 100, however, artificial creation of two to six snags per hectare was required. Our log-creation strategy was insufficient to satisfy the corresponding threshold criterion by age 80 to 100 for treatments promoting rapid development of live attributes. Thus, we estimate that creation of more than 15 Mg/ha of logs would be required in the shorter rotations. We expect, however, that actual log mass may develop more quickly than what was estimated with the simulation model. This is because the model does not consider the contribution of branches to the log pool. In general, however, treatments promoting rapid development of live, late-successional attributes likely will require addition of dead wood, which can be created from stems selected for removal in thinning entries.

Results of this study illustrate two important trends between developmental rate of late-successional attributes and long-term stand conditions. First, treatments that promote the most rapid development of late-successional conditions will not necessarily result in the highest levels of these attributes over the long term compared to treatments that delay development of these conditions. Second, treatments that promote similar rapid rates of attainment of late-successional conditions eventually can lead to

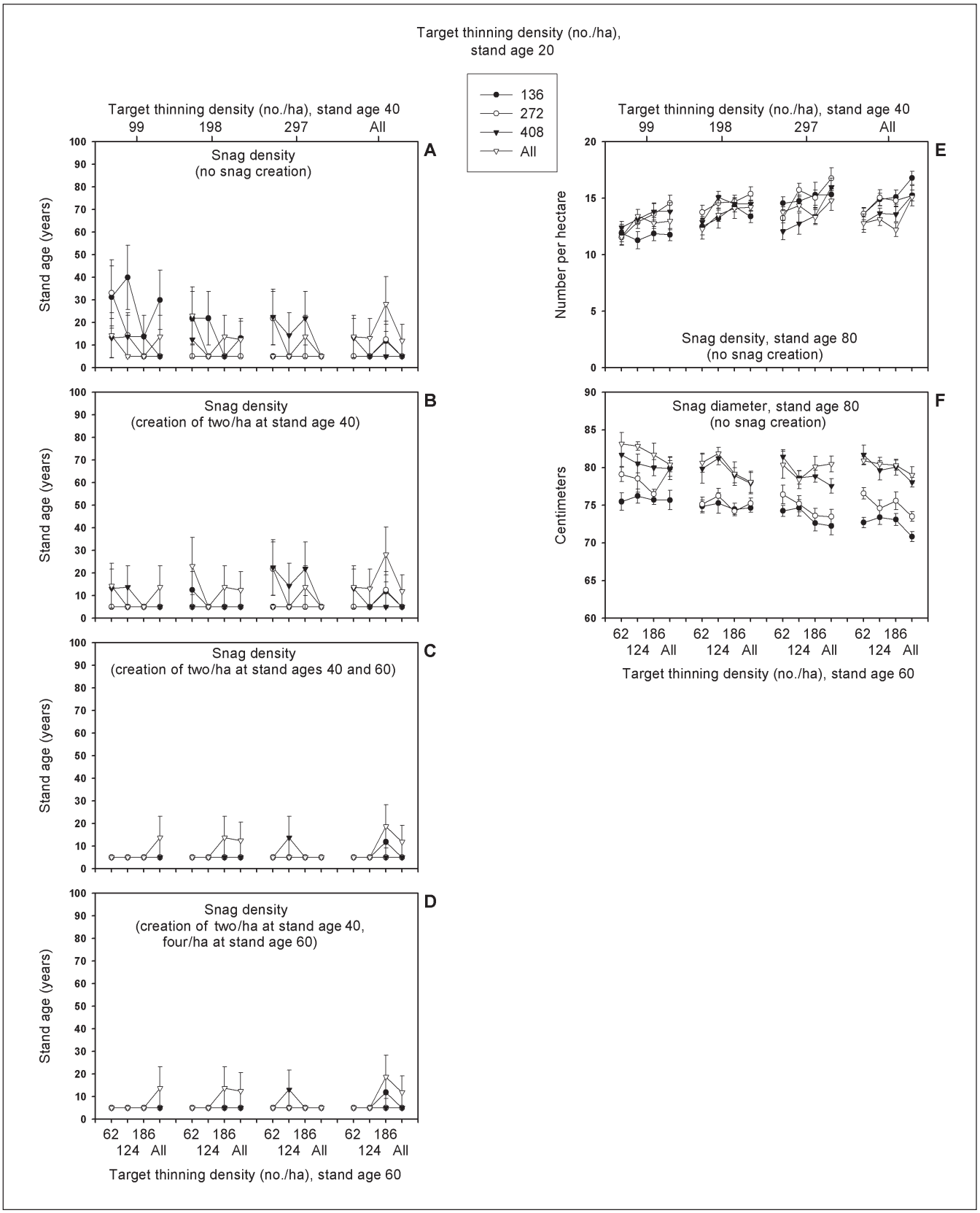

Figure 30—Stand age at which the snag criterion was satisfied, and density and size of snags (>50 centimeters d.b.h., >5 meters tall) at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 136-all first-rotation treatment, 80-year rotation strategy (second rotation in table 5). Graphs on left are mean (±1se) stand age when the snag criterion was satisfied for four snag-creation scenarios. Snag density (E) and size (F) are means (±1se) at age 80 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix table 34.

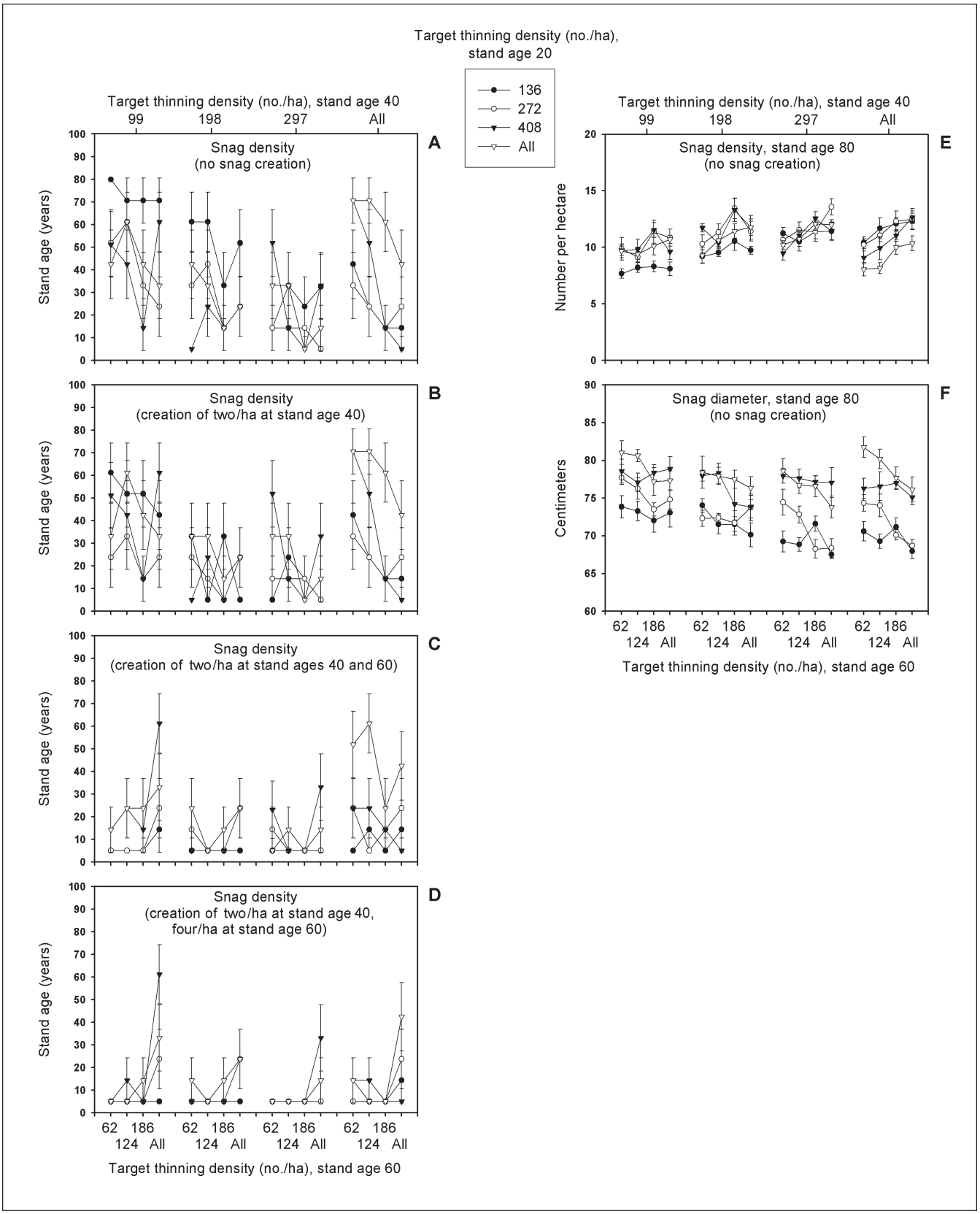

Figure 31—Stand age at which the snag criterion was satisfied, and density and size of snags (>50 centimeters d.b.h., >5 meters tall) at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 272-297 first-rotation treatment, 80-year rotation strategy (second rotation in table 5). Graphs on left are mean (±1se) stand age when the snag criterion was satisfied for four snag-creation scenarios. Snag density (E) and size (F) are means (±1se) at age 80 prior to the rotation harvest. Means are based on eight simulation replications. Data also are presented in appendix table 35.

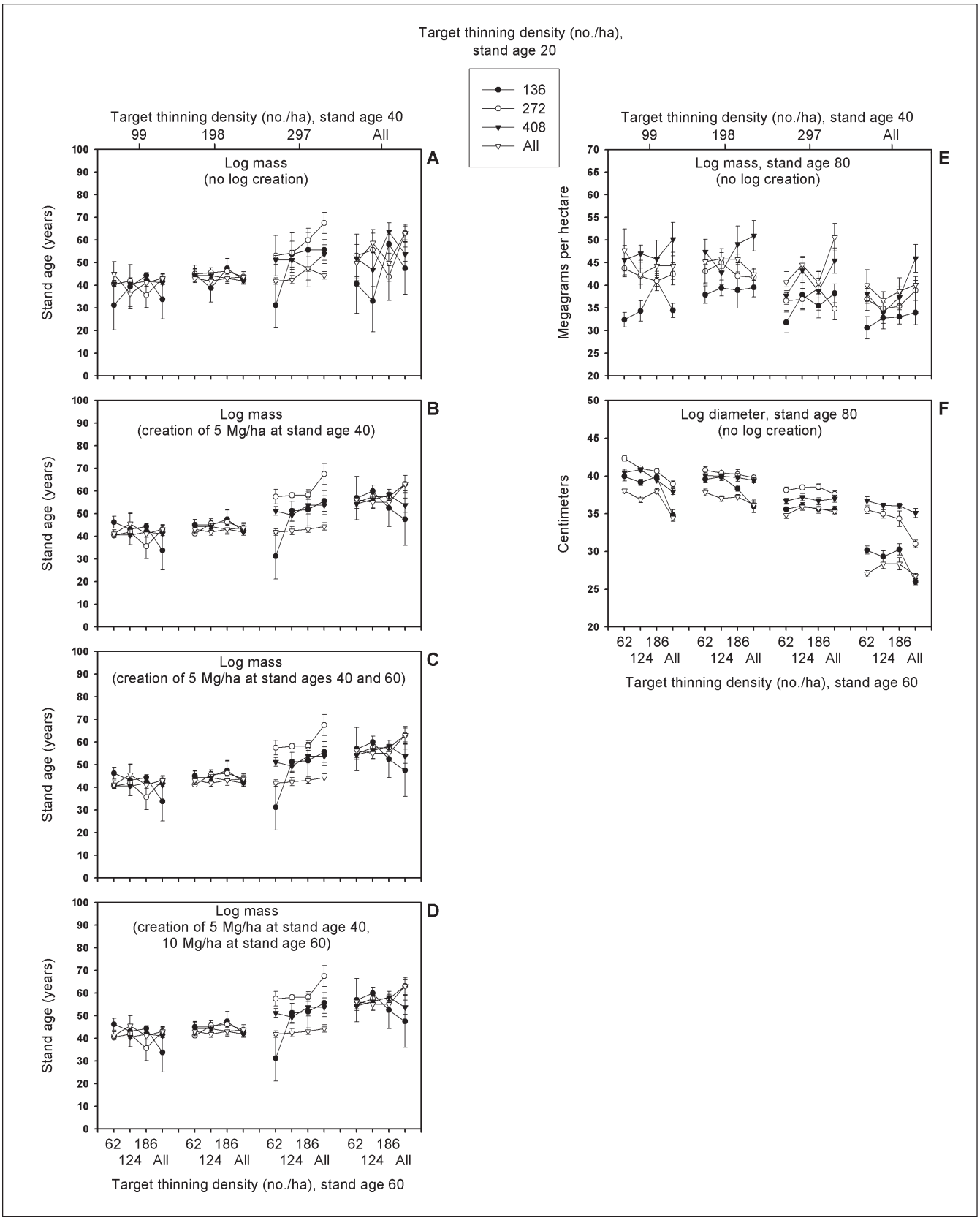

Figure 32—Stand age at which the log-mass criterion was satisfied, and mass and size of logs (>10 centimeters d.b.h. large-end diameter) at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 136-all first-rotation treatment, 80-year rotation strategy (second rotation in table 5). Graphs on left are mean (±1se) stand age when the log-mass criterion was satisfied for four log-creation scenarios. Log mass (E) and size (F) are means (±1se) at age 80 prior to the rotation harvest. All values are based on scenarios without artificial creation of snags. Means are based on eight simulation replications. Data also are presented in appendix table 36.

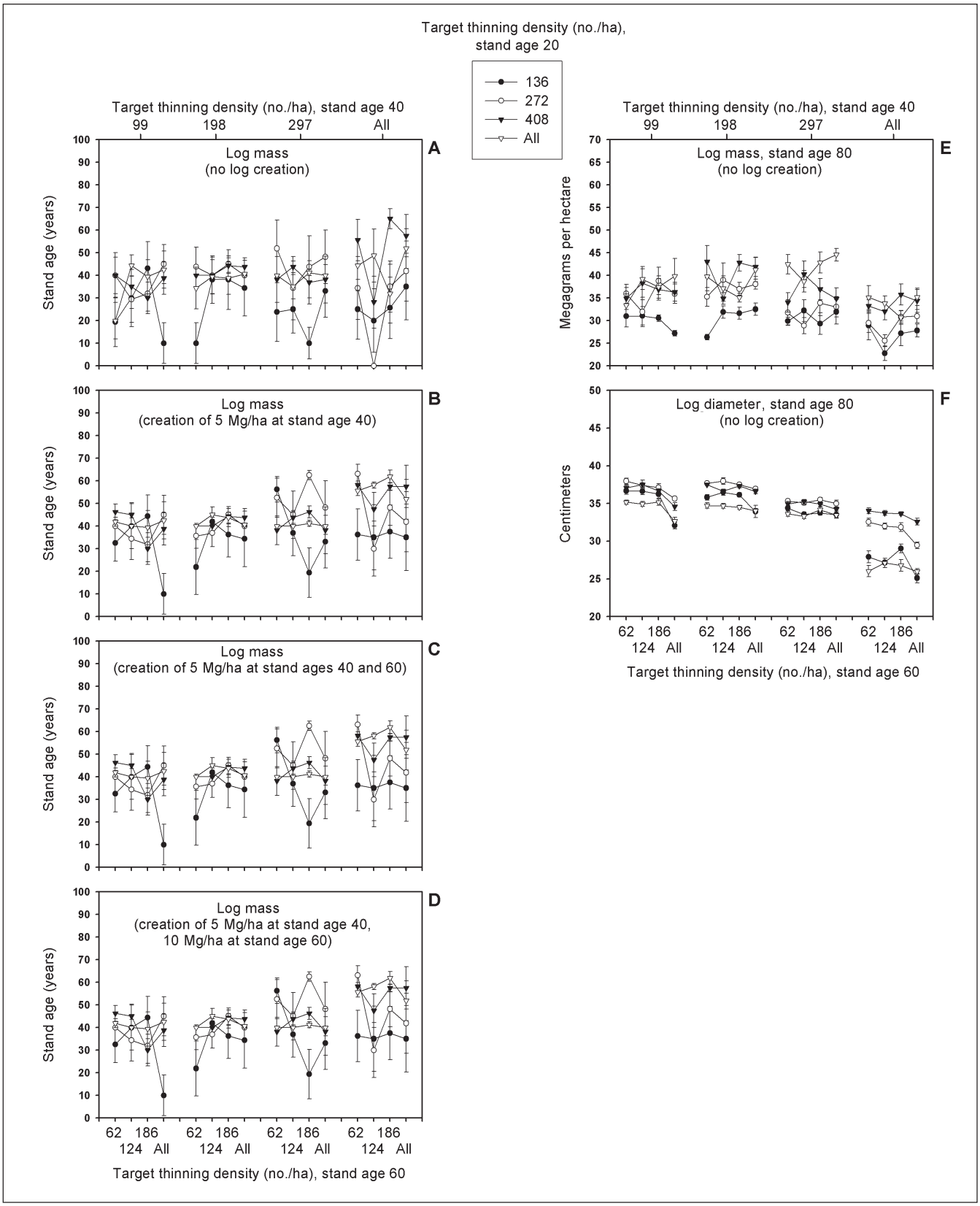

Figure 33—Stand age at which the log-mass criterion was satisfied, and mass and size of logs (>10 centimeters d.b.h. large-end diameter) at the end of the rotation for 64 experimental thinning treatments starting with stand conditions created by the 272-297 first-rotation treatment, 80-year rotation strategy (second rotation in table 5). Graphs on left are mean (±1se) stand age when the log-mass criterion was satisfied for four log-creation scenarios. Log mass (E) and size (F) are means (±1se) at age 80 prior to the rotation harvest. All values are based on scenarios without artificial creation of snags. Means are based on eight simulation replications. Data also are presented in appendix table 37.

appreciably different structures and compositions. An important implication of these results is the potential to create a range of stand structures to achieve rapid development of late-successional conditions. Managing for a variety of stand structures provides greater resilience to natural disturbances, offers greater habitat diversity for wildlife, and increases future options that will be essential as our understanding of uneven-age management increases. Determining actual benefits of different long-term stand conditions was beyond the scope of this study. However, desired future stand conditions as determined by integrative assessments involving foresters, wildlife biologists, and economists should be incorporated with goals related to the development of late-successional conditions in future assessments of thinning treatments.

Extracted merchantable volume—Tradeoffs between rate of attainment of late-successional conditions and volume were evident for longer rotations. For rotations ≥180 years, treatments that promoted the most rapid development of late-successional attributes (e.g., 136-99-186) afforded less volume (100 to 200 m^3/ha) compared to treatments that delayed development by about 10 to 30 years (e.g., all-99-186). Thinning to 136 TPH in the first entry removed a considerable amount of volume but resulted in a limited number of larger stems being removed in subsequent entries. Delaying an extensive thinning for 20 years resulted in the removal of more and larger stems and thus more volume than treatments initially thinning to 136 TPH. The potential to trade developmental time of late-successional attributes for extracted volume was less apparent for shorter rotations. For 80- to 100-year rotations, thinning to 136 TPH at age 40 produced less volume but generally much greater development of late-successional attributes than other treatments.

Second-Rotation Experiments

Stand characteristics—Retention levels of the first-rotation harvest facilitated rapid development of large boles in the second-rotation experiments. For all but the 260-year rotation strategy, the large-bole criterion generally was satisfied within 50 years of the beginning of the second rotation. This rapid attainment was due to the density of large boles in the residual canopy and continual recruitment of large boles from the residual cohort. Retaining 15 percent of the canopy cover in the 260-year strategy delayed satisfying the large-bole criterion relative to the first rotation, except for treatments initially thinning to 136 TPH. This delay was due largely to lower growth rates of stems under the old-growth canopy. In this study, we selected the largest boles for retention at the first-rotation harvest. In practice, retaining a cross section of sizes when harvesting older stands may be more desirable and would likely lead to more rapid development of large boles in subsequent rotations.

Initial stand conditions also influenced the developmental rate of other late-successional conditions. Stand conditions created by retention of 15-percent canopy cover in the 260-year rotation required a heavy thin of the planted and regenerated understory for rapid development of shade-tolerant stems and differentiation of canopy layers. In contrast, initial conditions of the 80-year rotation stands required light thins for balanced development of large boles, vertical diversity, and shade-tolerant stem densities. For stands initiated with ≥30-percent canopy cover, balancing overstory and understory stem development with light followed by heavy thins was necessary for rapid development of live, late-successional attributes.

Dead-wood criteria were satisfied sooner in the second than in the first rotation for similar thinning densities. Log mass was generally high at the end of the first rotation. For all rotation strategies, the threshold level of this attribute was achieved within 40 to 60 years in the second rotation without artificial supplements. An impor-

tant assumption of simulated rotation harvests was that logs were not burned or removed to facilitate artificial regeneration. In practice, site-preparation methods would lower initial levels of log mass and extend the amount of time required to satisfy the log-mass criterion. The enhanced snag densities of the initial stands in addition to natural recruitment generally were sufficient to satisfy the snag criterion within 40 years. For rotations ≥100 years, the influence of artificially created snags diminished with time owing to breakage and decay. In these rotations, natural recruitment of snags, which was influenced by thinning intensity, was more important. Higher thinning densities in the second and third entry promoted higher rates of stress-related mortality and, in turn, the development of more snags sooner.

The residual canopy cover of the initial stands influenced levels of late-successional conditions at the end of the second rotation. For the 180- and 260-year rotations, the added canopy cover restricted growth rates and thus decreased the density of large boles compared to similar treatments in the first rotation. For the shorter rotation strategies, the residual canopy provided a source of large boles not present in the first rotation; thus, more large boles were present at the end of the second than at the end of the first rotation for similar treatments. The 260- and 100-year rotation strategies resulted in lower values of vertical structure and higher densities of shade-tolerant stems in the second compared to the first rotation. The opposite trend occurred in the 180-year scenario. Both vertical diversity and shade-tolerant stem densities were generally higher for treatments in the second- compared to the first-rotation experiments for the 80-year rotation.

Extracted merchantable volume–The effects of residual canopy cover on extracted merchantable volume were generally predictable. The residual canopy in the initial stand decreased growth rates and overall sizes of stems. This resulted in an average of 16 percent (3 to 30 percent) less volume in the second rotation compared to the first rotation for similar treatments. An important feature of our final harvest retention was that the largest possible boles were retained. In practice, economic incentives would motivate the removal of some of the larger stems, which would be about twice the age of the rotation interval. Thus, our calculations of extracted volume for the second-rotation treatments likely underestimate what would be realized.

Model Limitations

A repeating theme throughout the rotation strategies was the importance of shade-tolerant stems in the development of multilayer canopies. Density of shade-tolerant stems in the original stand influenced the efficiency of treatments started with high thinning densities. The efficiency of treatments that initially thinned to 136 TPH was partly due to the simulated regeneration rates of shade-tolerant species. This apparent sensitivity of treatment efficiency to initial stand conditions and inseeding rates warrants special attention when evaluating results of this study. A formal sensitivity analysis to determine the effect of species composition of the initial stand on treatment performance was not conducted. Thus, the applicability of these results to single-species stands or young stands with substantially more shade-tolerant stems than the initial conditions used in this study is unknown. The modeled inseeding rate of shade-tolerant species was fine-tuned to empirical observations but still represented average conditions. In practice, seedbed conditions and seed source can be limiting constraints. In evaluating the results of this study, it is important to consider how well simulated and actual inseeding rates correspond. If shade-tolerant seed source or seedbed conditions are limiting, then actual developmental rates will be prolonged compared to predicted results. Conversely, predictions will be conservative for sites

with an abundant source of western hemlock or western redcedar seeds. Modeled inseeding rates are documented in Garman et al. (1999) and can be used for comparisons with empirical observations.

Although the simulated coarse woody debris trends are useful, these results should be viewed with caution owing to the assumptions and simplicity of the dead-wood algorithms. Simulated snag and log development are sensitive to ambient mortality rates. As a useful simplification, ambient mortality is modeled as an annual rate even though natural disturbances and tree mortality occur at irregular intervals. An important implication of this simplification is that simulated dead-wood recruitment is likely more constant over time than real-world recruitment rates. Another simplification is the use of a constant annual mortality rate independent of size or age. Actual mortality rates change with stand development (e.g., Harcombe 1986) and also are variable among stands. At best, natural recruitment levels reported in this study represent maxima. However, by not considering severe, natural stand-level disturbances and resulting pulses of dead wood, simulated results for the longer rotation intervals may underestimate coarse woody debris levels during portions of stand development.

These and other assumptions and simplifications introduce uncertainty and error into simulation results. However, given that uncertainty and error were constant among experiments, relative differences among treatments are most likely representative of actual responses. Thus, results of this study should be viewed in relative not absolute terms.

Management mplications

Multiple thinning strategies can enhance rapid development of late-successional attributes. Based on the results of this study, two general approaches can be used to balance the development of large boles with vertical differentiation and tree-species diversity. Initially removing 80 percent of the original stocking density promotes accelerated development of large boles but also can lead to the establishment of a dense tree understory. In practice, the density of this tree understory will depend on many factors, such as seed source, site conditions, and climatic factors. In this study, however, thinning the tree understory at age 60 to 99 TPH was essential to promote the most rapid development of live late-successional attributes. Alternatively, leaving more than 40 percent of the original stocking density and thinning heavy at age 60 only delayed attainment of late-successional thresholds by 10 to 30 years but afforded 100 to 200 m^3/ha more extracted volume. Both of these general strategies may require artificial creation of snags and logs, depending on the rotation interval and dead-wood objectives. Determining which of these general strategies to implement should be based on site-specific conditions and the vulnerability of a stand to natural disturbances. On highly exposed sites, treatments creating a sparse overstory should be avoided to minimize windthrow damage. Treatments leaving a higher density of overstory stems would reduce the likelihood of windthrow. Also, given other potential mortality factors, stands with higher stocking densities could sustain a greater loss of overstory stems and continue to lead to rapid development of late-successional conditions.

Criteria for selecting a thinning regime also should include desired long-term stand conditions. Results of this study illustrated two important relations between rapid development of late-successional attributes and long-term stand conditions. First, treatments that promote rapid development of an attribute will not necessarily produce the highest levels of the attribute over the course of a rotation. In this study, treatments providing rapid development of live, late-successional attributes generally produced

relatively lower densities of shade-tolerant stems, lower amounts of Douglas-fir basal area, and fewer snags and logs over a rotation compared to other treatments. Second, treatments promoting similar developmental rates of late-successional conditions can produce very different stand structures over the long term. Simply managing for late-successional conditions may be insufficient to satisfy long-term biodiversity needs. For instance, treatments that emphasize large-bole production at the expense of other attributes will create abundant habitat for wildlife species requiring large branches for nesting platforms, and that feed and nest in bark furrows characteristic of large Douglas-fir boles, but at the expense of overall habitat diversity. Treatments that balance levels of attributes over time will provide greater overall habitat diversity but possibly lower habitat quality for specific taxa.

Multiple thinning strategies should be considered when managing young forests over a watershed or landscape area. Managing for similar stand conditions over large extents can limit important habitat features, reduce functional connectivity, and also facilitate the spread of diseases and disturbances. Also, regardless of how extensively thinning treatments are evaluated prior to field implementation, there is still much uncertainty as to how actual stands will respond to a thinning treatment. Using more than one thinning regime for young stands ensures meeting specific management goals in addition to creating a diversity of habitat conditions. Also, stand structures created by multiple thinning strategies provide more future options, which will be important as our understanding of uneven-age management increases. A recommended approach is to use a collection of treatments that satisfy separate but overlapping goals. Goals could include rapid attainment of late-successional conditions, moderate attainment rates and economic return, and creation of different levels of late-successional attributes throughout a rotation. Results from this and other studies (e.g., Barbour and others 1997, McComb and others 1993, Tappeiner and others 1998) can be used to determine the range of stand-level treatments that could satisfy each of these goals.

Acknowledgments

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English Equivalents

1 centimeter (cm) = 0.394 inch

1 meter = 3.281 feet

1 square meter (m^2) = 10.7 square feet

1 cubic meter (m^3) = 35.31 cubic feet

1 hectare (ha) = 2.47 acres

1 megagram (Mg) = 1.1 ton

1 cubic meter per hectare (m3/ha) = 14.29 cubic feet per acre

1 square meter per hectare (m2/ha) = 4.37 square feet per acre

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Table 9—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments, 260-year rotation strategy (first rotation in table 2)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[b]			Stand density index by thinning entry[c]			Criteria[d]							PSME BA[f]	Extracted merchantable volume[g]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems		All[e]		
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	Age	(m^2/ha)	(m^3/ha)
1	136/99/62	136/0	99/18	62/63	150	171	241	110	34.5	138.1	11.6	123.8	69.8	138.1	58.8	1166.0
2	136/99/124	136/0	99/19	124/64	150	175	279	112.5	35.7	130	12.1	115.6	64.3	130.0	60.1	1166.9
3	136/99/186	136/0	99/18	180/62	150	172	300	112.5	35.8	117.5	12.4	110	57.7	118.8	59.7	1146.3
4	136/99/all	136/0	99/19	1064/64	150	174	443	114.4	36.6	116.3	11.4	111.3	65.6	117.5	59.7	1150.0
5	136/198/62	136/0	187/18	62/93	150	280	335	120.6	50.1	159.4	12.1	135.6	40.6	159.4	73.7	1183.7
6	136/198/124	136/0	195/19	111/95	150	287	380	123.1	51.3	130	11.7	128.1	39.1	138.8	75.5	1182.9
7	136/198/186	136/0	194/19	112/94	150	287	377	124.4	51.4	124.4	11.9	126.9	39.4	138.1	75.8	1170.9
8	136/198/all	136/0	196/19	780/92	150	281	508	123.1	48.9	123.8	12.2	128.1	53.8	144.4	72.8	1180.0
9	136/297/62	136/0	190/18	62/95	150	292	343	121.3	50.2	163.8	12	136.3	43.4	163.8	73.4	1167.6
10	136/297/124	136/0	209/18	118/96	150	297	387	123.8	50.9	136.3	11.8	126.3	38.9	140	75.0	1177.2
11	136/297/186	136/0	210/19	121/95	150	300	387	123.8	53.3	115.6	11.8	128.1	33.6	133.8	77.7	1202.6
12	136/297/all	136/0	204/18	754/96	150	294	519	125	51.8	113.1	12.2	130.0	50.9	139.4	75.9	1175.1
13	136/all/62	136/0	1060/20	62/92	150	422	317	122.5	45.5	169.4	12.1	141.3	52.3	169.4	68.7	1187.2
14	136/all/124	136/0	962/18	124/90	150	410	349	121.9	48.2	152.5	12.0	135.0	44.2	152.5	71.9	1170.5
15	136/all/186	136/0	1048/20	186/93	150	420	386	124.4	51.3	154.4	12.4	138.1	41.4	154.4	75.0	1178.0
16	136/all/all	136/0	994/19	1006/92	150	412	579	125.6	52.1	173.8	11.5	142.5	54.6	173.8	76.4	1142.4
17	272/99/62	272/0	99/7	62/58	271	168	219	120.6	37	153.8	11.7	131.9	67.0	153.8	63.3	1273.4
18	272/99/124	272/0	99/7	124/56	271	169	254	120.6	38.6	138.1	11.8	130.0	63.8	138.1	61.7	1276.5
19	272/99/186	272/0	99/7	186/58	271	169	303	123.8	43.4	141.9	12.1	135.0	53.2	141.9	66.4	1262.3
20	272/99/all	272/0	99/7	1093/57	271	168	442	126.3	43.8	166.9	11.3	148.1	62.8	172.5	66.1	1239.1
21	272/198/62	272/0	197/7	62/67	271	319	294	135	55.3	223.8	11.2	200.6	42.2	223.8	77.4	1280.9
22	272/198/124	272/0	197/7	124/68	271	319	403	142.5	67	246.4	8.9	229.4	26.0	246.4	90.4	1296.3
23	272/198/186	272/0	197/7	124/69	271	320	407	143.1	64.8	248.1	8.7	228.1	27.6	248.1	88.2	1258.3
24	272/198/all	272/0	197/7	659/68	271	321	540	143.1	64.5	236.9	9.6	210.0	35.0	236.9	88.6	1254.2
25	272/297/62	272/0	246/6	62/68	271	392	297	136.9	56.6	225	11.0	194.4	47.8	225.0	77.2	1301.6
26	272/297/124	272/0	244/7	124/70	271	392	412	145.6	68.8	253.4	8.2	231.9	24.9	253.4	91.1	1263.4
27	272/297/186	272/0	245/7	162/70	271	394	480	150	68.8	257.5	7.9	238.8	18.5	257.5	95.6	1261.1
28	272/297/all	272/0	244/7	604/69	271	391	598	153.1	72	247.5	8.5	221.9	28.2	247.5	96.0	1245.4
29	272/all/62	272/0	765/7	62/69	271	498	270	134.4	49.7	201.3	11.8	160.0	53.9	201.3	72.1	129.0
30	272/all/124	272/0	775/7	124/67	271	499	342	139.4	59	215	10.2	165.0	39.6	215.0	79.6	1291.1
31	272/all/186	272/0	748/6	186/66	271	496	421	146.9	67.6	215	9.0	182.5	25.5	223.1	88.8	1293.8
32	272/all/all	272/0	745/7	833/68	271	495	648	154.4	71.3	235	9.0	205.6	34.4	235.0	95.0	1236.5
33	408/99/62	408/0	99/4	62/35	351	137	148	124.4	32.4	133.8	11.0	123.8	75.5	133.8	57.4	1343.5
34	408/99/124	408/0	99/4	124/34	351	138	190	125.6	35.8	123.8	11.2	121.9	72.3	128.1	57.3	1333.4
35	408/99/186	408/0	99/4	186/36	351	138	228	129.4	37.1	118.1	11.5	125.0	68.0	130.0	59.0	1343.6
36	408/99/all	408/0	99/4	1094/37	351	139	402	132.5	43.1	140	11.0	138.8	62.6	151.9	67.5	1331.6

Table 9—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments, 260-year rotation strategy (first rotation in table 2) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[b]			Stand density index by thinning entry[c]			Criteria[d]							PSME BA[f]	Extracted merchantable volume[g]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems		All[e]		
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	Age	(m^2/ha)	(m^3/ha)
37	408/198/62	408/0	197/4	62/45	351	262	207	127.5	41	182.5	11.4	150	65.2	182.5	64.2	1357.9
38	408/198/124	408/0	197/4	124/44	351	262	286	134.4	52	210	11.4	163.8	45.3	210	74.1	1362
39	408/198/186	408/0	197/4	186/47	351	263	369	141.9	62	228.1	9.5	178.8	28.2	228.1	86.4	1339.4
40	408/198/all	408/0	197/4	937/46	351	263	523	146.3	60.3	230	10	195	42.9	230	83.6	1311
41	408/297/62	408/0	297/4	62/47	351	390	226	134.4	47.8	200	11.7	171.3	56.5	200	71.1	1376.2
42	408/297/124	408/0	297/4	124/46	351	389	321	141.3	58.3	238.8	9.6	215	34.8	238.8	82.5	1335.3
43	408/297/186	408/0	297/4	186/46	351	387	414	151.3	65.4	258.8	7.8	241.9	18.4	258.8	92	1343.1
44	408/297/all	408/0	297/4	730/47	351	388	603	158.1	66.7	258.8	7.9	231.3	24	258.8	95.7	1302.3
45	408/all/62	408/0	727/4	62/47	351	558	215	136.9	43.2	181.9	11.5	160	66.7	181.9	66.2	1338.9
46	408/all/124	408/0	744/4	124/47	351	561	298	142.5	56.9	222.5	10.6	178.8	43.1	222.5	79.7	1337.4
47	408/all/186	408/0	747/4	186/47	351	560	383	148.1	61.2	222.5	8.9	194.4	28.2	231.3	86.1	1352.1
48	408/all/all	408/0	766/4	814/48	351	563	698	163.8	68.3	150.6	8.5	228.1	25.5	231.9	100	1247.7
49	All/99/62	652/0	99/3	62/26	448	116	119	126.9	30.8	141.9	10.6	120.6	80	141.9	53.6	1350.3
50	All/99/124	652/0	99/3	124/27	448	115	157	128.8	33.5	130	10.8	119.4	73	130.6	54.4	1323.7
51	All/99/186	652/0	99/3	186/26	448	114	197	130.6	37.7	120.6	10.9	121.3	67.3	131.3	57.6	1349.6
52	All/99/all	652/0	99/3	984/25	448	114	348	138.1	43.3	108.8	10.3	130.6	58.8	138.8	66.7	1342.4
53	All/198/62	652/0	197/3	62/39	448	222	172	127.5	35.4	143.8	11	133.8	71.1	143.8	59.3	1388
54	All/198/124	652/0	197/3	124/37	448	223	224	131.3	44.1	106.9	11.9	130	57.8	132.5	67	1330.8
55	All/198/186	652/0	197/3	186/36	448	221	286	138.1	49.3	103.8	11.2	136.9	47.7	140.6	71.5	1351.5
56	All/198/all	652/0	197/3	1088/38	448	221	486	143.1	58	179.4	10.2	157.5	44.4	189.4	80.7	1351.9
57	All/297/62	652/0	297/3	62/41	448	330	196	131.3	41	180.6	11.5	159.4	64.9	180.6	64.1	1382.8
58	All/297/124	652/0	297/3	124/42	448	329	283	138.1	54.7	225	10.7	188.8	42	225	76.4	1380.2
59	All/297/186	652/0	297/3	186/41	448	330	358	145	60.2	238.1	8.9	220	24.9	238.8	85.1	1376.9
60	All/297/all	652/0	297/3	940/40	448	329	575	153.1	64.4	249.4	8.4	220.6	29.4	249.4	89.3	1339.8
61	All/all/62	652/0	796/3	62/40	448	603	192	136.3	40.3	161.9	11.1	159.4	65.3	173.1	64	1374.1
62	All/all/124	652/0	799/3	124/42	448	603	279	141.9	52.8	201.9	10.8	177.5	48.6	207.5	75.6	1359
63	All/all/186	652/0	806/3	186/40	448	607	358	147.5	58.3	218.8	9.1	195.6	30	230.6	84.4	1325.9
64	All/all/all	652/0	784/3	803/41	448	598	708	165.6	69	166.4	8.3	222.5	21.2	228.3	101	1214.4

[a] Target thinning density corresponds to densities specified in the experimental design; d.b.h. = diameter at breast height.

[b] Modeled density corresponds to actual simulated densities.

[c] Stand density index is a measure of the stocking density following a thinning entry.

[d] Under "Criteria," age is stand age when the threshold level of a criterion (see table 6) was met and is followed by the value of the criterion at stand age 260 prior to the final harvest.

[e] The minimum stand age when large bole, canopy height diversity index (CHDI), and shade-tolerant stem-density criteria were met.

[f] PSME BA is Douglas-fir basal area at stand age 260 prior to the rotation harvest.

[g] Extracted merchantable volume is the volume extracted in each thinning entry plus the rotation harvest at stand age 260.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 2.

