From:	Fitzgerald, Stephen Arthur
To:	Maness, Thomas; Huntington, Geoffrey; Davis, Anthony S
Cc:	Fitzgerald, Stephen Arthur
Subject:	Financial Analysis of Maintaining Newton & Cole Study for 5 years.
Date:	Friday, October 06, 2017 2:30:57 PM
Attachments:	2017 Blodgett 10 yr DCF_export restricted_Newton study2023.xlsx Harvest Schedule Map_Newton Study Held.pdf

Thomas, Geoff and Anthony,

The recent analysis by Stuntzner to layout (attached) and evaluate the financial effect (attached) of maintaining the Newton and Cole's Mature Forest Study has been completed. This analysis entailed harvesting other mature timber in the first 5 years and then harvesting the acres encompassing the Newton & Cole study in the second 5 years. This strategy would allow researchers to take final measurements and finish out the study.

The financial numbers come close to option number one, in Ken Hine's report, "Keep the Land, Harvest the Over-Mature Timber." Based on the harvest layout that Stuntzner developed, revenue would be approximately $6 million dollars in the first year. Following 4-5 years of green-up (an FPA requirement), we would then be able to harvest the other mature timber, which has an NPV of $14.3 million.

1st Year Cash Flow	10 Year Cash Flow	10 Year NPV	NPV in total
$5,959,000	$14,320,000	$14,320,000	$16,973,440

Let me know if you need any other information.

Fitz

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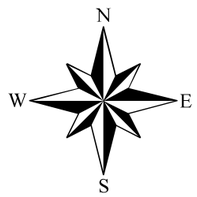
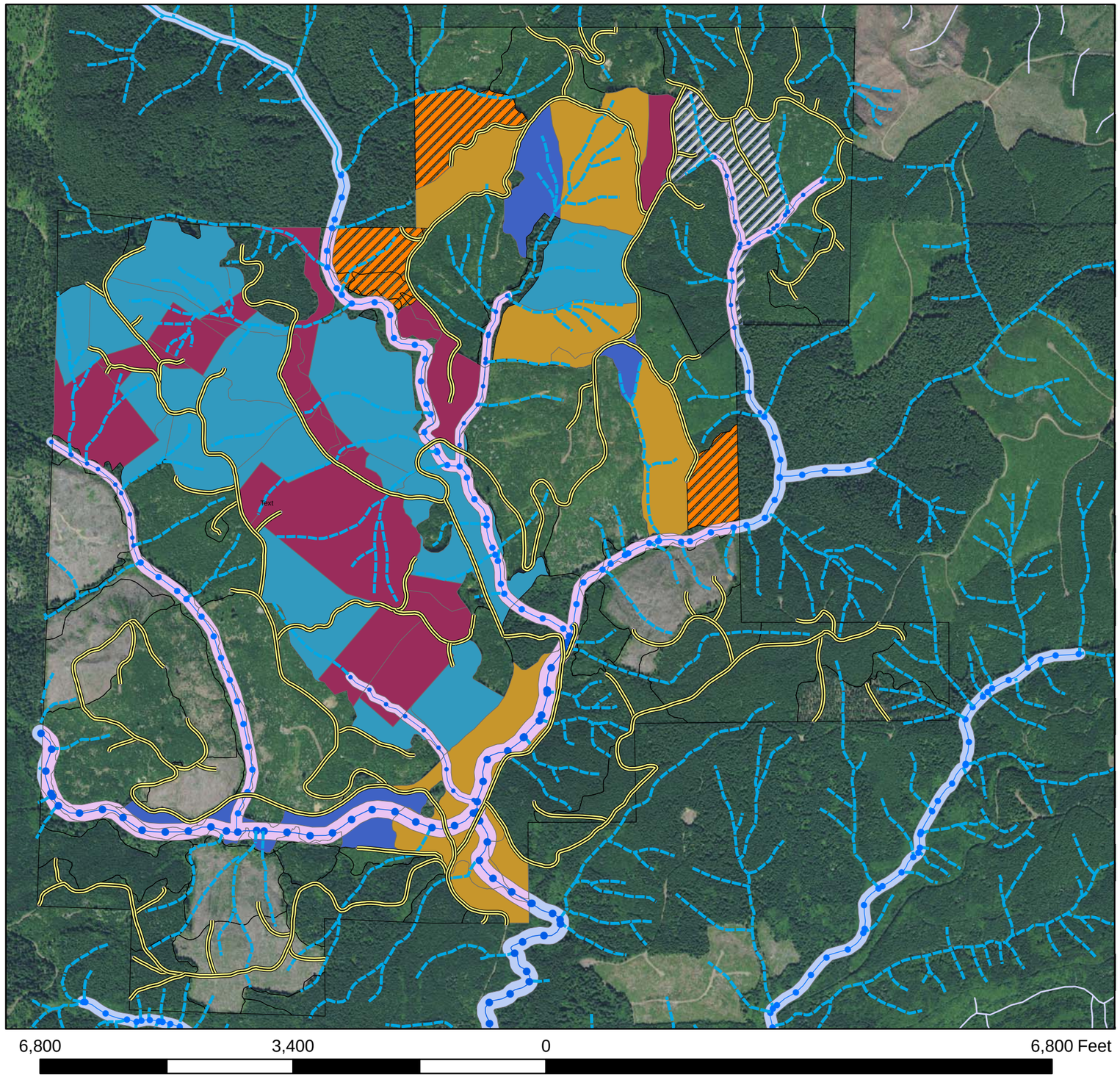
OSU BLODGETT TRACT MATURE TIMBER HARVEST SCHEDULE
HOLD NEWTON STUDY STANDS UNTIL YEAR 2023