Table 10—Simulated measures of snags for 64 experimental thinning treatments, 260-year rotation strategy (first rotation in table 2)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
1	136/99/62	136/0	98/18	62/63	150	171	241	101.9	21.9	95.9	93.1	21.9	95.9	81.9	21.9	95.9	76.3	21.9	95.9
2	136/99/124	136/0	98/19	123/64	150	175	279	116.3	19.1	104	111.3	19.1	104	101.9	19.1	104	97.5	19.1	104
3	136/99/186	136/0	98/18	180/62	150	172	300	118.1	20.9	98.8	106.3	20.9	98.8	88.1	20.9	98.8	82.5	20.9	98.8
4	136/99/all	136/0	98/19	1064/64	150	174	443	107.5	21.8	93.7	91.9	21.8	93.7	85	21.8	93.7	78.8	21.8	93.7
5	136/198/62	136/0	187/18	62/93	150	280	335	91.3	19.8	109.5	86.9	19.8	109.5	78.1	19.8	109.5	77.5	19.8	109.5
6	136/198/124	136/0	195/19	111/95	150	287	380	87.5	23	104.9	83.8	23	104.9	81.3	23	104.9	79.4	23	104.9
7	136/198/186	136/0	194/19	112/94	150	287	377	84.4	21.5	105.3	81.9	21.5	105.3	80	21.5	105.3	78.8	21.5	105.3
8	136/198/all	136/0	196/19	780/92	150	281	508	86.9	20.8	104.5	82.5	20.8	104.5	78.8	20.8	104.5	76.9	20.8	104.5
9	136/297/62	136/0	190/18	62/95	150	292	343	90.6	19.7	109.3	90.6	19.7	109.3	84.4	19.7	109.3	81.9	19.7	109.3
10	136/297/124	136/0	209/18	118/96	150	297	387	85	21.9	108	85	21.9	108	85	21.9	108	85	21.9	108
11	136/297/186	136/0	210/19	121/95	150	300	387	85.6	22.3	103.2	85.6	22.3	103.2	85.6	22.3	103.2	85.6	22.3	103.2
12	136/297/all	136/0	204/18	754/96	150	294	519	82.5	19.6	104.3	82.5	19.6	104.3	82.5	19.6	104.3	82.5	19.6	104.3
13	136/all/62	136/0	1060/20	62/92	150	422	317	83.8	19.8	107.8	83.8	19.8	107.8	81.9	19.8	107.8	80.6	19.8	107.8
14	136/all/124	136/0	962/18	123/90	150	410	349	84.4	19.8	106.6	84.4	19.8	106.6	81.3	19.8	106.6	80	19.8	106.6
15	136/all/186	136/0	1048/20	186/93	150	420	386	83.8	21.4	102.6	83.8	21.4	102.6	80.6	21.4	102.6	80	21.4	102.6
16	136/all/all	136/0	994/19	1006/92	150	412	579	81.9	24	97.9	81.9	24	97.9	81.9	24	97.9	81.9	24	97.9
17	272/99/62	272/0	99/7	62/58	271	168	219	128.8	20.9	94.3	122.5	20.9	94.3	106.3	20.9	94.3	102.5	20.9	94.3
18	272/99/124	272/0	99/7	123/56	271	169	254	100	22.5	97.6	91.9	22.5	97.6	81.3	22.5	97.6	80	22.5	97.6
19	272/99/186	272/0	99/7	186/58	271	169	303	99.4	23.1	96.5	93.8	23.1	96.5	83.8	23.1	96.5	81.3	23.1	96.5
20	272/99/all	272/0	99/7	1093/57	271	168	442	103.1	23.6	97.3	95.6	23.6	97.3	85.6	23.6	97.3	81.3	23.6	97.3
21	272/198/62	272/0	198/7	62/67	271	319	294	86.9	18.8	107.3	84.4	18.8	107.3	80.6	18.8	107.3	80	18.8	107.3
22	272/198/124	272/0	198/7	123/68	271	319	403	89.4	23.2	100.8	86.3	23.2	100.8	81.3	23.2	100.8	77.5	23.2	100.8
23	272/198/186	272/0	198/7	124/69	271	320	407	85	23.5	101.8	80.6	23.5	101.8	76.9	23.5	101.8	73.8	23.5	101.8
24	272/198/all	272/0	198/7	659/68	271	321	540	84.4	24.9	99.3	80.6	24.9	99.3	76.3	24.9	99.3	75	24.9	99.3
25	272/297/62	272/0	246/6	62/68	271	392	297	85.6	20.2	106.7	85.6	20.2	106.7	81.9	20.2	106.7	80.6	20.2	106.7
26	272/297/124	272/0	244/7	123/70	271	392	412	83.1	23.2	98.8	83.1	23.2	98.8	81.9	23.2	98.8	80	23.2	98.8
27	272/297/186	272/0	245/7	162/70	271	394	480	83.8	28.8	95.1	83.8	28.8	95.1	83.8	28.8	95.1	83.8	28.8	95.1
28	272/297/all	272/0	244/7	604/69	271	391	598	83.8	29.1	94.8	83.8	29.1	94.8	83.8	29.1	94.8	83.8	29.1	94.8
29	272/all/62	272/0	765/7	62/69	271	498	270	84.4	19.7	100.5	84.4	19.7	100.5	81.3	19.7	100.5	79.4	19.7	100.5
30	272/all/124	272/0	775/7	123/67	271	499	342	84.4	22	100.8	84.4	22	100.8	81.9	22	100.8	80	22	100.8
31	272/all/186	272/0	748/6	186/66	271	496	421	86.3	25.1	98.7	86.3	25.1	98.7	82.5	25.1	98.7	80	25.1	98.7
32	272/all/all	272/0	745/7	833/68	271	495	648	85.6	28.7	93.4	85.6	28.7	93.4	85.6	28.7	93.4	85.6	28.7	93.4
33	408/99/62	408/0	99/4	62/35	351	137	148	161.3	23.9	86.7	160.6	23.9	86.7	136.3	23.9	86.7	133.8	23.9	86.7
34	408/99/124	408/0	99/4	123/34	351	138	190	122.5	22.6	89.9	117.5	22.6	89.9	93.1	22.6	89.9	85	22.6	89.9
35	408/99/186	408/0	99/4	186/36	351	138	228	117.5	23	92.8	113.8	23	92.8	92.5	23	92.8	84.4	23	92.8
36	408/99/all	408/0	99/4	1094/37	351	139	402	113.8	25	91	104.4	25	91	99.4	25	91	95.6	25	91

Table 10—Simulated measures of snags for 64 experimental thinning treatments, 260-year rotation strategy (first rotation in table 2) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
37	408/198/62	408/0	198/4	62/45	351	262	207	120.6	20.9	97.1	115.6	20.9	97.1	101.9	20.9	97.1	98.1	20.9	97.1
38	408/198/124	408/0	198/4	123/44	351	262	286	97.5	22.7	101	90	22.7	101	81.9	22.7	101	80.6	22.7	101
39	408/198/186	408/0	198/4	186/47	351	263	369	95.6	23	99.6	90.6	23	99.6	81.9	23	99.6	80.6	23	99.6
40	408/198/all	408/0	198/4	937/46	351	263	523	93.1	23.6	99	88.1	23.6	99	83.8	23.6	99	80	23.6	99
41	408/297/62	408/0	297/4	62/47	351	390	226	113.8	19.8	98.8	107.5	19.8	98.8	100	19.8	98.8	98.1	19.8	98.8
42	408/297/124	408/0	297/4	123/46	351	389	321	90	22.2	101.2	86.3	22.2	101.2	80	22.2	101.2	80	22.2	101.2
43	408/297/186	408/0	297/4	186/46	351	387	414	93.8	25.7	96.6	88.8	25.7	96.6	84.4	25.7	96.6	81.3	25.7	96.6
44	408/297/all	408/0	297/4	730/47	351	388	603	87.5	30.3	90.5	83.8	30.3	90.5	80	30.3	90.5	77.5	30.3	90.5
45	408/all/62	408/0	727/4	62/47	351	558	215	91.3	23.3	90	91.3	23.3	90	86.9	23.3	90	81.9	23.3	90
46	408/all/124	408/0	744/4	123/47	351	561	298	93.1	21.9	100.1	93.1	21.9	100.1	87.5	21.9	100.1	81.9	21.9	100.1
47	408/all/186	408/0	747/4	186/47	351	560	383	93.1	24.4	97.9	93.1	24.4	97.9	86.9	24.4	97.9	82.5	24.4	97.9
48	408/all/all	408/0	766/4	814/48	351	563	698	86.9	35.6	88.2	86.9	35.6	88.2	86.9	35.6	88.2	86.9	35.6	88.2
49	All/99/62	652/0	99/3	62/26	448	116	119	148.8	27.8	82.1	148.8	27.8	82.1	131.3	27.8	82.1	105.6	27.8	82.1
50	All/99/124	652/0	99/3	123/27	448	115	157	137.5	24.3	85.1	135.6	24.3	85.1	110	24.3	85.1	97.5	24.3	85.1
51	All/99/186	652/0	99/3	186/26	448	114	197	136.9	24.2	91.9	132.5	24.2	91.9	118.8	24.2	91.9	110.6	24.2	91.9
52	All/99/all	652/0	99/3	984/25	448	114	348	116.9	28	88.5	109.4	28	88.5	100.6	28	88.5	95	28	88.5
53	All/198/62	652/0	198/3	62/39	448	222	172	126.9	24.5	89.6	119.4	24.5	89.6	104.4	24.5	89.6	95	24.5	89.6
54	All/198/124	652/0	198/3	123/37	448	223	224	106.9	21	95.6	104.4	21	95.6	89.4	21	95.6	82.5	21	95.6
55	All/198/186	652/0	198/3	186/36	448	221	286	103.8	22.7	97.7	98.8	22.7	97.7	89.4	22.7	97.7	81.9	22.7	97.7
56	All/198/all	652/0	198/3	1088/38	448	221	486	102.5	22.6	95.5	98.1	22.6	95.5	91.3	22.6	95.5	88.1	22.6	95.5
57	All/297/62	652/0	297/3	62/41	448	330	196	106.3	23.2	89.8	100	23.2	89.8	84.4	23.2	89.8	80.6	23.2	89.8
58	All/297/124	652/0	297/3	123/42	448	329	283	100.6	21.3	99.5	95	21.3	99.5	85	21.3	99.5	81.3	21.3	99.5
59	All/297/186	652/0	297/3	186/41	448	330	358	101.9	25.2	98.2	96.3	25.2	98.2	85	25.2	98.2	80.6	25.2	98.2
60	All/297/all	652/0	297/3	940/40	448	329	575	90	28.2	94.6	86.9	28.2	94.6	83.1	28.2	94.6	80	28.2	94.6
61	All/all/62	652/0	796/3	62/40	448	603	192	101.3	26.3	90.2	101.3	26.3	90.2	95.6	26.3	90.2	86.9	26.3	90.2
62	All/all/124	652/0	799/3	124/42	448	603	279	96.3	23	97.9	96.3	23	97.9	91.9	23	97.9	84.4	23	97.9
63	All/all/186	652/0	806/3	186/40	448	607	358	93.8	24.8	96.7	93.8	24.8	96.7	88.8	24.8	96.7	83.1	24.8	96.7
64	All/all/all	652/0	784/3	803/41	448	598	708	90	34.7	85.3	90	34.7	85.3	90	34.7	85.3	90	34.7	85.3

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each snag-creation strategy, age is stand age when the threshold level for snag density (see table 6) was met, followed by density and mean d.b.h. at stand age 260 prior to the rotation harvest.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 3.

Table 11—Simulated measures of logs for 64 experimental thinning treatments, 260-year rotation strategy (first rotation in table 2)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
1	36/99/62	136/0	99/18	62/63	150	171	241	135	101.9	54.3	131.3	101.9	54.3	131.3	101.9	54.3	131.3	101.9	54.3
2	136/99/124	136/0	99/19	124/64	150	175	279	131.3	111.2	55.7	128.8	111.2	55.7	128.8	111.2	55.7	128.8	111.2	55.7
3	136/99/186	136/0	99/18	180/62	150	172	300	137.5	124.3	57.8	130.6	124.3	57.8	130.6	124.3	57.8	130	124.3	57.8
4	136/99/all	136/0	99/19	1064/64	150	174	443	126.3	123	57	126.3	123	57	126.3	123	57	126.3	123	57
5	136/198/62	136/0	187/18	62/93	150	280	335	123.1	139.1	55.4	123.1	139.1	55.4	122.5	139.1	55.4	120	139.1	55.4
6	136/198/124	136/0	195/19	111/95	150	287	380	123.1	130.8	56.2	123.1	130.8	56.2	123.1	130.8	56.2	123.1	130.8	56.2
8	136/198/all	136/0	196/19	780/92	150	281	508	121.9	142.6	59.8	119.4	142.6	59.8	119.4	142.6	59.8	119.4	142.6	59.8
9	136/297/62	136/0	190/18	62/95	150	292	343	123.8	138.1	55.2	123.8	138.1	55.2	123.8	138.1	55.2	120.6	138.1	55.2
10	136/297/124	136/0	209/18	118/96	150	297	387	119.4	129.2	54.6	119.4	129.2	54.6	119.4	129.2	54.6	119.4	129.2	54.6
11	136/297/186	136/0	210/19	121/95	150	300	387	120.6	133.3	55.3	120.6	133.3	55.3	120.6	133.3	55.3	120.6	133.3	55.3
12	136/297/all	136/0	204/18	754/96	150	294	519	121.3	139.4	59.8	121.3	139.4	59.8	121.3	139.4	59.8	121.3	139.4	59.8
13	136/all/62	136/0	1060/20	62/92	150	422	317	127.5	132.3	54.7	127.5	132.3	54.7	121.9	132.3	54.7	115.6	132.3	54.7
14	136/all/124	136/0	962/18	124/90	150	410	349	117.5	126.4	55.1	117.5	126.4	55.1	113.1	126.4	55.1	103.8	126.4	55.1
15	136/all/186	136/0	1048/20	186/93	150	420	386	126.3	121.6	55.6	126.3	121.6	55.6	122.5	121.6	55.6	121.3	121.6	55.6
16	136/all/all	136/0	994/19	1006/92	150	412	579	120	130.7	59.1	120	130.7	59.1	120	130.7	59.1	120	130.7	59.1
17	272/99/62	272/0	99/7	62/58	271	168	219	132.5	109.2	52.4	128.8	109.2	52.4	124.4	109.2	52.4	118.8	109.2	52.4
18	272/99/124	272/0	99/7	124/56	271	169	254	133.1	106.9	56.1	130	106.9	56.1	126.3	106.9	56.1	122.5	106.9	56.1
19	272/99/186	272/0	99/7	186/58	271	169	303	130.6	120.6	54.5	128.1	120.6	54.5	128.1	120.6	54.5	128.1	120.6	54.5
20	272/99/all	272/0	99/7	1093/57	271	168	442	128.8	129.3	55.9	123.8	129.3	55.9	123.8	129.3	55.9	123.8	129.3	55.9
21	272/198/62	272/0	198/7	62/67	271	319	294	121.9	118.4	52.9	116.3	118.4	52.9	112.5	118.4	52.9	100.6	118.4	52.9
22	272/198/124	272/0	198/7	124/68	271	319	403	120	123.7	50.7	113.1	123.7	50.7	113.1	123.7	50.7	113.1	123.7	50.7
23	272/198/186	272/0	198/7	124/69	271	320	407	112.5	136.1	51.9	108.8	136.1	51.9	108.8	136.1	51.9	108.8	136.1	51.9
24	272/198/all	272/0	198/7	659/68	271	321	540	117.5	137.2	55.1	116.3	137.2	55.1	116.3	137.2	55.1	116.3	137.2	55.1
25	272/297/62	272/0	246/6	62/68	271	392	297	123.8	122.7	54.4	123.8	122.7	54.4	116.3	122.7	54.4	106.3	122.7	54.4
26	272/297/124	272/0	244/7	124/70	271	392	412	110	136.8	51.8	110	136.8	51.8	103.1	136.8	51.8	87.5	136.8	51.8
27	272/297/186	272/0	245/7	162/70	271	394	480	114.4	145.7	52	114.4	145.7	52	114.4	145.7	52	114.4	145.7	52
28	272/297/all	272/0	244/7	604/69	271	391	598	115	145.7	53.4	115	145.7	53.4	115	145.7	53.4	115	145.7	53.4
29	272/all/62	272/0	765/7	62/69	271	498	270	125	114.8	54.1	125	114.8	54.1	121.3	114.8	54.1	112.5	114.8	54.1
30	272/all/124	272/0	775/7	124/67	271	499	342	118.8	124.3	55	118.8	124.3	55	110	124.3	55	97.5	124.3	55
31	272/all/186	272/0	748/6	186/66	271	496	421	120.6	135	52.6	120.6	135	52.6	108.1	135	52.6	97.5	135	52.6
32	272/all/all	272/0	745/7	833/68	271	495	648	105.6	140.5	55.8	105.6	140.5	55.8	105.6	140.5	55.8	105.6	140.5	55.8
33	408/99/62	408/0	99/4	62/35	351	137	148	150.6	94.4	47.6	148.1	94.4	47.6	143.1	94.4	47.6	139.4	94.4	47.6
34	408/99/124	408/0	99/4	124/34	351	138	190	138.1	100.2	51.4	137.5	100.2	51.4	135	100.2	51.4	129.4	100.2	51.4
35	408/99/186	408/0	99/4	186/36	351	138	228	131.3	103.3	54.4	128.1	103.3	54.4	125.6	103.3	54.4	120	103.3	54.4
36	408/99/all	408/0	99/4	1094/37	351	139	402	126.9	109.3	51.1	125.6	109.3	51.1	125.6	109.3	51.1	125.6	109.3	51.1

Table 11—Simulated measures of logs for 64 experimental thinning treatments, 260-year rotation strategy (first rotation in table 2) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
37	408/198/62	408/0	198/4	62/45	351	262	207	138.8	105.6	51.5	130.6	105.6	51.5	122.5	105.6	51.5	112.5	105.6	51.5
38	408/198/124	408/0	198/4	124/44	351	262	286	124.4	122.1	54.8	121.9	122.1	54.8	117.5	122.1	54.8	103.8	122.1	54.8
39	408/198/186	408/0	198/4	186/47	351	263	369	125	115.1	51.6	119.4	115.1	51.6	118.1	115.1	51.6	113.8	115.1	51.6
40	408/198/all	408/0	198/4	937/46	351	263	523	118.8	127.9	55.9	112.5	127.9	55.9	112.5	127.9	55.9	112.5	127.9	55.9
41	408/297/62	408/0	297/4	62/47	351	390	226	128.8	112.3	51.7	121.3	112.3	51.7	113.1	112.3	51.7	97.5	112.3	51.7
42	408/297/124	408/0	297/4	124/46	351	389	321	123.8	128.7	52.8	117.5	128.7	52.8	106.9	128.7	52.8	93.8	128.7	52.8
43	408/297/186	408/0	297/4	186/46	351	387	414	113.1	137.6	50.1	110	137.6	50.1	100	137.6	50.1	83.8	137.6	50.1
44	408/297/all	408/0	297/4	730/47	351	388	603	109.4	140.8	51.5	102.5	140.8	51.5	102.5	140.8	51.5	102.5	140.8	51.5
45	408/all/62	408/0	727/4	62/47	351	558	215	131.3	109.7	50.7	131.3	109.7	50.7	121.9	109.7	50.7	113.1	109.7	50.7
46	408/all/124	408/0	744/4	124/47	351	561	298	121.9	115.2	54.1	121.9	115.2	54.1	113.8	115.2	54.1	99.4	115.2	54.1
47	408/all/186	408/0	747/4	186/47	351	560	383	113.1	136.7	53.2	113.1	136.7	53.2	103.8	136.7	53.2	94.4	136.7	53.2
48	408/all/all	408/0	766/4	814/48	351	563	698	108.8	147.4	52.8	108.8	147.4	52.8	108.8	147.4	52.8	108.8	147.4	52.8
49	All/99/62	652/0	99/3	62/26	448	116	119	152.5	96.4	46.6	145	96.4	46.6	141.9	96.4	46.6	135.6	96.4	46.6
50	All/99/124	652/0	99/3	124/27	448	115	157	141.9	98.6	50.2	138.1	98.6	50.2	134.4	98.6	50.2	130	98.6	50.2
51	All/99/186	652/0	99/3	186/26	448	114	197	146.9	117.8	54.9	143.1	117.8	54.9	135	117.8	54.9	128.8	117.8	54.9
52	All/99/all	652/0	99/3	984/25	448	114	348	137.5	114.1	50.8	131.9	114.1	50.8	131.9	114.1	50.8	131.9	114.1	50.8
53	All/198/62	652/0	198/3	62/39	448	222	172	139.4	106.5	49	138.1	106.5	49	129.4	106.5	49	119.4	106.5	49
54	All/198/124	652/0	198/3	124/37	448	223	224	136.3	103.8	53.9	134.4	103.8	53.9	128.8	103.8	53.9	121.3	103.8	53.9
55	All/198/186	652/0	198/3	186/36	448	221	286	128.1	112.5	53.7	124.4	112.5	53.7	117.5	112.5	53.7	105.6	112.5	53.7
56	All/198/all	652/0	198/3	1088/38	448	221	486	126.3	119	55.4	120	119	55.4	120	119	55.4	120	119	55.4
57	All/297/62	652/0	297/3	62/41	448	330	196	136.3	115.6	50.5	130	115.6	50.5	120	115.6	50.5	100.6	115.6	50.5
58	All/297/124	652/0	297/3	124/42	448	329	283	127.5	130.8	54.1	121.9	130.8	54.1	118.8	130.8	54.1	100	130.8	54.1
59	All/297/186	652/0	297/3	186/41	448	330	358	126.9	123.7	50.7	121.9	123.7	50.7	113.8	123.7	50.7	90.6	123.7	50.7
60	All/297/all	652/0	297/3	940/40	448	329	575	116.9	136	53.3	114.4	136	53.3	114.4	136	53.3	114.4	136	53.3
61	All/all/62	652/0	796/3	62/40	448	603	192	132.5	107.5	47.9	132.5	107.5	47.9	127.5	107.5	47.9	104.4	107.5	47.9
62	All/all/124	652/0	799/3	124/42	448	603	279	121.3	118.7	54.2	121.3	118.7	54.2	114.4	118.7	54.2	90	118.7	54.2
63	All/all/186	652/0	806/3	186/40	448	607	358	117.5	127.4	53.1	117.5	127.4	53.1	101.9	127.4	53.1	80	127.4	53.1
64	All/all/all	652/0	784/3	803/41	448	598	708	102.5	138.7	51.1	102.5	138.7	51.1	102.5	138.7	51.1	102.5	138.7	51.1

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each log-creation strategy, age is stand age when the threshold level for log mass (see table 6) was met, followed by mass and mean large-end diameter (LED) at stand age 260 prior to the final harvest. Data are from the no-snag-creation scenario (see text).

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 4.

Table 12—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 260-year rotation strategy (second rotation in table 2)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems		All[d]		
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	Age	(m^2/ha)	(m^3/ha)
1	136/99/62	125/11	99/10	62/35	329	274	282	125	24.3	133.8	10.3	120	84.8	136.3	51.3	1057.2
2	136/99/124	125/11	99/10	124/35	333	279	338	93.1	27.9	112.5	11.2	111.9	76.9	120	54.9	1079.7
3	136/99/186	125/11	99/10	186/35	333	279	408	93.8	29.6	115.2	11.1	115.2	75.3	110.1	57.2	1071.2
4	136/99/all	125/11	99/10	1167/34	333	282	576	115	32.3	107.5	10.6	106.3	70.5	127.5	58.9	1061
5	136/198/62	125/11	198/10	62/32	328	378	300	127.5	29.6	113.8	10.7	115	76.9	127.5	58.2	1132.1
6	136/198/124	125/10	198/10	124/34	322	374	366	131.3	36.2	104.4	11.6	109.4	66.3	131.3	62.1	1082.4
7	136/198/186	125/11	198/10	186/30	329	381	439	138.1	43.2	96.9	11.3	110.6	52.1	138.1	68.4	1098.3
8	136/198/all	125/10	198/9	1005/38	319	361	624	139.4	46.4	89.4	10.9	111.9	57.9	139.4	70.9	1096.6
9	136/297/62	125/11	273/10	62/26	331	444	291	117.5	28.1	115.6	10.4	110.6	79.9	131.3	55.4	1120.2
10	136/297/124	125/11	273/10	124/25	333	441	363	135.6	38.4	103.1	11.5	109.4	63	135.6	61.1	1076.4
11	136/297/186	125/11	266/10	186/26	336	442	451	106.9	48	99.4	10.5	111.3	43.9	133.8	74.1	1079.9
12	136/297/all	125/10	279/10	880	326	441	656	146.9	49	87.5	10.6	115.6	50.5	146.9	77	1096.3
13	136/all/62	125/11	1174/10	62/25	328	611	276	99.4	24.8	132.5	10.4	115.6	84.1	133.1	51	1120.4
14	136/all/124	125/10	1093/10	124/25	327	590	321	133.1	28.8	117.5	11.2	113.8	74.7	133.1	53.6	1097.2
15	136/all/186	125/11	1081/10	186/24	336	596	376	120	32.3	111.9	11.4	114.4	69.8	133.8	56.2	1092.6
16	136/all/all	125/11	1072/10	1176/26	329	585	725	128.8	46.9	90	10.1	126.9	57.5	145.6	77.2	1094.9
17	272/99/62	262/11	99/10	62/16	454	301	255	130.6	24.2	142.5	10.4	121.9	85.9	142.5	53.3	1158.8
18	272/99/124	262/11	99/10	124/16	448	300	319	115	27.8	121.3	10.7	123.8	78.4	132.5	54.2	1129.8
19	272/99/186	262/11	99/11	186/14	453	307	374	136.3	35.8	105.6	11.2	126.3	63.8	136.3	62.6	1135.8
20	272/99/all	262/11	99/10	1143/14	452	303	608	143.8	42.5	97.5	10.6	140.6	65.6	145	69.8	1144.3
21	272/198/62	262/11	198/10	62/12	445	414	265	140.6	30.2	123.1	10.3	151.9	79.5	151.9	58.1	1177
22	272/198/124	262/11	198/10	124/11	449	433	377	146.9	48.8	116.9	11.2	167.5	55.9	168.1	76.2	1223
23	272/198/186	262/11	198/10	186/12	450	416	455	151.3	55.4	121.9	10.2	169.4	40	171.3	84.4	1153.5
24	272/198/all	262/11	198/10	891/12	450	428	669	160	55.4	117.5	10.4	175.6	44.5	175.6	89.1	1185
25	272/297/62	262/10	285/9	62/11	446	511	260	143.8	33.2	127.5	10.3	152.5	78.5	152.5	61.4	1223.3
26	272/297/124	262/11	276/10	124/10	451	523	377	151.3	47.4	118.8	10.8	169.4	55.7	170.6	75	1173.7
27	272/297/186	262/11	280/10	186/11	451	521	470	163.8	53	128.8	9.7	198.1	36.1	202.5	88.3	1190.3
28	272/297/all	262/11	272/10	785/10	451	513	712	175	45.7	129.4	9.8	208.1	35.7	208.1	97.7	1160.8
29	272/all/62	262/11	905/10	62/11	453	666	253	147.5	27.6	133.1	10.3	125.6	82.1	147.5	58.1	1221.4
30	272/all/124	262/11	927/10	124/11	450	667	323	148.8	37.2	117.5	11	126.3	67	148.8	63	1182.4
31	272/all/186	262/11	880/10	186/11	450	653	388	155	47.4	107.5	11	131.9	55.4	155	72.4	1181.9
32	272/all/all	262/11	888/10	1048/10	450	661	784	171.9	43.5	116.9	10.4	175.6	41.8	181.9	97.3	1162.9
33	408/99/62	397/10	99/10	62/11	536	288	240	136.9	24.7	146.3	10.1	122.5	86	149.4	52.9	1205
34	408/99/124	397/11	99/10	124/11	537	294	295	138.8	27.8	128.8	10.7	121.3	80.8	139.4	52.5	1178.2
35	408/99/186	397/11	99/10	186/11	537	293	348	142.5	33.9	119.4	11.1	125.6	73.6	142.5	61.5	1188.9
36	408/99/all	397/11	99/10	1138/11	543	297	606	148.1	44.3	97.5	10.4	148.8	60.4	150.6	72.4	1200.7

Table 12—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 260-year rotation strategy (second rotation in table 2) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems		All[d]		
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	Age	(m^2/ha)	(m^3/ha)
37	408/198/62	397/11	198/10	62/10	539	404	258	126.9	29.8	131.3	10.3	150.6	77.6	150.6	61.4	1235.3
38	408/198/124	397/11	198/10	124/10	543	410	353	134.4	44.8	115	10.9	155	60.7	157.5	70	1215.2
39	408/198/186	397/11	198/10	186/10	540	413	439	162.5	54.2	123.8	10.2	174.4	41	174.4	82.5	1227.2
40	408/198/all	397/11	198/10	1025/11	542	411	686	173.8	54.9	119.4	10.2	195.6	40.8	195.6	91.9	1241.5
41	408/297/62	397/11	296/10	62/9	538	519	264	152.5	35.1	129.4	10.6	156.9	72.8	157.5	66	1285.7
42	408/297/124	397/10	296/9	124/10	533	508	356	157.5	49.8	129.4	10.6	183.1	53.3	183.8	76.8	1264.9
43	408/297/186	397/11	296/10	186/10	535	515	453	166.9	51.9	133.8	9.3	215.6	33.3	215.6	88.3	1248.8
44	408/297/all	397/11	296/10	834/10	536	514	732	198.1	41.5	137.5	9.6	226.3	29.3	226.3	104.2	1242.9
45	408/all/62	397/11	829/10	62/9	535	708	246	160	29.3	138.8	10.2	143.8	79.5	160	58	1242.5
46	408/all/124	397/10	837/10	124/9	535	706	326	161.9	43.8	114.4	10.5	142.5	62.8	161.9	70.9	1284.4
47	408/all/186	397/11	822/10	186/9	537	705	404	171.9	55.6	123.1	10.3	156.3	43.3	171.9	85.6	1292.2
48	408/all/all	397/11	837/10	1042/11	539	722	855	209.4	31	130.6	10.5	220.6	30.7	220.6	110.5	1199.3
49	All/99/62	1081/10	99/10	62/11	678	269	228	141.9	26.2	137.5	10.1	117.5	83.3	143.8	52.3	1218.4
50	All/99/124	1104/10	99/9	124/11	678	266	284	139.4	27.7	126.3	10.5	117.5	76.1	139.4	50.7	1148.2
51	All/99/186	1102/11	99/10	186/10	687	270	319	143.1	31.3	117.5	10.6	108.8	73.8	143.1	54.3	1145.5
52	All/99/all	1078/10	99/10	1115/10	676	269	531	149.4	37.3	106.9	10.2	105.6	65.9	149.4	63	1165.2
53	All/198/62	1093/10	198/9	62/10	680	359	238	144.4	25.7	136.3	10.4	123.1	83.5	144.4	52.6	1212.8
54	All/198/124	1089/10	198/10	124/10	680	363	319	146.9	37.7	108.8	10.9	106.9	66.6	146.9	59.6	1187.8
55	All/198/186	1101/11	198/10	186/10	689	376	404	152.5	44.5	100	10.9	108.1	54.7	152.5	70.2	1191.8
56	All/198/all	1092/11	198/10	1052/10	687	374	634	158.1	52.6	105	10.2	117.5	50.1	158.1	79.9	1215.3
57	All/297/62	1095/11	296/10	62/10	683	450	251	145	29.6	126.3	10.6	128.1	77.5	145	56.2	1229.6
58	All/297/124	1108/11	296/10	124/10	693	458	344	150	40.9	114.4	11	113.8	58.6	150	65.4	1209.5
59	All/297/186	1131/11	296/10	186/10	690	455	422	160	54.4	119.4	10.2	120.6	37.1	160	81.4	1268.8
60	All/297/all	1094/11	296/10	931/9	686	449	672	173.8	52.4	111.3	10.1	131.9	33.2	173.8	91.7	1244.1
61	All/all/62	1099/11	1004/10	62/10	688	773	242	163.1	29.9	130	10.1	119.4	74.8	163.1	58	1270.5
62	All/all/124	1110/10	1003/10	124/9	681	773	303	165.6	40	120.6	10.2	117.5	62.3	165.6	64.4	1285.9
63	All/all/186	1072/11	993/10	186/10	683	777	386	169.4	48.4	112.5	10.2	124.4	48.8	169.4	74.2	1251.3
64	All/all/all	1094/11	981/10	863/10	684	776	852	220.6	28.7	160	9.9	198.1	34	220.6	111.7	1194.5

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] Stand density index is a measure of the stocking density following a thinning entry.

[c] Under "Criteria," age is stand age when the threshold level of a criterion (see table 6) was met and is followed by the value of the criterion at stand age 260 prior to the rotation harvest.

[d] The minimum stand age when large bole, canopy height diversity index (CHDI), and shade-tolerant stem-density criteria were met.

[e] PSME BA is Douglas-fir basal area at stand age 260 prior to harvest.

[f] Extracted merchantable volume is the volume extracted in each thinning entry plus the rotation harvest at stand age 260.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 6.

Table 13—Simulated measures of snags for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 260-year rotation strategy (second rotation in table 2)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
1	136/99/62	136/11	99/10	62/35	329	274	282	164.4	24.3	87	148.8	24.3	87	134.4	24.3	87	113.8	24.3	87
2	136/99/124	136/11	99/10	124/35	333	279	338	160	22.4	93.4	145.6	22.4	93.4	130	22.4	93.4	126.9	22.4	93.4
3	136/99/186	136/11	99/10	182/35	333	279	408	148	22.5	95	130	22.5	95	110	22.5	95	100	22.5	95
4	136/99/all	136/11	99/10	1167/34	333	282	576	115	24.6	89.7	83.1	24.6	89.7	69.4	24.6	89.7	69.4	24.6	89.7
5	136/198/62	136/11	198/10	62/32	328	378	300	135	21.5	90.4	120.6	21.5	90.4	102.5	21.5	90.4	85	21.5	90.4
6	136/198/124	136/10	198/10	124/34	322	374	366	60	20	98.2	17.5	20	98.2	5	20	98.2	5	20	98.2
7	136/198/186	136/11	198/10	186/30	329	381	439	58.8	20.9	100.7	45.6	20.9	100.7	18.1	20.9	100.7	5	20.9	100.7
8	136/198/all	136/10	198/9	1005/38	319	361	624	5	23	96.4	5	23	96.4	5	23	96.4	5	23	96.4
9	136/297/62	136/11	273/10	62/26	331	444	291	91.3	22.4	90.5	91.3	22.4	90.5	81.3	22.4	90.5	51.9	22.4	90.5
10	136/297/124	136/11	273/10	124/25	333	441	363	45	18.5	100.7	45	18.5	100.7	18.8	18.5	100.7	5	18.5	100.7
11	136/297/186	136/11	266/10	186/26	336	442	451	63.1	22.2	102.6	63.1	22.2	102.6	44.4	22.2	102.6	5	22.2	102.6
12	136/297/all	136/10	279/10	880/29	326	441	656	5	25.6	97.5	5	25.6	97.5	5	25.6	97.5	5	25.6	97.5
13	136/all/62	136/11	1174/10	62/25	328	611	276	154.4	24	86.5	154.4	24	86.5	139.4	24	86.5	117.5	24	86.5
14	136/all/124	136/10	1093/10	124/25	327	590	321	132.5	20.7	92.4	132.5	20.7	92.4	115.6	20.7	92.4	88.1	20.7	92.4
15	136/all/186	136/11	1081/10	186/24	336	596	376	101.9	20.9	95.6	101.9	20.9	95.6	29.4	20.9	95.6	5	20.9	95.6
16	136/all/all	136/11	1072/10	1176/26	329	585	725	30.6	26.6	94.1	30.6	26.6	94.1	30.6	26.6	94.1	30.6	26.6	94.1
17	272/99/62	272/11	99/10	62/16	454	301	255	160.6	24.9	85.6	160.6	24.9	85.6	155.6	24.9	85.6	103.1	24.9	85.6
18	272/99/124	272/11	99/10	124/16	448	300	319	145	23.6	93.3	143.8	23.6	93.3	109.4	23.6	93.3	78.8	23.6	93.3
19	272/99/186	272/11	99/11	186/14	453	307	374	110	22.3	98.8	110	22.3	98.8	102.5	22.3	98.8	18.8	22.3	98.8
20	272/99/all	272/11	99/10	1143/14	452	303	608	73.1	23	92	73.1	23	92	73.1	23	92	73.1	23	92
21	272/198/62	272/11	198/10	62/12	445	414	265	151.9	23.4	90.6	151.9	23.4	90.6	133.8	23.4	90.6	86.9	23.4	90.6
22	272/198/124	272/11	198/10	124/11	449	433	377	58.8	19.2	101.6	58.8	19.2	101.6	33.1	19.2	101.6	31.3	19.2	101.6
23	272/198/186	272/11	198/10	186/12	450	416	455	5	22.5	102.6	5	22.5	102.6	5	22.5	102.6	5	22.5	102.6
24	272/198/all	272/11	198/10	891/12	450	428	669	18.1	25.3	94.2	18.1	25.3	94.2	18.1	25.3	94.2	18.1	25.3	94.2
25	272/297/62	272/10	285/9	62/11	446	511	260	143.1	23.4	85.1	143.1	23.4	85.1	138.8	23.4	85.1	112.5	23.4	85.1
26	272/297/124	272/11	276/10	124/10	451	523	377	94.4	22.7	102	94.4	22.7	102	42.5	22.7	102	5	22.7	102
27	272/297/186	272/11	280/10	186/11	451	521	470	51.3	27	97.9	51.3	27	97.9	16.9	27	97.9	16.9	27	97.9
28	272/297/all	272/11	272/10	785/10	451	513	712	40.6	31.2	89.7	40.6	31.2	89.7	40.6	31.2	89.7	40.6	31.2	89.7
29	272/all/62	272/11	905/10	62/11	453	666	253	161.9	24.2	85.9	161.9	24.2	85.9	158.1	24.2	85.9	149.4	24.2	85.9
30	272/all/124	272/11	927/10	124/11	450	667	323	127.5	22.2	93.3	127.5	22.2	93.3	93.1	22.2	93.3	71.3	22.2	93.3
31	272/all/186	272/11	880/10	186/11	450	653	388	97.5	21.7	96.5	97.5	21.7	96.5	30	21.7	96.5	5	21.7	96.5
32	272/all/all	272/11	888/10	1048/10	450	661	784	67.5	33.8	88.5	67.5	33.8	88.5	67.5	33.8	88.5	67.5	33.8	88.5
33	408/99/62	408/10	99/10	62/11	536	288	240	170.6	28.4	82.3	170.6	28.4	82.3	170.6	28.4	82.3	168.8	28.4	82.3
34	408/99/124	408/11	99/10	124/11	537	294	295	146.9	22.9	91.1	146.9	22.9	91.1	126.3	22.9	91.1	68.1	22.9	91.1
35	408/99/186	408/11	99/10	186/11	537	293	348	134.4	22	88.5	134.4	22	88.5	110.6	22	88.5	78.8	22	88.5
36	408/99/all	408/11	99/10	1138/11	543	297	606	106.3	25.3	93.4	103.8	25.3	93.4	103.8	25.3	93.4	103.8	25.3	93.4

Table 13—Simulated measures of snags for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 260-year rotation strategy (second rotation in table 2) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
37	408/198/62	408/11	198/10	62/10	539	404	258	158.8	25.3	84.4	158.8	25.3	84.4	151.3	25.3	84.4	118.1	25.3	84.4
38	408/198/124	408/11	198/10	124/10	543	410	353	88.1	21.5	98.7	88.1	21.5	98.7	71.9	21.5	98.7	17.5	21.5	98.7
39	408/198/186	408/11	198/10	186/10	540	413	439	70	23.3	100.4	56.9	23.3	100.4	41.3	23.3	100.4	5	23.3	100.4
40	408/198/all	408/11	198/10	1025/11	542	411	686	58.1	28.6	94.4	58.1	28.6	94.4	58.1	28.6	94.4	58.1	28.6	94.4
41	408/297/62	408/11	297/10	62/9	538	519	264	147.5	22.9	89.3	147.5	22.9	89.3	126.3	22.9	89.3	101.3	22.9	89.3
42	408/297/124	408/10	297/9	124/10	533	508	356	103.1	22.4	101.5	102.5	22.4	101.5	70.6	22.4	101.5	31.3	22.4	101.5
43	408/297/186	408/11	297/10	186/10	535	515	453	95	26.4	97.2	95	26.4	97.2	70	26.4	97.2	30.6	26.4	97.2
44	408/297/all	408/11	297/10	834/10	536	514	732	79.4	36.1	85.8	78.8	36.1	85.8	78.8	36.1	85.8	78.8	36.1	85.8
45	408/all/62	408/11	829/10	62/9	535	708	246	156.3	28.1	82.6	156.3	28.1	82.6	149.4	28.1	82.6	118.8	28.1	82.6
46	408/all/124	408/10	837/10	124/9	535	706	326	121.9	22.2	95.1	121.9	22.2	95.1	115	22.2	95.1	58.8	22.2	95.1
47	408/all/186	408/11	822/10	186/9	537	705	404	98.8	23	94.3	98.8	23	94.3	83.8	23	94.3	45.6	23	94.3
48	408/all/all	408/11	837/10	1042/11	539	722	855	85	41.6	81.3	85	41.6	81.3	85	41.6	81.3	85	41.6	81.3
49	All/99/62	1081/10	99/10	62/11	678	269	228	169.4	27.5	82.1	169.4	27.5	82.1	163.8	27.5	82.1	146.9	27.5	82.1
50	All/99/124	1104/10	99/9	124/11	678	266	284	149.4	24.5	86.3	149.4	24.5	86.3	143.8	24.5	86.3	111.9	24.5	86.3
51	All/99/186	1102/11	99/10	186/10	687	270	319	133.1	21.9	92.3	133.1	21.9	92.3	125	21.9	92.3	46.9	21.9	92.3
52	All/99/all	1078/10	99/10	1115/10	676	269	531	123.1	25.6	88.4	123.1	25.6	88.4	120	25.6	88.4	120	25.6	88.4
53	All/198/62	1093/10	198/9	62/10	680	359	238	160	28	83	160	28	83	155	28	83	133.1	28	83
54	All/198/124	1089/10	198/10	124/10	680	363	319	121.3	21.7	94	121.3	21.7	94	79.4	21.7	94	46.3	21.7	94
55	All/198/186	1101/11	198/10	186/10	689	376	404	105	22	97.5	91.9	22	97.5	86.9	22	97.5	43.1	22	97.5
56	All/198/all	1092/11	198/10	1052/10	687	374	634	81.9	24.3	96	81.3	24.3	96	81.3	24.3	96	81.3	24.3	96
57	All/297/62	1095/11	297/10	62/10	683	450	251	176.9	24.9	88.9	176.9	24.9	88.9	176.9	24.9	88.9	171.9	24.9	88.9
58	All/297/124	1108/11	297/10	124/10	693	458	344	120.6	20.8	100	120	20.8	100	100	20.8	100	19.4	20.8	100
59	All/297/186	1131/11	297/10	186/10	690	455	422	102.5	23.3	101.8	102.5	23.3	101.8	85.6	23.3	101.8	30.6	23.3	101.8
60	All/297/all	1094/11	297/10	931/9	686	449	672	69.4	29.1	89.9	69.4	29.1	89.9	69.4	29.1	89.9	69.4	29.1	89.9
61	All/all/62	1099/11	1004/10	62/10	688	773	242	158.1	23.8	88.1	158.1	23.8	88.1	151.9	23.8	88.1	120.6	23.8	88.1
62	All/all/124	1110/10	1003/10	124/9	681	773	303	129.4	21.9	88.6	129.4	21.9	88.6	126.3	21.9	88.6	75	21.9	88.6
63	All/all/186	1072/11	993/10	186/10	683	777	386	126.3	23.9	92.8	126.3	23.9	92.8	119.4	23.9	92.8	88.8	23.9	92.8
64	All/all/all	1094/11	981/10	863/10	684	776	852	114.4	43.9	78.4	114.4	43.9	78.4	114.4	43.9	78.4	114.4	43.9	78.4

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each snag-creation strategy, age is stand age when the threshold level for snag density (see table 6) was met, followed by density and mean d.b.h. at stand age 260 prior to the rotation harvest.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 7.

Table 14—Simulated measures of logs for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 260-year rotation strategy (second rotation in table 2)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
1	136/99/62	136/11	99/10	62/35	329	274	282	5	134.3	51.5	5	134.3	51.5	5	134.3	51.5	5	134.3	51.5
2	136/99/124	136/11	99/10	124/35	333	279	338	5	123.2	55.1	5	123.2	55.1	5	123.2	55.1	5	123.2	55.1
3	136/99/186	136/11	99/10	182/35	333	279	408	5	107.6	53.5	5	107.6	53.5	5	107.6	53.5	5	107.6	53.5
4	136/99/all	136/11	99/10	1167/34	333	282	576	5	125.9	55	5	125.9	55	5	125.9	55	5	125.9	55
5	136/198/62	136/11	198/10	62/32	328	378	300	5	119	50.8	5	119	50.8	5	119	50.8	5	119	50.8
6	136/198/124	136/10	198/10	124/34	322	374	366	5	122.7	57.2	5	122.7	57.2	5	122.7	57.2	5	122.7	57.2
7	136/198/186	136/11	198/10	186/30	329	381	439	5	129	57.6	5	129	57.6	5	129	57.6	5	129	57.6
8	136/198/all	136/10	198/9	1005/38	319	361	624	5	128	59.4	5	128	59.4	5	128	59.4	5	128	59.4
9	136/297/62	136/11	273/10	62/26	331	444	291	5	128.7	51.3	5	128.7	51.3	5	128.7	51.3	5	128.7	51.3
10	136/297/124	136/11	273/10	124/25	333	441	363	5	133.9	57.5	5	133.9	57.5	5	133.9	57.5	5	133.9	57.5
11	136/297/186	136/11	266/10	186/26	336	442	451	5	146.2	56.4	5	146.2	56.4	5	146.2	56.4	5	146.2	56.4
12	136/297/all	136/10	279/10	880/29	326	441	656	5	136	57.5	5	136	57.5	5	136	57.5	5	136	57.5
13	136/all/62	136/11	1174/10	62/25	328	611	276	5	126.9	48.3	5	126.9	48.3	5	126.9	48.3	5	126.9	48.3
14	136/all/124	136/10	1093/10	124/25	327	590	321	5	130.6	55.3	5	130.6	55.3	5	130.6	55.3	5	130.6	55.3
15	136/all/186	136/11	1081/10	186/24	336	596	376	5	127.3	58.7	5	127.3	58.7	5	127.3	58.7	5	127.3	58.7
16	136/all/all	136/11	1072/10	1176/26	329	585	725	5	133.9	56.8	5	133.9	56.8	5	133.9	56.8	5	133.9	56.8
17	272/99/62	272/11	99/10	62/16	454	301	255	5	102.8	48.9	5	102.8	48.9	5	102.8	48.9	5	102.8	48.9
18	272/99/124	272/11	99/10	124/16	448	300	319	5	135	54.2	5	135	54.2	5	135	54.2	5	135	54.2
19	272/99/186	272/11	99/11	186/14	453	307	374	5	109.4	56.2	5	109.4	56.2	5	109.4	56.2	5	109.4	56.2
20	272/99/all	272/11	99/10	1143/14	452	303	608	5	131.4	55.5	5	131.4	55.5	5	131.4	55.5	5	131.4	55.5
21	272/198/62	272/11	198/10	62/12	445	414	265	5	120.8	49.9	5	120.8	49.9	5	120.8	49.9	5	120.8	49.9
22	272/198/124	272/11	198/10	124/11	449	433	377	5	129.6	54.4	5	129.6	54.4	5	129.6	54.4	5	129.6	54.4
23	272/198/186	272/11	198/10	186/12	450	416	455	5	146.5	54	5	146.5	54	5	146.5	54	5	146.5	54
24	272/198/all	272/11	198/10	891/12	450	428	669	5	150.8	56.3	5	150.8	56.3	5	150.8	56.3	5	150.8	56.3
25	272/297/62	272/10	285/9	62/11	446	511	260	5	127.5	49	5	127.5	49	5	127.5	49	5	127.5	49
26	272/297/124	272/11	276/10	124/10	451	523	377	5	127.8	53.6	5	127.8	53.6	5	127.8	53.6	5	127.8	53.6
27	272/297/186	272/11	280/10	186/11	451	521	470	5	151.6	52.3	5	151.6	52.3	5	151.6	52.3	5	151.6	52.3
28	272/297/all	272/11	272/10	785/10	451	513	712	5	155.5	52.7	5	155.5	52.7	5	155.5	52.7	5	155.5	52.7
29	272/all/62	272/11	905/10	62/11	453	666	253	5	106.2	46.7	5	106.2	46.7	5	106.2	46.7	5	106.2	46.7
30	272/all/124	272/11	927/10	124/11	450	667	323	5	124.7	52.7	5	124.7	52.7	5	124.7	52.7	5	124.7	52.7
31	272/all/186	272/11	880/10	186/11	450	653	388	5	124.9	55.9	5	124.9	55.9	5	124.9	55.9	5	124.9	55.9
32	272/all/all	272/11	888/10	1048/10	450	661	784	5	148.2	54.8	5	148.2	54.8	5	148.2	54.8	5	148.2	54.8
33	408/99/62	408/10	99/10	62/11	536	288	240	5	109.3	46.8	5	109.3	46.8	5	109.3	46.8	5	109.3	46.8
34	408/99/124	408/11	99/10	124/11	537	294	295	5	119.7	51	5	119.7	51	5	119.7	51	5	119.7	51
35	408/99/186	408/11	99/10	186/11	537	293	348	5	123.3	55.5	5	123.3	55.5	5	123.3	55.5	5	123.3	55.5
36	408/99/all	408/11	99/10	1138/11	543	297	606	5	142.4	55.2	5	142.4	55.2	5	142.4	55.2	5	142.4	55.2

Table 14—Simulated measures of logs for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 260-year rotation strategy (second rotation in table 2) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
37	408/198/62	408/11	198/10	62/10	539	404	258	5	113.5	47.2	5	113.5	47.2	5	113.5	47.2	5	113.5	47.2
38	408/198/124	408/11	198/10	124/10	543	410	353	5	135.6	55.7	5	135.6	55.7	5	135.6	55.7	5	135.6	55.7
39	408/198/186	408/11	198/10	186/10	540	413	439	5	148.5	55	5	148.5	55	5	148.5	55	5	148.5	55
40	408/198/all	408/11	198/10	1025/11	542	411	686	5	144.7	56.4	5	144.7	56.4	5	144.7	56.4	5	144.7	56.4
41	408/297/62	408/11	297/10	62/9	538	519	264	5	119.3	47.3	5	119.3	47.3	5	119.3	47.3	5	119.3	47.3
42	408/297/124	408/10	297/9	124/10	533	508	356	5	127.6	52.7	5	127.6	52.7	5	127.6	52.7	5	127.6	52.7
43	408/297/186	408/11	297/10	186/10	535	515	453	5	154.1	52	5	154.1	52	5	154.1	52	5	154.1	52
44	408/297/all	408/11	297/10	834/10	536	514	732	5	152.8	51.3	5	152.8	51.3	5	152.8	51.3	5	152.8	51.3
45	408/all/62	408/11	829/10	62/9	535	708	246	5	118.1	46.9	5	118.1	46.9	5	118.1	46.9	5	118.1	46.9
46	408/all/124	408/10	837/10	124/9	535	706	326	5	130.7	50.9	5	130.7	50.9	5	130.7	50.9	5	130.7	50.9
47	408/all/186	408/11	822/10	186/9	537	705	404	5	127.4	55.2	5	127.4	55.2	5	127.4	55.2	5	127.4	55.2
48	408/all/all	408/11	837/10	1042/11	539	722	855	5	151.9	49.6	5	151.9	49.6	5	151.9	49.6	5	151.9	49.6
49	All/99/62	1081/10	99/10	62/11	678	269	228	5	99.7	46.3	5	99.7	46.3	5	99.7	46.3	5	99.7	46.3
50	All/99/124	1104/10	99/9	124/11	678	266	284	5	130.6	51	5	130.6	51	5	130.6	51	5	130.6	51
51	All/99/186	1102/11	99/10	186/10	687	270	319	5	119	54.8	5	119	54.8	5	119	54.8	5	119	54.8
52	All/99/all	1078/10	99/10	1115/10	676	269	531	5	128.6	52.7	5	128.6	52.7	5	128.6	52.7	5	128.6	52.7
53	All/198/62	1093/10	198/9	62/10	680	359	238	5	117.7	47.8	5	117.7	47.8	5	117.7	47.8	5	117.7	47.8
54	All/198/124	1089/10	198/10	124/10	680	363	319	5	118.5	54.8	5	118.5	54.8	5	118.5	54.8	5	118.5	54.8
55	All/198/186	1101/11	198/10	186/10	689	376	404	5	127.6	57.8	5	127.6	57.8	5	127.6	57.8	5	127.6	57.8
56	All/198/all	1092/11	198/10	1052/10	687	374	634	5	126.8	58.9	5	126.8	58.9	5	126.8	58.9	5	126.8	58.9
57	All/297/62	1095/11	297/10	62/10	683	450	251	5	119.1	47.7	5	119.1	47.7	5	119.1	47.7	5	119.1	47.7
58	All/297/124	1108/11	297/10	124/10	693	458	344	5	148.4	55.1	5	148.4	55.1	5	148.4	55.1	5	148.4	55.1
59	All/297/186	1131/11	297/10	186/10	690	455	422	5	134.7	55.9	5	134.7	55.9	5	134.7	55.9	5	134.7	55.9
60	All/297/all	1094/11	297/10	931/9	686	449	672	5	153.7	56.6	5	153.7	56.6	5	153.7	56.6	5	153.7	56.6
61	All/all/62	1099/11	1004/10	62/10	688	773	242	5	98.7	45.9	5	98.7	45.9	5	98.7	45.9	5	98.7	45.9
62	All/all/124	1110/10	1003/10	124/9	681	773	303	5	117.1	51.4	5	117.1	51.4	5	117.1	51.4	5	117.1	51.4
63	All/all/186	1072/11	993/10	186/10	683	777	386	5	137.9	56.7	5	137.9	56.7	5	137.9	56.7	5	137.9	56.7
64	All/all/all	1094/11	981/10	863/10	684	776	852	5	156.6	50.9	5	156.6	50.9	5	156.6	50.9	5	156.6	50.9

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each log-creation strategy, age is stand age when the threshold level for log mass (see table 6) was met, followed by mass and mean large-end diameter (LED) at stand age 260 prior to the rotation harvest. Data are from the no-snag creation scenario (see text).

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 8.

Table 15—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments, 180-year rotation strategy (first rotation in table 3)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems		All[d]		
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	Age	(m^2/ha)	(m^3/ha)
1	136/99/62	136/0	99/18	62/63	150	171	241	110	40.3	138.1	9.3	123.8	38.5	138.1	52.7	733
2	136/99/124	136/0	99/19	124/64	150	175	279	112.5	42.8	130	9.6	115.6	41.7	130	55.1	800.2
3	136/99/186	136/0	99/18	180/62	150	172	300	112.5	42.2	117.5	9.8	110	49.4	118.8	55.7	808
4	136/99/all	136/0	99/19	1064/64	150	174	443	114.4	40.6	116.3	9.3	111.3	52.6	117.5	54.5	812.9
5	136/198/62	136/0	187/18	62/93	150	280	335	120.6	57.6	159.4	8.3	135.6	17.9	159.4	69.2	832.1
6	136/198/124	136/0	195/19	111/95	150	287	380	123.1	55.2	130	9	128.1	27.4	138.8	70.7	856.8
7	136/198/186	136/0	194/19	112/94	150	287	377	124.4	53.3	124.4	8.9	126.9	25	138.1	69.3	857.4
8	136/198/all	136/0	196/19	780/92	150	281	508	123.1	52.3	123.8	8.4	128.1	26.5	144.4	68.3	845.1
9	136/297/62	136/0	190/18	62/95	150	292	343	121.3	54.8	163.8	8.3	136.3	16.2	163.8	68.2	829.1
10	136/297/124	136/0	209/18	118/96	150	297	387	123.8	53.5	136.3	9.1	126.3	26.3	140	70.1	852.5
11	136/297/186	136/0	210/19	121/95	150	300	387	123.8	54.2	115.6	9.2	128.1	27.2	133.8	71.9	844.7
12	136/297/all	136/0	204/18	754/96	150	294	519	125	52.6	113.1	8.3	130	23.8	139.4	69.1	834.6
13	136/all/62	136/0	1060/20	62/92	150	422	317	122.5	54.2	169.4	8.2	141.3	20.5	169.4	63.9	822.7
14	136/all/124	136/0	962/18	124/90	150	410	349	121.9	55.9	152.5	8.6	135	26.5	152.5	67.1	838.2
15	136/all/186	136/0	1048/20	186/93	150	420	386	124.4	57.9	154.4	9	138.1	35.9	154.4	68.7	833.2
16	136/all/all	136/0	994/19	1006/92	150	412	579	125.6	50.7	173.8	8.3	142.5	30	173.8	70.1	806.3
17	272/99/62	272/0	99/7	62/58	271	168	219	120.6	44.5	153.8	8.5	131.9	33.9	153.8	55.6	834.4
18	272/99/124	272/0	99/7	124/56	271	169	254	120.6	44.2	138.1	9.1	130	39.2	138.1	55.4	856.7
19	272/99/186	272/0	99/7	186/58	271	169	303	123.8	46.8	141.9	9.2	135	39.9	141.9	60.6	881.6
20	272/99/all	272/0	99/7	1093/57	271	168	442	126.3	45.7	166.9	8.4	148.1	36.5	172.5	61.4	851.6
21	272/198/62	272/0	198/7	62/67	271	319	294	135	53.2	>180	7.2	>180	5.5	>180	68.9	929.2
22	272/198/124	272/0	198/7	124/68	271	319	403	142.5	41.6	>180	8	>180	3.5	>180	80.8	961.4
23	272/198/186	272/0	198/7	184/69	271	320	407	143.1	41.4	>180	8	>180	3.5	>180	80	953.3
24	272/198/all	272/0	198/7	659/68	271	321	540	143.1	40.6	>180	7.8	>180	3.9	>180	81	959.8
25	272/297/62	272/0	246/6	62/68	271	392	297	136.9	53.9	>180	6.9	>180	5.3	>180	69.8	929.8
26	272/297/124	272/0	244/7	124/70	271	392	412	145.6	40.5	>180	8	>180	3.1	>180	81.7	958
27	272/297/186	272/0	245/7	162/70	271	394	480	150	34.1	>180	8.7	>180	4.2	>180	88.4	977.6
28	272/297/all	272/0	244/7	604/69	271	391	598	153.1	33.9	>180	8.5	>180	3.6	>180	88.7	964.7
29	272/all/62	272/0	765/7	62/69	271	498	270	134.4	52.6	>180	7.5	160	18.3	>180	63.5	888
30	272/all/124	272/0	775/7	124/67	271	499	342	139.4	50	>180	7.7	165	15.2	>180	71.7	939.3
31	272/all/186	272/0	748/6	186/66	271	496	421	146.9	43.8	>180	8	182.5	9.9	>180	80.1	970
32	272/all/all	272/0	745/7	833/68	271	495	648	154.4	31.4	>180	8.2	>180	4.7	>180	86.2	960.2
33	408/99/62	408/0	99/4	62/35	351	137	148	124.4	31.9	133.8	9.1	123.8	58.5	133.8	48	875.7
34	408/99/124	408/0	99/4	124/34	351	138	190	125.6	34.1	123.8	9.1	121.9	52.8	128.1	49.1	906.2
35	408/99/186	408/0	99/4	186/36	351	138	228	129.4	36.9	118.1	9.2	125	54.2	130	51.7	942.5
36	408/99/all	408/0	99/4	1094/37	351	139	402	132.5	40.9	140	9.1	138.8	48	151.9	58.5	916.7

Table 15—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments, 180-year rotation strategy (first rotation in table 3) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems		All[d]		
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	Age	(m^2/ha)	(m^3/ha)
37	408/198/62	408/0	198/4	62/45	351	262	207	127.5	44.2	>180	8	150	30.9	>180	56.6	931.4
38	408/198/124	408/0	198/4	124/44	351	262	286	134.4	44.7	>180	7.8	163.8	13.9	>180	66.4	990
39	408/198/186	408/0	198/4	186/47	351	263	369	141.9	41.9	>180	8.2	178.8	11.1	>180	75.1	990.8
40	408/198/all	408/0	198/4	937/46	351	263	523	146.3	38.8	>180	7.6	>180	6.8	>180	75.4	988.6
41	408/297/62	408/0	297/4	62/47	351	390	226	134.4	46.4	>180	7.4	171.3	18.5	>180	62.2	909.5
42	408/297/124	408/0	297/4	124/46	351	389	321	141.3	42.6	>180	7.8	>180	3.1	>180	73.4	1006.1
43	408/297/186	408/0	297/4	186/46	351	387	414	151.3	35.7	>180	9	>180	3.7	>180	82.9	1041.7
44	408/297/all	408/0	297/4	730/47	351	388	603	158.1	28.2	>180	9.6	>180	4.1	>180	86.8	1028
45	408/all/62	408/0	727/4	62/47	351	558	215	136.9	41.4	181.9	8	160	29.9	181.9	56.2	889.8
46	408/all/124	408/0	744/4	124/47	351	561	298	142.5	42	>180	7.8	178.8	10.5	>180	69.7	963.7
47	408/all/186	408/0	747/4	186/47	351	560	383	148.1	36.8	>180	8.7	>180	9.2	>180	77.1	1019.5
48	408/all/all	408/0	766/4	814/48	351	563	698	163.8	23.8	150.6	9.4	>180	5	>180	93	969.7
49	All/99/62	652/0	99/3	62/26	448	116	119	126.9	24.2	141.9	8.8	120.6	70.8	141.9	44.4	885.9
50	All/99/124	652/0	99/3	124/27	448	115	157	128.8	28.2	130	9.1	119.4	61.7	130.6	45	881.9
51	All/99/186	652/0	99/3	186/26	448	114	197	130.6	32.6	120.6	9.2	121.3	54.7	131.3	51.3	932.8
52	All/99/all	652/0	99/3	984/25	448	114	348	138.1	33.7	108.8	9	130.6	51.1	138.8	57	942.8
53	All/198/62	652/0	198/3	62/39	448	222	172	127.5	37.3	143.8	8.9	133.8	46	143.8	51.9	904.4
54	All/198/124	652/0	198/3	124/37	448	223	224	131.3	41.6	106.9	8.4	130	30.6	132.5	57.7	924
55	All/198/186	652/0	198/3	186/36	448	221	286	138.1	40.9	103.8	8.7	136.9	26.3	140.6	63.1	980
56	All/198/all	652/0	198/3	1088/38	448	221	486	143.1	38.9	179.4	7.9	157.5	15.3	>180	70.1	984.9
57	All/297/62	652/0	297/3	62/41	448	330	196	131.3	40.2	180.6	8.1	159.4	30.7	180.6	56.1	925.8
58	All/297/124	652/0	297/3	124/42	448	329	283	138.1	43.6	>180	7.8	>180	8.6	>180	68	995.3
59	All/297/186	652/0	297/3	186/41	448	330	358	145	39.2	>180	8.7	>180	6.7	>180	75.6	1032.2
60	All/297/all	652/0	297/3	940/40	448	329	575	153.1	32.6	>180	8.9	>180	8	>180	80	1013.4
61	All/all/62	652/0	796/3	62/40	448	603	192	136.3	38.1	161.9	8.3	159.4	32.6	173.1	55.2	879.2
62	All/all/124	652/0	799/3	124/42	448	603	279	141.9	41.4	>180	7.9	177.5	12.1	>180	66.6	948.9
63	All/all/186	652/0	806/3	186/40	448	607	358	147.5	37.2	>180	8.7	>180	9.5	>180	74.3	997.7
64	All/all/all	652/0	784/3	803/41	448	598	708	165.6	23.5	166.4	9.4	>180	9.3	>180	91.7	948.9

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] Stand density index is a measure of the stocking density following a thinning entry.

[c] Under "Criteria," age is stand age when the threshold level of a criterion (see table 6) was met and is followed by the value of the criterion at stand age 180 prior to the rotation harvest.

[d] The minimum stand age when large bole, canopy height diversity index (CHDI), and shade-tolerant stem density criteria were met.

[e] PSME BA is Douglas-fir basal area at stand age 180 prior to harvest.

[f] Extracted merchantable volume is the volume extracted in each thinning entry plus the rotation harvest at stand age 180.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 9.

Table 16—Simulated measures of snags for 64 experimental thinning treatments, 180-year rotation strategy (first rotation in table 3)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
1	36/99/62	136/0	99/18	62/63	150	171	241	101.9	16.2	94.4	93.1	16.2	94.4	81.9	16.2	94.4	76.3	16.2	94.4
2	136/99/124	136/0	99/19	124/64	150	175	279	116.3	16.7	91.2	111.3	16.7	91.2	101.9	16.7	91.2	97.5	16.7	91.2
3	136/99/186	136/0	99/18	180/62	150	172	300	118.1	17.1	89.5	106.3	17.1	89.5	88.1	17.1	89.5	82.5	17.1	89.5
4	136/99/all	136/0	99/19	1064/64	150	174	443	107.5	17.2	91.7	91.9	17.2	91.7	85	17.2	91.7	78.8	17.2	91.7
5	136/198/62	136/0	187/18	62/93	150	280	335	91.3	18.5	91.9	86.9	18.5	91.9	78.1	18.5	91.9	77.5	18.5	91.9
6	136/198/124	136/0	195/19	111/95	150	287	380	87.5	20.9	89.1	83.8	20.9	89.1	81.3	20.9	89.1	79.4	20.9	89.1
7	136/198/186	136/0	194/19	112/94	150	287	377	84.4	23	87.5	81.9	23	87.5	80	23	87.5	78.8	23	87.5
8	136/198/all	136/0	196/19	780/92	150	281	508	86.9	20.7	88.7	82.5	20.7	88.7	78.8	20.7	88.7	76.9	20.7	88.7
9	136/297/62	136/0	190/18	62/95	150	292	343	90.6	21.5	90.1	90.6	21.5	90.1	84.4	21.5	90.1	81.9	21.5	90.1
10	136/297/124	136/0	209/18	118/96	150	297	387	85	25	88.1	85	25	88.1	85	25	88.1	85	25	88.1
11	136/297/186	136/0	210/19	121/95	150	300	387	85.6	22	88.6	85.6	22	88.6	85.6	22	88.6	85.6	22	88.6
12	136/297/all	136/0	204/18	754/96	150	294	519	82.5	21.7	87.6	82.5	21.7	87.6	82.5	21.7	87.6	82.5	21.7	87.6
13	136/all/62	136/0	1060/20	62/92	150	422	317	83.8	18.6	95.1	83.8	18.6	95.1	81.9	18.6	95.1	80.6	18.6	95.1
14	136/all/124	136/0	962/18	124/90	150	410	349	84.4	19.2	92.4	84.4	19.2	92.4	81.3	19.2	92.4	80	19.2	92.4
15	136/all/186	136/0	1048/20	186/93	150	420	386	83.8	19.4	91.4	83.8	19.4	91.4	80.6	19.4	91.4	80	19.4	91.4
16	136/all/all	136/0	994/19	1006/92	150	412	579	81.9	20.3	88.2	81.9	20.3	88.2	81.9	20.3	88.2	81.9	20.3	88.2
17	272/99/62	272/0	99/7	62/58	271	168	219	128.8	13	92.9	122.5	13	92.9	106.3	13	92.9	102.5	13	92.9
18	272/99/124	272/0	99/7	124/56	271	169	254	100	18.5	88.9	91.9	18.5	88.9	81.3	18.5	88.9	80	18.5	88.9
19	272/99/186	272/0	99/7	186/58	271	169	303	99.4	17.4	88.8	93.8	17.4	88.8	83.8	17.4	88.8	81.3	17.4	88.8
20	272/99/all	272/0	99/7	1093/57	271	168	442	103.1	17.9	90.2	95.6	17.9	90.2	85.6	17.9	90.2	81.3	17.9	90.2
21	272/198/62	272/0	198/7	62/67	271	319	294	86.9	20.7	88.8	84.4	20.7	88.8	80.6	20.7	88.8	80	20.7	88.8
22	272/198/124	272/0	198/7	124/68	271	319	403	89.4	29.5	81.3	86.3	29.5	81.3	81.3	29.5	81.3	77.5	29.5	81.3
23	272/198/186	272/0	198/7	124/69	271	320	407	85	29.2	81.3	80.6	29.2	81.3	76.9	29.2	81.3	73.8	29.2	81.3
24	272/198/all	272/0	198/7	659/68	271	321	540	84.4	29.7	80.7	80.6	29.7	80.7	76.3	29.7	80.7	75	29.7	80.7
25	272/297/62	272/0	246/6	62/68	271	392	297	85.6	19.6	87.1	85.6	19.6	87.1	81.9	19.6	87.1	80.6	19.6	87.1
26	272/297/124	272/0	244/7	124/70	271	392	412	83.1	28.9	79.6	83.1	28.9	79.6	81.9	28.9	79.6	80	28.9	79.6
27	272/297/186	272/0	245/7	162/70	271	394	480	83.8	34.2	76.8	83.8	34.2	76.8	83.8	34.2	76.8	83.8	34.2	76.8
28	272/297/all	272/0	244/7	604/69	271	391	598	83.8	33.4	77.3	83.8	33.4	77.3	83.8	33.4	77.3	83.8	33.4	77.3
29	272/all/62	272/0	765/7	62/69	271	498	270	84.4	17.8	89.2	84.4	17.8	89.2	81.3	17.8	89.2	79.4	17.8	89.2
30	272/all/124	272/0	775/7	124/67	271	499	342	84.4	22.7	84.8	84.4	22.7	84.8	81.9	22.7	84.8	80	22.7	84.8
31	272/all/186	272/0	748/6	186/66	271	496	421	86.3	27.9	81.2	86.3	27.9	81.2	82.5	27.9	81.2	80	27.9	81.2
32	272/all/all	272/0	745/7	833/68	271	495	648	85.6	35.3	77.3	85.6	35.3	77.3	85.6	35.3	77.3	85.6	35.3	77.3
33	408/99/62	408/0	99/4	62/35	351	137	148	161.3	13.2	85.2	160.6	13.2	85.2	136.3	13.2	85.2	133.8	13.2	85.2
34	408/99/124	408/0	99/4	124/34	351	138	190	122.5	17	82.1	117.5	17	82.1	93.1	17	82.1	85	17	82.1
35	408/99/186	408/0	99/4	186/36	351	138	228	117.5	17.5	81.3	113.8	17.5	81.3	92.5	17.5	81.3	84.4	17.5	81.3
36	408/99/all	408/0	99/4	1094/37	351	139	402	113.8	16.9	86.7	104.4	16.9	86.7	99.4	16.9	86.7	95.6	16.9	86.7

Table 16—Simulated measures of snags for 64 experimental thinning treatments, 180-year rotation strategy (first rotation in table 3) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
37	408/198/62	408/0	198/4	62/45	351	262	207	120.6	15	88.6	115.6	15	88.6	101.9	15	88.6	98.1	15	88.6
38	408/198/124	408/0	198/4	124/44	351	262	286	97.5	21.1	84.7	90	21.1	84.7	81.9	21.1	84.7	80.6	21.1	84.7
39	408/198/186	408/0	198/4	186/47	351	263	369	95.6	25.2	81.7	90.6	25.2	81.7	81.9	25.2	81.7	80.6	25.2	81.7
40	408/198/all	408/0	198/4	937/46	351	263	523	93.1	26.4	80.3	88.1	26.4	80.3	83.8	26.4	80.3	80	26.4	80.3
41	408/297/62	408/0	297/4	62/47	351	390	226	113.8	16.9	88.5	107.5	16.9	88.5	100	16.9	88.5	98.1	16.9	88.5
42	408/297/124	408/0	297/4	124/46	351	389	321	90	24	81.5	86.3	24	81.5	80	24	81.5	80	24	81.5
43	408/297/186	408/0	297/4	186/46	351	387	414	93.8	31.2	75.7	88.8	31.2	75.7	84.4	31.2	75.7	81.3	31.2	75.7
44	408/297/all	408/0	297/4	730/47	351	388	603	87.5	36.1	75	83.8	36.1	75	80	36.1	75	77.5	36.1	75
45	408/all/62	408/0	727/4	62/47	351	558	215	91.3	19.2	86.7	91.3	19.2	86.7	86.9	19.2	86.7	81.9	19.2	86.7
46	408/all/124	408/0	744/4	124/47	351	561	298	93.1	22	82.6	93.1	22	82.6	87.5	22	82.6	81.9	22	82.6
47	408/all/186	408/0	747/4	186/47	351	560	383	93.1	30.3	79.1	93.1	30.3	79.1	86.9	30.3	79.1	82.5	30.3	79.1
48	408/all/all	408/0	766/4	814/48	351	563	698	86.9	39.9	72.4	86.9	39.9	72.4	86.9	39.9	72.4	86.9	39.9	72.4
49	All/99/62	652/0	99/3	62/26	448	116	119	148.8	15.9	78.2	148.8	15.9	78.2	131.3	15.9	78.2	105.6	15.9	78.2
50	All/99/124	652/0	99/3	124/27	448	115	157	137.5	18.4	79.2	135.6	18.4	79.2	110	18.4	79.2	97.5	18.4	79.2
51	All/99/186	652/0	99/3	186/26	448	114	197	136.9	18.8	78.2	132.5	18.8	78.2	118.8	18.8	78.2	110.6	18.8	78.2
52	All/99/all	652/0	99/3	984/25	448	114	348	116.9	20.1	81.5	109.4	20.1	81.5	100.6	20.1	81.5	95	20.1	81.5
53	All/198/62	652/0	198/3	62/39	448	222	172	126.9	14.2	86.7	119.4	14.2	86.7	104.4	14.2	86.7	95	14.2	86.7
54	All/198/124	652/0	198/3	124/37	448	223	224	106.9	17.1	83	104.4	17.1	83	89.4	17.1	83	82.5	17.1	83
55	All/198/186	652/0	198/3	186/36	448	221	286	103.8	21.1	82.1	98.8	21.1	82.1	89.4	21.1	82.1	81.9	21.1	82.1
56	All/198/all	652/0	198/3	1088/38	448	221	486	102.5	23.9	79.3	98.1	23.9	79.3	91.3	23.9	79.3	88.1	23.9	79.3
57	All/297/62	652/0	297/3	62/41	448	330	196	106.3	15.4	88.5	100	15.4	88.5	84.4	15.4	88.5	80.6	15.4	88.5
58	All/297/124	652/0	297/3	124/42	448	329	283	100.6	22.5	81.7	95	22.5	81.7	85	22.5	81.7	81.3	22.5	81.7
59	All/297/186	652/0	297/3	186/41	448	330	358	101.9	26.4	79.9	96.3	26.4	79.9	85	26.4	79.9	80.6	26.4	79.9
60	All/297/all	652/0	297/3	940/40	448	329	575	90	31.4	76.3	86.9	31.4	76.3	83.1	31.4	76.3	80	31.4	76.3

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each snag-creation strategy, age is stand age when the threshold level for snag density (see table 6) was met, followed by density and mean d.b.h. at stand age 180 prior to the rotation harvest.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 10.

Table 17—Simulated measures of logs for 64 experimental thinning treatments, 180-year rotation strategy (first rotation in table 3)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
1	136/99/62	136/0	99/18	62/63	150	171	241	135	66.6	27.2	131.3	67.3	27.5	131.3	67.5	27.5	131.3	67.5	27.5
2	136/99/124	136/0	99/19	124/64	150	175	279	131.3	63.4	30	128.8	64.1	30.2	128.8	64.1	30.3	128.8	64.1	30.3
3	136/99/186	136/0	99/18	180/62	150	172	300	137.5	68.6	32.5	130.6	69.1	32.7	130.6	69.1	32.7	130	69.1	32.7
4	136/99/all	136/0	99/19	1064/64	150	174	443	126.3	66.5	32.1	126.3	67	32.3	126.3	67	32.3	126.3	67	32.3
5	136/198/62	136/0	187/18	62/93	150	280	335	123.1	78	33.5	123.1	78	33.5	122.5	78.4	33.4	120	78.8	33.4
6	136/198/124	136/0	195/19	111/95	150	287	380	123.1	78.4	35.8	123.1	78.4	35.8	123.1	78.4	35.8	123.1	78.4	35.8
7	136/198/186	136/0	194/19	112/94	150	287	377	119.4	81.7	37	119.4	81.7	37	119.4	81.7	37	119.4	81.7	37
8	136/198/all	136/0	196/19	780/92	150	281	508	121.9	80	36.3	119.4	80.4	36.4	119.4	80.4	36.4	119.4	80.4	36.4
9	136/297/62	136/0	190/18	62/95	150	292	343	123.8	83.6	33.4	123.8	83.6	33.4	123.8	83.9	33.3	120.6	84.6	33.4
10	136/297/124	136/0	209/18	118/96	150	297	387	119.4	75.2	36.2	119.4	75.2	36.2	119.4	75.2	36.2	119.4	75.2	36.2
11	136/297/186	136/0	210/19	121/95	150	300	387	120.6	74.4	36.3	120.6	74.4	36.3	120.6	74.4	36.3	120.6	74.4	36.3
12	136/297/all	136/0	204/18	754/96	150	294	519	121.3	88.7	36.7	121.3	88.7	36.7	121.3	88.7	36.7	121.3	88.7	36.7
13	136/all/62	136/0	1060/20	62/92	150	422	317	127.5	78.2	31.7	127.5	78.2	31.7	121.9	79.9	31	115.6	81.5	31.5
14	136/all/124	136/0	962/18	124/90	150	410	349	117.5	72.2	34.4	117.5	72.2	34.4	113.1	73.8	33.7	103.8	75	34
15	136/all/186	136/0	1048/20	186/93	150	420	386	126.3	73.5	37.5	126.3	73.5	37.5	122.5	74.9	36.8	121.3	75.2	36.9
16	136/all/all	136/0	994/19	1006/92	150	412	579	120	81.8	38	120	81.8	38	120	81.8	38	120	81.8	38
17	272/99/62	272/0	99/7	62/58	271	168	219	132.5	62.2	26.1	128.8	63	26.5	124.4	64.5	26	118.8	65.9	26.7
18	272/99/124	272/0	99/7	124/56	271	169	254	133.1	62.2	28.7	130	62.8	29	126.3	64.2	28.5	122.5	65.5	29
19	272/99/186	272/0	99/7	186/58	271	169	303	130.6	65.4	31.4	128.1	66.2	31.7	128.1	66.2	31.7	128.1	66.3	31.7
20	272/99/all	272/0	99/7	1093/57	271	168	442	128.8	62.6	31.5	123.8	63.2	31.8	123.8	63.2	31.8	123.8	63.2	31.8
21	272/198/62	272/0	198/7	62/67	271	319	294	121.9	73.8	29.4	116.3	74.6	29.6	112.5	76.2	29.1	100.6	77.7	29.7
22	272/198/124	272/0	198/7	124/68	271	319	403	120	82.5	34	113.1	83.2	34.2	113.1	83.2	34.2	113.1	83.3	34.2
23	272/198/186	272/0	198/7	124/69	271	320	407	112.5	87.8	33.1	108.8	88.5	33.3	108.8	88.5	33.3	108.8	88.5	33.3
24	272/198/all	272/0	198/7	659/68	271	321	540	117.5	77.8	35	116.3	78.4	35.2	116.3	78.4	35.2	116.3	78.4	35.2
25	272/297/62	272/0	246/6	62/68	271	392	297	123.8	71	28.5	123.8	71	28.5	116.3	72.5	27.9	106.3	74.1	28.6
26	272/297/124	272/0	244/7	124/70	271	392	412	110	87.5	33.2	110	87.5	33.2	103.1	89.1	32.6	87.5	90.6	33
27	272/297/186	272/0	245/7	162/70	271	394	480	114.4	89.6	35.2	114.4	89.6	35.2	114.4	89.6	35.2	114.4	89.6	35.2
28	272/297/all	272/0	244/7	604/69	271	391	598	115	86	35.7	115	86	35.7	115	86	35.7	115	86	35.7
29	272/all/62	272/0	765/7	62/69	271	498	270	125	69.3	28.5	125	69.3	28.5	121.3	70.9	27.9	112.5	72.4	28.5
30	272/all/124	272/0	775/7	124/67	271	499	342	118.8	78.9	32.6	118.8	78.9	32.6	110	80.5	31.9	97.5	82.2	32.5
31	272/all/186	272/0	748/6	186/66	271	496	421	120.6	83.4	35.9	120.6	83.4	35.9	108.1	85	35.3	97.5	86.6	35.7
32	272/all/all	272/0	745/7	833/68	271	495	648	105.6	86.5	37.4	105.6	86.5	37.4	105.6	86.5	37.4	105.6	86.5	37.4
33	408/99/62	408/0	99/4	62/35	351	137	148	150.6	47.4	25	148.1	48	25.5	143.1	49.6	24.9	139.4	51.2	25.9
34	408/99/124	408/0	99/4	124/34	351	138	190	138.1	58.1	27	137.5	58.7	27.3	135	60.3	26.8	129.4	61.7	27.4
35	408/99/186	408/0	99/4	186/36	351	138	228	131.3	57.7	28.7	128.1	58.3	29	125.6	59.7	28.5	120	61.1	29
36	408/99/all	408/0	99/4	1094/37	351	139	402	126.9	59.1	31.3	125.6	59.9	31.6	125.6	59.9	31.6	125.6	59.9	31.6

Table 17—Simulated measures of logs for 64 experimental thinning treatments, 180-year rotation strategy (first rotation in table 3) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
37	408/198/62	408/0	198/4	62/45	351	262	207	138.8	61.1	25.9	130.6	61.7	26.1	122.5	63.3	25.6	112.5	64.9	26.4
38	408/198/124	408/0	198/4	124/44	351	262	286	124.4	72.8	30.3	121.9	73.3	30.5	117.5	74.9	29.9	103.8	76.4	30.5
39	408/198/186	408/0	198/4	186/47	351	263	369	125	71.6	33.6	119.4	72.2	33.8	118.1	72.6	33.6	113.8	73.4	33.7
40	408/198/all	408/0	198/4	937/46	351	263	523	118.8	72.6	34.6	112.5	73.1	34.8	112.5	73.1	34.8	112.5	73.1	34.8
41	408/297/62	408/0	297/4	62/47	351	390	226	128.8	58.6	25.7	121.3	59.3	26	113.1	60.8	25.5	97.5	62.5	26.3
42	408/297/124	408/0	297/4	124/46	351	389	321	123.8	72.6	30.1	117.5	73.2	30.3	106.9	74.8	29.8	93.8	76.4	30.4
43	408/297/186	408/0	297/4	186/46	351	387	414	113.1	82.9	34.1	110	83.5	34.2	100	85.1	33.7	83.8	86.7	34
44	408/297/all	408/0	297/4	730/47	351	388	603	109.4	86.5	35.8	102.5	87.4	35.9	102.5	87.4	35.9	102.5	87.4	35.9
45	408/all/62	408/0	727/4	62/47	351	558	215	131.3	68.7	26.5	131.3	68.7	26.5	121.9	70.2	25.9	113.1	71.8	26.6
46	408/all/124	408/0	744/4	124/47	351	561	298	121.9	69	28.2	121.9	69	28.2	113.8	70.6	27.6	99.4	72.2	28.2
47	408/all/186	408/0	747/4	186/47	351	560	383	113.1	72.9	32.6	113.1	72.9	32.6	103.8	74.5	31.9	94.4	76.1	32.5
48	408/all/all	408/0	766/4	814/48	351	563	698	108.8	90.3	35.6	108.8	90.3	35.6	108.8	90.3	35.6	108.8	90.3	35.6
49	All/99/62	652/0	99/3	62/26	448	116	119	152.5	48.5	26.3	145	49.1	26.6	141.9	50.7	26	135.6	52.2	26.8
50	All/99/124	652/0	99/3	124/27	448	115	157	141.9	55.8	26.5	138.1	56.7	27	134.4	58.2	26.5	130	59.6	27.1
51	All/99/186	652/0	99/3	186/26	448	114	197	146.9	52	27.1	143.1	52.7	27.5	135	53.9	27	128.8	55.1	27.4
52	All/99/all	652/0	99/3	984/25	448	114	348	137.5	60	30.8	131.9	60.6	31.1	131.9	60.6	31.1	131.9	60.6	31.1
53	All/198/62	652/0	198/3	62/39	448	222	172	139.4	51.5	25.3	138.1	52.1	25.6	129.4	53.7	25	119.4	55.3	26
54	All/198/124	652/0	198/3	124/37	448	223	224	136.3	56.6	26.8	134.4	57.1	27	128.8	58.8	26.5	121.3	60.4	27.3
55	All/198/186	652/0	198/3	186/36	448	221	286	128.1	67.2	30.9	124.4	67.8	31.1	117.5	69.3	30.6	105.6	70.8	31
56	All/198/all	652/0	198/3	1088/38	448	221	486	126.3	68.6	33.5	120	69.2	33.7	120	69.2	33.7	120	69.2	33.7
57	All/297/62	652/0	297/3	62/41	448	330	196	136.3	56.4	25.7	130	57	26	120	58.6	25.5	100.6	60.2	26.3
58	All/297/124	652/0	297/3	124/42	448	329	283	127.5	63.4	28.6	121.9	64	28.8	118.8	65.5	28.3	100	67.2	29
59	All/297/186	652/0	297/3	186/41	448	330	358	126.9	69.1	31.4	121.9	69.8	31.6	113.8	71.3	31	90.6	72.8	31.4
60	All/297/all	652/0	297/3	940/40	448	329	575	116.9	76.1	34.1	114.4	76.7	34.2	114.4	76.7	34.2	114.4	76.7	34.2
61	All/all/62	652/0	796/3	62/40	448	603	192	132.5	64.2	25.6	132.5	64.2	25.6	127.5	65.7	25	104.4	67.4	25.8
62	All/all/124	652/0	799/3	124/42	448	603	279	121.3	69	27.2	121.3	69	27.2	114.4	70.6	26.6	90	72.3	27.3
63	All/all/186	652/0	806/3	186/40	448	607	358	117.5	76.9	30.5	117.5	76.9	30.5	101.9	78.4	29.9	80	80.1	30.5
64	All/all/all	652/0	784/3	803/41	448	598	708	102.5	92.2	34.2	102.5	92.2	34.2	102.5	92.2	34.2	102.5	92.2	34.2

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each log-creation strategy, age is stand age when the threshold level for log mass (see table 6) was met, followed by mass and mean large-end diameter (LED) at stand age 180 prior to the rotation harvest. Data are from the no-snag-creation scenario (see text).