Legend

Blodgett Roads.NAD83 - UTM zone 10N

Blodgett_Streams.NAD83 - UTM zone 10N

<all other values>

STREAMCL

FL

FM

FS

NM

NS

Newton_buffers

HarvestYea

2016

2017

2018

2019

2023

2024

NAIP 2016 Ortho Photo

RGB

Red: Band_1

Green: Band_2

Blue: Band_3

ACTIVE RESEARCH PROJECTS @ BLODGETT

1. **Red Alder Management Study**
   Hardwood Coop: Ahrens & Shaw

Short Summary: Approximately 30 acre study site containing red alder planted to variety of replicated tree spacing. This study will conclude in about 10 years, and is part of a network of 109 plots from California to British Columbia. Some plots are pruned (for wood quality), and the measurements are used to update a growth model for red alder.

2. **Westside Mature Forest Thinning Study**
   Co-PI's: Matt Powers, John Bailey, and Liz Cole

Introduction

Comprehensive experiments were established in 50-year-old conifer stands in two widely differing sites with the general objective of establishing underplanted conifers beneath variously thinned overstory second-growth forests. The ultimate goal was to provide the framework for management systems that would provide both high quality habitat of older forests combined with high yields of high quality wood products.

The installations are in a Valley foothill site, McDonald Forest, near Corvallis, OR, and a coastal site, the Blodgett Tract, about 50 km east-southeast of Astoria, OR. These sites reflect major differences in soil and climate within the Oregon Coast Range. Regular sampling of overstory growth, underplanted seedling responses, and understory plant communities has been conducted out to 20 years post-treatment, and the study's PIs are currently working with BLM cooperators to secure approximately $200,000 in additional funds to add comprehensive deadwood inventories at both installations.

The study longevity was originally scheduled for fifty years post-thinning. At a meeting with the PI's and Research Forest staff earlier this year, it was decided that measurements on both installations would continue through year 30. At that time, continuation of the study will be re-evaluated based on 30-year trends and the ability to establish long-term growth and structural development trajectories. Year 25 measurements in McDonald Forest start June 2018 and will be completed by April 2019. Year 25 measurements at Blodgett are scheduled to start July 2020 and be completed by April 2022. Year 30 measurements in McDonald would start June 2023 and be completed by April 2024, with year 30 measurements at Blodgett starting in July 2025 and being completed by April 2027 (Figure 1).

Background and Rationale

The Mature Forest Study (MFS) is a long-term study of managed Douglas-fir and Douglas-fir/western hemlock forests in western Oregon that evaluates the interacting effects of overstory density management, conifer underplantings, and understory vegetation management within the context of goals related to simultaneously producing late seral habitat characteristics and high yields of quality wood products. The study stands were initially treated 24 years ago at the McDonald site and 21 years ago at the Blodgett site and currently have overstory cohort ages of approximately 74-79 years.