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 10.

Table 18—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments starting with stand conditions created by the all-297-186 first-rotation treatment, 180-year rotation strategy (second rotation in table 3)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems		All[d]		
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	Age	(m^2/ha)	(m^3/ha)
1	136/99/62	104/31	99/27	62/29	353	349	326	5	25	108.1	9.8	122.5	49.7	122.5	51	615.4
2	136/99/124	104/31	99/28	124/29	351	354	384	5	26.2	93.8	10.6	110	45	110	53.4	589.3
3	136/99/186	105/30	99/27	186/28	348	348	436	5	27.1	88.8	11.3	110.6	48.8	110.6	58.2	614.1
4	136/99/all	105/30	99/28	1000/28	349	358	628	5	25.6	81.3	11	116.9	45.8	116.9	60.9	636.7
5	136/198/62	105/30	189/28	62/27	348	441	339	5	27	106.9	9.9	116.9	33.5	116.9	57.5	646.2
6	136/198/124	104/31	187/29	124/27	351	446	415	5	23.3	90	11.4	116.3	29.5	116.3	63	634.4
7	136/198/186	106/29	178/27	184/26	343	429	470	5	22.6	73.8	12.3	116.3	32.2	116.3	67.6	623.1
8	136/198/all	105/30	189/28	855/27	349	440	658	5	21	69.4	11.6	119.4	35.1	119.4	68.5	631.5
9	136/297/62	105/30	202/27	62/27	345	441	331	5	25.7	106.9	10.1	111.9	37.6	111.9	54.2	641.1
10	136/297/124	105/30	192/28	124/26	347	441	408	5	24.4	91.3	11.4	113.8	30	113.8	62	628.7
11	136/297/186	106/29	188/27	186/27	345	439	478	5	22.8	70	12.3	116.3	32.3	116.3	67	623
12	136/297/all	106/29	201/27	862/28	346	442	671	5	22.6	70	12.1	121.3	33.3	121.3	71.4	656.3
13	136/all/62	105/30	982/28	62/27	347	616	318	5	23.3	115.6	9.8	119.4	52.2	120.6	51.6	646
14	136/all/124	105/30	981/28	124/26	350	613	362	5	23.6	100.6	10.1	116.3	52.3	116.3	50.2	621.4
15	136/all/186	106/29	864/27	186/26	343	591	419	5	26.8	90	11.1	120	52.3	120	56.4	646
16	136/all/all	105/30	974/28	1162/27	349	620	749	5	22.3	65.6	11.6	132.5	44	132.5	69.8	662.8
17	272/99/62	242/29	99/27	62/25	446	358	319	5	23.9	113.1	9.7	130	45.6	130	52	668.4
18	272/99/124	241/30	99/28	124/26	448	365	395	5	25.5	92.5	10.9	111.9	30.9	113.8	59.3	656.2
19	272/99/186	242/29	99/27	182/25	441	356	445	5	25	88.8	12	135.6	29.8	135.6	67.6	679.7
20	272/99/all	241/30	99/28	956/25	452	365	631	5	23.8	78.8	11.1	145	27.4	145	67.7	686.7
21	272/198/62	241/30	198/28	62/26	447	473	341	5	24.9	106.9	10	148.8	24.7	150.6	59.2	699
22	272/198/124	241/30	198/27	124/25	445	466	421	5	19.5	91.3	11.2	134.4	14.9	135	67.6	674.2
23	272/198/186	241/30	198/27	186/25	446	466	509	5	18.9	72.5	12.4	113.9	15.7	113.9	79.5	687.9
24	272/198/all	241/30	198/27	738/26	447	470	678	5	17.8	70	11.7	137.8	14	137.8	79.5	694.9
25	272/297/62	241/30	242/27	62/25	447	515	330	5	21.7	108.1	9.8	155.6	28.5	155.6	58.6	695.8
26	272/297/124	242/29	238/27	124/25	443	506	420	5	19.1	88.1	11.7	132.6	14.4	133.9	68.8	694.9
27	272/297/186	241/30	235/28	186/25	450	515	510	5	17.8	72.5	12.2	106.4	14.9	108.9	77.4	664.2
28	272/297/all	242/29	244/27	751/24	442	512	698	5	17.2	68.8	11.2	140.9	13.7	140.9	83.2	696.5
29	272/all/62	242/29	815/27	62/25	445	652	315	5	20.3	113.8	9.7	128.1	45	128.1	51.1	692.6
30	272/all/124	242/29	806/27	124/24	443	644	372	5	21.6	95.6	10.9	121.3	31.2	121.3	60.3	712.2
31	272/all/186	241/30	807/28	186/26	445	657	452	5	21.6	84.4	12.2	125	28.8	125	68.9	711.9
32	272/all/all	241/30	801/28	999/25	447	655	771	5	17	64.4	10.7	127.5	19.9	127.5	81.1	706.5
33	408/99/62	378/29	99/27	62/25	529	353	321	5	22.4	105	9.9	130	41	130	52.6	661.8
34	408/99/124	377/29	99/27	124/25	531	350	381	5	24.9	93.1	11.1	120	34.5	121.3	58	672.6
35	408/99/186	377/30	99/28	181/26	533	356	445	5	22.8	88.1	11.8	115	29.9	116.9	64.3	652.1
36	408/99/all	377/30	99/27	992/26	531	353	625	5	23.8	81.3	11.1	125	26.9	125.6	65.5	681.5

Table 18—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments starting with stand conditions created by the all-297-186 first-rotation treatment, 180-year rotation strategy (second rotation in table 3) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems		All[d]		
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	Age	(m^2/ha)	(m^3/ha)
37	408/198/62	377/30	198/27	62/24	537	449	326	5	22.9	106.9	9.9	141.9	26.7	146.3	55.8	660.4
38	408/198/124	378/29	198/27	124/26	535	454	423	5	21.7	86.3	11.9	101.3	13.1	101.9	69.1	684.6
39	408/198/186	377/30	198/27	186/25	533	450	499	5	17.8	73.1	12.3	94.4	13.1	94.4	76.5	680.5
40	408/198/all	376/31	198/29	719/26	539	461	663	5	18.9	74.4	11.8	83.8	16.1	83.8	76.7	672.8
41	408/297/62	376/30	296/28	62/25	535	544	334	5	21.6	106.9	9.8	151.9	27	153.8	57.2	685.6
42	408/297/124	377/30	296/28	124/25	537	544	415	5	19.8	89.4	11.7	120.8	13.4	121.4	68.7	694.5
43	408/297/186	378/29	296/26	186/24	529	537	483	5	17.6	76.9	12.1	147.5	10.4	147.5	78.3	726.8
44	408/297/all	377/29	296/27	595/25	530	536	687	5	16.2	73.1	10.9	88.1	21.7	88.1	81.6	676.9
45	408/all/62	377/30	681/28	62/25	535	668	327	5	21.8	107.5	10	135	30.9	136.9	56.7	687.2
46	408/all/124	377/30	675/27	124/25	534	670	401	5	19.2	93.8	11.3	119.4	16.7	120	66.2	714
47	408/all/186	377/29	662/28	186/25	530	662	462	5	18.3	76.3	11.7	91.3	17.3	91.3	71.5	697
48	408/all/all	378/29	649/27	714/25	527	660	751	5	17.3	68.8	10.3	91.3	25.2	91.3	85.8	677
49	All/99/62	1041/30	99/28	62/26	671	339	311	5	20.5	106.3	9.8	114.4	49.9	115	50	655.8
50	All/99/124	1032/30	99/28	124/26	673	344	382	5	23.3	92.5	10.8	100.6	36.6	101.3	56.4	634.2
51	All/99/186	1027/30	99/28	182/26	677	340	426	5	25.1	88.8	11.5	86.3	40.5	91.3	59.7	652.5
52	All/99/all	1050/30	99/27	923/25	670	340	583	5	23.9	83.1	11.2	88.8	44.2	90	58	661.4
53	All/198/62	999/30	198/28	62/25	670	425	322	5	24.3	105.6	10.3	106.3	32.2	107.5	57.3	697
54	All/198/124	1042/30	198/28	124/26	673	427	406	5	23.1	90	11.4	88.8	27	90.6	60.6	652.4
55	All/198/186	1013/29	198/27	186/25	663	419	469	5	20.6	76.3	12	84.4	27.4	84.4	69.3	685
56	All/198/all	1031/30	198/28	854/25	675	425	637	5	21.1	75	11.6	85.6	30.1	85.6	68.4	694.6
57	All/297/62	995/30	296/27	62/25	667	495	328	5	21.8	106.3	10.2	105.6	34.8	109.4	53.8	694
58	All/297/124	1031/29	296/27	124/25	671	497	396	5	22.6	90.6	11.6	96.3	21.1	97.5	61.7	691.1
59	All/297/186	1021/30	296/28	186/25	676	499	473	5	18.1	75	11.8	88.8	28.7	88.8	68.7	697.4
60	All/297/all	1023/30	296/28	608/26	679	502	658	5	18.3	73.1	11.4	86.9	35.2	86.9	74.7	705.5
61	All/all/62	1013/29	784/27	62/25	668	716	319	5	19.3	106.9	10	107.5	37.3	112.5	51.7	695.9
62	All/all/124	1018/31	808/28	124/26	676	726	387	5	19.4	93.8	11.1	102.5	28.8	102.5	59	697.6
63	All/all/186	1062/30	825/28	186/25	672	725	438	5	18.7	88.8	11.3	95.6	30.3	95.6	66.9	715.5
64	All/all/all	1002/31	836/29	677/26	673	731	765	5	17.4	66.3	9.7	98.1	32.1	98.1	85.1	681.9

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] Stand density index is a measure of the stocking density following a thinning entry.

[c] Under "Criteria," age is stand age when the threshold level of the a criterion (see table 6) was met and is followed by the value of the criterion at stand age 180 prior to the rotation harvest.

[d] The minimum stand age when large bole, CHDI, and shade-tolerant stem density criteria were met.

[e] PSME BA is Douglas-fir basal area at stand age 180 prior to harvest.

[f] Extracted merchantable volume is the volume extracted in each thinning entry plus the rotation harvest at stand age 180.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 12.

Table 19—Simulated measures of snags for 64 experimental thinning treatments starting with stand conditions created by the all-297-186 first-rotation treatment, 180-year rotation strategy (second rotation in table 3)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
1	136/99/62	104/31	99/27	62/29	353	349	326	147.5	10.9	113.6	147.5	10.9	113.6	111.9	10.9	113.6	111.9	10.9	113.6
2	136/99/124	104/31	99/28	124/29	351	354	384	58.1	14.9	104.2	58.1	14.9	104.2	40	14.9	104.2	25.6	14.9	104.2
3	136/99/186	105/30	99/27	186/28	348	348	436	64.4	16.5	102.5	63.1	16.5	102.5	5	16.5	102.5	5	16.5	102.5
4	136/99/all	105/30	99/28	1000/28	349	358	628	63.8	15.9	100.5	63.8	15.9	100.5	63.8	15.9	100.5	63.8	15.9	100.5
5	136/198/62	105/30	189/28	62/27	348	441	339	106.9	12.1	107.9	106.9	12.1	107.9	69.4	12.1	107.9	38.8	12.1	107.9
6	136/198/124	104/31	187/29	124/27	351	446	415	43.8	18	98.8	43.1	18	98.8	5	18	98.8	5	18	98.8
7	136/198/186	106/29	178/27	184/26	343	429	470	5	21	88.8	5	21	88.8	5	21	88.8	5	21	88.8
8	136/198/all	105/30	189/28	855/27	349	440	658	53.1	21.9	88.7	53.1	21.9	88.7	53.1	21.9	88.7	53.1	21.9	88.7
9	136/297/62	105/30	202/27	62/27	345	441	331	113.1	11.9	108.7	113.1	11.9	108.7	48.8	11.9	108.7	48.8	11.9	108.7
10	136/297/124	105/30	192/28	124/26	347	441	408	51.9	16.8	97.1	51.9	16.8	97.1	25	16.8	97.1	25	16.8	97.1
11	136/297/186	106/29	188/27	186/27	345	439	478	5	23.8	88.2	5	23.8	88.2	5	23.8	88.2	5	23.8	88.2
12	136/297/all	106/29	201/27	862/28	346	442	671	42.5	21.8	88.6	42.5	21.8	88.6	42.5	21.8	88.6	42.5	21.8	88.6
13	136/all/62	105/30	982/28	62/27	347	616	318	157.5	11.4	109.3	157.5	11.4	109.3	109.4	11.4	109.3	109.4	11.4	109.3
14	136/all/124	105/30	981/28	124/26	350	613	362	102.5	14.7	101.4	102.5	14.7	101.4	53.8	14.7	101.4	39.4	14.7	101.4
15	136/all/186	106/29	864/27	186/26	343	591	419	91.3	16.2	98.2	91.3	16.2	98.2	71.3	16.2	98.2	37.5	16.2	98.2
16	136/all/all	105/30	974/28	1162/27	349	620	749	43.1	20.4	93.5	43.1	20.4	93.5	43.1	20.4	93.5	43.1	20.4	93.5
17	272/99/62	242/29	99/27	62/25	446	358	319	122.5	12.5	111.2	122.5	12.5	111.2	56.9	12.5	111.2	25.6	12.5	111.2
18	272/99/124	241/30	99/28	124/26	448	365	395	80.6	14.6	108.2	80.6	14.6	108.2	18.8	14.6	108.2	5	14.6	108.2
19	272/99/186	242/29	99/27	182/25	441	356	445	43.1	18.2	90.6	43.1	18.2	90.6	43.1	18.2	90.6	43.1	18.2	90.6
20	272/99/all	241/30	99/28	956/25	452	365	631	42.5	18.4	94.9	42.5	18.4	94.9	42.5	18.4	94.9	42.5	18.4	94.9
21	272/198/62	241/30	198/28	62/26	447	473	341	87.5	15.2	104.9	87.5	15.2	104.9	31.9	15.2	104.9	5	15.2	104.9
22	272/198/124	241/30	198/27	124/25	445	466	421	81.3	23.3	90.6	81.3	23.3	90.6	29.4	23.3	90.6	16.9	23.3	90.6
23	272/198/186	241/30	198/27	186/25	446	466	509	42.5	25.7	78.6	42.5	25.7	78.6	17.5	25.7	78.6	17.5	25.7	78.6
24	272/198/all	241/30	198/27	738/26	447	470	678	70.6	27.5	81.3	70.6	27.5	81.3	70.6	27.5	81.3	70.6	27.5	81.3
25	272/297/62	241/30	242/27	62/25	447	515	330	100.6	13.5	104.2	100.6	13.5	104.2	41.3	13.5	104.2	26.9	13.5	104.2
26	272/297/124	242/29	238/27	124/25	443	506	420	58.8	21.4	89.9	58.8	21.4	89.9	17.5	21.4	89.9	5	21.4	89.9
27	272/297/186	241/30	235/28	186/25	450	515	510	100.6	28.8	81.2	100.6	28.8	81.2	73.1	28.8	81.2	59.4	28.8	81.2
28	272/297/all	242/29	244/27	751/24	442	512	698	84.4	31	76.3	84.4	31	76.3	84.4	31	76.3	84.4	31	76.3
29	272/all/62	242/29	815/27	62/25	445	652	315	141.9	13.6	109.6	141.9	13.6	109.6	103.1	13.6	109.6	45	13.6	109.6
30	272/all/124	242/29	806/27	124/24	443	644	372	82.5	16	98.4	82.5	16	98.4	48.1	16	98.4	5	16	98.4
31	272/all/186	241/30	807/28	186/26	445	657	452	115.6	20.4	89.4	115.6	20.4	89.4	70.6	20.4	89.4	18.1	20.4	89.4
32	272/all/all	241/30	801/28	999/25	447	655	771	85.6	29	80.8	85.6	29	80.8	85.6	29	80.8	85.6	29	80.8
33	408/99/62	378/29	99/27	62/25	529	353	321	150.6	11.9	110.7	150.6	11.9	110.7	119.4	11.9	110.7	101.9	11.9	110.7
34	408/99/124	377/29	99/27	124/25	531	350	381	81.9	15	102	81.9	15	102	37.5	15	102	37.5	15	102
35	408/99/186	377/30	99/28	181/26	533	356	445	61.3	19.7	96.4	61.3	19.7	96.4	61.3	19.7	96.4	61.3	19.7	96.4
36	408/99/all	377/30	99/27	992/26	531	353	625	63.1	17.7	93.8	63.1	17.7	93.8	63.1	17.7	93.8	63.1	17.7	93.8

Table 19—Simulated measures of snags for 64 experimental thinning treatments starting with stand conditions created by the all-297-186 first-rotation treatment, 180-year rotation strategy (second rotation in table 3) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
37	408/198/62	377/30	198/27	62/24	537	449	326	78.1	14.3	103.8	78.1	14.3	103.8	34.4	14.3	103.8	18.8	14.3	103.8
38	408/198/124	378/29	198/27	124/26	535	454	423	89.4	20.4	90.9	89.4	20.4	90.9	33.8	20.4	90.9	32.5	20.4	90.9
39	408/198/186	377/30	198/27	186/25	533	450	499	57.5	26.1	82.5	57.5	26.1	82.5	57.5	26.1	82.5	57.5	26.1	82.5
40	408/198/all	376/31	198/29	719/26	539	461	663	99.4	25.4	82.7	99.4	25.4	82.7	99.4	25.4	82.7	99.4	25.4	82.7
41	408/297/62	376/30	297/28	62/25	535	544	334	130.6	13.5	106.8	130.6	13.5	106.8	80.6	13.5	106.8	45	13.5	106.8
42	408/297/124	377/30	297/28	124/25	537	544	415	75.6	21.2	88.9	75.6	21.2	88.9	30.6	21.2	88.9	18.1	21.2	88.9
43	408/297/186	378/29	297/26	186/24	529	537	483	32.5	27.1	80.3	32.5	27.1	80.3	17.5	27.1	80.3	17.5	27.1	80.3
44	408/297/all	377/29	297/27	595/25	530	536	687	55.6	30.6	76.5	55.6	30.6	76.5	55.6	30.6	76.5	55.6	30.6	76.5
45	408/all/62	377/30	681/28	62/25	535	668	327	121.3	13.2	107.5	121.3	13.2	107.5	119.4	13.2	107.5	84.4	13.2	107.5
46	408/all/124	377/30	675/27	124/25	534	670	401	87.5	18.3	90.9	87.5	18.3	90.9	83.1	18.3	90.9	5	18.3	90.9
47	408/all/186	377/29	662/28	186/25	530	662	462	75	23.6	83.5	75	23.6	83.5	32.5	23.6	83.5	18.1	23.6	83.5
48	408/all/all	378/29	649/27	714/25	527	660	751	60	30.2	74.1	60	30.2	74.1	60	30.2	74.1	60	30.2	74.1
49	All/99/62	1041/30	99/28	62/26	671	339	311	98.1	11.5	104.2	95.6	11.5	104.2	64.4	11.5	104.2	48.8	11.5	104.2
50	All/99/124	1032/30	99/28	124/26	673	344	382	93.1	15.8	101.8	93.1	15.8	101.8	75	15.8	101.8	58.1	15.8	101.8
51	All/99/186	1027/30	99/28	182/26	677	340	426	90	17.5	94.1	90	17.5	94.1	90	17.5	94.1	90	17.5	94.1
52	All/99/all	1050/30	99/27	923/25	670	340	583	86.3	16.5	95.5	86.3	16.5	95.5	86.3	16.5	95.5	86.3	16.5	95.5
53	All/198/62	999/30	198/28	62/25	670	425	322	131.9	11.5	101.1	131.9	11.5	101.1	107.5	11.5	101.1	45.6	11.5	101.1
54	All/198/124	1042/30	198/28	124/26	673	427	406	101.9	18.1	97.7	101.3	18.1	97.7	58.1	18.1	97.7	5	18.1	97.7
55	All/198/186	1013/29	198/27	186/25	663	419	469	56.9	22.5	85.3	56.9	22.5	85.3	56.9	22.5	85.3	56.9	22.5	85.3
56	All/198/all	1031/30	198/28	854/25	675	425	637	45.6	22	90.7	45.6	22	90.7	45.6	22	90.7	45.6	22	90.7
57	All/297/62	995/30	297/27	62/25	667	495	328	125	12.6	110.1	125	12.6	110.1	121.3	12.6	110.1	40	12.6	110.1
58	All/297/124	1031/29	297/27	124/25	671	497	396	60	18.4	92	60	18.4	92	18.8	18.4	92	5	18.4	92
59	All/297/186	1021/30	297/28	186/25	676	499	473	87.5	24.7	85.5	87.5	24.7	85.5	30.6	24.7				
60	All/297/all	1023/30	297/28	608/26	679	502	658	88.1	27.5	82.5	88.1	27.5	82.5	88.1	27.5	82.5	88.1	27.5	82.5
61	All/all/62	1013/29	784/27	62/25	668	716	319	140	13.4	105.4	140	13.4	105.4	122.5	13.4	105.4	68.1	13.4	105.4
62	All/all/124	1018/31	808/28	124/26	676	726	387	130	17.7	95.6	130	17.7	95.6	108.8	17.7	95.6	51.9	17.7	95.6
63	All/all/186	1062/30	825/28	186/25	672	725	438	92.5	20.3	87.4	92.5	20.3	87.4	48.1	20.3	87.4	18.8	20.3	87.4
64	All/all/all	1002/31	836/29	677/26	673	731	765	116.3	28.7	76.1	116.3	28.7	76.1	116.3	28.7	76.1	116.3	28.7	76.1

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each snag-creation strategy, age is stand age when the threshold level for snag density (see table 6) was met, followed by density and mean d.b.h. at stand age 180 prior to the rotation harvest.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 13.

Table 20—Simulated measures of logs for 64 experimental thinning treatments starting with stand conditions created by the all-297-186 first-rotation treatment, 180-year rotation strategy (second rotation in table 3)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
1	136/99/62	104/31	99/27	62/29	353	349	326	5	98.6	28.7	5	99.6	28.9	5	101.2	28.5	5	102.8	28.9
2	136/99/124	104/31	99/28	124/29	351	354	384	5	110.6	32.9	5	111.6	33	5	113.1	32.6	5	114.3	32.7
3	136/99/186	105/30	99/27	186/28	348	348	436	5	105	34.9	5	106	35	5	106.1	34.9	5	106.3	34.9
4	136/99/all	105/30	99/28	1000/28	349	358	628	5	108.1	35.5	5	109.2	35.6	5	109.2	35.6	5	109.2	35.6
5	136/198/62	105/30	189/28	62/27	348	441	339	5	102.5	28	5	102.5	28	5	104.1	27.5	5	105.7	27.9
6	136/198/124	104/31	187/29	124/27	351	446	415	5	111.3	31.8	5	111.3	31.8	5	112.9	31.4	5	114.6	31.6
7	136/198/186	106/29	178/27	184/26	343	429	470	5	121	37.9	5	121	37.9	5	121.4	37.8	5	121.7	37.8
8	136/198/all	105/30	189/28	855/27	349	440	658	5	109.6	38.1	5	109.6	38.1	5	109.6	38.1	5	109.6	38.1
9	136/297/62	105/30	202/27	62/27	345	441	331	5	107.4	28.2	5	107.4	28.2	5	109	27.7	5	110.6	28.1
10	136/297/124	105/30	192/28	124/26	347	441	408	5	108	32.8	5	108	32.8	5	109.6	32.3	5	111.2	32.5
11	136/297/186	106/29	188/27	186/27	345	439	478	5	112	36.7	5	112	36.7	5	112.4	36.6	5	112.9	36.7
12	136/297/all	106/29	201/27	862/28	346	442	671	5	100.5	37.4	5	100.5	37.4	5	100.5	37.4	5	100.5	37.4
13	136/all/62	105/30	982/28	62/27	347	616	318	5	93.2	28.1	5	93.2	28.1	5	94.8	27.6	5	96.5	28.1
14	136/all/124	105/30	981/28	124/26	350	613	362	5	108.9	31.2	5	108.9	31.2	5	110.5	30.8	5	112.1	31.1
15	136/all/186	106/29	864/27	186/26	343	591	419	5	104.1	33.9	5	104.1	33.9	5	105.7	33.3	5	107.4	33.6
16	136/all/all	105/30	974/28	1162/27	349	620	749	5	104.6	38.9	5	104.6	38.9	5	104.6	38.9	5	104.6	38.9
17	272/99/62	242/29	99/27	62/25	446	358	319	5	112.2	28.5	5	113.2	28.6	5	114.8	28.2	5	116.5	28.5
18	272/99/124	241/30	99/28	124/26	448	365	395	5	95.3	31	5	96.3	31.2	5	97.8	30.7	5	99.1	30.9
19	272/99/186	242/29	99/27	182/25	441	356	445	5	109.3	35.9	5	110.2	35.9	5	110.2	35.9	5	110.4	35.9
20	272/99/all	241/30	99/28	956/25	452	365	631	5	111.4	35.2	5	112.3	35.2	5	112.3	35.2	5	112.3	35.2
21	272/198/62	241/30	198/28	62/26	447	473	341	5	98.2	28.1	5	98.4	28.1	5	100.1	27.7	5	101.6	28
22	272/198/124	241/30	198/27	124/25	445	466	421	5	111.3	31.7	5	111.7	31.7	5	113.2	31.3	5	114.9	31.5
23	272/198/186	241/30	198/27	186/25	446	466	509	5	105.5	35.4	5	105.9	35.4	5	105.9	35.4	5	106.1	35.4
24	272/198/all	241/30	198/27	738/26	447	470	678	5	117.2	37.7	5	117.5	37.7	5	117.5	37.7	5	117.5	37.7
25	272/297/62	241/30	242/27	62/25	447	515	330	5	102.6	28.9	5	102.6	28.9	5	104.2	28.5	5	105.8	28.8
26	272/297/124	242/29	238/27	124/25	443	506	420	5	98.3	31.8	5	98.3	31.8	5	99.9	31.3	5	101.5	31.6
27	272/297/186	241/30	235/28	186/25	450	515	510	5	109.6	36.3	5	109.6	36.3	5	110.8	35.9	5	112.2	36
28	272/297/all	242/29	244/27	751/24	442	512	698	5	106.4	37.7	5	106.4	37.7	5	106.4	37.7	5	106.4	37.7
29	272/all/62	242/29	815/27	62/25	445	652	315	5	111.1	29	5	111.1	29	5	112.7	28.5	5	114.3	28.8
30	272/all/124	242/29	806/27	124/24	443	644	372	5	95.5	29.7	5	95.5	29.7	5	97.1	29.3	5	98.7	29.6
31	272/all/186	241/30	807/28	186/26	445	657	452	5	98.5	32.6	5	98.5	32.6	5	100.1	32.1	5	101.7	32.3
32	272/all/all	241/30	801/28	999/25	447	655	771	5	119.9	39	5	119.9	39	5	119.9	39	5	119.9	39
33	408/99/62	378/29	99/27	62/25	529	353	321	5	98.6	27.5	5	99.5	27.6	5	101.1	27.2	5	102.7	27.5
34	408/99/124	377/29	99/27	124/25	531	350	381	5	107.4	30.2	5	108.3	30.3	5	109.6	30	5	110.7	30.1
35	408/99/186	377/30	99/28	181/26	533	356	445	5	103.4	34.8	5	104.4	34.9	5	104.4	34.9	5	104.5	34.9
36	408/99/all	377/30	99/27	992/26	531	353	625	5	100.9	35.1	5	101.8	35.2	5	101.8	35.2	5	101.8	35.2

Table 20—Simulated measures of logs for 64 experimental thinning treatments starting with stand conditions created by the all-297-186 first-rotation treatment, 180-year rotation strategy (second rotation in table 3) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
37	408/198/62	377/30	198/27	62/24	537	449	326	5	116.8	29.4	5	117.2	29.4	5	118.8	29	5	120.4	29.3
38	408/198/124	378/29	198/27	124/26	535	454	423	5	101.3	31.1	5	102	31.2	5	103.5	30.8	5	105	30.9
39	408/198/186	377/30	198/27	186/25	533	450	499	5	120.1	37.8	5	120.7	37.8	5	120.7	37.8	5	120.8	37.8
40	408/198/all	376/31	198/29	719/26	539	461	663	5	102.2	37.7	5	102.7	37.7	5	102.7	37.7	5	102.7	37.7
41	408/297/62	376/30	296/28	62/25	535	544	334	5	107.6	28.3	5	107.9	28.4	5	109.5	28	5	111.1	28.3
42	408/297/124	377/30	296/28	124/25	537	544	415	5	90.7	29.9	5	90.9	30	5	92.5	29.5	5	94.1	29.8
43	408/297/186	378/29	296/26	186/24	529	537	483	5	104.4	35.5	5	104.7	35.5	5	106.2	35	5	107.9	35.2
44	408/297/all	377/29	296/27	595/25	530	536	687	5	123.6	40.2	5	123.9	40.2	5	123.9	40.2	5	123.9	40.2
45	408/all/62	377/30	681/28	62/25	535	668	327	5	89.9	27.2	5	89.9	27.2	5	91.5	26.7	5	93.1	27
46	408/all/124	377/30	675/27	124/25	534	670	401	5	105.7	30.3	5	105.7	30.3	5	107.3	29.9	5	108.9	30.1
47	408/all/186	377/29	662/28	186/25	530	662	462	5	103.3	35.3	5	103.3	35.3	5	104.9	34.7	5	106.5	34.9
48	408/all/all	378/29	649/27	714/25	527	660	751	5	109.9	39.4	5	109.9	39.4	5	109.9	39.4	5	109.9	39.4
49	All/99/62	1041/30	99/28	62/26	671	339	311	5	109.7	28.2	5	110.7	28.3	5	112.2	27.9	5	113.3	28.1
50	All/99/124	1032/30	99/28	124/26	673	344	382	5	96.1	29.5	5	96.9	29.6	5	97.4	29.4	5	98	29.5
51	All/99/186	1027/30	99/28	182/26	677	340	426	5	92.2	33.8	5	93	33.8	5	93	33.8	5	93	33.8
52	All/99/all	1050/30	99/27	923/25	670	340	583	5	111.5	35	5	112.3	35.1	5	112.3	35.1	5	112.3	35.1
53	All/198/62	999/30	198/28	62/25	670	425	322	5	92.6	27.2	5	93.4	27.4	5	95	26.9	5	96.6	27.3
54	All/198/124	1042/30	198/28	124/26	673	427	406	5	106.3	32.3	5	106.8	32.3	5	108.4	31.9	5	109.6	32
55	All/198/186	1013/29	198/27	186/25	663	419	469	5	117.6	39.9	5	118.2	39.9	5	118.2	39.9	5	118.2	39.9
56	All/198/all	1031/30	198/28	854/25	675	425	637	5	98.2	38	5	98.9	38	5	98.9	38	5	98.9	38
57	All/297/62	995/30	296/27	62/25	667	495	328	5	105.4	28.6	5	105.9	28.7	5	107.5	28.3	5	109.1	28.6
58	All/297/124	1031/29	296/27	124/25	671	497	396	5	108.1	33.2	5	108.7	33.3	5	110.3	32.8	5	111.8	33
59	All/297/186	1021/30	296/28	186/25	676	499	473	5	114.9	40	5	115.3	40	5	116.8	39.5	5	118.1	39.5
60	All/297/all	1023/30	296/28	608/26	679	502	658	5	106.9	43.4	5	107.5	43.4	5	107.5	43.4	5	107.5	43.4
61	All/all/62	1013/29	784/27	62/25	668	716	319	5	105	28	5	105	28	5	106.6	27.6	5	108.2	27.9
62	All/all/124	1018/31	808/28	124/26	676	726	387	5	103.4	30.3	5	103.4	30.3	5	105	29.8	5	106.7	30.1
63	All/all/186	1062/30	825/28	186/25	672	725	438	5	101	33.4	5	101	33.4	5	102.6	32.9	5	104.2	33.1
64	All/all/all	1002/31	836/29	677/26	673	731	765	5	120	41.2	5	120	41.2	5	120	41.2	5	120	41.2

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each log-creation strategy, age is stand age when the threshold level for log mass (see table 6) was met, followed by mass and mean large-end diameter (LED) at stand age 180 prior to the rotation harvest. Data are from the no-snag-creation scenario (see text).

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 14.

Table 21—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments, 100-year rotation strategy (first rotation in table 4)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[d]	Extracted merchantable volume[e]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems				
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	LSI	(m^2/ha)	(m^3/ha)
1	136/99/62	136/0	99/18	62/63	150	171	241	>100	2.1	>100	6.7	>100	3.1	58.6	36.2	436.8
2	136/99/124	136/0	99/19	124/64	150	175	279	>100	1.9	>100	7.5	>100	3.5	58.1	37.3	464.5
3	136/99/186	136/0	99/18	180/62	150	172	300	>100	2.1	>100	7.6	>100	5.4	66.6	37.7	454.5
4	136/99/all	136/0	99/19	1065/64	150	174	443	>100	1.1	>100	7.7	>100	3.7	49.9	37.5	446.1
5	136/198/62	136/0	188/18	62/93	150	280	335	>100	0.1	>100	7.4	>100	1.4	21.5	48.7	513.4
6	136/198/124	136/0	195/19	112/95	150	287	380	>100	0	91.9	8.4	>100	1.5	20.1	50.5	513.3
7	136/198/186	136/0	195/19	113/94	150	287	377	>100	0.1	>100	8.4	>100	1.4	21.3	50.2	514.3
8	136/198/all	136/0	196/19	780/92	150	281	508	>100	0	87.5	8.7	>100	1.3	18.8	48.9	516.4
9	136/297/62	136/0	190/18	62/95	150	292	343	>100	0.1	>100	7.7	>100	1.1	19.7	49.6	515.6
10	136/297/124	136/0	209/18	118/96	150	297	387	>100	0	91.9	8.6	>100	1.3	19.7	50.9	514.1
11	136/297/186	136/0	210/19	121/95	150	300	387	>100	0	91.9	8.5	>100	1.6	20.9	51.5	514.8
12	136/297/all	136/0	204/18	754/96	150	294	519	>100	0	89.4	8.9	>100	1.7	22.6	50.4	499.9
13	136/all/62	136/0	1060/20	62/92	150	422	317	>100	0.1	>100	7.2	>100	1.2	20.4	45.5	513.1
14	136/all/124	136/0	962/18	124/90	150	410	349	>100	0.2	>100	8	>100	0.8	18.6	46.8	507.4
15	136/all/186	136/0	1049/20	186/93	150	420	386	>100	0	90	8.4	>100	1.2	18	47.6	505.5
16	136/all/all	136/0	995/19	1006/92	150	412	579	>100	0	90	9.4	>100	1.3	18.9	49.3	496.6
17	272/99/62	272/0	99/7	62/58	271	168	219	>100	0.3	>100	6.8	>100	0.8	19.3	34.2	521.1
18	272/99/124	272/0	99/7	124/56	271	169	254	>100	0.3	>100	7.9	>100	1.8	29.2	35.5	529.4
19	272/99/186	272/0	99/7	186/58	271	169	303	>100	0	95	8.7	>100	2.7	27.9	39.2	543.9
20	272/99/all	272/0	99/7	1093/57	271	168	442	>100	0.2	95	8.7	>100	2.5	30.4	40	533.1
21	272/198/62	272/0	198/7	62/67	271	319	294	>100	0	>100	7.3	>100	2.9	26.2	46.3	616.8
22	272/198/124	272/0	198/7	123/68	271	319	403	>100	0	>100	6.3	>100	5.2	32.6	58.1	625.9
23	272/198/186	272/0	198/7	125/69	271	320	407	>100	0	>100	6.2	>100	4.9	31.6	58.6	612.2
24	272/198/all	272/0	198/7	659/68	271	321	540	>100	0	>100	6.4	>100	4.9	32.2	58.3	616.2
25	272/297/62	272/0	246/6	62/68	271	392	297	>100	0	>100	7	>100	2.7	25.2	45.9	598.9
26	272/297/124	272/0	245/7	124/70	271	392	412	>100	0	>100	6.1	>100	4.7	30.8	58.7	617.5
27	272/297/186	272/0	245/7	163/70	271	394	480	>100	0	>100	5.5	>100	5.9	32.8	65.6	616.2
28	272/297/all	272/0	244/7	605/69	271	391	598	>100	0	>100	5.9	>100	6.4	35.1	65.7	613.9
29	272/all/62	272/0	765/7	62/69	271	498	270	>100	0	>100	7.4	>100	1.7	20.1	41.2	570.5
30	272/all/124	272/0	775/7	124/67	271	499	342	>100	0	>100	7.3	>100	3.1	27.4	47.8	599.8
31	272/all/186	272/0	749/6	186/66	271	496	421	>100	0	>100	6.6	>100	4.5	31.3	56.2	608.9
32	272/all/all	272/0	746/7	833/68	271	495	648	>100	0	>100	6.1	>100	7.4	38.5	64.3	604.9
33	408/99/62	408/0	99/4	62/35	351	137	148	>100	0.2	>100	6.2	>100	0.8	16.7	25.2	562.5
34	408/99/124	408/0	99/4	124/34	351	138	190	>100	0.3	>100	6.9	>100	1.9	27.9	28.2	532.9
35	408/99/186	408/0	99/4	186/36	351	138	228	>100	0.1	>100	7.2	>100	1.8	23.9	30.1	541.8
36	408/99/all	408/0	99/4	1094/37	351	139	402	>100	0	>100	7.9	>100	2.8	28.1	35.2	541.3

Table 21—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments, 100-year rotation strategy (first rotation in table 4) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[d]	Extracted merchantable volume[e]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems				
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	LSI	(m^2/ha)	(m^3/ha)
37	408/198/62	408/0	198/4	62/45	351	262	207	>100	0	>100	6.6	>100	2.1	21.8	33.7	607.8
38	408/198/124	408/0	198/4	124/44	351	262	286	>100	0	>100	7.2	>100	3.3	28.7	42.7	637.9
39	408/198/186	408/0	198/4	186/47	351	263	369	>100	0	>100	6.9	>100	5.5	35.3	50.2	633.6
40	408/198/all	408/0	198/4	938/46	351	263	523	>100	0	>100	6.6	>100	6.2	36.3	51.4	633.8
41	408/297/62	408/0	297/4	62/47	351	390	226	>100	0	>100	6.6	>100	2.1	21.1	37.3	609.7
42	408/297/124	408/0	297/4	124/46	351	389	321	>100	0	>100	6.3	>100	4.7	31.1	48.2	641.7
43	408/297/186	408/0	297/4	186/46	351	387	414	>100	0	>100	5.5	>100	7	35.6	57.6	640
44	408/297/all	408/0	297/4	731/47	351	388	603	>100	0	>100	5.6	>100	8.7	39.9	63.8	634
45	408/all/62	408/0	727/4	62/47	351	558	215	>100	0	>100	6.5	>100	2.2	22.2	34.2	573.1
46	408/all/124	408/0	745/4	124/47	351	561	298	>100	0	>100	6.5	>100	3.9	28.6	44.3	604.9
47	408/all/186	408/0	748/4	186/47	351	560	383	>100	0	>100	6.4	>100	6.6	37.3	52.9	608.2
48	408/all/all	408/0	766/4	815/48	351	563	698	>100	0	>100	5.6	94.5	11.5	42.9	71.1	560.2
49	All/99/62	652/0	99/3	62/26	448	116	119	>100	0	->100	5.8	>100	1.1	14.2	20.9	598
50	All/99/124	652/0	99/3	124/27	448	115	157	>100	0	>100	6.3	>100	1.8	19.2	23.9	571.2
51	All/99/186	652/0	99/3	185/26	448	114	197	>100	0	>100	6.8	>100	3.1	26.2	27.7	544
52	All/99/all	652/0	99/3	985/25	448	114	348	>100	0	>100	7.5	>100	5.2	35.6	32.5	519.8
53	All/198/62	652/0	198/3	62/39	448	222	172	>100	0	>100	6.2	>100	2.1	21	28.3	580.4
54	All/198/124	652/0	198/3	124/37	448	223	224	>100	0	>100	7.4	>100	5	34.8	33.6	581.6
55	All/198/186	652/0	198/3	186/36	448	221	286	>100	0	>100	7.8	>100	6.3	40	38.6	593.4
56	All/198/all	652/0	198/3	1088/38	448	221	486	>100	0	>100	7.7	>100	8.4	45.2	45.2	590.3
57	All/297/62	652/0	297/3	62/41	448	330	196	>100	0	>100	6.3	>100	2.8	24.2	32.1	600.6
58	All/297/124	652/0	297/3	124/42	448	329	283	>100	0	>100	6.9	>100	5.9	36.4	42.4	624.8
59	All/297/186	652/0	297/3	186/41	448	330	358	>100	0	>100	6.8	>100	6.6	38.4	50.5	630
60	All/297/all	652/0	297/3	941/40	448	329	575	>100	0	>100	6.4	>100	9.8	44.3	56.3	601.4
61	All/all/62	652/0	796/3	62/40	448	603	192	>100	0	>100	6.3	>100	2.9	24.8	31.5	551.7
62	All/all/124	652/0	798/3	124/42	448	603	279	>100	0	>100	6.5	>100	5.7	34.9	41.4	571.5
63	All/all/186	652/0	806/3	186/40	448	607	358	>100	0	>100	6.6	>100	7.3	39.7	49.5	573.8
64	All/all/all	652/0	785/3	803/41	448	598	708	>100	0	>100	6.4	73.1	12.5	45.6	71.2	503.8

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] Stand density index is a measure of the stocking density following a thinning entry.

[c] Under "Criteria," age is stand age when the threshold level of a criterion (see table 6) was met and is followed by the value of the criterion at stand age 100 prior to the rotation harvest; LSI is the late-successional index (see text).

[d] PSME BA is Douglas-fir basal area at stand age 100 prior to harvest.

[e] Extracted merchantable volume is the volume extracted in each thinning entry plus the rotation harvest at stand age 100.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 15.

Table 22—Simulated measures of snags for 64 experimental thinning treatments, 100-year rotation strategy (first rotation in table 4)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
1	136/99/62	136/0	99/18	62/63	150	171	241	100	10.3	68.7	95	11.8	67.2	80	14.4	65.4	75	16	64.6
2	136/99/124	136/0	99/19	124/64	150	175	279	100	10.3	67.2	90	11.8	65.9	80	14.3	64.3	75	15.8	63.6
3	136/99/186	136/0	99/18	180/62	150	172	300	>100	9.9	66.4	90	11.5	65.2	80	13.7	63.9	75	15	63.4
4	136/99/all	136/0	99/19	1064/64	150	174	443	100	10.4	67.8	90	11.9	66.4	80	13.9	65.2	75	15	64.6
5	136/198/62	136/0	187/18	62/93	150	280	335	90	14.1	65.5	85	15.2	64.9	80	17.4	63.9	80	19.3	63.2
6	136/198/124	136/0	195/19	111/95	150	287	380	85	14.7	64.8	85	15.9	64.2	80	16.7	63.8	80	17	63.6
7	136/198/186	136/0	194/19	112/94	150	287	377	85	15.4	65.6	80	16.3	65.2	80	17	64.9	80	17.2	64.8
8	136/198/all	136/0	196/19	780/92	150	281	508	85	14.7	65.5	85	15.8	64.9	80	16.9	64.4	75	17.5	64.1
9	136/297/62	136/0	190/18	62/95	150	292	343	90	14.3	66.3	90	14.3	66.3	85	15.8	65.4	80	17.8	64.6
10	136/297/124	136/0	209/18	118/96	150	297	387	85	16.1	65.4	85	16.1	65.4	85	16.1	65.4	85	16.1	65.4
11	136/297/186	136/0	210/19	121/95	150	300	387	85	14.7	64.9	85	14.7	64.9	85	14.7	64.9	85	14.7	64.9
12	136/297/all	136/0	204/18	754/96	150	294	519	85	16.8	64.6	85	16.8	64.6	85	16.8	64.6	85	16.8	64.6
13	136/all/62	136/0	1060/20	62/92	150	422	317	85	15.4	65.9	85	15.4	65.9	80	17	65.1	80	18.9	64.3
14	136/all/124	136/0	962/18	124/90	150	410	349	85	15	64.8	85	15	64.8	80	16.6	64.1	80	18.5	63.5
15	136/all/186	136/0	1048/20	186/93	150	420	386	80	16.3	65.5	80	16.3	65.5	80	17.8	64.8	80	19.8	64.1
16	136/all/all	136/0	994/19	1006/92	150	412	579	85	16.9	64.6	85	16.9	64.6	85	16.9	64.6	85	16.9	64.6
17	272/99/62	272/0	99/7	62/58	271	168	219	>100	9.1	65.1	100	10.7	64.1	85	13.4	62.7	80	15.4	62
18	272/99/124	272/0	99/7	124/56	271	169	254	95	11.4	64.2	90	13	63.4	80	15.7	62.3	80	17.6	61.8
19	272/99/186	272/0	99/7	186/58	271	169	303	100	10.5	64.2	95	12.1	63.3	85	14.7	62.2	80	16.5	61.6
20	272/99/all	272/0	99/7	1093/57	271	168	442	>100	9.8	61.9	95	11.3	61.4	85	13.3	60.8	80	14.4	60.4
21	272/198/62	272/0	199/7	62/67	271	319	294	85	14.9	61.3	85	16.5	60.9	80	19.2	60.3	80	21.2	60.1
22	272/198/124	272/0	199/7	124/68	271	319	403	90	16.6	60.7	85	18.1	60.4	80	20.4	59.9	80	22.1	59.5
23	272/198/186	272/0	199/7	124/69	271	320	407	85	18.5	60.4	80	20	60.2	75	22	59.9	75	23.1	59.7
24	272/198/all	272/0	199/7	659/68	271	321	540	85	18.5	60.2	80	20	60	75	22	59.7	75	23.1	59.4
25	272/297/62	272/0	246/6	62/68	271	392	297	85	16.1	61.1	85	16.1	61.1	80	17.6	60.7	80	19.6	60.4
26	272/297/124	272/0	244/7	124/70	271	392	412	85	18.3	60.2	85	18.3	60.2	80	19.9	60	80	21.8	59.8
27	272/297/186	272/0	245/7	162/70	271	394	480	85	21.8	60.3	85	21.8	60.3	85	21.8	60.3	85	21.8	60.3
28	272/297/all	272/0	244/7	604/69	271	391	598	85	20	59.8	85	20	59.8	85	20	59.8	85	20	59.8
29	272/all/62	272/0	765/7	62/69	271	498	270	85	15.5	60.9	85	15.5	60.9	80	17.1	60.5	80	19	60.2
30	272/all/124	272/0	775/7	124/67	271	499	342	85	16.7	61.1	85	16.7	61.1	80	18.3	60.7	80	20.3	60.4
31	272/all/186	272/0	748/6	186/66	271	496	421	85	18.1	59.7	85	18.1	59.7	80	19.7	59.5	80	21.6	59.3
32	272/all/all	272/0	745/7	833/68	271	495	648	85	19	59.2	85	19	59.2	85	19	59.2	85	19	59.2
33	408/99/62	408/0	99/4	62/35	351	137	148	>100	5.3	62.2	>100	6.9	60.9	>100	9.6	60	85	11.6	59.6
34	408/99/124	408/0	99/4	124/34	351	138	190	>100	7.2	62.3	>100	8.7	61.4	90	11.5	60.5	80	13.4	60
35	408/99/186	408/0	99/4	186/36	351	138	228	>100	7.9	63.9	>100	9.5	62.8	95	12.2	61.7	85	14.2	61
36	408/99/all	408/0	99/4	1094/37	351	139	402	>100	9.7	63.4	100	11.3	62.5	90	13.2	61.8	85	14.4	61.4

Table 22—Simulated measures of snags for 64 experimental thinning treatments, 100-year rotation strategy (first rotation in table 4) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
37	408/198/62	408/0	199/4	62/45	351	262	207	>100	8.9	61.3	100	10.5	60.8	85	13.2	60.2	80	15.2	59.9
38	408/198/124	408/0	199/4	124/44	351	262	286	95	11.5	60.5	90	13.1	60.2	80	15.8	59.9	80	17.8	59.6
39	408/198/186	408/0	199/4	186/47	351	263	369	95	13.3	60.9	90	14.9	60.6	80	17.6	60.1	80	19.6	59.7
40	408/198/all	408/0	199/4	937/46	351	263	523	95	14	60.1	90	15.5	59.8	85	17.5	59.6	80	18.6	59.4
41	408/297/62	408/0	297/4	62/47	351	390	226	100	10.9	60.3	90	12.5	59.9	80	15.2	59.3	80	17.2	59.1
42	408/297/124	408/0	297/4	124/46	351	389	321	90	14	58.9	85	15.6	58.7	80	18.3	58.5	80	20.3	58.4
43	408/297/186	408/0	297/4	186/46	351	387	414	90	15.4	59.4	90	17	59.3	80	19.7	59	80	21.7	58.9
44	408/297/all	408/0	297/4	730/47	351	388	603	90	16.7	59.6	85	18.3	59.4	80	20.3	59.1	75	21.4	58.8
45	408/all/62	408/0	727/4	62/47	351	558	215	90	12.8	59.9	90	12.8	59.9	85	14.4	59.6	80	16.4	59.4
46	408/all/124	408/0	744/4	124/47	351	561	298	95	13	59.6	95	13	59.6	90	14.5	59.4	80	16.5	59.2
47	408/all/186	408/0	747/4	186/47	351	560	383	90	14.6	59.8	90	14.6	59.8	85	16.2	59.6	80	18.1	59.4
48	408/all/all	408/0	766/4	814/48	351	563	698	85	18.3	58.1	85	18.3	58.1	85	18.3	58.1	85	18.3	58.1
49	All/99/62	652/0	99/3	62/26	448	116	119	>100	4.2	65.2	>100	5.7	63.1	>100	8.4	61.2	100	10.4	60.4
50	All/99/124	652/0	99/3	124/27	448	115	157	>100	5.3	61.8	>100	6.9	60.9	>100	9.6	59.9	95	11.6	59.4
51	All/99/186	652/0	99/3	186/26	448	114	197	>100	5.5	61.6	>100	7	60.8	>100	9.7	59.9	90	11.5	59.4
52	All/99/all	652/0	99/3	984/25	448	114	348	>100	7	61.5	>100	8.5	60.8	100	10.5	60.1	95	11.7	59.9
53	All/198/62	652/0	199/3	62/39	448	222	172	>100	8.2	62.1	>100	9.7	61.4	90	12.4	60.6	80	14.4	60.2
54	All/198/124	652/0	199/3	124/37	448	223	224	>100	8.2	61	>100	9.7	60.5	90	12.4	59.9	80	14.4	59.6
55	All/198/186	652/0	199/3	186/36	448	221	286	>100	9.6	62.2	100	11.2	61.6	90	13.9	60.8	80	15.9	60.4
56	All/198/all	652/0	199/3	1088/38	448	221	486	>100	9.9	59.4	95	11.5	59.2	90	13.4	59	85	14.6	58.9
57	All/297/62	652/0	297/3	62/41	448	330	196	>100	9.4	61	100	10.9	60.5	85	13.7	59.9	80	15.6	59.6
58	All/297/124	652/0	297/3	124/42	448	329	283	100	10.7	61	95	12.3	60.6	85	15	60	80	16.9	59.8
59	All/297/186	652/0	297/3	186/41	448	330	358	100	10.6	59.9	95	12.2	59.7	85	14.9	59.2	80	16.8	59
60	All/297/all	652/0	297/3	940/40	448	329	575	90	15.7	59.2	85	17.2	59.1	85	19.2	58.9	80	20.4	58.8
61	All/all/62	652/0	796/3	62/40	448	603	192	100	10.1	59.4	100	10.1	59.4	95	11.7	59.2	85	13.6	59.1
62	All/all/124	652/0	799/3	124/42	448	603	279	95	11.9	59.2	95	11.9	59.2	90	13.5	59	85	15.4	58.9
63	All/all/186	652/0	806/3	186/40	448	607	358	95	13.9	59.3	95	13.9	59.3	90	15.4	59.2	80	17.4	59.1
64	All/all/all	652/0	784/3	803/41	448	598	708	90	18.2	58.2	90	18.2	58.2	90	18.2	58.2	90	18.2	58.2

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each snag-creation strategy, age is stand age when the threshold level for snag density (see table 6) was met, followed by density and mean d.b.h. at stand age 100 prior to the rotation harvest.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 16.

Table 23—Simulated measures of logs for 64 experimental thinning treatments, 100-year rotation strategy (first rotation in table 4)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
1	136/99/62	136/0	99/18	62/63	150	171	241	>100	13.5	32.1	>100	16.6	36.8	>100	18	34.4	>100	20.4	32.1
2	136/99/124	136/0	99/19	124/64	150	175	279	>100	14.5	32.5	>100	17.4	36.9	>100	17.5	36.8	>100	19.4	34.7
3	136/99/186	136/0	99/18	180/62	150	172	300	>100	15.2	31	>100	18.3	35	>100	18.3	35	>100	19.3	34.1
4	136/99/all	136/0	99/19	1064/64	150	174	443	>100	13.6	23.8	>100	16.7	29.4	>100	16.7	29.4	>100	16.7	29.4
5	136/198/62	136/0	187/18	62/93	150	280	335	>100	18.4	35.4	>100	18.4	35.4	>100	19.5	34.2	>100	22.2	32.7
6	136/198/124	136/0	195/19	111/95	150	287	380	>100	21.1	33.5	>100	21.3	33.7	>100	21.3	33.7	>100	21.3	33.7
7	136/198/186	136/0	194/19	112/94	150	287	377	>100	22.1	34.2	>100	22.1	34.2	>100	22.1	34.2	>100	22.1	34.2
8	136/198/all	136/0	196/19	780/92	150	281	508	>100	18.7	28.9	>100	19.5	30	>100	19.5	30	>100	19.5	30
9	136/297/62	136/0	190/18	62/95	150	292	343	>100	17.2	34.4	>100	17.2	34.4	>100	18.1	32.7	>100	21.5	31
10	136/297/124	136/0	209/18	118/96	150	297	387	>100	19.2	34.3	>100	19.2	34.3	>100	19.2	34.3	>100	19.2	34.3
11	136/297/186	136/0	210/19	121/95	150	300	387	>100	18.8	32.5	>100	18.8	32.5	>100	18.8	32.5	>100	18.8	32.5
12	136/297/all	136/0	204/18	754/96	150	294	519	>100	19	29.3	>100	19	29.3	>100	19	29.3	>100	19	29.3
13	136/all/62	136/0	1060/20	62/92	150	422	317	>100	16.8	23.9	>100	16.8	23.9	>100	21.9	18.8	>100	27	25
14	136/all/124	136/0	962/18	124/90	150	410	349	>100	19	24.6	>100	19	24.6	>100	24	19.8	>100	28.4	23.5
15	136/all/186	136/0	1048/20	186/93	150	420	386	>100	17.1	23.2	>100	17.1	23.2	>100	21.7	18.5	>100	24.5	18.5
16	136/all/all	136/0	994/19	1006/92	150	412	579	>100	21.6	20.6	>100	21.6	20.6	>100	21.6	20.6	>100	21.6	20.6
17	272/99/62	272/0	99/7	62/58	271	168	219	>100	15.2	33.6	>100	18.3	37.4	>100	23.1	31.3	>100	28.2	35.4
18	272/99/124	272/0	99/7	124/56	271	169	254	>100	13.9	32.8	>100	16.8	36.9	>100	21.3	30.8	>100	25.7	34.5
19	272/99/186	272/0	99/7	186/58	271	169	303	>100	14.6	32.6	>100	17.7	36.6	>100	17.7	36.6	>100	18.5	35.9
20	272/99/all	272/0	99/7	1093/57	271	168	442	>100	17.6	26	>100	20.4	30.2	>100	20.4	30.2	>100	20.4	30.2
21	272/198/62	272/0	198/7	62/67	271	319	294	>100	17.2	39.2	>100	20.3	40.9	>100	25.4	34	95	30.3	37.6
22	272/198/124	272/0	198/7	124/68	271	319	403	>100	21.4	40.7	>100	24.4	42.1	>100	24.4	42.1	>100	24.6	41.9
23	272/198/186	272/0	198/7	124/69	271	320	407	>100	21.5	40.3	>100	24.4	41.7	>100	24.4	41.7	>100	24.4	41.7
24	272/198/all	272/0	198/7	659/68	271	321	540	>100	20	36.7	>100	22.9	38.6	>100	22.9	38.6	>100	22.9	38.6
25	272/297/62	272/0	246/6	62/68	271	392	297	>100	17.9	39.8	>100	17.9	39.8	>100	23	31.5	>100	27.9	36
26	272/297/124	272/0	244/7	124/70	271	392	412	>100	25.3	42.1	>100	25.3	42.1	100	30.4	35.4	85	35.4	38.1
27	272/297/186	272/0	245/7	162/70	271	394	480	>100	22.9	41.4	>100	22.9	41.4	>100	22.9	41.4	>100	22.9	41.4
28	272/297/all	272/0	244/7	604/69	271	391	598	>100	22.5	39.2	>100	22.5	39.2	>100	22.5	39.2	>100	22.5	39.2
29	272/all/62	272/0	765/7	62/69	271	498	270	>100	18.1	35.8	>100	18.1	35.8	>100	23	28.7	>100	27.8	33.5
30	272/all/124	272/0	775/7	124/67	271	499	342	>100	22.6	36.5	>100	22.6	36.5	>100	27.6	30.3	85	32.7	34.4
31	272/all/186	272/0	748/6	186/66	271	496	421	>100	22	36.6	>100	22	36.6	>100	26.9	30.3	95	31.9	34.3
32	272/all/all	272/0	745/7	833/68	271	495	648	>100	26.6	31.7	>100	26.6	31.7	>100	26.6	31.7	>100	26.6	31.7
33	408/99/62	408/0	99/4	62/35	351	137	148	>100	10.9	29.1	>100	13.9	34.5	>100	18.8	27.7	>100	23.9	33.4
34	408/99/124	408/0	99/4	124/34	351	138	190	>100	12.8	29.7	>100	16	34.4	>100	20.8	28.5	>100	25.7	32.2
35	408/99/186	408/0	99/4	186/36	351	138	228	>100	14.5	29.7	>100	17.6	34	>100	22.1	28.6	>100	26.9	31.7
36	408/99/all	408/0	99/4	1094/37	351	139	402	>100	15.6	24.5	>100	18.7	29.3	>100	18.7	29.3	>100	18.7	29.3

Table 23—Simulated measures of logs for 64 experimental thinning treatments, 100-year rotation strategy (first rotation in table 4) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
37	408/198/62	408/0	198/4	62/45	351	262	207	>100	15.1	33.3	>100	18.2	36.4	>100	23.2	30	>100	28.4	34.8
38	408/198/124	408/0	198/4	124/44	351	262	286	>100	18.6	34.3	>100	21.6	36.9	>100	26.6	31.4	80	31.6	35
39	408/198/186	408/0	198/4	186/47	351	263	369	>100	19.5	34.5	>100	22.6	37	>100	23.8	35.5	>100	26.5	34.9
40	408/198/all	408/0	198/4	937/46	351	263	523	>100	20.9	30.2	>100	23.8	32.9	>100	23.8	32.9	>100	23.8	32.9
41	408/297/62	408/0	297/4	62/47	351	390	226	>100	18	33.9	>100	21	36.3	>100	26	30.6	80	31.2	35
42	408/297/124	408/0	297/4	124/46	351	389	321	>100	20.9	35.3	>100	23.8	37.2	>100	28.9	31.7	80	34.1	35.4
43	408/297/186	408/0	297/4	186/46	351	387	414	>100	24	36.3	>100	27	38	95	32	33.1	80	37.1	35.7
44	408/297/all	408/0	297/4	730/47	351	388	603	>100	26.4	35.1	>100	29.4	36.7	>100	29.4	36.7	>100	29.4	36.7
45	408/all/62	408/0	727/4	62/47	351	558	215	>100	19.5	32.8	>100	19.5	32.8	>100	24.4	26.7	>100	29.4	31.6
46	408/all/124	408/0	744/4	124/47	351	561	298	>100	21.3	33	>100	21.3	33	>100	26.2	27.1	95	31.5	31.9
47	408/all/186	408/0	747/4	186/47	351	560	383	>100	22.4	33.7	>100	22.4	33.7	>100	27.4	27.8	80	32.5	32.3
48	408/all/all	408/0	766/4	814/48	351	563	698	>100	25.7	31.2	>100	25.7	31.2	>100	25.7	31.2	>100	25.7	31.2
49	All/99/62	652/0	99/3	62/26	448	116	119	>100	11.5	25.8	>100	14.5	31.4	>100	19.5	25.2	>100	24.3	30.8
50	All/99/124	652/0	99/3	124/27	448	115	157	>100	11.9	26.2	>100	15.1	31.9	>100	19.9	26.1	>100	24.6	30.7
51	All/99/186	652/0	99/3	186/26	448	114	197	>100	12.4	26.2	>100	15.4	31.2	>100	19.4	26.3	>100	23.4	29.1
52	All/99/all	652/0	99/3	984/25	448	114	348	>100	13.3	23.9	>100	16.3	29.4	>100	16.3	29.4	->100	16.3	29.4
53	All/198/62	652/0	198/3	62/39	448	222	172	>100	13.7	28.4	>100	16.6	32.6	>100	21.9	26.5	>100	26.9	31.9
54	All/198/124	652/0	198/3	124/37	448	223	224	>100	13.6	28	>100	16.6	32.4	>100	21.6	26.3	>100	26.7	31.7
55	All/198/186	652/0	198/3	186/36	448	221	286	>100	17.9	28.9	>100	20.8	32.3	>100	25.7	27.4	80	30.8	31.3
56	All/198/all	652/0	198/3	1088/38	448	221	486	>100	20	25.4	>100	23	29	>100	23	29	>100	23	29
57	All/297/62	652/0	297/3	62/41	448	330	196	>100	19	29.1	>100	21.8	32.1	>100	26.9	27.2	80	32	31.9
58	All/297/124	652/0	297/3	124/42	448	329	283	>100	18.7	29.9	>100	21.7	32.9	>100	26.7	28.2	80	31.7	32.6
59	All/297/186	652/0	297/3	186/41	448	330	358	>100	19.4	30.2	>100	22.4	33.1	>100	27.5	28.2	80	32.4	31.7
60	All/297/all	652/0	297/3	940/40	448	329	575	>100	21	28.1	>100	24.1	31	>100	24.1	31	>100	24.1	31
61	All/all/62	652/0	796/3	62/40	448	603	192	>100	21.2	26.7	>100	21.2	26.7	>100	26.2	21.9	80	31.4	27.5
62	All/all/124	652/0	799/3	124/42	448	603	279	>100	22.1	27	>100	22.1	27	>100	27	22.4	80	32.2	27.7
63	All/all/186	652/0	806/3	186/40	448	607	358	>100	24.9	27.5	>100	24.9	27.5	>100	29.9	23.2	80	35	28
64	All/all/all	652/0	784/3	803/41	448	598	708	100	30.2	27.1	100	30.2	27.1	100	30.2	27.1	100	30.2	27.1

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each log-creation strategy, age is stand age when the threshold level for log mass (see table 6) was met, followed by mass and mean large-end diameter (LED) at stand age 100 prior to the rotation harvest. Data are from the no-snag-creation scenario (see text).

Notes:All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 17.

Table 24—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 100-year rotation strategy (second rotation in table 4)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems		All[d]		
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	Age	(m^2/ha)	(m^3/ha)
1	136/99/62	91/44	69/50	55/52	360	397	423	15	32.5	65	8.8	28.1	42.5	65	50.8	290.3
2	136/99/124	91/44	71/49	55/53	356	395	423	15	32.9	61.9	8.7	30	41.6	61.9	51	289.6
3	136/99/186	91/44	71/50	53/53	358	396	420	15	32.1	66.3	8.7	29.4	41.6	66.3	49.8	277.1
4	136/99/all	91/44	72/49	385/52	359	396	562	15	32.3	59.4	9.4	30.6	41.9	59.4	50.7	299.6
5	136/198/62	90/45	71/49	55/53	363	396	423	15	31.9	56.9	8.6	28.1	42.2	56.9	49.6	281.1
6	136/198/124	90/45	70/50	53/52	365	398	418	15	32.6	64.4	8.6	28.8	41.5	64.4	50.2	262.7
7	136/198/186	91/44	72/49	57/52	357	394	422	15	32.3	60.6	8.7	29.4	41.7	60.6	50.5	289.7
8	136/198/all	91/44	72/50	371/52	360	400	557	15	33	58.1	9.5	27.5	42.2	58.1	51.3	322.1
9	136/297/62	90/45	68/50	53/52	361	395	412	15	31.6	69.4	8.6	28.8	41.1	69.4	48.9	254.7
10	136/297/124	91/44	72/49	55/52	356	392	418	15	32	58.8	8.6	28.8	42.3	58.8	49.7	272.5
11	136/297/186	89/46	70/50	54/51	366	401	413	15	31.9	61.9	8.6	27.5	43.2	61.9	49.1	269.9
12	136/297/all	90/45	71/48	379/52	361	394	558	15	32.5	58.8	9.4	28.1	43.4	58.8	49.8	285.8
13	136/all/62	90/45	458/49	62/52	360	530	400	15	32.7	90.6	8.6	28.8	20.8	90.6	50.4	290.2
14	136/all/124	91/44	464/49	124/52	360	529	464	15	32.9	56.3	9.3	29.4	38.7	56.3	50.8	301.2
15	136/all/186	90/45	473/50	150/53	361	540	488	15	32.6	55.6	9.4	29.4	41.6	55.6	50.5	296.4
16	136/all/all	91/44	478/47	575/50	358	522	596	15	29.8	57.5	9.6	28.1	42.2	57.5	47.7	276.1
17	272/99/62	226/45	99/49	62/49	439	407	406	15	31.3	76.3	9.1	28.8	34.6	76.3	48.8	309
18	272/99/124	227/44	99/48	82/48	436	398	427	15	31.9	70	9.7	30	39.4	70	49.7	333.8
19	272/99/186	228/43	99/48	81/47	434	392	422	15	31	71.3	9.6	27.5	41.6	71.3	48.2	316.6
20	272/99/all	227/44	99/48	438/49	435	399	562	15	31.8	70.6	10.5	28.8	41.2	70.6	49.9	354.9
21	272/198/62	227/44	178/48	62/51	438	473	404	15	31.3	69.4	9.1	28.8	31.7	69.4	48.7	322.2
22	272/198/124	225/46	176/49	124/50	444	481	482	15	31.4	65.6	10.2	28.1	50	65.6	50.2	349.6
23	272/198/186	227/44	178/48	140/52	437	478	508	15	31.9	63.1	10.1	30	53.4	63.1	49.8	358.7
24	272/198/all	226/45	178/48	256/51	439	478	552	15	31.5	63.8	10.3	29.4	52.3	63.8	50.5	360.5
25	272/297/62	226/45	179/49	62/52	441	482	413	15	32.7	63.1	9.2	28.1	31	63.1	50.5	337.1
26	272/297/124	227/44	180/47	124/51	436	478	486	15	32.2	60.6	10.2	29.4	52.6	60.6	50.8	366.8
27	272/297/186	226/45	178/49	138/52	439	481	501	15	32.4	64.4	10.2	27.5	51.9	64.4	51	368.1
28	272/297/all	226/45	180/47	242/50	440	478	543	15	31	63.1	10.2	28.8	55.4	63.1	48.7	327.7
29	272/all/62	226/45	346/49	62/51	439	539	404	15	32.3	73.1	9.1	28.8	31.6	73.1	49.7	330.1
30	272/all/124	227/44	357/48	124/51	439	541	479	15	31.7	64.4	10.1	30.6	47.7	64.4	50.5	353.4
31	272/all/186	227/44	357/47	158/49	441	535	508	15	31	63.8	10.2	29.4	53.7	63.8	50.3	361.8
32	272/all/all	225/45	343/48	322/50	441	532	563	15	31.2	58.1	10.5	30	51.1	58.1	48.6	331.4
33	408/99/62	362/46	99/49	62/48	498	394	401	15	31.7	84.4	8.9	28.1	28.4	84.4	48.4	332.8
34	408/99/124	363/44	99/49	82/47	494	393	421	15	32.1	75.6	9.5	32.5	32.8	75.6	49.2	349.1
35	408/99/186	362/45	99/49	86/48	492	395	426	15	31.8	75	9.7	33.8	34.1	75	49.1	348.7
36	408/99/all	362/44	99/48	522/46	490	386	562	15	31.8	74.4	10.1	34.4	33.3	74.4	48.9	359.9

Table 24—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 100-year rotation strategy (second rotation in table 4) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems		All[d]		
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	Age	(m^2/ha)	(m^3/ha)
37	408/198/62	363/44	198/49	62/50	493	479	398	15	31.3	73.1	8.8	29.4	26.2	73.1	48.8	339.8
38	408/198/124	363/44	198/48	124/50	491	476	464	15	31.1	61.3	10	29.4	40.3	61.3	48.5	361.1
39	408/198/186	363/44	198/48	155/49	492	473	500	15	31.6	65	10.1	28.8	43.4	65	50.1	391.4
40	408/198/all	362/45	198/48	280/50	495	476	548	15	32	69.4	10.3	28.8	42.6	69.4	50.2	370
41	408/297/62	363/43	270/48	62/50	488	527	392	15	31.6	84.4	8.8	29.4	25.9	84.4	48.6	357.3
42	408/297/124	362/45	263/49	124/53	498	531	470	15	31.9	34.4	10	28.8	36.3	34.4	49.2	367.6
43	408/297/186	362/45	268/48	186/50	493	526	522	15	31	46.9	10.1	28.1	50	46.9	48.7	374.7
44	408/297/all	363/44	268/48	236/50	488	528	551	15	31.3	47.5	10.1	26.3	48	47.5	49.4	378.3
45	408/all/62	362/45	341/49	62/52	495	556	398	15	32.4	59.4	9.1	26.9	26.2	59.4	48.9	340.4
46	408/all/124	362/45	335/48	124/50	496	554	469	15	31.8	52.5	10.1	31.3	36.6	52.5	49.4	345.3
47	408/all/186	363/44	360/46	186/49	489	549	517	15	29.9	59.4	9.9	30	46.6	59.4	48.3	375.6
48	408/all/all	362/45	344/49	260/50	500	557	566	15	31.7	45.6	10	30	46.4	45.6	49.6	367.9
49	All/99/62	721/45	99/49	62/47	568	387	391	15	33	90	8.8	47.5	22.5	90	49.6	352.3
50	All/99/124	736/44	99/47	88/46	567	380	411	15	31.2	78.8	9.3	55.6	29.1	78.8	49	346.6
51	All/99/186	746/44	99/48	88/46	567	377	411	15	31	78.8	9.2	47.5	27.1	78.8	48.6	344.3
52	All/99/all	738/44	99/48	566/46	568	384	572	15	31.9	76.3	10	43.1	28.7	76.3	49.2	366.1
53	All/198/62	740/45	198/48	62/49	570	461	389	15	31.2	90.1	8.6	29.4	22.6	90.1	48.1	336.8
54	All/198/124	732/45	198/49	124/48	571	465	458	15	32.1	68.8	9.9	28.1	33.3	68.8	49.7	373.9
55	All/198/186	722/44	198/48	157/50	564	462	495	15	32.7	69.4	10.2	28.8	38.5	69.4	51.5	401.8
56	All/198/all	731/45	198/48	329/49	574	465	556	15	31	58.1	10.4	27.5	40.6	58.1	48.6	379.9
57	All/297/62	726/44	297/48	62/51	567	537	397	15	31.9	83.8	8.6	28.8	22.7	83.8	48.6	340.6
58	All/297/124	716/44	297/47	124/49	564	524	448	15	30.8	34.4	9.9	28.1	34.9	34.4	48	353.7
59	All/297/186	734/44	297/48	186/49	568	528	508	15	31.1	40.6	10	28.8	41.7	40.6	49	386.1
60	All/297/all	721/44	297/49	253/51	568	542	557	15	31.6	34.4	10.2	28.1	45.8	34.4	49.5	380.8
61	All/all/62	738/45	449/49	62/51	570	591	391	15	31.4	89.4	8.7	27.5	21.3	89.4	48.3	333.3
62	All/all/124	737/44	472/47	124/48	571	589	435	15	30.4	34.4	9.5	30.6	29.6	34.4	47.5	352.7
63	All/all/186	733/45	465/48	186/50	567	591	502	15	30.5	30.6	10	28.8	39.4	30.6	48.1	366.1
64	All/all/all	742/44	459/48	299/51	565	589	584	15	30.8	32.5	10.3	27.5	44.6	33.1	49.1	388.9

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] Stand density index is a measure of the stocking density following a thinning entry.

[c] For each "Criteria," age is stand age when the threshold level of the criterion (see table 6) was met and is followed by the value of a criterion at stand age 100 prior to the rotation harvest; the "All" column is the minimum stand age when large bole, CHDI, and shade-tolerant stem density criteria were met.

[d] The minimum stand age when large bole, CHDI, and shade-tolerant stem density criteria were met.

[e] PSME BA is Douglas-fir basal area at stand age 100 prior to harvest.

[f] Extracted merchantable volume is the volume extracted in each thinning entry plus the rotation harvest at stand age 100.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 19.

Table 25—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments starting with stand conditions created by the 408-297-all first-rotation treatment, 100-year rotation strategy (second rotation in table 4)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems		All[d]		
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	Age	(m^2/ha)	(m^3/ha)
1	136/99/62	78/57	84/57	62/56	313	374	393	50	34.2	>100	7.8	50	30.8	>100	47.1	409.4
2	136/99/124	77/58	82/58	76/57	317	373	416	49.4	34	>100	7.8	50	35.9	>100	46.9	393.4
3	136/99/186	78/57	80/58	75/56	315	376	416	50	34.7	100	7.7	50	37	100	47.6	409.8
4	136/99/all	78/57	82/58	544/56	316	377	566	50	34.3	80.6	8.4	50	35.9	80.6	47.7	415.4
5	136/198/62	77/58	82/58	62/55	318	372	389	50	33.5	100	7.8	50	31.5	100	45.5	388.3
6	136/198/124	78/57	81/57	77/55	315	373	409	50.6	34	>100	7.7	50	36.2	>100	46.6	406.1
7	136/198/186	78/57	79/58	73/55	315	371	408	50	33.4	>100	7.7	50	36.5	>100	46.1	389.8
8	136/198/all	77/58	83/58	550/55	317	377	563	49.4	32.6	80	8.5	50	34.2	80	46.7	404.4
9	136/297/62	78/56	82/57	62/55	315	373	395	50	33.7	100	7.7	50	32.2	100	46	392.7
10	136/297/124	78/57	80/58	76/56	315	373	409	50	32.6	>100	7.8	50	36.6	>100	45.4	381.2
11	136/297/186	78/57	83/57	79/54	316	372	410	50	32.9	100	7.8	50	36.3	100	45.5	380.5
12	136/297/all	78/57	84/57	538/55	315	370	556	50	33.7	80	8.5	50	35.7	80	45.6	388.6
13	136/all/62	78/57	675/57	62/55	314	527	355	50	34.4	>100	6.9	69.1	11	>100	45.3	423
14	136/all/124	78/57	655/59	124/56	316	530	413	50	34.7	98	8.1	50	19.7	98	46.2	411.5
15	136/all/186	77/58	695/59	186/55	319	535	455	50	33.3	58.8	8.9	50	25.7	58.8	46.2	411.3
16	136/all/all	78/57	668/58	746/56	316	527	625	50.6	34.4	55	9.2	50	37.8	55	46.7	431.3
17	272/99/62	214/57	99/57	62/53	410	379	381	50.6	32.9	99.5	7.9	50.6	30	99.5	47.3	461.5
18	272/99/124	213/58	99/59	92/54	413	385	426	50	33.6	97.1	7.8	51.3	40.3	97.1	49.7	479.6
19	272/99/186	214/57	99/58	92/54	412	383	426	50	34.1	>100	7.8	50	39	>100	49.4	488
20	272/99/all	214/57	99/57	541/53	410	377	564	50	32.9	68.8	8.5	50	41	68.8	48.6	486.8
21	272/198/62	214/57	179/57	62/52	408	463	371	50	31.6	>100	7.9	50.6	30.1	>100	46	462.2
22	272/198/124	213/58	177/59	124/55	414	473	471	50	32.8	68.3	8.1	50.6	54.3	68.3	50.6	495.6
23	272/198/186	214/57	179/57	146/54	412	463	499	50	33.5	64.4	8.3	50	61.5	64.4	51.6	521.9
24	272/198/all	214/57	179/57	311/54	412	469	565	50	33	64.4	8.6	50	61.5	64.4	52.5	525.6
25	272/297/62	213/58	176/59	62/55	414	467	383	50.6	33.9	100	7.8	50.6	29.9	100	48	461.9
26	272/297/124	215/56	177/56	124/51	408	456	455	50	31.4	68.3	8.1	50.6	56.3	68.3	48.2	482.2
27	272/297/186	214/56	177/58	146/55	410	469	505	50	32.8	63.8	8.4	50	64.4	63.8	52.2	525.3
28	272/297/all	214/57	177/57	305/53	411	464	558	50	32.9	65	8.7	50	60.9	65	51.6	529.5
29	272/all/62	215/56	439/57	62/53	405	540	366	50.6	33	>100	7.8	50	25.5	>100	46.6	476.3
30	272/all/124	214/57	434/57	124/54	411	544	451	50	32.7	72.1	8.1	50.6	47.7	72.1	49.1	496.3
31	272/all/186	214/57	436/57	179/53	407	542	512	50.6	32.7	62.5	8.5	50.6	61.7	62.5	52.4	536
32	272/all/all	213/58	415/59	385/55	414	543	594	50	33.3	63.8	8.9	51.3	62.2	63.8	52.6	528.6
33	408/99/62	350/57	99/57	62/53	484	365	372	50	34.5	>100	7.7	55	24.3	>100	47.9	487.2
34	408/99/124	350/57	99/58	100/54	481	367	419	50	32.8	83.1	8.6	56.3	33.9	83.1	48.6	494.6
35	408/99/186	350/56	99/57	102/53	480	366	421	50.6	35.7	88.1	8.4	55.6	32.2	88.1	50.8	513.8
36	408/99/all	350/57	99/56	634/53	481	362	574	50	33.9	75	9	56.9	33.8	75	49.7	519.4

Table 25—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments starting with stand conditions created by the 408-297-all first-rotation treatment, 100-year rotation strategy (second rotation in table 4) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems		All[d]		
		40	60	80	40	60	80	Age	No./ha	Age	CHDI	Age	No./ha	Age	(m^2/ha)	(m^3/ha)
37	408/198/62	350/57	198/57	62/53	479	456	370	50	33.3	>100	7.6	53.8	23.7	>100	47.3	494.1
38	408/198/124	349/58	198/58	124/55	484	462	455	50	34.4	69.4	8.9	53.8	40	69.4	50.7	525.9
39	408/198/186	350/57	198/57	164/52	482	456	490	50.6	32.3	71.3	9	52.5	49.8	71.3	50.3	530.7
40	408/198/all	349/58	198/58	371/54	480	455	568	51.3	33	70	9.5	53.8	49.1	70	51.6	545.5
41	408/297/62	350/57	280/57	62/53	480	529	362	50.6	32.8	>100	7.6	52.5	23.7	>100	45.8	463.9
42	408/297/124	350/57	276/58	124/54	482	528	445	50	33.7	68.8	8.8	53.1	39.2	68.8	49.7	521.6
43	408/297/186	349/58	281/58	186/54	485	527	514	50	32.2	68.1	9	51.9	53.5	68.1	51	527.4
44	408/297/all	350/57	280/57	292/54	481	531	577	50	31.5	68.1	9.1	51.3	59	68.1	52.2	536.5
45	408/all/62	351/56	403/56	62/53	480	558	359	50	31.8	>100	7.5	52.5	22.9	>100	44.9	460.9
46	408/all/124	349/58	400/57	124/53	484	561	440	50	32.2	66.9	8.8	53.8	39.1	66.9	48.5	499.7
47	408/all/186	350/57	403/58	186/54	480	569	512	50.6	32.6	66.9	9.1	54.4	52	66.9	52.1	533.2
48	408/all/all	350/57	412/57	341/54	481	566	594	50	33.3	67.5	9.3	52.5	59.2	67.5	52.9	544.1
49	All/99/62	784/58	99/57	62/53	584	354	362	51.3	34.3	>100	7.5	59.4	20.2	>100	46.3	472
50	All/99/124	804/56	99/57	109/52	587	350	404	50	33.1	93.1	8.6	63.8	29.5	93.1	47.5	512.9
51	All/99/186	799/56	99/56	109/52	579	346	405	50.6	32.4	93.1	8.6	63.8	27	93.1	46.8	498
52	All/99/all	788/59	99/58	705/54	588	357	569	51.3	34.1	78.8	8.8	63.8	27.8	78.8	48	505.3
53	All/198/62	786/58	198/59	62/54	590	443	365	50	33.9	>100	7.3	58.1	19.2	>100	46.4	489.6
54	All/198/124	807/57	198/57	124/53	588	436	431	50	33.3	75	9	53.1	32.9	75	48.4	527.6
55	All/198/186	793/57	198/58	166/53	585	438	480	50	33.8	74.4	9.1	53.8	40.3	74.4	50.6	559
56	All/198/all	824/58	198/58	472/54	591	436	574	50	32.8	71.9	9.8	53.1	37	71.9	50.7	562.5
57	All/297/62	789/57	297/58	62/54	582	508	361	51.3	33.6	>100	7.3	53.8	19.1	>100	46.2	498.5
58	All/297/124	784/58	297/58	124/54	585	512	432	50	34.9	80	8.8	53.8	29.2	80	49.6	531.2
59	All/297/186	799/58	297/58	186/54	589	512	494	50.6	32.7	66.9	9.1	53.1	42.1	66.9	50	544
60	All/297/all	814/57	297/57	332/54	584	504	570	50.6	32.9	66.9	9.2	54.4	46.7	66.9	51.3	567.6
61	All/all/62	796/57	490/58	62/55	587	611	359	50.6	33	>100	7.1	66.3	15.2	>100	46.6	491.2
62	All/all/124	790/57	496/57	124/53	586	609	420	51.3	32.8	86.9	8.8	55	28.7	86.9	48.8	530.8
63	All/all/186	809/57	507/57	186/53	587	612	478	50	30.5	58.1	9.2	54.4	39.1	60	48.6	533.1
64	All/all/all	824/57	490/58	341/54	590	612	615	50	30.7	55.6	9.2	53.8	55.2	59.4	52.6	561.9

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] Stand density index is a measure of the stocking density following a thinning entry.