The study design incorporates two types of thinning—uniform thinning and thinning using gaps with three (Blodgett) or four (McDonald) overstory densities. Each of these included at least 2 understory vegetation management treatments (untreated and a site preparation treatment) before

underplanting with three (Blodgett) or four (McDonald) conifer species. This design allows for examining 32 (McDonald) and 18 (Blodgett) trajectories of stand development based on different treatment combinations. Each installation has three blocks (replications) for a total of 24 density plots at McDonald, covering approximately 150 acres and 18 density plots at Blodgett, covering approximately 112 acres.

Sampling of overstory composition and structure, planted conifer size and survival, and understory vegetation composition and structure has been conducted eight times since treatment installation, and is currently being repeated at five-year intervals. This provides a unique dataset for assessing long-term trade-offs between management goals related to wood production and promoting the development of structurally-complex, late-seral habitat, as well as for improving our understanding of general stand development processes in managed Douglas-fir (McDonald) and Douglas-fir/western hemlock (Blodgett) stands.

Continued investment in the MFS would provide opportunities to apply the study's existing long-term dataset towards evaluating outcomes from specific management objectives and management directions associated with the Harvest Land base and Late-Successional Reserve land use allocations in the BLM's new ROD and RMP for Northwestern and Coastal Oregon, Forest Service LSR's, ODF's structure-based management, including the Elliott Forest, and small woodland owners/commercial timberlands interested in habitat management as well as timber production. Continued research on the MFS will provide information about the impacts of commercial thinning treatments spanning a range of relative densities on timber production, stand composition, vegetative species diversity, and the development of structural complexity. Work on the MFS would also provide information about the use of integrated vegetation management treatments including thinning, vegetation control, gap creation, and conifer underplantings to promote the development of diverse understory plant communities, maintain vegetative species diversity, promote the development of structural complexity, create and maintain areas for hardwood and shrub dominance, and adjust stand composition. In addition, continued research on the MFS will offer insights into emerging natural resource management challenges such as providing detailed information about fuel loadings and conditions for predicting wildfire behavior in multi-cohort or long-rotation systems, evaluating the impacts of density management treatments on climate change adaptation/drought response, assessing carbon storage for purposes of climate change mitigation or valuation of extended rotations and complex stand structures in C markets, and for examining the impacts of management in "mature" stands (i.e.,. stand ages greater than 80 years) as the MFS treatment areas continue to age. Because the two installations vary in terms of species composition and climate, comparison of trends between the sites allows for a broader range of inference.

Objectives:

Original Short-term:

1. To develop practices for efficient conifer regeneration in the understory of 40-70-year-old Douglas-fir stands, using modifications of current technology in planting and competition management.
2. To determine the environmental variables that are most likely to affect a) seedling establishment (years 1-3) and b) later growth, and how environments in understories change with time.
3. To quantify responses of shrubs and forbs to thinning and site preparation, and their subsequent effect on conifer regeneration.
4. To develop procedures for monitoring responses to thinning approaches and understory regeneration establishment and growth.

Original Long-term

1. Determine the relationship between changes in overstory density and structure to understory seedling and shrub growth.
2. Establish variable spacing and density studies in Douglas-fir stands that can be used to develop options for managing Douglas-fir and mixed conifers in long rotations, with late successional characteristics.
3. Determine whether distribution of trees after thinning influences stand growth and yield.

Recent statement of objectives:

1. Examine trade-offs between overstory volume production and the development of late seral habitat features (e.g., large-diameter live trees and deadwood, multi-layered canopies, a shade tolerant understory and midstory tree component, and varied tree sizes) across a range of density management treatments carried through nearly a full biological rotation.
2. Improve our understanding of stand dynamics in maturing Douglas-fir and Douglas-fir/western hemlock forests including how density management treatments and underplanting various species impact growth, yield, and structural development as stands pass 80-years of age.
3. Evaluate the interactive effects of overstory density and dense understory conifer regeneration on the development of vertical stratification in variable density thinning treatments.
4. Assess the effectiveness of understory cohort release treatments designed to accelerate vertical recruitment and increase tree size variability by reducing competition among naturally-regenerated hemlock in the understory cohort at the Blodgett site.
5. Examine how interactions among varying levels of overstory density reduction and understory vegetation management treatments impact long-term patterns of understory vegetation development (i.e., do understory vegetation management treatments in thinned stands alter the legacy effect of existing vegetation on long-term understory vegetation dynamics or impact establishment of late seral-associated understory species?).
6. Evaluate the ability of various density management treatments to influence drought impacts on overstory and understory tree growth.
7. Improve estimates of overstory and understory tree growth in two-aged stands and two-storied stand structures.
8. Expand the capacity to answer future questions related to currently unanticipated management objectives or challenges by continuing to build on the Mature Forest Study's detailed long-term dataset on overstory tree growth, understory cohort development, and understory vegetation dynamics in moist Douglas-fir and Douglas-fir/western hemlock forests.

Anticipated Future Outcomes

Vegetation measurements: Analyses of 20-year understory vegetation trajectories by M.S. student Jim Priebe suggest that understory communities show evidence of long-term overstory and understory treatment impacts over the study's lifetime, and that understory communities have shown rapid change over the last 5-10 years and may be converging back towards pre-treatment conditions. The 25-30-year post-treatment measurements will help us to evaluate whether these apparent changes do, in fact, represent a loss of the initial treatment effects on understory development, or whether they are indicative of some other shift in understory community dynamics. Such information provides direct inferential power about the potential for extended rotations to influence late seral habitat characteristics and vegetative diversity. Given current observations (see above), the 25-30-year post-treatment measurements may provide valuable insights about the longevity of overstory density reductions and understory release treatments on understory vegetation development. This information could help determine appropriate thinning

cycles for long-rotation silvicultural systems intended to promote long-term development of late seral understory communities. This data could also be used in combination with overstory growth and yield data to evaluate long-term tradeoffs between wood yields and understory habitat development across varying thinning intensities and rotation lengths.

Underplanted measurements: This information would improve our understanding of the long-term impacts of gap vs uniform thinning approaches, varying residual overstory densities, and understory release treatments on understory cohort development in two-aged stands. This would contribute to our understanding of the development of three key indicators of late seral and old-growth habitat in managed stands (i.e., vertical layering, a shade tolerant understory component, and a range of tree sizes). In addition to inferences about treatment impacts on the development of structural complexity, this research activity would provide valuable data about understory tree growth under varying overstory densities that could be used in the development of growing stock allocation schemes for multi-aged stand management in moist Douglas-fir forests. Finally, the information would allow us to evaluate how varying levels of damage to understory cohort trees impact their growth under varying overstory densities. This information would be useful for assessing potential for seedling/sapling recovery following storm or logging damage.

Overstory measurements: This information would improve our understanding of overstory tree growth and development over long rotations. In addition to improving estimates of tree growth and stand yields across varying thinning intensities, the 25-year overstory re-measurement of McDonald would allow us to evaluate how mature overstory Douglas-fir respond to varying levels of crown loss over the short-term (four-five years post-disturbance from the November 2014 ice storm). Continuation of overstory data would also improve our ability to evaluate overstory density impacts on understory vegetation dynamics and understory tree growth in two-storied stands.

Coarse wood inventory: Deadwood data collection will allow us to evaluate long-term (20+ year) recruitment of a key element of wildlife habitat and one of the primary indicators of late seral structural conditions. Funding is requested to inventory standing snags and down deadwood for the first time since treatment installation at McDonald, and for the first time ever at the Blodgett site. These data will provide information about deadwood recruitment in managed Douglas-fir systems across a range of residual overstory densities. Contrasting deadwood levels in MFS treatments with unmanaged stands of similar age will provide a basis for evaluating differences in deadwood pools of mature stands between harvest and reserve-based land use allocations. In addition to the direct implications for late seral habitat development, these deadwood data could also be used in combination with existing vegetation inventory data to evaluate thinning impacts on fuel loadings and aboveground carbon stocks across a range of residual stand densities. Fuels data could be used in later projects to model wildfire behavior in mature, managed Douglas-fir and Douglas-fir/hemlock systems in western Oregon.