[c] Under "Criteria," age is stand age when the threshold level of a criterion (see table 6) was met and is followed by the value of the criterion at stand age 100 prior to the rotation harvest.

[d] The minimum stand age when large bole, CHDI, and shade-tolerant stem density criteria were met.

[e] PSME BA is Douglas-fir basal area at stand age 100 prior to harvest.

[f] Extracted merchantable volume is the volume extracted in each thinning entry plus the rotation harvest at stand age 100.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 20.

Table 26—Simulated measures of snags for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 100-year rotation strategy (second rotation in table 4)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
1	136/99/62	91/44	69/50	55/52	360	397	423	5	16.5	90.8	5	16.5	90.8	5	16.5	90.8	5	16.6	90.7
2	136/99/124	91/44	71/49	55/53	356	395	423	5	15.9	89.5	5	15.9	89.5	5	15.9	89.5	5	15.9	89.5
3	136/99/186	91/44	71/50	53/53	358	396	420	5	15.5	88.5	5	15.5	88.5	5	15.5	88.5	5	15.5	88.5
4	136/99/all	91/44	72/49	385/52	359	396	562	16.9	14.5	89	16.9	14.5	89	16.9	14.5	89	16.9	14.5	89
5	136/198/62	90/45	71/49	55/53	363	396	423	5	17.1	89.8	5	17.1	89.8	5	17.1	89.8	5	17.1	89.8
6	136/198/124	90/45	70/50	53/52	365	398	418	5	17.2	87.6	5	17.2	87.6	5	17.2	87.6	5	17.2	87.6
7	136/198/186	91/44	72/49	57/52	357	394	422	5	16.3	89.3	5	16.3	89.3	5	16.3	89.3	5	16.3	89.3
8	136/198/all	91/44	72/50	371/52	360	400	557	5	16	85.8	5	16	85.8	5	16	85.8	5	16	85.8
9	136/297/62	90/45	68/50	53/52	361	395	412	5	18.1	90.7	5	18.1	90.7	5	18.1	90.7	5	18.1	90.7
10	136/297/124	91/44	72/49	55/52	356	392	418	5	17.8	87.5	5	17.8	87.5	5	17.8	87.5	5	17.8	87.5
11	136/297/186	89/46	70/50	54/51	366	401	413	5	16.4	92.6	5	16.4	92.6	5	16.4	92.6	5	16.4	92.6
12	136/297/all	90/45	71/48	379/52	361	394	558	5	17.3	90.2	5	17.3	90.2	5	17.3	90.2	5	17.3	90.2
13	136/all/62	90/45	458/49	62/52	360	530	400	5	16.2	88.4	5	16.2	88.4	5	17.7	85.5	5	19.7	82.3
14	136/all/124	91/44	464/49	124/52	360	529	464	5	15.6	88.4	5	15.6	88.4	5	16.4	86.8	5	17.1	85.6
15	136/all/186	90/45	473/50	150/53	361	540	488	5	16.7	88.8	5	16.7	88.8	5	16.7	88.8	5	16.7	88.8
16	136/all/all	91/44	478/47	575/50	358	522	596	5	17.9	90.6	5	17.9	90.6	5	17.9	90.6	5	17.9	90.6
17	272/99/62	226/45	99/49	62/49	439	407	406	5	14.7	94.8	5	16.3	91.1	5	18.8	86.1	5	19.9	84.3
18	272/99/124	227/44	99/48	82/48	436	398	427	5	15.7	94.3	5	17.2	90.8	5	18.9	87.5	5	19.4	86.8
19	272/99/186	228/43	99/48	81/47	434	392	422	5	16	93.9	5	17.6	90.5	5	19.5	86.8	5	20.2	85.8
20	272/99/all	227/44	99/48	438/49	435	399	562	5	14.8	91.9	5	16.4	88.5	5	18.3	85	5	18.8	84
21	272/198/62	227/44	178/48	62/51	438	473	404	5	16.4	90.4	5	16.4	90.4	5	18	87.4	5	19.9	83.9
22	272/198/124	225/46	176/49	124/50	444	481	482	5	16.3	90.8	5	16.3	90.8	5	16.7	89.9	5	16.7	89.9
23	272/198/186	227/44	178/48	140/52	437	478	508	5	16.3	90.2	5	16.3	90.2	5	16.3	90.2	5	16.3	90.2
24	272/198/all	226/45	178/48	256/51	439	478	552	5	16.3	90.7	5	16.3	90.7	5	16.3	90.7	5	16.3	90.7
25	272/297/62	226/45	179/49	62/52	441	482	413	16.9	15	90.8	16.9	15	90.8	5	16.6	87.4	5	18.4	84.1
26	272/297/124	227/44	180/47	124/51	436	478	486	5	16	88.4	5	16	88.4	5	16	88.4	5	16	88.4
27	272/297/186	226/45	178/49	138/52	439	481	501	5	14.9	89.6	5	14.9	89.6	5	14.9	89.6	5	14.9	89.6
28	272/297/all	226/45	180/47	242/50	440	478	543	5	16.2	89.5	5	16.2	89.5	5	16.2	89.5	5	16.2	89.5
29	272/all/62	226/45	346/49	62/51	439	539	404	5	15	92.3	5	15	92.3	5	16.5	88.8	5	18.4	85.2
30	272/all/124	227/44	357/48	124/51	439	541	479	5	15.3	93	5	15.3	93	5	16.5	90.3	5	16.7	89.8
31	272/all/186	227/44	357/47	158/49	441	535	508	5	15.5	89.9	5	15.5	89.9	5	15.5	89.9	5	15.5	89.9
32	272/all/all	225/45	343/48	322/50	441	532	563	5	17.4	93.7	5	17.4	93.7	5	17.4	93.7	5	17.4	93.7
33	408/99/62	362/46	99/49	62/48	498	394	401	5	14.3	96.9	5	15.9	92.9	5	18.3	87.9	5	19.7	85.3
34	408/99/124	363/44	99/49	82/47	494	393	421	5	14.3	94	5	15.8	90.2	5	17.7	86.5	5	18.7	84.8
35	408/99/186	362/45	99/49	86/48	492	395	426	5	15.1	93.6	5	16.6	90	5	18.6	86.3	5	19.7	84.4
36	408/99/all	362/44	99/48	522/46	490	386	562	5	14.2	94.6	5	15.7	90.8	5	17.7	86.9	5	18.8	84.9

Table 26—Simulated measures of snags for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 100-year rotation strategy (second rotation in table 4) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
37	408/198/62	363/44	198/49	62/50	493	479	398	5	15.1	93.2	5	16.4	90.4	5	18.1	87.1	5	19.7	84.3
38	408/198/124	363/44	198/48	124/50	491	476	464	5	17	93.7	5	18.2	91.1	5	19.8	88.2	5	20	87.9
39	408/198/186	363/44	198/48	155/49	492	473	500	5	15.4	91.2	5	16.8	88.2	5	17.5	86.9	5	17.5	86.9
40	408/198/all	362/45	198/48	280/50	495	476	548	5	15.3	93.4	5	16.7	90	5	17.2	89.1	5	17.2	89.1
41	408/297/62	363/43	270/48	62/50	488	527	392	5	14.3	94.2	5	14.3	94.2	5	15.8	90.4	5	17.7	86.4
42	408/297/124	362/45	263/49	124/53	498	531	470	5	14.5	97.2	5	14.5	97.2	5	16	93.2	5	16.7	91.4
43	408/297/186	362/45	268/48	186/50	493	526	522	5	16.3	92	5	16.3	92	5	16.4	91.8	5	16.4	91.8
44	408/297/all	363/44	268./48	236/50	488	528	551	5	16.4	91.5	5	16.4	91.5	5	16.4	91.5	5	16.4	91.5
45	408/all/62	362/45	341/49	62/52	495	556	398	5	15.2	94.4	5	15.2	94.4	5	16.8	90.9	5	18.7	86.9
46	408/all/124	362/45	335/48	124/50	496	554	469	5	14.8	90.9	5	14.8	90.9	5	16.2	87.8	5	16.9	86.4
47	408/all/186	363/44	360/46	186/49	489	549	517	5	15.6	94.2	5	15.6	94.2	5	16	93.3	5	16	93.3
48	408/all/all	362/45	344/49	260/50	500	557	566	5	15.6	92.6	5	15.6	92.6	5	15.6	92.6	5	15.6	92.6
49	All/99/62	721/45	99/49	62/47	568	387	391	16.9	13.6	96.6	5	15.2	92.5	5	17.7	87.1	5	19.2	84.4
50	All/99/124	736/44	99/47	88/46	567	380	411	5	14.3	95.2	5	15.9	91.4	5	17.8	87.4	5	18.9	85.4
51	All/99/186	746/44	99/48	88/46	567	377	411	5	14	97.3	5	15.6	93.3	5	17.5	89.1	5	18.6	87
52	All/99/all	738/44	99/48	566/46	568	384	572	16.9	12.6	95	5	14.2	90.8	5	16.2	86.7	5	17.3	84.5
53	All/198/62	740/45	198/48	62/49	570	461	389	5	15.1	96.5	5	16.6	92.8	5	19	88	5	20.9	84.7
54	All/198/124	732/45	198/49	124/48	571	465	458	5	14.8	92.2	5	16.4	88.5	5	18.5	84.4	5	18.9	83.6
55	All/198/186	722/44	198/48	157/50	564	462	495	5	13.8	90.7	5	15.3	87.1	5	16.9	84	5	17.3	83.2
56	All/198/all	731/45	198/48	329/49	574	465	556	5	14.9	95.7	5	16.5	91.9	5	17.9	89.1	5	18.3	88.3
57	All/297/62	726/44	296/48	62/51	567	537	397	5	15.4	94.7	5	15.9	93.4	5	17.4	90.1	5	19.4	86.4
58	All/297/124	716/44	296/47	124/49	564	524	448	5	16	94.2	5	16.6	93.2	5	18.1	89.6	5	18.8	88.3
59	All/297/186	734/44	296/48	186/49	568	528	508	5	14.7	94.6	5	15.3	92.7	5	16.2	90.6	5	16.5	90.2
60	All/297/all	721/44	296/49	253/51	568	542	557	5	15.5	91.7	5	15.9	90.9	5	15.9	90.9	5	15.9	90.9
61	All/all/62	738/45	449/49	62/51	570	591	391	16.9	13.8	96.4	16.9	13.8	96.4	5	15.3	92.2	5	17.2	87.9
62	All/all/124	737/44	472/47	124/48	571	589	435	5	16.2	91.3	5	16.2	91.3	5	17.7	88.2	5	19.4	85.1
63	All/all/186	733/45	465/48	186/50	567	591	502	5	15.3	94	5	15.3	94	5	16.6	90.9	5	17.2	89.6
64	All/all/all	742/44	459/48	299/51	565	589	584	5	15.2	93.1	5	15.2	93.1	5	15.2	93.1	5	15.2	93.1

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each snag-creation strategy, age is stand age when the threshold level for snag density (see table 6) was met, followed by density and mean d.b.h. at stand age 100 prior to the rotation harvest.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 21.

Table 27—Simulated measures of snags for 64 experimental thinning treatments starting with conditions created by the 408-297-all first-rotation treatment, 100-year rotation strategy (second rotation in table 4)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
1	136/99/62	78/57	84/57	62/56	313	374	393	5	18	78.4	5	18	78.4	5	19.4	76.8	5	21.1	74.9
2	136/99/124	77/58	82/58	76/57	317	373	416	5	20.1	76.2	5	20.1	76.2	5	20.1	76.2	5	20.1	76.2
3	136/99/186	78/57	80/58	75/56	315	376	416	5	18.8	78.9	5	18.8	78.9	5	18.8	78.9	5	18.8	78.9
4	136/99/all	78/57	82/58	544/56	316	377	566	5	19.1	79	5	19.1	79	5	19.1	79	5	19.1	79
5	136/198/62	77/58	82/58	62/55	318	372	389	5	18.5	80.7	5	18.5	80.7	5	19.9	78.9	5	21.3	77.1
6	136/198/124	78/57	81/57	77/55	315	373	409	5	19.5	78.4	5	19.5	78.4	5	19.5	78.4	5	19.5	78.4
7	136/198/186	78/57	79/58	73/55	315	371	408	5	18.3	79.1	5	18.3	79.1	5	18.3	79.1	5	18.3	79.1
8	136/198/all	77/58	83/58	550/55	317	377	563	5	20	78.7	5	20	78.7	5	20	78.7	5	20	78.7
9	136/297/62	78/56	82/57	62/55	315	373	395	5	20.6	78.2	5	20.6	78.2	5	22.2	76.5	5	23.7	75.1
10	136/297/124	78/57	80/58	76/56	315	373	409	5	19.9	79.8	5	19.9	79.8	5	19.9	79.8	5	19.9	79.8
11	136/297/186	78/57	83/57	79/54	316	372	410	5	19.6	79.5	5	19.6	79.5	5	19.6	79.5	5	19.6	79.5
12	136/297/all	78/57	84/57	538/55	315	370	556	5	20.9	78.7	5	20.9	78.7	5	20.9	78.7	5	20.9	78.7
13	136/all/62	78/57	675/57	62/55	314	527	355	5	15.8	82.3	5	15.8	82.3	5	17.3	79.9	5	19.3	77.6
14	136/all/124	78/57	655/59	124/56	316	530	413	5	17.3	81.5	5	17.3	81.5	5	18.8	79.4	5	20.8	77.2
15	136/all/186	77/58	695/59	186/55	319	535	455	5	19.7	79.6	5	19.7	79.6	5	21.2	77.9	5	23.2	75.9
16	136/all/all	78/57	668/58	746/56	316	527	625	5	19	78.4	5	19	78.4	5	19	78.4	5	19	78.4
17	272/99/62	214/57	99/57	62/53	410	379	381	5	16.1	81.5	5	16.6	80.6	5	18.2	78.4	5	20	76
18	272/99/124	213/58	99/59	92/54	413	385	426	5	16.5	83.1	5	17.2	82	5	17.2	82	5	17.2	82
19	272/99/186	214/57	99/58	92/54	412	383	426	5	16	83.7	5	16.7	82.3	5	16.8	82.1	5	16.8	82.1
20	272/99/all	214/57	99/57	541/53	410	377	564	5	17.8	82.3	5	18.4	81.4	5	18.4	81.4	5	18.4	81.4
21	272/198/62	214/57	179/57	62/52	408	463	371	5	17.5	82.9	5	17.5	82.9	5	19.1	80.6	5	21	77.9
22	272/198/124	213/58	177/59	124/55	414	473	471	5	16.5	83.3	5	16.5	83.3	5	17.9	80.9	5	18.8	79.6
23	272/198/186	214/57	179/57	146/54	412	463	499	5	17.2	81.5	5	17.2	81.5	5	17.2	81.5	5	17.2	81.5
24	272/198/all	214/57	179/57	311/54	412	469	565	5	17.5	81	5	17.5	81	5	17.5	81	5	17.5	81
25	272/297/62	213/58	176/59	62/55	414	467	383	5	15.4	82.5	5	15.4	82.5	5	16.9	80	5	18.9	77.1
26	272/297/124	215/56	177/56	124/51	408	456	455	5	17.8	82.5	5	17.8	82.5	5	19	80.6	5	19.6	79.9
27	272/297/186	214/56	177/58	146/55	410	469	505	5	16.5	80.2	5	16.5	80.2	5	16.5	80.2	5	16.5	80.2
28	272/297/all	214/57	177/57	305/53	411	464	558	5	18.1	81.5	5	18.1	81.5	5	18.1	81.5	5	18.1	81.5
29	272/all/62	215/56	439/57	62/53	405	540	366	5	16.4	85	5	16.4	85	5	17.9	82.5	5	19.9	79.6
30	272/all/124	214/57	434/57	124/54	411	544	451	5	17.2	81.4	5	17.2	81.4	5	18.7	79	5	20.6	76.6
31	272/all/186	214/57	436/57	179/53	407	542	512	5	16.5	81	5	16.5	81	5	16.5	81	5	16.5	81
32	272/all/all	213/58	415/59	385/55	414	543	594	5	16.7	82.2	5	16.7	82.2	5	16.7	82.2	5	16.7	82.2
33	408/99/62	350/57	99/57	62/53	484	365	372	5	14.5	83.9	5	15.2	82.6	5	16.8	79.7	5	18.1	77.7
34	408/99/124	350/57	99/58	100/54	481	367	419	5	16.2	84.2	5	17.2	82.5	5	17.2	82.5	5	17.2	82.5
35	408/99/186	350/56	99/57	102/53	480	366	421	5	14	80.5	5	15	78.9	5	15.1	78.8	5	15.1	78.8
36	408/99/all	350/57	99/56	634/53	481	362	574	5	14.7	82	5	15.8	80.2	5	15.8	80.2	5	15.8	80.2

Table 27—Simulated measures of snags for 64 experimental thinning treatments starting with conditions created by the 408-297-all first-rotation treatment, 100-year rotation strategy (second rotation in table 4) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		40	60	80	40	60	80	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
37	408/198/62	350/57	198/57	62/53	479	456	370	5	15.6	83	5	15.9	82.4	5	17.5	79.8	5	19.4	77.1
38	408/198/124	349/58	198/58	124/55	484	462	455	5	15.7	82.6	5	16.1	81.9	5	17.5	79.6	5	17.8	79.2
39	408/198/186	350/57	198/57	164/52	482	456	490	5	16.8	83.9	5	17.7	82.5	5	17.7	82.5	5	17.7	82.5
40	408/198/all	349/58	198/58	371/54	480	455	568	5	16.4	84.4	5	16.6	83.9	5	16.6	83.9	5	16.6	83.9
41	408/297/62	350/57	280/57	62/53	480	529	362	5	16.1	85.4	5	16.1	85.4	5	17.6	82.7	5	19.6	79.7
42	408/297/124	350/57	276/58	124/54	482	528	445	5	15.8	84.1	5	15.8	84.1	5	17.3	81.4	5	19	78.7
43	408/297/186	349/58	281/58	186/54	485	527	514	5	17	83.4	5	17	83.4	5	18.1	81.8	5	18.3	81.5
44	408/297/all	350/57	280/57	297/54	481	531	577	5	17.2	82.7	5	17.2	82.7	5	17.2	82.7	5	17.2	82.7
45	408/all/62	351/56	403/56	62/53	480	558	359	5	15.8	84.8	5	15.8	84.8	5	17.4	82.1	5	19.3	79
46	408/all/124	349/58	400/57	124/53	484	561	440	5	16.7	85.1	5	16.7	85.1	5	18.3	82.4	5	19.8	80.2
47	408/all/186	350/57	403/58	186/54	480	569	512	5	15	84.6	5	15	84.6	5	16.1	82.4	5	16.6	81.6
48	408/all/all	350/57	412/57	341/54	481	566	594	5	16.4	81.5	5	16.4	81.5	5	16.4	81.5	5	16.4	81.5
49	All/99/62	784/58	99/57	62/53	584	354	362	5	14.8	85.8	5	15.9	83.9	5	17.6	81	5	18.5	79.5
50	All/99/124	804/56	99/57	109/52	587	350	404	5	15.2	84.6	5	16.3	82.8	5	16.3	82.8	5	16.3	82.8
51	All/99/186	799/56	99/56	109/52	579	346	405	5	15.7	85.7	5	16.6	84	5	16.6	84	5	16.6	84
52	All/99/all	788/59	99/58	705/54	588	357	569	5	16.1	85.5	5	17	83.9	5	17	83.8	5	17	83.8
53	All/198/62	786/58	198/59	62/54	590	443	365	5	14.9	87.1	5	15.3	86.2	5	16.9	83.2	5	18.8	80
54	All/198/124	807/57	198/57	124/53	588	436	431	5	15.6	83.2	5	16.2	82.3	5	17.6	80	5	18.5	78.5
55	All/198/186	793/57	198/58	166/53	585	438	480	5	15.5	82.3	5	16.3	80.9	5	16.3	80.9	5	16.3	80.9
56	All/198/all	824/58	198/58	472/54	591	436	574	5	15.8	83.8	5	16.5	82.7	5	16.5	82.7	5	16.5	82.7
57	All/297/62	789/57	296/58	62/54	582	508	361	5	15.7	84.6	5	15.9	84.1	5	17.5	81.4	5	19.4	78.3
58	All/297/124	784/58	296/58	124/54	585	512	432	5	13.8	83.9	5	13.9	83.6	5	15.5	80.4	5	17	77.8
59	All/297/186	799/58	296/58	186/54	589	512	494	5	16.4	83.5	5	16.7	83	5	18	80.9	5	18.2	80.6
60	All/297/all	814/57	296/57	332/54	584	504	570	16.9	15.1	82.3	16.9	15.7	81.4	16.9	15.7	81.4	16.9	15.7	81.4
61	All/all/62	796/57	490/58	62/55	587	611	359	5	14.1	85.2	5	14.1	85.2	5	15.6	82.1	5	17.5	78.8
62	All/all/124	790/57	496/57	124/53	586	609	420	5	15.3	83.8	5	15.3	83.8	5	16.8	80.9	5	18.5	78.3
63	All/all/186	809/57	507/57	186/53	587	612	478	5	16.6	85	5	16.6	85	5	18.2	82.2	5	19.6	80
64	All/all/all	824/57	490/58	341/54	590	612	615	5	16.6	85.7	5	16.6	85.7	5	16.6	85.7	5	16.6	85.7

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each snag-creation strategy, age is stand age when the threshold level for snag density (see table 6) was met, followed by density and mean d.b.h. at stand age 100 prior to the rotation harvest.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 22.

Table 28—Simulated measures of logs for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 100-year rotation strategy (second rotation in table 4)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
1	136/99/62	91/44	69/50	55/52	360	397	423	33.1	71.8	58.5	33.1	71.8	58.5	33.1	71.8	58.5	33.1	71.8	58.5
2	136/99/124	91/44	71/49	55/53	356	395	423	25.6	65.1	58.3	25.6	65.1	58.3	25.6	65.1	58.3	25.6	65.1	58.3
3	136/99/186	91/44	71/50	53/53	358	396	420	28.1	82.9	58.7	28.1	82.9	58.7	28.1	82.9	58.7	28.1	82.9	58.7
4	136/99/all	91/44	72/49	385/52	359	396	562	27.5	77.2	58.2	27.5	77.2	58.2	27.5	77.2	58.2	27.5	77.2	58.2
5	136/199/62	90/45	71/49	55/53	363	396	423	30	81.6	59.7	30	81.6	59.7	30	81.6	59.7	30	81.6	59.7
6	136/199/124	90/45	70/50	53/52	365	398	418	33.1	79	58.4	33.1	79	58.4	33.1	79	58.4	33.1	79	58.4
7	136/199/186	91/44	72/49	57/52	357	394	422	33.1	75.3	58.5	33.1	75.3	58.5	33.1	75.3	58.5	33.1	75.3	58.5
8	136/199/all	91/44	72/50	371/52	360	400	557	30	76.2	58.6	30	76.2	58.6	30	76.2	58.6	30	76.2	58.6
9	136/297/62	90/45	68/50	53/52	361	395	412	31.9	78.9	59.4	31.9	78.9	59.4	31.9	78.9	59.4	31.9	78.9	59.4
10	136/297/124	91/44	72/49	55/52	356	392	418	28.8	75.3	59.9	28.8	75.3	59.9	28.8	75.3	59.9	28.8	75.3	59.9
11	136/297/186	89/46	70/50	54/51	366	401	413	33.8	73.6	58.9	33.8	73.6	58.9	33.8	73.6	58.9	33.8	73.6	58.9
12	136/297/all	90/45	71/48	379/52	361	394	558	26.9	74.1	58.3	26.9	74.1	58.3	26.9	74.1	58.3	26.9	74.1	58.3
13	136/all/62	90/45	458/49	62/52	360	530	400	27.5	67.8	55.8	27.5	67.8	55.8	27.5	72.2	52.4	27.5	76.3	52
14	136/all/124	91/44	464/49	124/52	360	529	464	33.1	75	55.6	33.1	75	55.6	33.1	75.3	55.3	33.1	77	54.5
15	136/all/186	90/45	473/50	150/53	361	540	488	29.4	72.7	53	29.4	72.7	53	29.4	72.7	53	29.4	72.7	53
16	136/all/all	91/44	478/47	575/50	358	522	596	31.3	82.8	52.5	31.3	82.8	52.5	31.3	82.8	52.5	31.3	82.8	52.5
17	272/99/62	226/45	99/49	62/49	439	407	406	33.8	79.4	52.5	33.8	81.2	52.2	33.8	81.3	52.2	33.8	84.4	51.4
18	272/99/124	227/44	99/48	82/48	436	398	427	31.3	70.7	52.2	31.3	72.5	51.9	31.3	72.5	51.9	31.3	72.5	51.9
19	272/99/186	228/43	99/48	81/47	434	392	422	27.5	79.2	51.9	27.5	80.8	51.7	27.5	80.8	51.7	27.5	80.8	51.7
20	272/99/all	227/44	99/48	438/49	435	399	562	30.6	81.6	52.7	30.6	83.4	52.4	30.6	83.4	52.4	30.6	83.4	52.4
21	272/199/62	227/44	178/48	62/51	438	473	404	25	77.9	48.3	25	77.9	48.3	25	82.1	45.8	25	86.5	45.6
22	272/199/124	225/46	176/49	124/50	444	481	482	31.9	77.2	48	31.9	77.2	48	31.9	77.2	48	31.9	78.5	47.7
23	272/199/186	227/44	178/48	140/52	437	478	508	33.1	82.2	48.8	33.1	82.2	48.8	33.1	82.2	48.8	33.1	82.2	48.8
24	272/199/all	226/45	178/48	256/51	439	478	552	25.6	83.9	49.4	25.6	83.9	49.4	25.6	83.9	49.4	25.6	83.9	49.4
25	272/297/62	226/45	179/49	62/52	441	482	413	22.5	73.4	49.2	22.5	73.4	49.2	22.5	77.7	46.5	22.5	81.9	46.2
26	272/297/124	227/44	180/47	124/51	436	478	486	25	69.6	47.7	25	69.6	47.7	25	69.6	47.7	25	71.1	47.4
27	272/297/186	226/45	178/49	138/52	439	481	501	31.9	75.6	48.7	31.9	75.6	48.7	31.9	75.6	48.7	31.9	75.6	48.7
28	272/297/all	226/45	180/47	242/50	440	478	543	22.5	90.6	49.3	22.5	90.6	49.3	22.5	90.6	49.3	22.5	90.6	49.3
29	272/all/62	226/45	346/49	62/51	439	539	404	31.3	77.5	48.6	31.3	77.5	48.6	31.3	81.6	46.2	31.3	85.9	46
30	272/all/124	227/44	357/48	124/51	439	541	479	28.8	73.2	48	28.8	73.2	48	28.8	74.7	47.1	28.8	77.8	46.3
31	272/all/186	227/44	357/47	158/49	441	535	508	33.1	80.8	47.8	33.1	80.8	47.8	33.1	80.8	47.8	33.1	80.8	47.8
32	272/all/all	225/45	343/48	322/50	441	532	563	30	83.5	47.7	30	83.5	47.7	30	83.5	47.7	30	83.5	47.7
33	408/99/62	362/46	99/49	62/48	498	394	401	28.8	75	47.8	28.8	77	47.7	28.8	77	47.7	28.8	79.9	47
34	408/99/124	363/44	99/49	82/47	494	393	421	30	82.9	47.8	30	84.9	47.7	30	84.9	47.7	30	84.9	47.7
35	408/99/186	362/45	99/49	86/48	492	395	426	33.8	77	47.3	33.8	78.8	47.2	33.8	78.8	47.2	33.8	78.8	47.2
36	408/99/all	362/44	99/48	522/46	490	386	562	31.3	77.9	48.8	31.3	79.7	48.6	31.3	79.7	48.6	31.3	79.7	48.6

Table 28—Simulated measures of logs for 64 experimental thinning treatments starting with stand conditions created by the 136-99-186 first-rotation treatment, 100-year rotation strategy (second rotation in table 4) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
37	408/199/62	363/44	198/49	62/50	493	479	398	33.1	76.7	44.6	33.1	77.9	44.4	33.1	82.2	42.3	33.1	86.4	42.2
38	408/199/124	363/44	198/48	124/50	491	476	464	29.4	74.4	43.8	29.4	75.6	43.6	29.4	76.5	43.3	29.4	80.2	42.6
39	408/199/186	363/44	198/48	155/49	492	473	500	30	75.4	44.1	30	76.9	43.9	30	76.9	43.9	30	76.9	43.9
40	408/199/all	362/45	198/48	280/50	495	476	548	26.9	78.1	43.3	26.9	79.4	43.1	26.9	79.4	43.1	26.9	79.4	43.1
41	408/297/62	363/43	270/48	62/50	488	527	392	26.3	75.8	41	26.3	75.8	41	26.3	80.1	38.9	26.3	84.4	39.1
42	408/297/124	362/45	263/49	124/53	498	531	470	27.5	79.8	41.4	27.5	79.8	41.4	27.5	83.9	39.4	27.5	88	39.1
43	408/297/186	362/45	268/48	186/50	493	526	522	28.1	82.7	40.9	28.1	82.7	40.9	28.1	82.7	40.9	28.1	83.7	40.7
44	408/297/all	363/44	268/48	236/50	488	528	551	30.6	77.9	40.8	30.6	77.9	40.8	30.6	77.9	40.8	30.6	77.9	40.8
45	408/all/62	362/45	341/49	62/52	495	556	398	33.8	75.8	39.8	33.8	75.8	39.8	33.8	80.1	37.7	33.8	84.4	38
46	408/all/124	362/45	335/48	124/50	496	554	469	29.4	80.2	41.2	29.4	80.2	41.2	29.4	84.3	39.1	29.4	88.5	38.8
47	408/all/186	363/44	360/46	186/49	489	549	517	26.3	83.4	41.7	26.3	83.4	41.7	26.3	83.7	41.6	26.3	86.1	41.2
48	408/all/all	362/45	344/49	260/50	500	557	566	31.9	87.5	40.8	31.9	87.5	40.8	31.9	87.5	40.8	31.9	87.5	40.8
49	All/99/62	721/45	99/49	62/47	568	387	391	33.8	73.2	45.9	33.8	75.3	45.9	33.8	75.3	45.9	33.8	77.6	45.3
50	All/99/124	736/44	99/47	88/46	567	380	411	33.8	82.3	46.2	33.8	84.5	46.2	33.8	84.5	46.2	33.8	84.5	46.2
51	All/99/186	746/44	99/48	88/46	567	377	411	26.3	75.7	46.9	26.3	77.7	46.8	26.3	77.7	46.8	26.3	77.7	46.8
52	All/99/all	738/44	99/48	566/46	568	384	572	23.1	79.6	45.4	23.1	81.8	45.4	23.1	81.8	45.4	23.1	81.8	45.4
53	All/199/62	740/45	198/48	62/49	570	461	389	26.9	74.8	44.2	26.9	76.6	44	26.9	80.9	42	26.9	85.1	41.8
54	All/199/124	732/45	198/49	124/48	571	465	458	30.6	80.1	43.4	30.6	81.8	43.2	30.6	82.5	43.1	30.6	86.3	42.3
55	All/199/186	722/44	198/48	157/50	564	462	495	28.1	74.5	42.7	28.1	76.2	42.5	28.1	76.2	42.5	28.1	76.2	42.5
56	All/199/all	731/45	198/48	329/49	574	465	556	28.1	79.3	43.1	28.1	81.1	42.9	28.1	81.1	42.9	28.1	81.1	42.9
57	All/297/62	726/44	297/48	62/51	567	537	397	26.9	71.3	38.8	26.9	71.3	38.8	26.9	75.7	36.7	26.9	80	37.1
58	All/297/124	716/44	297/47	124/49	564	524	448	32.5	75.7	39.4	32.5	75.7	39.4	32.5	79.8	37.5	32.5	83.9	37.3
59	All/297/186	734/44	297/48	186/49	568	528	508	30.6	86.3	40	30.6	86.4	40	30.6	87.1	39.7	30.6	90.9	39.1
60	All/297/all	721/44	297/49	253/51	568	542	557	26.9	78.2	38.5	26.9	78.3	38.5	26.9	78.3	38.5	26.9	78.3	38.5
61	All/all/62	738/45	449/49	62/51	570	591	391	31.9	79.7	36.6	31.9	79.7	36.6	31.9	84	34.8	31.9	88.3	35.2
62	All/all/124	737/44	472/47	124/48	571	589	435	30	83.1	37.3	30	83.1	37.3	30	87.3	35.5	30	91.4	35.7
63	All/all/186	733/45	465/48	186/50	567	591	502	26.9	86.1	36.8	26.9	86.1	36.8	26.9	90	35.2	26.9	94.1	34.9
64	All/all/all	742/44	459/48	299/51	565	589	584	26.9	85.8	35.9	26.9	85.8	35.9	26.9	85.8	35.9	26.9	85.8	35.9

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each log-creation strategy, age is stand age when the threshold level for log mass (see table 6) was met, followed by mass and mean large-end diameter (LED) at stand age 100 prior to the rotation harvest. Data are from the no-snag-creation scenario (see text).

Notes:All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 23.

Table 29—Simulated measures of logs for 64 experimental thinning treatments starting with stand conditions created by the 408-297-all first-rotation treatment, 100-year rotation strategy (second rotation in table 4)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
1	136/99/62	78/57	84/57	62/56	313	374	393	9.4	59.9	47.6	9.4	59.9	47.6	9.4	60.7	47	9.4	63.3	46.2
2	136/99/124	77/58	82/58	76/57	317	373	416	11.3	63.5	47.6	11.3	63.5	47.6	11.3	63.5	47.6	11.3	63.5	47.6
3	136/99/186	78/57	80/58	75/56	315	376	416	18.1	60.8	47.3	18.1	60.8	47.3	18.1	60.8	47.3	18.1	60.8	47.3
4	136/99/all	78/57	82/58	544/56	316	377	566	13.1	59.7	46.5	13.1	59.7	46.5	13.1	59.7	46.5	13.1	59.7	46.5
5	136/199/62	77/58	82/58	62/55	318	372	389	18.1	65.3	47.9	18.1	65.3	47.9	18.1	66.1	47.4	18.1	67.8	47.1
6	136/199/124	78/57	81/57	77/55	315	373	409	11.3	59.4	47.4	11.3	59.4	47.4	11.3	59.4	47.4	11.3	59.4	47.4
7	136/199/186	78/57	79/58	73/55	315	371	408	15.6	64.3	47.6	15.6	64.3	47.6	15.6	64.3	47.6	15.6	64.3	47.6
8	136/199/all	77/58	83/58	550/55	317	377	563	13.8	66.1	46	13.8	66.1	46	13.8	66.1	46	13.8	66.1	46
9	136/297/62	78/56	82/57	62/55	315	373	395	15	63	48.3	15	63	48.3	15	63.8	47.7	15	66	47.3
10	136/297/124	78/57	80/58	76/56	315	373	409	15.6	68	47.8	15.6	68	47.8	15.6	68	47.8	15.6	68	47.8
11	136/297/186	78/57	83/57	79/54	316	372	410	18.8	66.4	48	18.8	66.4	48	18.8	66.4	48	18.8	66.4	48
12	136/297/all	78/57	84/57	538/55	315	370	556	12.5	66.1	46.7	12.5	66.1	46.7	12.5	66.1	46.7	12.5	66.1	46.7
13	136/all/62	78/57	675/57	62/55	314	527	355	13.1	56.5	43.4	13.1	56.5	43.4	13.1	61.1	40.2	13.1	65.7	41.1
14	136/all/124	78/57	655/59	124/56	316	530	413	21.9	59.4	43.1	21.9	59.4	43.1	21.9	63.7	40.2	21.9	68.2	40.9
15	136/all/186	77/58	695/59	186/55	319	535	455	16.9	60.2	42.4	16.9	60.2	42.4	16.9	63.5	40.2	16.9	67.3	39.5
16	136/all/all	78/57	668/58	746/56	316	527	625	16.3	59.6	39.4	16.3	59.6	39.4	16.3	59.6	39.4	16.3	59.6	39.4
17	272/99/62	214/57	99/57	62/53	410	379	381	17.5	69.7	46	17.5	71.7	45.9	17.5	76.2	43.4	17.5	80.9	43.1
18	272/99/124	213/58	99/59	92/54	413	385	426	15	63.8	45.3	15	65.8	45.1	15	65.8	45.1	15	65.8	45.1
19	272/99/186	214/57	99/58	92/54	412	383	426	16.9	62.2	45.2	16.9	64.2	45.1	16.9	64.2	45.1	16.9	64.2	45.1
20	272/99/all	214/57	99/57	541/53	410	377	564	13.1	63.7	44.3	13.1	65.4	44.2	13.1	65.4	44.2	13.1	65.4	44.2
21	272/199/62	214/57	179/57	62/52	408	463	371	15.6	69	44.1	15.6	69	44.1	15.6	73.4	41.5	15.6	78.4	41.8
22	272/199/124	213/58	177/59	124/55	414	473	471	10.6	63.2	43.4	10.6	63.2	43.4	10.6	65.5	41.9	10.6	69.7	41.5
23	272/199/186	214/57	179/57	146/54	412	463	499	13.1	70.7	44	13.1	70.7	44	13.1	70.7	44	13.1	70.7	44
24	272/199/all	214/57	179/57	311/54	412	469	565	13.1	63.5	43.6	13.1	63.5	43.6	13.1	63.5	43.6	13.1	63.5	43.6
25	272/297/62	213/58	176/59	62/55	414	467	383	9.4	69.6	43.6	9.4	69.6	43.6	9.4	74.3	40.8	9.4	78.8	41.2
26	272/297/124	215/56	177/56	124/51	408	456	455	11.9	67.9	43.9	11.9	67.9	43.9	11.9	70.6	42.3	11.9	74.9	42
27	272/297/186	214/56	177/58	146/55	410	469	505	10.6	61.9	43.2	10.6	61.9	43.2	10.6	61.9	43.2	10.6	61.9	43.2
28	272/297/all	214/57	177/57	305/53	411	464	558	15	68.8	43.7	15	68.8	43.7	15	68.8	43.7	15	68.8	43.7
29	272/all/62	215/56	439/57	62/53	405	540	366	16.3	64.5	43.5	16.3	64.5	43.5	16.3	68.9	40.8	16.3	73.8	41.3
30	272/all/124	214/57	434/57	124/54	411	544	451	11.3	71.9	43.4	11.3	71.9	43.4	11.3	76.3	40.9	11.3	80.9	41
31	272/all/186	214/57	436/57	179/53	407	542	512	18.1	63.8	42.9	18.1	63.8	42.9	18.1	63.8	42.9	18.1	63.8	42.8
32	272/all/all	213/58	415/59	385/55	414	543	594	18.8	62.8	42.5	18.8	62.8	42.5	18.8	62.8	42.5	18.8	62.8	42.5
33	408/99/62	350/57	99/57	62/53	484	365	372	15	63.1	43.3	15	64.9	43.3	15	69.2	40.8	15	73.5	40.4
34	408/99/124	350/57	99/58	100/54	481	367	419	13.8	64.3	43.3	13.8	66.3	43.3	13.8	66.3	43.3	13.8	66.3	43.3
35	408/99/186	350/56	99/57	102/53	480	366	421	11.9	59	42.1	11.9	61	42.1	11.9	61	42.1	11.9	61	42.1
36	408/99/all	350/57	99/56	634/53	481	362	574	17.5	60.9	41.9	17.5	62.9	41.8	17.5	62.9	41.8	17.5	62.9	41.8

Table 29—Simulated measures of logs for 64 experimental thinning treatments starting with stand conditions created by the 408-297-all first-rotation treatment, 100-year rotation strategy (second rotation in table 4) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 60			5 Mg/ha created at stand ages 60 and 80			5 Mg/ha created at stand age 60, 10 Mg/ha created at stand age 80		
		40	60	80	40	60	80	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
37	408/199/62	350/57	198/57	62/53	479	456	370	15	67	41.2	15	68.9	41.1	15	73.8	38.5	15	78.1	39
38	408/199/124	349/58	198/58	124/55	484	462	455	15.6	60.4	41.1	15.6	62.2	41	15.6	66.8	38.5	15.6	71.2	38.3
39	408/199/186	350/57	198/57	164/52	482	456	490	11.9	65.3	41.1	11.9	67.3	41	11.9	67.3	41	11.9	67.3	41
40	408/199/all	349/58	198/58	371/54	480	455	568	14.4	64	41	14.4	65.9	40.9	14.4	65.9	40.9	14.4	65.9	40.9
41	408/297/62	350/57	280/57	62/53	480	529	362	15	69.5	39.3	15	69.5	39.3	15	74.2	36.8	15	78.5	37.4
42	408/297/124	350/57	276/58	124/54	482	528	445	13.1	66.3	39.7	13.1	66.3	39.7	13.1	71	37.1	13.1	75.8	37.6
43	408/297/186	349/58	281/58	186/54	485	527	514	14.4	68.1	39.4	14.4	68.1	39.4	14.4	71.4	37.7	14.4	75.6	37.4
44	408/297/all	350/57	280/57	292/54	481	531	577	14.4	68.6	39.4	14.4	68.6	39.4	14.4	68.6	39.4	14.4	68.6	39.4
45	408/all/62	351/56	403/56	62/53	480	558	359	17.5	71.2	40.1	17.5	71.2	40.1	17.5	76.2	37.6	17.5	80.7	38.1
46	408/all/124	349/58	400/57	124/53	484	561	440	15	65.9	39.3	15	65.9	39.3	15	70.4	36.8	15	75.1	37.3
47	408/all/186	350/57	403/58	186/54	480	569	512	14.4	65.6	38.8	14.4	65.6	38.8	14.4	69.4	36.8	14.4	73.9	36.6
48	408/all/all	350/57	412/57	341/54	481	566	594	18.1	71.2	38.8	18.1	71.2	38.8	18.1	71.2	38.8	18.1	71.2	38.8
49	All/99/62	784/58	99/57	62/53	584	354	362	16.3	61.2	39	16.3	63.2	39.1	16.3	66.3	37.5	16.3	70.5	36.8
50	All/99/124	804/56	99/57	109/52	587	350	404	12.5	61.2	39.3	12.5	63.5	39.4	12.5	63.5	39.4	12.5	63.5	39.4
51	All/99/186	799/56	99/56	109/52	579	346	405	12.5	66.9	40	12.5	69	40	12.5	69	40	12.5	69	40
52	All/99/all	788/59	99/58	705/54	588	357	569	12.5	59.9	38	12.5	61.8	38.1	12.5	61.8	38.1	12.5	61.8	38.1
53	All/199/62	786/58	198/59	62/54	590	443	365	12.5	61.8	38.3	12.5	63.7	38.3	12.5	68.1	36.1	12.5	72.8	36.6
54	All/199/124	807/57	198/57	124/53	588	436	431	8.8	61.9	38.3	8.8	63.7	38.3	8.8	67.7	36.3	8.8	71.9	35.9
55	All/199/186	793/57	198/58	166/53	585	438	480	11.9	60.3	37.9	11.9	62.3	38	11.9	62.3	38	11.9	62.3	38
56	All/199/all	824/58	198/58	472/54	591	436	574	16.9	63.5	37.7	16.9	65.3	37.7	16.9	65.3	37.7	16.9	65.3	37.7
57	All/297/62	789/57	297/58	62/54	582	508	361	7.5	62.7	36.4	7.5	64.8	36.4	7.5	69.5	34.1	7.5	74.1	34.9
58	All/297/124	784/58	297/58	124/54	585	512	432	14.4	61.1	36.5	14.4	63.1	36.5	14.4	67.8	34.2	14.4	72.3	34.8
59	All/297/186	799/58	297/58	186/54	589	512	494	14.4	68	36.5	14.4	70	36.5	14.4	74.3	34.5	14.4	78.6	34.3
60	All/297/all	814/57	297/57	332/54	584	504	570	14.4	65	36.1	14.4	67	36.1	14.4	67	36.1	14.4	67	36.1
61	All/all/62	796/57	490/58	62/55	587	611	359	11.3	62.9	33.2	11.3	62.9	33.2	11.3	68.2	30.6	11.3	72.4	31.6
62	All/all/124	790/57	496/57	124/53	586	609	420	15.6	60.1	33.1	15.6	60.1	33.1	15.6	64.8	30.7	15.6	69.3	31.7
63	All/all/186	809/57	507/57	186/53	587	612	478	12.5	73.6	33.1	12.5	73.6	33.1	12.5	78.1	31.2	12.5	83	31.9
64	All/all/all	824/57	490/58	341/54	590	612	615	14.4	67.3	32.8	14.4	67.3	32.8	14.4	67.3	32.8	14.4	67.3	32.8

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each log-creation strategy, age is stand age when the threshold level for log mass (see table 6) was met, followed by mass and mean large-end diameter (LED) at stand age 100 prior to the rotation harvest. Data are from the no-snag-creation scenario (see text).

Notes:All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 24.

Table 30—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments, 80-year rotation strategy (first rotation in table 5)

Exp. no.	Target thinning density by entry (stand ages 40/60)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]		Stand density index by thinning entry[b]		Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)		Stand age (years)		Large boles		CHDI		Shade-tolerant density				
		40	60	40	60	Age	No./ha	Age	CHDI	Age	No./ha	LSI[d]	(m^2/ha)	(m^3/ha)
1	136/99	136/0	99/18	150	171	>80	25.8	>80	5.4	>80	0.9	13/60	26.3	623.2
5	136/198	136/0	187/18	150	280	>80	13.3	>80	5.4	>80	1.4	21/68	38.7	670.1
9	136/297	136/0	190/18	150	292	>80	11.7	>80	5.2	>80	1.7	21/23	39.9	665
13	136/all	136/0	1060/20	150	422	>80	10.9	>80	5.4	>80	1.9	21/23	38.7	665.9
17	272/99	272/0	99/7	271	168	>80	5.5	>80	4.2	>80	3.3	16/66	27.7	681.4
21	272/198	272/0	198/7	271	319	>80	0	>80	3.7	>80	7	29/25	45.3	718.2
25	272/297	272/0	246/6	271	392	>80	0	>80	3.5	>80	9.1	33/32	53	707.1
29	272/all	272/0	765/7	271	498	>80	0	>80	4.2	>80	8.3	31/31	52	690.8
33	408/99	408/0	99/4	351	137	>80	0	>80	4.3	>80	3.4	17/64	22.8	659.7
37	408/198	408/0	198/4	351	262	>80	0	>80	4.5	>80	7.6	32/30	38	687.7
41	408/297	408/0	297/4	351	390	>80	0	>80	4.6	80	10.1	32/37	51	630.3
45	408/all	408/0	727/4	351	558	>80	0	>80	5.7	80	11.1	38/39	59.3	582.6
49	All/99	652/0	99/3	448	116	>80	0	>80	4.5	>80	3.1	19/65	19	617
53	All/198	652/0	198/3	448	222	>80	0	>80	5.2	>80	5.6	33/32	32.3	647.8
57	All/297	652/0	297/3	448	330	>80	0	>80	5.7	>80	8	43/43	43.4	623.7
61	All/all	652/0	796/3	448	603	>80	0	>80	5.8	73	10.8	43/41	61.2	526.7

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] Stand density index is a measure of the stocking density following a thinning entry.

[c] Under "Criteria," age is stand age when the threshold level of a criterion (see table 6) was met and is followed by the value of a criterion at stand age 80 prior to the rotation harvest.

[d] LSI is the late-successional Index (see text). The first value under LSI is based on boles >100 centimeters (cm); the second is based on boles >80-cm d.b.h. (see text).

[e] PSME BA is Douglas-fir basal area at stand age 80 prior to harvest.

[f] Extracted merchantable volume is the volume extracted in each thinning entry plus the rotation harvest at stand age 80.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Density values under large boles are for stems >80-cm d.b.h. Data are graphed in figure 25.

Table 31—Simulated measures of snags and logs for 64 experimental thinning treatments, 80-year rotation strategy (first rotation in table 5)

Exp. no.	Target thinning density by entry (stand ages 40/60)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]		Stand density index by thinning entry		Snag- or log-creation strategies[b]											
		Stand age (years)		Stand age (years)		No snag creation			Four snags created at stand age 60			No log creation			10 Mg/ha of logs created at stand age 60		
		40	60	40	60	Age	No./ha	LED	Age	No./ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
								cm			*cm*			*cm*			*cm*
1	136/99	136/0	99/18	150	171	>80	6.8	73.6	>80	8.4	71.8	>80	6	32.8	>80	11.2	42.6
5	136/198	136/0	187/18	150	280	>80	8.5	70.7	>80	9.7	69.8	>80	9	37.5	>80	9	37.5
9	136/297	136/0	190/18	150	292	>80	8.2	70.2	>80	8.2	70.2	>80	8.7	36.1	>80	8.7	36.1
13	136/all	136/0	1060/20	150	422	>80	9.3	70.2	>80	9.3	70.2	>80	10.1	24.8	>80	10.1	24.8
17	272/99	272/0	99/7	271	168	>80	5.3	70	>80	6.9	68.6	>80	9.5	36.9	>80	14.7	43.5
21	272/198	272/0	198/7	271	319	>80	8.1	64.3	>80	9.6	63.7	>80	9.6	39	>80	14.6	43
25	272/297	272/0	246/6	271	392	>80	8.9	64.9	>80	8.9	64.9	>80	11.6	40.3	>80	11.6	40.3
29	272/all	272/0	765/7	271	498	>80	9.7	64.5	>80	9.7	64.5	>80	12	37	>80	12	37
33	408/99	407/0	99/4	351	137	>80	3.7	69.6	>80	5.2	67.2	>80	7.1	31.1	>80	12.4	40.3
37	408/198	407/0	198/4	351	262	>80	5.1	65.9	>80	6.7	65	>80	10	33.8	>80	15.1	39.8
41	408/297	407/0	297/4	351	390	>80	6.6	63.6	>80	8.2	63	>80	11.5	33.8	>80	16.4	38.7
45	408/all	407/0	727/4	351	558	>80	8.3	62.8	>80	8.3	62.8	>80	15.5	33.9	>80	15.5	33.9
49	All/99	652/0	99/3	448	116	>80	2.4	68.7	>80	4	66.5	>80	9.8	20.5	>80	14.7	31
53	All/198	652/0	198/3	448	222	>80	4.1	65.3	>80	5.6	64.4	>80	12.4	21.3	>80	17.3	30.1
57	All/297	652/0	297/3	448	330	>80	5.2	65.3	>80	6.8	64.4	>80	15.8	21.7	>80	20.6	28.4
61	All/all	652/0	796/3	448	603	>80	6.3	63	>80	6.3	63	>80	19.4	22.1	>80	19.4	22.1

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each snag- or log-creation strategy, age is stand age when the corresponding threshold level (see table 6) was met, followed by density (or mass) and mean d.b.h. (or mean large-end diameter [LED]) at stand age 80 prior to the rotation harvest.

Notes: Data for logs are from the no-snag-creation scenario (see text). All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 26.

Table 32—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments starting with stand conditions created by the 136-all first-rotation treatment, 80-year rotation strategy (second rotation in table 5)

Exp. no.	Target thinning density by entry (stand ages 20/40/60)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems				
		20	40	60	20	40	60	Age	No./ha	Age	CHDI	Age	No./ha	LSI[d]	(m^2/ha)	(m^3/ha)
1	136/99/62	126/9	99/8	62/27	105	131	164	>80	7.7	>80	5.1	>80	5.7	79.4	22.6	593.2
2	136/99/124	125/10	99/9	124/24	110	128	189	75.3	8.1	>80	5.8	75.8	11.6	91.9	21.8	594.4
3	136/99/186	126/9	99/8	186/24	107	125	219	75.3	7.3	>80	6.2	72.5	15.4	92.7	22.8	618.1
4	136/99/all	126/9	99/8	1191/27	106	129	397	>80	7.3	>80	6.5	72.6	17	93	25.4	668.7
5	136/198/62	126/9	198/8	62/38	107	194	198	>80	7.6	>80	5.9	>80	8.1	88.3	27.3	631.8
6	136/198/124	126/9	198/8	124/41	108	196	254	>80	7.1	>80	7.3	70	14.6	96.7	29.4	640.9
7	136/198/186	125/10	198/9	186/38	112	201	290	>80	7.8	>80	7.4	65.6	17	97.6	30.2	666.1
8	136/198/all	126/9	198/8	954/42	105	198	442	75.3	6.8	76.1	8.1	61.3	18.5	97.9	31.7	678.6
9	136/297/62	126/9	294/8	62/47	107	259	230	>80	7.4	>80	6.6	>80	7.7	89.1	31.1	677.5
10	136/297/124	126/9	297/8	124/46	108	253	275	>80	7.5	>80	7.5	70.6	13.6	97.8	32.4	684.8
11	136/297/186	126/9	297/8	186/50	107	266	343	>80	7.4	>80	7.7	61.9	15.6	98.4	36.5	718.6
12	136/297/all	126/9	291/8	804/48	107	258	478	>80	7.4	74.4	8.3	60	18	99.4	37.2	722.2
13	136/all/62	126/9	1211/8	62/47	107	399	217	>80	7.9	>80	6.1	>80	4.2	77.7	29.4	654.6
14	136/all/124	126/9	1143/9	124/46	109	394	255	>80	7.5	>80	7.1	>80	6.4	87	30.6	665.3
15	136/all/186	127/8	1095/8	186/46	102	382	289	>80	6.7	>80	7.3	78.3	8.8	93.1	31.9	701.1
16	136/all/all	126/9	1190/9	988/44	109	395	544	>80	7.7	76.5	8.1	60	19.6	99.3	38.8	716.4
17	272/99/62	253/18	99/17	62/31	212	198	216	33.8	14.6	>80	5.7	>80	7	85.1	29.9	603.2
18	272/99/124	253/18	99/17	124/34	214	202	275	33.1	15.1	>80	7.1	76.3	9.8	94.3	34.4	639.1
19	272/99/186	253/18	99/17	181/31	212	198	309	33.8	14.9	78	7.9	66.4	15	98.6	35.2	662.5
20	272/99/all	252/19	99/17	925/33	217	203	442	34.4	14.3	77.3	8.2	66.3	14.1	100	36.2	637.9
21	272/198/62	253/18	198/16	62/35	208	280	247	34.4	14.4	>80	6.4	73.4	11	93.7	35.7	685.1
22	272/198/124	253/18	198/16	124/31	211	288	322	33.8	13.9	>80	6.7	68.8	16.2	95.7	42.1	714.7
23	272/198/186	252/19	198/17	167/33	218	294	383	33.1	15.3	>80	7.1	67.5	18.8	97	48	733.4
24	272/198/all	252/19	198/17	717/32	215	288	501	33.8	15.2	75	7.9	65.6	20.6	99.3	46.1	724.2
25	272/297/62	253/18	291/16	62/30	209	360	229	33.8	14.2	>80	6	75.9	10.8	93	33.2	674.1
26	272/297/124	252/19	289/17	124/30	215	364	314	34.4	15.4	>80	7.1	70.6	15.9	96.9	40.7	714
27	272/297/186	253/18	286/17	186/27	214	361	386	33.8	15	>80	7.1	71.9	16.8	96.9	47.7	741.9
28	272/297/all	253/18	288/16	549/26	213	359	520	34.4	14.4	>80	7.6	70	19.6	98.6	51.5	747
29	272/all/62	252/19	953/17	62/27	214	467	211	33.8	14.9	>80	5.4	>80	5.9	81.3	29.6	636.8
30	272/all/124	253/18	958/16	124/27	208	465	270	33.8	14.3	>80	7.1	73.9	13.5	95.9	34.2	694.4
31	272/all/186	253/18	949/17	186/26	213	468	330	33.8	14.6	>80	7.7	73.1	14.5	99	39.6	717.5
32	272/all/all	252/19	986/17	767/26	215	474	579	33.8	15.1	74.9	8	72.5	14.6	100	52	729.8
33	408/99/62	374/25	99/23	62/28	300	234	234	33.1	19.8	>80	5.8	>80	6.8	84.9	33.1	595.9
34	408/99/124	364/24	99/22	124/27	294	227	285	33.1	19.1	>80	7.1	76.3	9.8	92.2	37	632.2
35	408/99/186	356/25	99/23	179/29	293	233	343	32.5	20	75.8	8.2	68.8	15.8	100	40.6	650.8
36	408/99/all	362/24	99/22	970/28	295	228	476	31.9	18.9	75.8	8.2	70	15.1	100	39.7	639.5

Table 32—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments starting with stand conditions created by the 136-all first-rotation treatment, 80-year rotation strategy (second rotation in table 5) (continued)

Exp. no.	Target thinning density by entry (stand ages 20/40/60)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems				
		20	40	60	20	40	60	Age	No./ha	Age	CHDI	Age	No./ha	LSI[d]	(m^2/ha)	(m^3/ha)
37	408/198/62	365/24	198/22	62/27	294	316	249	33.1	19.8	>80	6.1	76.6	9.7	91.3	36.2	652.6
38	408/198/124	370/24	198/22	124/27	297	312	326	32.5	19	>80	7.2	73.8	14.6	97.5	43.5	690.3
39	408/198/186	362/24	198/22	176/27	292	314	396	32.5	19.4	>80	7.5	72.5	16.5	98.3	49.8	721.7
40	408/198/all	368/24	198/22	749/26	294	313	527	33.1	19.5	65.3	8.1	73.1	14.1	100	49.3	702.2
41	408/297/62	370/25	297/23	62/24	298	398	240	31.3	20.2	>80	5.8	>80	8	86.8	34.8	652.3
42	408/297/124	369/25	297/24	124/25	299	402	322	33.1	20.6	>80	7.6	>80	8.9	95.7	43.2	702.8
43	408/297/186	368/25	297/23	186/24	299	402	396	33.1	20.4	>80	7.6	79.5	8	92.6	50.9	749.2
44	408/297/all	370/25	297/23	572/23	300	401	561	32.5	19.8	75.5	8.1	>80	5.2	85.8	57.4	759.6
45	408/all/62	364/25	867/23	62/24	298	519	230	31.9	19.9	>80	5.6	>80	6.2	82.6	32.6	639.7
46	408/all/124	353/24	860/22	124/23	290	513	292	32.5	19.9	>80	7.2	79.5	9	93.8	38.8	679.8
47	408/all/186	366/25	835/23	186/23	295	515	362	31.3	20.1	78.8	7.9	79.5	8	93	44.8	722.6
48	408/all/all	359/24	863/22	734/22	288	517	610	33.1	19.1	55.1	8.3	>80	4.2	81.2	57.4	732.2
49	All/99/62	929/24	99/22	62/26	365	213	219	34.4	19.5	>80	5.6	>80	6.7	83.6	30.2	555.3
50	All/99/124	950/25	99/24	124/27	368	223	273	33.8	20	>80	6.9	76.6	10.1	94.1	33.1	577.8
51	All/99/186	919/25	99/23	184/26	365	216	313	33.8	19.9	>80	7.5	73.3	13.3	98.3	35.3	621.2
52	All/99/all	910/25	99/23	972/27	365	220	461	34.4	20.3	>80	7.7	72.6	13.4	97.9	37.1	622.9
53	All/198/62	896/24	198/22	62/26	359	284	234	34.4	19.6	>80	5.9	79.5	8.4	89.1	33.3	610.7
54	All/198/124	936/25	198/23	124/26	365	285	301	34.4	19.2	>80	7.6	73.9	14.3	98.7	37.6	657.9
55	All/198/186	929/24	198/22	186/28	365	286	373	33.1	19.4	78.8	7.9	71.9	16.2	99.6	43.7	687.3
56	All/198/all	870/24	198/23	878/27	362	290	521	34.4	20.2	63.8	8.5	74.5	13.1	100	45.2	698.6
57	All/297/62	876/25	297/23	62/27	356	349	238	33.1	19.9	>80	6	78.8	9.3	91.1	33.9	634.5
58	All/297/124	962/24	297/22	124/26	364	347	302	35	19.6	>80	7.5	75.8	11.7	98.4	39	683.4
59	All/297/186	847/25	297/23	186/26	356	355	372	33.8	20.1	>80	7.8	76.5	11.8	97.8	45.4	723
60	All/297/all	934/25	297/23	675/25	369	352	529	33.8	19.1	66.3	8.3	78	10.8	100	48.8	724.8
61	All/all/62	959/24	1060/22	62/22	362	558	215	33.1	19.5	>80	5.4	>80	5	79.1	29.7	609.5
62	All/all/124	912/25	1015/23	124/23	367	553	277	34.4	20.2	>80	7.1	>80	5.8	85.7	36.3	666.4
63	All/all/186	910/25	1037/23	186/22	365	560	332	33.1	20.4	78.8	7.7	>80	5	84	40.2	703
64	All/all/all	900/25	1034/23	693/22	363	561	621	33.8	19.8	52.5	8.3	>80	1.8	69.6	57.7	726.1

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] Stand density index is a measure of the stocking density following a thinning entry.

[c] Under "Criteria," age is stand age when the threshold level of a criterion (see table 6) was met and is followed by the value of a criterion at stand age 80 prior to the rotation harvest.

[d] LSI is the late-successional index (see text).

[e] PSME BA is Douglas-fir basal area at stand age 80 prior to harvest.

[f] Extracted merchantable volume is the volume extracted in each thinning entry plus the rotation harvest at stand age 80.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 28.

Table 33—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments starting with stand conditions created by the 272-297 first-rotation treatment, 80-year rotation strategy (second rotation in table 5)

Exp. no.	Target thinning density by entry (stand ages 20/40/60)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems				
		20	40	60	20	40	60	Age	No./ha	Age	CHDI	Age	No./ha	LSI[d]	(m^2/ha)	(m^3/ha)
1	136/99/62	126/9	99/8	62/25	100	118	148	>80	7	>80	5	>80	5.9	79.3	20.3	588.2
2	136/99/124	124/11	99/10	124/26	110	129	193	68.1	9.1	>80	5.9	75.8	12.6	91.9	22.4	591.8
3	136/99/186	125/10	99/9	186/27	105	128	221	76.5	8.3	>80	6.2	74.4	14.1	93.8	23.3	619.3
4	136/99/all	126/9	99/9	1196/27	104	124	388	>80	7.8	>80	6.5	70.6	16	94.7	25	663.8
5	136/198/62	126/9	198/8	62/40	100	184	193	>80	6.7	>80	5.9	>80	6.9	84.4	26.9	646.2
6	136/198/124	127/8	198/8	124/41	98	191	246	>80	7.1	>80	7.3	72	15.2	96.8	28.4	663.3
7	136/198/186	125/10	198/9	186/41	108	195	287	76.5	8.1	>80	7.5	65	17.1	97.7	29.6	665.5
8	136/198/all	125/10	198/9	969/42	106	199	446	73.9	8.4	74.8	8.2	59.4	17.8	99.3	32.1	688
9	136/297/62	126/9	293/8	62/51	100	252	231	>80	7.4	>80	6.7	>80	8.3	90.9	31.6	675.7
10	136/297/124	125/10	297/9	124/48	106	252	280	76.5	8.4	>80	7.6	70	14.1	98.4	33	697.7
11	136/297/186	125/10	297/9	186/52	106	258	336	>80	7.8	79.5	7.8	58.8	16.4	98.6	35.5	707.6
12	136/297/all	126/9	291/9	819/53	104	256	474	77.1	7.9	73.1	8.7	59.4	19.8	99.5	36.6	717.5
13	136/all/62	124/11	1217/10	62/49	112	405	220	>80	9.1	>80	6.2	>80	3.5	75.6	30.1	651
14	136/all/124	126/9	1146/8	124/53	99	389	261	>80	7.3	>80	7.3	>80	5.5	84	31.6	678.5
15	136/all/186	125/10	1104/9	186/49	107	384	295	73.3	8	>80	7.5	76.8	9.5	94.6	32.7	683.7
16	136/all/all	126/9	1195/8	969/53	103	391	548	>80	7.7	75.8	8.2	60	20.2	99.2	38.7	726.4
17	272/99/62	252/19	99/17	62/37	205	190	213	45.6	14.5	>80	5.8	>80	5.9	82.2	29.4	610.7
18	272/99/124	252/19	99/17	124/36	205	189	262	45.6	15.2	>80	7.1	77.6	8.7	93.6	32.8	658.4
19	272/99/186	253/18	99/16	181/38	202	187	306	50.1	14.5	78.8	7.9	65.8	14	99.1	33.8	664.7
20	272/99/all	251/20	99/18	954/36	211	196	448	45	15.9	75.8	8.2	64.4	14.6	100	35.5	661.4
21	272/198/62	251/20	198/18	62/36	208	278	243	45.6	16.1	>80	6.6	72.6	12	94.5	34.8	683.5
22	272/198/124	250/20	198/18	124/35	213	286	327	45	16.2	>80	6.8	68.1	18	96.2	42.4	716.9
23	272/198/186	252/18	198/17	167/38	205	276	371	46.3	14.7	>80	7.1	64.4	22.2	97.1	44.4	727.3
24	272/198/all	252/19	198/18	727/36	208	283	497	45	15.2	78.4	7.7	64.4	20.6	98.9	45.1	707.8
25	272/297/62	251/20	285/18	62/28	212	360	223	45.6	16	>80	6	77.4	10.2	92	32.5	667.2
26	272/297/124	252/19	290/18	124/30	207	359	302	45.6	15.4	>80	7	70	17.6	96.9	39.3	721.6
27	272/297/186	252/19	286/18	186/29	208	358	386	45	16	>80	7.1	68.1	19.3	97	47.7	761.8
28	272/297/all	250/20	286/18	555/29	213	361	528	45	16.5	>80	7.7	70.6	16.4	99	52.4	742
29	272/all/62	252/19	969/18	62/29	206	463	205	46.3	15.4	>80	5.6	>80	6.8	84.4	28.4	647.7
30	272/all/124	252/19	958/17	124/29	205	465	266	45	15.6	>80	7.3	71.9	13.1	97.6	33.9	702
31	272/all/186	252/19	965/17	186/29	207	465	324	46.3	15.4	>80	7.6	71.3	15.8	98.6	38.9	718.7
32	272/all/all	252/19	1006/18	763/26	210	476	581	45.6	16.1	>80	7.8	72.5	14.7	99.5	52.4	754.4
33	408/99/62	372/27	99/26	62/30	300	231	232	45	22.6	>80	5.8	>80	5.5	81.1	33	611.8
34	408/99/124	366/26	99/24	124/30	294	225	287	45	21.3	>80	7.3	76.1	10.2	94.7	36.9	654.3
35	408/99/186	358/26	99/24	182/31	288	220	327	45	21.1	76.5	8.2	66.3	16.2	100	38.4	645.3
36	408/99/all	366/27	99/25	982/31	299	227	486	45	22.1	75	8.4	71.4	12.8	100	41.2	652.5

Table 33—Simulated measures for live attributes and extracted merchantable volume for 64 experimental thinning treatments starting with stand conditions created by the 272-297 first-rotation treatment, 80-year rotation strategy (second rotation in table 5) (continued)

Exp. no.	Target thinning density by entry (stand ages 20/40/60)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry[b]			Criteria[c]							PSME BA[e]	Extracted merchantable volume[f]
		Stand age (years)			Stand age (years)			Large boles		CHDI		Shade-tolerant stems				
		20	40	60	20	40	60	Age	No./ha	Age	CHDI	Age	No./ha	LSI[d]	(m^2/ha)	(m^3/ha)
37	408/198/62	371/26	198/23	62/27	291	304	237	45	19.6	>80	6	75.9	10.9	92.6	33.9	648.5
38	408/198/124	371/27	198/25	124/27	297	310	325	45	21.9	>80	7.2	71.9	13.7	97.6	44.2	710.9
39	408/198/186	364/27	198/24	178/29	292	310	400	45	20.9	>80	7.5	70.6	17	98.4	49.3	720.5
40	408/198/all	372/27	198/25	756/26	298	311	523	45	21.5	67.9	8.1	73.8	14.7	100	49.1	702.4
41	408/297/62	374/26	297/25	62/25	294	395	231	45	21.5	>80	5.9	79.5	8.8	89.8	33.7	668.5
42	408/297/124	372/27	297/24	124/24	296	392	310	45	20.2	>80	7.4	75.8	11.3	98.1	41.2	708.2
43	408/297/186	374/26	297/24	186/24	295	393	386	45	20.4	>80	7.5	78.8	9.8	95.2	48.6	735.2
44	408/297/all	375/27	297/25	572/26	302	399	567	45	21.6	73.4	8.1	>80	5.8	87.4	57.9	751.5
45	408/all/62	369/27	865/25	62/25	297	519	225	45.6	22.2	>80	5.6	>80	6.7	83.9	32	659.2
46	408/all/124	359/27	854/25	124/25	292	511	284	45.6	21.6	>80	7.3	78	10.7	96.4	37.2	685.6
47	408/all/186	370/27	833/25	186/25	298	513	354	45	21.3	79.5	7.9	>80	8.6	95.3	43.5	719
48	408/all/all	363/27	860/24	725/24	295	513	617	45	21.3	50	8.4	>80	3.7	79.2	58.3	735.9
49	All/99/62	930/27	99/24	62/28	364	206	213	45	21.2	>80	5.6	>80	5.8	81.5	29.5	569.1
50	All/99/124	962/27	99/25	124/28	368	208	260	45	21.3	>80	6.8	78.1	10.2	93.6	31.3	582.4
51	All/99/186	919/26	99/25	186/28	362	209	308	45	21.6	>80	7.6	72.1	14.1	98.2	35	639
52	All/99/all	914/27	99/25	985/29	366	212	460	45	21.7	>80	7.8	71.3	14	99.4	36.2	634.2
53	All/198/62	899/27	198/25	62/28	363	282	233	45	21.9	>80	5.9	79.5	8.7	90	32.4	623
54	All/198/124	937/27	198/24	124/27	365	277	296	45	21.4	>80	7.8	71.9	15.8	99.5	37.3	666.4
55	All/198/186	930/27	198/25	186/27	369	282	364	45	21.8	76.5	8.1	71.3	15.2	100	42.9	694.2
56	All/198/all	878/27	198/25	900/27	362	283	514	45	21.4	62.5	8.5	73.3	15.3	100	43.3	695.2
57	All/297/62	877/27	297/24	62/27	353	342	230	45	21	>80	6	79.5	8.6	89.1	32.1	637.3
58	All/297/124	968/27	297/25	124/27	367	344	297	45	21.3	>80	7.6	75.8	11.5	98.8	38.3	687.4
59	All/297/186	850/27	297/24	186/26	356	347	362	45	20.7	>80	7.8	77.3	11.3	98.1	43	706
60	All/297/all	934/27	297/25	685/27	365	346	534	45	21.3	58.8	8.4	78.1	10.5	100	49.2	725
61	All/all/62	956/27	1050/25	62/24	363	555	208	46.3	21.2	>80	5.5	>80	5.6	80.8	29.1	622.7
62	All/all/124	913/27	1021/25	124/23	366	551	266	45	21.8	>80	7.2	>80	7.2	90	34.6	668.8
63	All/all/186	912/27	1030/25	186/24	365	557	329	46.3	21.9	78.8	7.8	>80	7.3	91.5	39.8	718.7
64	All/all/all	906/26	1029/24	682/23	364	552	612	45	21.1	50.6	8.3	>80	2.2	73	57.5	740.4

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] Stand density index is a measure of the stocking density following a thinning entry.

[c] Under "Criteria," age is stand age when the threshold level of a criterion (see table 6) was met and is followed by the value of a criterion at stand age 80 prior to the rotation harvest.

[d] LSI is the late-successional index (see text).

[e] PSME BA is Douglas-fir basal area at stand age 80 prior to harvest.

[f] Extracted merchantable volume is the volume extracted in each thinning entry plus the rotation harvest at stand age 80.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 29.

Table 34—Simulated measures of snags for 64 experimental thinning treatments starting with stand conditions created by the 136-all first-rotation treatment, 80-year rotation strategy (second rotation in table 5)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 40			Two snags/ha created at stand ages 40 and 60			Two snags/ha created at stand age 40, 4 snags/ha created at stand age 60		
		20	40	60	20	40	60	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
1	136/99/62	126/9	99/8	62/27	105	131	164	31.3	11.9	75.5	5	13.5	73.1	5	16.2	70	5	18.1	68.3
2	136/99/124	125/10	99/9	124/24	110	128	189	40	11.3	76.2	5	12.8	73.7	5	15.6	70.3	5	17.5	68.3
3	136/99/186	126/9	99/8	186/24	107	125	219	13.8	11.9	75.7	5	13.4	73.4	5	15.9	70.3	5	17.5	68.8
4	136/99/all	126/9	99/8	1191/27	106	129	397	30	11.8	75.7	5	13.3	73.4	5	15.3	70.9	5	16.4	69.5
5	136/198/62	126/9	198/8	62/38	107	194	198	21.9	12.5	74.9	12.5	14.1	72.6	5	16.8	69.8	5	18.7	68.5
6	136/198/124	126/9	198/8	124/41	108	196	254	21.9	13.2	75.3	5	14.8	73	5	17.5	70.2	5	19.4	68.8
7	136/198/186	125/10	198/9	186/38	112	201	290	5	14.3	74.4	5	15.9	72.5	5	18.4	70	5	20.1	68.6
8	136/198/all	126/9	198/8	954/42	105	198	442	13.1	13.4	74.6	5	14.9	72.5	5	16.9	70.2	5	18	69.1
9	136/297/62	126/9	294/8	62/47	107	259	230	5	14.5	74.2	5	15.6	72.8	5	17.9	70.6	5	19.9	69.3
10	136/297/124	126/9	297/8	124/46	108	253	275	5	14.7	74.6	5	16.1	72.9	5	18.6	70.6	5	20.6	69.3
11	136/297/186	126/9	297/8	186/50	107	266	343	5	15.3	72.6	5	16.4	71.2	5	18.4	69.5	5	19.9	68.4
12	136/297/all	126/9	291/8	804/48	107	258	478	5	15.3	72.2	5	16.5	70.9	5	17.8	69.6	5	18	69.4
13	136/all/62	126/9	1211/8	62/47	107	399	217	5	13.6	72.7	5	13.6	72.7	5	15.2	71.1	5	17.1	69.5
14	136/all/124	126/9	1143/9	124/46	109	394	255	5	14.9	73.4	5	14.9	73.4	5	16.5	71.9	5	18.4	70.3
15	136/all/186	127/8	1095/8	186/46	102	382	289	11.9	15.1	73.1	11.9	15.1	73.1	11.9	16.6	71.7	11.9	18.6	70.2
16	136/all/all	126/9	1190/9	988/44	109	395	544	5	16.8	70.8	5	16.8	70.8	5	16.8	70.8	5	16.8	70.8
17	272/99/62	253/18	99/17	62/31	212	198	216	33.1	11.5	79.1	5	13.1	75.9	5	15.5	72.7	5	17.5	70.9
18	272/99/124	253/18	99/17	124/34	214	202	275	14.4	12.9	78.5	5	14.2	76.1	5	16.4	73.5	5	18.1	72.1
19	272/99/186	253/18	99/17	181/31	212	198	309	5	13.6	76.5	5	15.1	74	5	16.8	72.1	5	18	71
20	272/99/all	252/19	99/17	925/33	217	203	442	5	14.6	79.9	5	16	77.4	5	17	76	5	17.1	75.9
21	272/198/62	253/18	198/16	62/35	208	280	247	5	13.8	75.1	5	14.5	74	5	16.1	72.2	5	18.1	70.6
22	272/198/124	253/18	198/16	124/31	211	288	322	5	14.6	76.2	5	15.7	74.5	5	17.5	72.8	5	19.4	71.1
23	272/198/186	252/19	198/17	167/33	218	294	383	5	14.7	74.2	5	15.3	73.3	5	15.3	73.3	5	15.3	73.3
24	272/198/all	252/19	198/17	717/32	215	288	501	5	15.4	75.3	5	16.4	73.8	5	16.8	73.3	5	16.8	73.3
25	272/297/62	253/18	291/16	62/30	209	360	229	21.9	13.2	76.4	21.9	13.2	76.4	5	14.8	74.3	5	16.7	72.2
26	272/297/124	252/19	289/17	124/30	215	364	314	5	15.7	75.2	5	15.7	75.2	5	17.3	73.6	5	19.2	71.9
27	272/297/186	253/18	286/17	186/27	214	361	386	5	15	73.6	5	15	73.6	5	16.6	72	5	18.5	70.4
28	272/297/all	253/18	288/16	549/26	213	359	520	5	16.7	73.5	5	16.7	73.5	5	16.7	73.5	5	16.7	73.5
29	272/all/62	252/19	953/17	62/27	214	467	211	5	13.6	76.6	5	13.6	76.6	5	15.2	74.5	5	17.1	72.5
30	272/all/124	253/18	958/16	124/27	208	465	270	5	15	74.6	5	15	74.6	5	16.6	72.9	5	18.5	71.3
31	272/all/186	253/18	949/17	186/26	213	468	330	12.5	14.8	75.6	12.5	14.8	75.6	5	16.4	73.8	5	18.3	72
32	272/all/all	252/19	986/17	767/26	215	474	579	5	15.2	73.5	5	15.2	73.5	5	15.2	73.5	5	15.2	73.5
33	408/99/62	374/25	99/23	62/28	300	234	234	13.1	12.4	81.7	13.1	12.5	81.6	5	14	78.8	5	16	76.1
34	408/99/124	364/24	99/22	124/27	294	227	285	13.8	13.1	80.5	13.8	13.8	79.2	5	15.4	76.7	5	17.1	74.8
35	408/99/186	356/25	99/23	179/29	293	233	343	13.8	13.8	80	5	14.6	78.3	5	15	77.6	5	15	77.6
36	408/99/all	362/24	99/22	970/28	295	228	476	5	13.8	79.9	5	14.1	79.4	5	14.1	79.4	5	14.1	79.4

Table 34—Simulated measures of snags for 64 experimental thinning treatments starting with stand conditions created by the 136-all first-rotation treatment, 80-year rotation strategy (second rotation in table 5) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		20	40	60	20	40	60	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
37	408/198/62	365/24	198/22	62/27	294	316	249	12.5	12.9	79.8	5	13.2	79	5	14.8	76.8	5	16.7	74.5
38	408/198/124	370/24	198/22	124/27	297	312	326	5	15.1	81.2	5	15.6	80.3	5	17.2	78.2	5	19.1	75.9
39	408/198/186	362/24	198/22	176/27	292	314	396	5	14.5	79	5	15	77.9	5	15	77.9	5	15	77.9
40	408/198/all	368/24	198/22	749/26	294	313	527	13.1	14.5	77.9	5	14.8	77.4	5	14.8	77.4	5	14.8	77.4
41	408/297/62	370/25	297/23	62/24	298	398	240	22.5	12.1	81.4	22.5	12.1	81.4	5	13.6	78.6	5	15.6	75.8
42	408/297/124	369/25	297/24	124/25	299	402	322	14.4	12.7	78.7	14.4	12.7	78.7	13.8	14.3	76.2	13.1	16.3	73.8
43	408/297/186	368/25	297/23	186/24	299	402	396	21.9	13.4	78.8	21.9	13.4	78.8	5	15	76.5	5	16.9	74
44	408/297/all	370/25	297/23	572/23	300	401	561	5	16	77.6	5	16	77.6	5	16	77.6	5	16	77.6
45	408/all/62	364/25	867/23	62/24	298	519	230	13.1	12.8	81.7	13.1	12.8	81.7	5	14.4	78.9	5	16.3	76.2
46	408/all/124	353/24	860/22	124/23	290	513	292	5	13.7	79.6	5	13.7	79.6	5	15.2	77.3	5	17.2	75
47	408/all/186	366/25	835/23	186/23	295	515	362	5	13.6	80.1	5	13.6	80.1	5	15.1	77.6	5	17.1	75.1
48	408/all/all	359/24	863/22	734/22	288	517	610	5	15.2	78	5	15.2	78	5	15.2	78	5	15.2	78
49	All/99/62	929/24	99/22	62/26	365	213	219	4.4	11.6	83.1	14.4	11.8	82.5	5	13.4	79.4	5	15.3	76.5
50	All/99/124	950/25	99/24	124/27	368	223	273	5	13.4	82.8	5	13.8	82.2	5	15.3	79.6	5	17.2	76.8
51	All/99/186	919/25	99/23	184/26	365	216	313	5	12.8	81.7	5	13.1	81.1	5	14.3	78.8	5	14.8	77.9
52	All/99/all	910/25	99/23	972/27	365	220	461	13.8	13	80.4	13.8	13	80.4	13.8	13	80.4	13.8	13	80.4
53	All/198/62	896/24	198/22	62/26	359	284	234	23.1	12.3	80.7	23.1	12.3	80.5	5	13.9	77.9	5	15.8	75.3
54	All/198/124	936/25	198/23	124/26	365	285	301	5	13.5	81.9	5	13.7	81.5	5	15.3	78.9	5	17.3	76.4
55	All/198/186	929/24	198/22	186/28	365	286	373	13.8	14.1	79.2	13.8	14.2	79.1	13.8	14.2	79.1	13.8	14.2	79.1
56	All/198/all	870/24	198/23	878/27	362	290	521	12.5	14.2	78.1	12.5	14.5	77.5	12.5	14.5	77.5	12.5	14.5	77.5
57	All/297/62	876/25	297/23	62/27	356	349	238	5	13.8	80.4	5	14.5	79	5	16.2	76.6	5	18.2	74.5
58	All/297/124	962/24	297/22	124/26	364	347	302	5	14.4	78.4	5	14.7	77.6	5	16.3	75.6	5	18.3	73.6
59	All/297/186	847/25	297/23	186/26	356	355	372	13.8	13.3	80.1	13.8	13.6	79.5	5	15.1	77.2	5	17.1	74.5
60	All/297/all	934/25	297/23	675/25	369	352	529	5	14.8	80.5	5	14.9	80.2	5	14.9	80.2	5	14.9	80.2
61	All/all/62	959/24	1060/22	62/22	362	558	215	13.8	12.8	80.9	13.8	12.8	80.9	5	14.4	78.3	5	16.3	75.7
62	All/all/124	912/25	1015/23	124/23	367	553	277	13.1	13.1	80.5	13.1	13.1	80.5	5	14.7	77.9	5	16.6	75.2
63	All/all/186	910/25	1037/23	186/22	365	560	332	28.1	12.2	80.3	28.1	12.2	80.3	18.8	13.8	77.6	18.8	15.7	75
64	All/all/all	900/25	1034/23	693/22	363	561	621	11.9	15.1	79	11.9	15.1	79	11.9	15.1	79	11.9	15.1	79

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each snag-creation strategy, age is stand age when the threshold level for snag density (see table 6) was met, followed by density and mean d.b.h. at stand age 80 prior to the rotation harvest.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 30.

Table 35—Simulated measures of snags for 64 experimental thinning treatments starting with stand conditions created by the 272-297 first-rotation treatment, 80-year rotation strategy (second rotation in table 5)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		20	40	60	20	40	60	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
1	136/99/62	126/9	99/8	62/25	100	118	148	80	7.7	73.8	61.3	9.2	70.6	5	11.8	67.1	5	13.8	65.2
2	136/99/124	124/11	99/10	124/26	110	129	193	70.6	8.2	73.3	51.9	9.8	70.4	5	12.3	67	5	14.1	65.1
3	136/99/186	125/10	99/9	186/27	105	128	221	70.6	8.3	72	51.9	9.9	69.4	5	12.3	66.3	5	13.8	64.9
4	136/99/all	126/9	99/9	1196/27	104	124	388	70.6	8.1	73	42.5	9.7	70.2	14.4	11.6	67.2	5	12.8	65.8
5	136/198/62	126/9	198/8	62/40	100	184	193	61.3	9.2	74	33.1	10.7	71.2	5	13.5	68	5	15.4	66.6
6	136/198/124	127/8	198/8	124/41	98	191	246	61.3	9.5	71.5	5	11.1	69.1	5	13.8	66.2	5	15.7	64.8
7	136/198/186	125/10	198/9	186/41	108	195	287	33.1	10.5	71.5	33.1	12.1	69.1	5	14.8	66.4	5	16.6	64.9
8	136/198/all	125/10	198/9	969/42	106	199	446	51.9	9.7	70.1	5	11.3	68	5	13.2	65.7	5	14.4	64.5
9	136/297/62	126/9	293/8	62/51	100	252	231	14.4	11.2	69.2	5	12.3	67.9	5	14.6	66	5	16.5	65
10	136/297/124	125/10	297/9	124/48	106	252	280	33.1	10.5	68.8	23.8	11.9	66.8	5	14.4	64.7	5	16.4	63.8
11	136/297/186	125/10	297/9	186/52	106	258	336	23.8	11.4	71.6	14.4	12.5	70	5	14.7	67.7	5	15.9	66.7
12	136/297/all	126/9	291/9	819/53	104	256	474	32.5	11.4	67.5	5	12.6	66.1	5	14	64.8	5	14.5	64.3
13	136/all/62	124/11	1217/10	62/49	112	405	220	42.5	10.4	70.6	42.5	10.4	70.6	5	12	68.8	5	13.9	67.2
14	136/all/124	126/9	1146/8	124/53	99	389	261	23.8	11.7	69.3	23.8	11.7	69.3	14.4	13.2	67.9	5	15.2	66.5
15	136/all/186	125/10	1104/9	186/49	107	384	295	14.4	12.1	71.2	14.4	12.1	71.2	5	13.6	69.6	5	15.6	68.1
16	136/all/all	126/9	1195/8	969/53	103	391	548	14.4	12.3	68	14.4	12.3	68	14.4	12.3	68	14.4	12.3	68
17	272/99/62	252/19	99/17	62/37	205	190	213	51.9	9.9	77.7	23.8	11.2	74.4	5	13.5	71.1	5	15.4	69.4
18	272/99/124	252/19	99/17	124/36	205	189	262	61.3	9.1	76.2	33.1	10.4	73.1	5	12.4	70.4	5	14.3	68.6
19	272/99/186	253/18	99/16	181/38	202	187	306	33.1	11.4	73.5	14.4	12.6	71.2	5	14.1	69.5	5	14.9	68.7
20	272/99/all	251/20	99/18	954/36	211	196	448	23.8	10.8	74.8	23.8	11.8	73	23.8	12.2	72.5	23.8	12.2	72.5
21	272/198/62	251/20	198/18	62/36	208	278	243	33.1	10.3	72.3	23.8	10.8	71.3	14.4	12.4	69.4	5	14.3	67.7
22	272/198/124	250/20	198/18	124/35	213	286	327	42.5	11.3	72.4	14.4	12	71.2	5	13.5	69.6	5	15.5	67.9
23	272/198/186	252/18	198/17	167/38	205	276	371	14.4	13.4	71.7	5	14.6	70.1	5	14.6	70	5	14.6	70
24	272/198/all	252/19	198/18	727/36	208	283	497	23.8	11.4	73.7	23.8	12.2	72.3	23.8	12.2	72.2	23.8	12.2	72.2
25	272/297/62	251/20	285/18	62/28	212	360	223	14.4	10.6	74.5	14.4	10.6	74.5	14.4	12.2	72.1	5	14.2	70
26	272/297/124	252/19	290/18	124/30	207	359	302	14.4	11.5	72.8	14.4	11.5	72.8	5	13.1	70.9	5	15	69.1
27	272/297/186	252/19	286/18	186/29	208	358	386	14.4	11.4	68.3	14.4	11.4	68.3	5	12.9	66.9	5	14.9	65.4
28	272/297/all	250/20	286/18	555/29	213	361	528	5	13.6	68.4	5	13.6	68.4	5	13.6	68.4	5	13.6	68.4
29	272/all/62	252/19	969/18	62/29	206	463	205	33.1	10.2	74.3	33.1	10.2	74.3	23.8	11.8	71.9	5	13.7	69.7
30	272/all/124	252/19	958/17	124/29	205	465	266	23.8	11	74	23.8	11	74	5	12.6	71.8	5	14.5	69.9
31	272/all/186	252/19	965/17	186/29	207	465	324	14.4	12.3	70.1	14.4	12.3	70.1	14.4	13.9	68.6	5	15.8	67.1
32	272/all/all	252/19	1006/18	763/26	210	476	581	23.8	12.5	68.7	23.8	12.5	68.7	23.8	12.5	68.7	23.8	12.5	68.7
33	408/99/62	372/27	99/26	62/30	300	231	232	51.3	9.7	78.6	51.3	9.8	78.4	14.4	11.3	75.4	5	13.3	72.7
34	408/99/124	366/26	99/24	124/30	294	225	287	42.5	9.8	77.1	42.5	10	76.7	23.8	11.6	73.9	14.4	13.5	71.4
35	408/99/186	358/26	99/24	182/31	288	220	327	14.4	11.5	78.4	14.4	11.8	77.9	14.4	12.7	76	5	13.7	74.6
36	408/99/all	366/27	99/25	982/31	299	227	486	61.3	9.6	78.9	61.3	9.7	78.7	61.3	9.7	78.7	61.3	9.7	78.7

Table 35—Simulated measures of snags for 64 experimental thinning treatments starting with stand conditions created by the 272-297 first-rotation treatment, 80-year rotation strategy (second rotation in table 5) (continued)

Exp. no.	Target thinning density by entry (stand ages 40/60/80)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Snag-creation strategies[b]											
		Stand age (years)			Stand age (years)			No snag creation			Two snags/ha created at stand age 60			Two snags/ha created at stand ages 60 and 80			Two snags/ha created at stand age 60, 4 snags/ha created at stand age 80		
		20	40	60	20	40	60	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.	Age	No./ha	D.b.h.
										cm			*cm*			*cm*			*cm*
37	408/198/62	371/26	198/23	62/27	291	304	237	5	11.7	78	5	11.8	77.8	5	13.4	75.3	5	15.3	73
38	408/198/124	371/27	198/25	124/27	297	310	325	23.8	10.4	78.3	23.8	10.4	78.1	5	12	75.3	5	13.9	72.4
39	408/198/186	364/27	198/24	178/29	292	310	400	14.4	13.3	74.2	5	13.5	73.9	5	13.5	73.9	5	13.5	73.9
40	408/198/all	372/27	198/25	756/26	298	311	523	23.8	11.8	73.8	23.8	11.8	73.8	23.8	11.8	73.8	23.8	11.8	73.8
41	408/297/62	374/26	297/25	62/25	294	395	231	51.9	9.5	77.9	51.9	9.5	77.9	23.1	11	74.8	5	13	72
42	408/297/124	372/27	297/24	124/24	296	392	310	14.4	11	77.6	14.4	11	77.6	5	12.6	75	5	14.5	72.6
43	408/297/186	374/26	297/24	186/24	295	393	386	5	12.5	77.2	5	12.5	77.2	5	14.1	74.9	5	16.1	72.4
44	408/297/all	375/27	297/25	572/26	302	399	567	33.1	11.4	77	33.1	11.4	77	33.1	11.4	77	33.1	11.4	77
45	408/all/62	369/27	865/25	62/25	297	519	225	70.6	9.1	76.3	70.6	9.1	76.3	23.8	10.6	73.4	14.4	12.6	70.8
46	408/all/124	359/27	854/25	124/25	292	511	284	51.9	9.9	76.6	51.9	9.9	76.6	23.8	11.5	73.8	14.4	13.4	71.4
47	408/all/186	370/27	833/25	186/25	298	513	354	14.4	11	77	14.4	11	77	14.4	12.6	74.4	5	14.5	71.8
48	408/all/all	363/27	860/24	725/24	295	513	617	5	12.6	75.1	5	12.6	75.1	5	12.6	75.1	5	12.6	75.1
49	All/99/62	930/27	99/24	62/28	364	206	213	42.5	9.7	81	33.1	10	80.2	14.4	11.7	76.7	5	13.6	73.9
50	All/99/124	962/27	99/25	124/28	368	208	260	61.3	9.4	80.6	61.3	9.4	80.6	23.8	10.9	77.2	5	12.9	74
51	All/99/186	919/26	99/25	186/28	362	209	308	42.5	10.1	77.2	42.5	10.1	77.2	23.8	11.4	74.7	14.4	12.6	72.8
52	All/99/all	914/27	99/25	985/29	366	212	460	33.1	10.7	77.3	33.1	10.7	77.3	33.1	10.7	77.3	33.1	10.7	77.3
53	All/198/62	899/27	198/25	62/28	363	282	233	42.5	9.3	78.4	33.1	9.5	77.9	23.8	11	74.7	14.4	13	72
54	All/198/124	937/27	198/24	124/27	365	277	296	33.1	10.6	77.9	33.1	10.7	77.6	5	12.3	74.9	5	14.3	72.5
55	All/198/186	930/27	198/25	186/27	369	282	364	14.4	11.4	77.5	14.4	11.6	77.2	14.4	12.4	75.8	14.4	12.7	75.3
56	All/198/all	878/27	198/25	900/27	362	283	514	23.8	11.8	76.3	23.8	11.8	76.2	23.8	11.8	76.2	23.8	11.8	76.2
57	All/297/62	877/27	297/24	62/27	353	342	230	33.1	10.2	78.6	33.1	10.3	78.5	5	11.8	75.7	5	13.8	73.1
58	All/297/124	968/27	297/25	124/27	367	344	297	33.1	10.7	76.7	33.1	10.8	76.6	14.4	12.4	74.1	5	14.3	71.7
59	All/297/186	850/27	297/24	186/26	356	347	362	5	12.1	76.6	5	12.1	76.5	5	13.7	74.2	5	15.6	71.9
60	All/297/all	934/27	297/25	685/27	365	346	534	14.4	12	73.8	14.4	12	73.8	14.4	12	73.8	14.4	12	73.8
61	All/all/62	956/27	1050/25	62/24	363	555	208	70.6	8.1	81.7	70.6	8.1	81.7	51.9	9.6	77.6	14.4	11.6	74.1
62	All/all/124	913/27	1021/25	124/23	366	551	266	70.6	8.2	80.2	70.6	8.2	80.2	61.3	9.7	76.2	5	11.7	72.7
63	All/all/186	912/27	1030/25	186/24	365	557	329	61.3	10	77.7	61.3	10	77.7	23.8	11.6	74.7	5	13.5	71.9
64	All/all/all	906/26	1029/24	682/23	364	552	612	42.5	10.4	76.1	42.5	10.4	76.1	42.5	10.4	76.1	42.5	10.4	76.1

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each snag-creation strategy, age is stand age when the threshold level for snag density (see table 6) was met, followed by density and mean d.b.h. at stand age 80 prior to the rotation harvest.

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 31.

Table 36—Simulated measures of logs for 64 experimental thinning treatments starting with stand conditions created by the 136-all first-rotation treatment, 80-year rotation strategy (second rotation in table 5)

Exp. no.	Target thinning density by entry (stand ages 20/40/60)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 40			5 Mg/ha created at stand ages 40 and 60			5 Mg/ha created at stand age 40, 10 Mg/ha created at stand age 60		
		20	40	60	20	40	60	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
1	136/99/62	126/9	99/8	62/27	105	131	164	31.3	32.4	39.9	46.3	37.1	40.1	46.3	37.1	40.1	46.3	37.1	40.1
2	136/99/124	125/10	99/9	124/24	110	128	189	39.4	34.3	39.2	43.1	39	39.2	43.1	39	39.2	43.1	39	39.2
3	136/99/186	126/9	99/8	186/24	107	125	219	44.4	41	39.9	44.4	44.8	39.2	44.4	44.8	39.2	44.4	44.8	39.2
4	136/99/all	126/9	99/8	1191/27	106	129	397	33.8	34.4	34.8	33.8	34.4	34.8	33.8	34.4	34.8	33.8	34.4	34.8
5	136/198/62	126/9	198/8	62/38	107	194	198	45	37.9	39.6	45	43	40.5	45	43	40.5	45	43	40.5
6	136/198/124	126/9	198/8	124/41	108	196	254	38.8	39.4	39.9	45	44.4	40.3	45	44.4	40.3	45	44.4	40.3
7	136/198/186	125/10	198/9	186/38	112	201	290	47.5	38.9	38.3	47.5	41.2	38.2	47.5	41.2	38.2	47.5	41.2	38.2
8	136/198/all	126/9	198/8	954/42	105	198	442	42.5	39.5	36	42.5	39.5	36	42.5	39.5	36	42.5	39.5	36
9	136/297/62	126/9	294/8	62/47	107	259	230	31.3	31.8	35.6	31.3	37.9	38.4	31.3	37.9	38.4	31.3	37.9	38.4
10	136/297/124	126/9	297/8	124/46	108	253	275	53.8	37.9	36	51.3	43.3	37.8	51.3	43.3	37.8	51.3	43.3	37.8
11	136/297/186	126/9	297/8	186/50	107	266	343	55.6	35.5	35.6	51.9	36.4	35.7	51.9	36.4	35.7	51.9	36.4	35.7
12	136/297/all	126/9	291/8	804/48	107	258	478	55.6	38.2	35.5	55.6	38.2	35.5	55.6	38.2	35.5	55.6	38.2	35.5
13	136/all/62	126/9	1211/8	62/47	107	399	217	40.6	30.6	30.2	56.9	36.8	34.6	56.9	36.8	34.6	56.9	36.8	34.6
14	136/all/124	126/9	1143/9	124/46	109	394	255	33.1	32.8	29.3	60	39	33.6	60	39	33.6	60	39	33.6
15	136/all/186	127/8	1095/8	186/46	102	382	289	58.1	33	30.3	52.5	39.1	34.2	52.5	39.1	34.2	52.5	39.1	34.2
16	136/all/all	126/9	1190/9	988/44	109	395	544	47.5	34	26	47.5	34	26	47.5	34	26	47.5	34	26
17	272/99/62	253/18	99/17	62/31	212	198	216	40.6	43.7	42.3	40.6	49.9	43.9	40.6	49.9	43.9	40.6	49.9	43.9
18	272/99/124	253/18	99/17	124/34	214	202	275	41.9	42	41	41.9	46.6	41.8	41.9	46.6	41.8	41.9	46.6	41.8
19	272/99/186	253/18	99/17	181/31	212	198	309	35.6	41	40.6	35.6	41.6	40.7	35.6	41.6	40.7	35.6	41.6	40.7
20	272/99/all	252/19	99/17	925/33	217	203	442	43.1	42.5	38.9	43.1	42.5	38.9	43.1	42.5	38.9	43.1	42.5	38.9
21	272/198/62	253/18	198/16	62/35	208	280	247	45	43.1	40.7	41.3	49.3	42.7	41.3	49.3	42.7	41.3	49.3	42.7
22	272/198/124	253/18	198/16	124/31	211	288	322	45.6	45	40.4	45.6	51.1	41.6	45.6	51.1	41.6	45.6	51.1	41.6
23	272/198/186	252/19	198/17	167/33	218	294	383	46.3	42.1	40.2	46.3	42.1	40.2	46.3	42.1	40.2	46.3	42.1	40.2
24	272/198/all	252/19	198/17	717/32	215	288	501	43.8	41.8	39.7	43.8	41.8	39.7	43.8	41.8	39.7	43.8	41.8	39.7
25	272/297/62	253/18	291/16	62/30	209	360	229	53.1	36.6	38.1	57.5	42.8	40.8	57.5	42.8	40.8	57.5	42.8	40.8
26	272/297/124	252/19	289/17	124/30	215	364	314	54.4	37	38.5	58.1	43.2	41	58.1	43.2	41	58.1	43.2	41
27	272/297/186	253/18	286/17	186/27	214	361	386	60	39.4	38.6	58.1	45.4	40.2	58.1	45.4	40.2	58.1	45.4	40.2
28	272/297/all	253/18	288/16	549/26	213	359	520	67.5	34.8	37.6	67.5	34.8	37.6	67.5	34.8	37.6	67.5	34.8	37.6
29	272/all/62	252/19	953/17	62/27	214	467	211	53.1	36.9	35.5	55	43.2	38.6	55	43.2	38.6	55	43.2	38.6
30	272/all/124	253/18	958/16	124/27	208	465	270	55.6	34.9	35	57.5	41	38.2	57.5	41	38.2	57.5	41	38.2
31	272/all/186	253/18	949/17	186/26	213	468	330	43.8	35.4	34.3	57.5	41.6	37.3	57.5	41.6	37.3	57.5	41.6	37.3
32	272/all/all	252/19	986/17	767/26	215	474	579	63.1	38.9	31	63.1	38.9	31	63.1	38.9	31	63.1	38.9	31
33	408/99/62	374/25	99/23	62/28	300	234	234	40.6	45.6	40.5	40.6	51.8	41.9	40.6	51.8	41.9	40.6	51.8	41.9
34	408/99/124	364/24	99/22	124/27	294	227	285	40.6	47	40.8	40.6	51.7	41.6	40.6	51.7	41.6	40.6	51.7	41.6
35	408/99/186	356/25	99/23	179/29	293	233	343	41.9	45.8	39.5	41.9	45.8	39.5	41.9	45.8	39.5	41.9	45.8	39.5
36	408/99/all	362/24	99/22	970/28	295	228	476	41.3	50.2	37.9	41.3	50.2	37.9	41.3	50.2	37.9	41.3	50.2	37.9

Table 36—Simulated measures of logs for 64 experimental thinning treatments starting with stand conditions created by the 136-all first-rotation treatment, 80-year rotation strategy (second rotation in table 5) (continued)

Exp. no.	Target thinning density by entry (stand ages 20/40/60)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 40			5 Mg/ha created at stand ages 40 and 60			5 Mg/ha created at stand age 40, 10 Mg/ha created at stand age 60		
		20	40	60	20	40	60	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
37	408/198/62	365/24	198/22	62/27	294	316	249	44.4	47.4	40.1	44.4	53.4	41.7	44.4	53.4	41.7	44.4	53.4	41.7
38	408/198/124	370/24	198/22	124/27	297	312	326	44.4	42.8	40	44.4	49	41.1	44.4	49	41.1	44.4	49	41.1
39	408/198/186	362/24	198/22	176/27	292	314	396	43.1	49.1	39.8	43.1	49.1	39.8	43.1	49.1	39.8	43.1	49.1	39.8
40	408/198/all	368/24	198/22	749/26	294	313	527	41.9	50.9	39.4	41.9	50.9	39.4	41.9	50.9	39.4	41.9	50.9	39.4
41	408/297/62	370/25	297/23	62/24	298	398	240	51.3	37.7	36.7	51.3	43.9	39.1	51.3	43.9	39.1	51.3	43.9	39.1
42	408/297/124	369/25	297/24	124/25	299	402	322	51.3	43.3	37.2	49.4	49.3	39.1	49.4	49.3	39.1	49.4	49.3	39.1
43	408/297/186	368/25	297/23	186/24	299	402	396	47.5	38.8	36.7	53.8	44.9	38.5	53.8	44.9	38.5	53.8	44.9	38.5
44	408/297/all	370/25	297/23	572/23	300	401	561	53.8	45.4	37	53.8	45.4	37	53.8	45.4	37	53.8	45.4	37
45	408/all/62	364/25	867/23	62/24	298	519	230	51.9	38.2	36.7	54.4	44.4	39.1	54.4	44.4	39.1	54.4	44.4	39.1
46	408/all/124	353/24	860/22	124/23	290	513	292	46.9	33.9	36.1	56.3	40.2	38.9	56.3	40.2	38.9	56.3	40.2	38.9
47	408/all/186	366/25	835/23	186/23	295	515	362	63.8	37.3	36.1	58.1	43.5	38.3	58.1	43.5	38.3	58.1	43.5	38.3
48	408/all/all	359/24	863/22	734/22	288	517	610	53.8	46	35.1	53.8	46	35.1	53.8	46	35.1	53.8	46	35.1
49	All/99/62	929/24	99/22	62/26	365	213	219	45	47.8	38	41.3	54	39.6	41.3	54	39.6	41.3	54	39.6
50	All/99/124	950/25	99/24	124/27	368	223	273	36.3	42.3	36.9	45.6	47.7	37.7	45.6	47.7	37.7	45.6	47.7	37.7
51	All/99/186	919/25	99/23	184/26	365	216	313	41.3	44.3	38	41.3	44.9	38	41.3	44.9	38	41.3	44.9	38
52	All/99/all	910/25	99/23	972/27	365	220	461	43.1	44.3	34.5	43.1	44.3	34.5	43.1	44.3	34.5	43.1	44.3	34.5
53	All/198/62	896/24	198/22	62/26	359	284	234	43.1	45.2	37.8	43.1	51.5	39.9	43.1	51.5	39.9	43.1	51.5	39.9
54	All/198/124	936/25	198/23	124/26	365	285	301	41.9	45.9	37	41.9	51.9	38.5	41.9	51.9	38.5	41.9	51.9	38.5
55	All/198/186	929/24	198/22	186/28	365	286	373	43.1	45.8	37.2	43.1	45.8	37.2	43.1	45.8	37.2	43.1	45.8	37.2
56	All/198/all	870/24	198/23	878/27	362	290	521	43.8	42.3	36.2	43.8	42.3	36.2	43.8	42.3	36.2	43.8	42.3	36.2
57	All/297/62	876/25	297/23	62/27	356	349	238	41.9	40.7	34.8	41.9	46.8	37.3	41.9	46.8	37.3	41.9	46.8	37.3
58	All/297/124	962/24	297/22	124/26	364	347	302	42.5	44.5	35.9	42.5	50.7	38	42.5	50.7	38	42.5	50.7	38
59	All/297/186	847/25	297/23	186/26	356	355	372	47.5	40.6	35.7	43.1	46.7	37.3	43.1	46.7	37.3	43.1	46.7	37.3
60	All/297/all	934/25	297/23	675/25	369	352	529	44.4	50.6	35.3	44.4	50.6	35.3	44.4	50.6	35.3	44.4	50.6	35.3
61	All/all/62	959/24	1060/22	62/22	362	558	215	50	40	27	56.3	46.1	30.5	56.3	46.1	30.5	56.3	46.1	30.5
62	All/all/124	912/25	1015/23	124/23	367	553	277	58.8	36.7	28.4	55	42.9	31.8	55	42.9	31.8	55	42.9	31.8
63	All/all/186	910/25	1037/23	186/22	365	560	332	50	38.7	28.4	55	44.8	31.6	55	44.8	31.6	55	44.8	31.6
64	All/all/all	900/25	1034/23	693/22	363	561	621	63.1	40.1	26.8	63.1	40.1	26.8	63.1	40.1	26.8	63.1	40.1	26.8

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each log-creation strategy, age is stand age when the threshold level for log mass (see table 6) was met, followed by mass and mean large-end diameter (LED) at stand age 80 prior to the rotation harvest. Data are from the no-snag-creation scenario (see text).

Notes: All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 32.

Table 37—Simulated measures of logs for 64 experimental thinning treatments starting with stand conditions created by the 272-297 first-rotation treatment, 80-year rotation strategy (second rotation in table 5)

Exp. no.	Target thinning density by entry (stand ages 20/40/60)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 40			5 Mg/ha created at stand ages 40 and 60			5 Mg/ha created at stand age 40, 10 Mg/ha created at stand age 60		
		20	40	60	20	40	60	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
1	136/99/62	126/9	99/8	62/25	100	118	148	19.4	30.9	36.7	32.5	35.7	37.5	32.5	35.7	37.5	32.5	35.7	37.5
2	136/99/124	124/11	99/10	124/26	110	129	193	30	31	36.6	40	35.3	36.7	40	35.3	36.7	40	35.3	36.7
3	136/99/186	125/10	99/9	186/27	105	128	221	43.1	30.5	36.2	44.4	34	35.7	44.4	34	35.7	44.4	34	35.7
4	136/99/all	126/9	99/9	1196/27	104	124	388	10	27.2	32.1	10	27.2	32.1	10	27.2	32.1	10	27.2	32.1
5	136/198/62	126/9	198/8	62/40	100	184	193	10	26.3	35.8	21.9	31.3	37.4	21.9	31.3	37.4	21.9	31.3	37.4
6	136/198/124	127/8	198/8	124/41	98	191	246	38.1	31.9	36.5	41.9	37.1	37.5	41.9	37.1	37.5	41.9	37.1	37.5
7	136/198/186	125/10	198/9	186/41	108	195	287	38.1	31.6	36.1	36.3	34.1	36	36.3	34.1	36	36.3	34.1	36
8	136/198/all	125/10	198/9	969/42	106	199	446	34.4	32.5	33.9	34.4	32.5	33.9	34.4	32.5	33.9	34.4	32.5	33.9
9	136/297/62	126/9	293/8	62/51	100	252	231	23.8	29.9	34.4	56.3	35.8	37.5	56.3	35.8	37.5	56.3	35.8	37.5
10	136/297/124	125/10	297/9	124/48	106	252	280	25	32.2	33.6	36.9	37.3	35.2	36.9	37.3	35.2	36.9	37.3	35.2
11	136/297/186	125/10	297/9	186/52	106	258	336	10	29.3	33.7	19.4	30.4	33.7	19.4	30.4	33.7	19.4	30.4	33.7
12	136/297/all	126/9	291/9	819/53	104	256	474	33.1	31.9	33.5	33.1	31.9	33.5	33.1	31.9	33.5	33.1	31.9	33.5
13	136/all/62	124/11	1217/10	62/49	112	405	220	25	28.9	27.9	36.3	35.2	33.1	36.3	35.2	33.1	36.3	35.2	33.1
14	136/all/124	126/9	1146/8	124/53	99	389	261	20	22.8	27.1	35	28.9	33.2	35	28.9	33.2	35	28.9	33.2
15	136/all/186	125/10	1104/9	186/49	107	384	295	25.6	27.1	29	37.5	33.4	34	37.5	33.4	34	37.5	33.4	34
16	136/all/all	126/9	1195/8	969/53	103	391	548	35	27.8	25.1	35	27.8	25.1	35	27.8	25.1	35	27.8	25.1
17	272/99/62	252/19	99/17	62/37	205	190	213	40	35.9	38	40	42	40.3	40	42	40.3	40	42	40.3
18	272/99/124	252/19	99/17	124/36	205	189	262	29.4	31.9	37.4	34.4	36.6	39.2	34.4	36.6	39.2	34.4	36.6	39.2
19	272/99/186	253/18	99/16	181/38	202	187	306	31.9	38.8	37.1	31.9	39	37.1	31.9	39	37.1	31.9	39	37.1
20	272/99/all	251/20	99/18	954/36	211	196	448	45	35.9	35.6	45	35.9	35.6	45	35.9	35.6	45	35.9	35.6
21	272/198/62	251/20	198/18	62/36	208	278	243	43.8	35.3	37.7	35.6	41.3	40.5	35.6	41.3	40.5	35.6	41.3	40.5
22	272/198/124	250/20	198/18	124/35	213	286	327	40	39	38	36.9	44.8	39.7	36.9	44.8	39.7	36.9	44.8	39.7
23	272/198/186	252/18	198/17	167/38	205	276	371	45	37	37.5	45	37	37.5	45	37	37.5	45	37	37.5
24	272/198/all	252/19	198/18	727/36	208	283	497	40	38	36.9	40	38	36.9	40	38	36.9	40	38	36.9
25	272/297/62	251/20	285/18	62/28	212	360	223	51.9	31.8	35.3	52.5	37.8	38.8	52.5	37.8	38.8	52.5	37.8	38.8
26	272/297/124	252/19	290/18	124/30	207	359	302	34.4	28.9	35.1	45	35	38.8	45	35	38.8	45	35	38.8
27	272/297/186	252/19	286/18	186/29	208	358	386	43.8	33.9	35.5	62.5	40	38	62.5	40	38	62.5	40	38
28	272/297/all	250/20	286/18	555/29	213	361	528	48.1	33	35	48.1	33	35	48.1	33	35	48.1	33	35
29	272/all/62	252/19	969/18	62/29	206	463	205	34.4	29.5	32.5	63.1	35.6	36.6	63.1	35.6	36.6	63.1	35.6	36.6
30	272/all/124	252/19	958/17	124/29	205	465	266	0	25.6	32	30	31.7	36.6	30	31.7	36.6	30	31.7	36.6
31	272/all/186	252/19	965/17	186/29	207	465	324	35	30.8	31.9	48.1	36.9	35.8	48.1	36.9	35.8	48.1	36.9	35.8
32	272/all/all	252/19	1006/18	763/26	210	476	581	41.9	31	29.4	41.9	31	29.4	41.9	31	29.4	41.9	31	29.4
33	408/99/62	372/27	99/26	62/30	300	231	232	40	34.9	37.1	46.3	41.1	39.6	46.3	41.1	39.6	46.3	41.1	39.6
34	408/99/124	366/26	99/24	124/30	294	225	287	35	38.3	37.5	45	43.1	39	45	43.1	39	45	43.1	39
35	408/99/186	358/26	99/24	182/31	288	220	327	30	36.9	36.7	30	37.5	36.8	30	37.5	36.8	30	37.5	36.8
36	408/99/all	366/27	99/25	982/31	299	227	486	38.8	36.3	34.6	38.8	36.3	34.6	38.8	36.3	34.6	38.8	36.3	34.6

Table 37—Simulated measures of logs for 64 experimental thinning treatments starting with stand conditions created by the 272-297 first-rotation treatment, 80-year rotation strategy (second rotation in table 5) (continued)

Exp. no.	Target thinning density by entry (stand ages 20/40/60)[a]	Modeled density (no./ha) by thinning entry (≤60 cm/>60 cm d.b.h.)[a]			Stand density index by thinning entry			Log-creation strategies[b]											
		Stand age (years)			Stand age (years)			No log creation			5 Mg/ha created at stand age 40			5 Mg/ha created at stand ages 40 and 60			5 Mg/ha created at stand age 40, 10 Mg/ha created at stand age 60		
		20	40	60	20	40	60	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED	Age	Mg/ha	LED
										cm			*cm*			*cm*			*cm*
37	408/198/62	371/26	198/23	62/27	291	304	237	40	43	37.5	40	49.1	39.7	40	49.1	39.7	40	49.1	39.7
38	408/198/124	371/27	198/25	124/27	297	310	325	40	34.9	36.6	40	41	38.7	40	41	38.7	40	41	38.7
39	408/198/186	364/27	198/24	178/29	292	310	400	44.4	42.8	37.3	44.4	42.8	37.3	44.4	42.8	37.3	44.4	42.8	37.3
40	408/198/all	372/27	198/25	756/26	298	311	523	43.8	41.9	36.6	43.8	41.9	36.6	43.8	41.9	36.6	43.8	41.9	36.6
41	408/297/62	374/26	297/25	62/25	294	395	231	38.1	34	34.9	38.1	40.1	37.8	38.1	40.1	37.8	38.1	40.1	37.8
42	408/297/124	372/27	297/24	124/24	296	392	310	43.8	40.2	35.2	43.8	46.4	37.5	43.8	46.4	37.5	43.8	46.4	37.5
43	408/297/186	374/26	297/24	186/24	295	393	386	36.9	37	34.9	46.3	43.2	37.1	46.3	43.2	37.1	46.3	43.2	37.1
44	408/297/all	375/27	297/25	572/26	302	399	567	38.1	34.8	34.3	38.1	34.8	34.3	38.1	34.8	34.3	38.1	34.8	34.3
45	408/all/62	369/27	865/25	62/25	297	519	225	55.6	33.2	34	58.1	39.5	36.9	58.1	39.5	36.9	58.1	39.5	36.9
46	408/all/124	359/27	854/25	124/25	292	511	284	28.1	32	33.7	47.5	38.1	36.8	47.5	38.1	36.8	47.5	38.1	36.8
47	408/all/186	370/27	833/25	186/25	298	513	354	65	35.8	33.7	57.5	42	36.3	57.5	42	36.3	57.5	42	36.3
48	408/all/all	363/27	860/24	725/24	295	513	617	57.5	34.3	32.6	57.5	34.3	32.6	57.5	34.3	32.6	57.5	34.3	32.6
49	All/99/62	930/27	99/24	62/28	364	206	213	20	33.4	35.2	41.9	39.4	37.9	41.9	39.4	37.9	41.9	39.4	37.9
50	All/99/124	962/27	99/25	124/28	368	208	260	44.4	39.1	34.9	40	45	36.6	40	45	36.6	40	45	36.6
51	All/99/186	919/26	99/25	186/28	362	209	308	39.4	37.4	35.2	39.4	38.6	35.4	39.4	38.6	35.4	39.4	38.6	35.4
52	All/99/all	914/27	99/25	985/29	366	212	460	42.5	39.8	32.7	42.5	39.8	32.7	42.5	39.8	32.7	42.5	39.8	32.7
53	All/198/62	899/27	198/25	62/28	363	282	233	34.4	39.7	34.7	40	45.9	37.4	40	45.9	37.4	40	45.9	37.4
54	All/198/124	937/27	198/24	124/27	365	277	296	39.4	37.1	34.7	45	43.2	37.1	45	43.2	37.1	45	43.2	37.1
55	All/198/186	930/27	198/25	186/27	369	282	364	38.8	35.1	34.5	43.8	35.2	34.6	43.8	35.2	34.6	43.8	35.2	34.6
56	All/198/all	878/27	198/25	900/27	362	283	514	40.6	41.2	34	40.6	41.2	34	40.6	41.2	34	40.6	41.2	34
57	All/297/62	877/27	297/24	62/27	353	342	230	40	42.4	33.6	40	48.5	36.3	40	48.5	36.3	40	48.5	36.3
58	All/297/124	968/27	297/25	124/27	367	344	297	35	38.7	33.3	40	44.8	35.9	40	44.8	35.9	40	44.8	35.9
59	All/297/186	850/27	297/24	186/26	356	347	362	41.3	42.8	34.2	41.3	48.9	36	41.3	48.9	36	41.3	48.9	36
60	All/297/all	934/27	297/25	685/27	365	346	534	40	44.6	33.4	40	44.6	33.4	40	44.6	33.4	40	44.6	33.4
61	All/all/62	956/27	1050/25	62/24	363	555	208	44.4	35.1	26	55.6	41.3	30.2	55.6	41.3	30.2	55.6	41.3	30.2
62	All/all/124	913/27	1021/25	124/23	366	551	266	48.8	33.8	27.1	58.1	40	31	58.1	40	31	58.1	40	31
63	All/all/186	912/27	1030/25	186/24	365	557	329	31.9	30.7	26.8	61.9	36.9	30.8	61.9	36.9	30.8	61.9	36.9	30.8
64	All/all/all	906/26	1029/24	682/23	364	552	612	51.9	35.2	26	51.9	35.2	26	51.9	35.2	26	51.9	35.2	26

[a] Target thinning density and modeled density are explained in table 9; d.b.h. = diameter at breast height.

[b] For each log-creation strategy, age is stand age when the threshold level for log mass (see table 6) was met, followed by mass and mean large-end diameter (LED) at stand age 80 prior to the rotation harvest. Data are from the no snag-creation scenario (see text).

Notes:All values (except target thinning densities) are means based on 8 simulation replications. Data are graphed in figure 33.

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