Data collected for Mature Forest Study and status of measurements and analyses

Coarse Woody Debris (McDonald only):
Year 0 and Year 1: Length of logs in a 5 meter radius circle of each vegetation sample plot (960 points) was measured and placed into different categories. Small logs had diameters less than 12 inches. Medium logs ranged from 12 to 20 inches, and large logs were greater than 20 inches. There were three decay classes: 1-- no evidence of decay; 2 to 3--corresponded to logs within decay classes 2 to 3, some evidence of decay, but still a hard core present; and 4 to 5--corresponding to decay classes 4 to 5 in which almost all of the log was soft. Logs were separated for conifers and hardwoods.
Status: Data entered but not analyzed. (Funding cut in year 2 eliminating further measurements.) Interest expressed in resumption of measurements including expanding to Blodgett pending funding.

Overstory (both installations):
Complete inventory of trees over 2 inches immediately after thinning within the 3.6 acre measure plots. Diameter measurements taken immediately after thinning and years 3, 5, 7, 10, 15, and 20 after thinning. Originally tracking over 5100 trees at McDonald and 4200 at Blodgett. Height measurements taken on a 10% subsample at all intervals except year 3.
Status: Data through year 20 summarized. Manuscript based on year 15 measurements published. Measurements for years 25 and 30 pending for both installations. Next up, 2018 McDonald.

Vegetation (both installations):
Vegetation cover estimates collected prior to spraying and thinning, and growing seasons 1, 3, 5, 7, 10, 15, and 20 years after thinning. Cover was visually rated in 1- and 5-m radius nested plots, 960 plots at McDonald, 720 at Blodgett. Cover estimates collected in the 1-m plots included percent shrubs, trailing blackberry, swordfern, brackenfern, other ferns, grass, forb, sedge and rushes, planted conifers, and natural conifers. Planted and natural conifers were segregated by species after year 3. Every forb species within 1-m radius of the plot center was recorded. In the 5-m plots, cover estimates were made individually for every shrub and fern (excluding arboreal ferns) species in 3 layers: 0-1.49m (low), 1.5-5m (mid), > 5-15 m (tall), and >15 m (overstory). Height of maximum leaf area by species in each layer was also estimated.
Status: Year 15 data published. Year 20 data summarized, published in Priebe thesis. Journal manuscripts in preparation. Measurements for year 25 and 30 pending. Next up, 2018 McDonald.

Underplanted Seedlings (both installations):
Random seedlings grids were established after planting, and underplantings were measured in year 0, 1, 2, 3, 4 (McDonald Only), 5, 7, 10, 15, and 20 after thinning. Originally tracking 6912 seedlings at McDonald and 4320 at Blodgett.
Status: Manuscript on biotic injuries resulting from underplanting environment published. Manuscript based on years 4 (McDonald) and 10 (both sites) growth and survival published; years 15 and years 20 data summarized. Ice storm damage (McDonald) in Priebe thesis. Journal publication in review. Year 25 and 30 measurements pending. Next up, 2018 McDonald.

Snag component (McDonald Only)
Several plots had greater than the target basal area after thinning, so a snag study was initiated to remove those trees. Snags were created by girdling, herbicide injection, topping at the base of the crown, and topping at mid-crown. Some of the trees were inoculated. Utilization, bark beetle activity, and fungal colonization were monitored for 4 years after treatments.
Status: Manuscript published on results. Height of snag recorded during year 20 diameter measurements. Summaries provided to BLM. Re-measurement unknown pending funding.

Ice storm damage (McDonald only)
In November 2014, the McDonald Forests plots were damaged by an ice storm. It was decided that storm damage needed to be assessed on an individual tree basis for the overstory so that future growth measurements could determine recovery rates based on damage level. Data collected included estimates of loss of crown, type of damage, if top broken at what diameter, and density of crown. Damage to underplantings was also assessed the summer following the storm, including direct versus indirect damage, degree of damage, breakage, bending, and loss of crown.
Status: Data on overstory summarized. Damage to underplantings published in Priebe thesis, manuscript in review. Future evaluations will be part of scheduled overstory and understory measurements.

Natural Regeneration (both installations)

Natural regeneration was evaluated on the study sites 4 and 13 years after thinning at McDonald and 10 years after thinning at Blodgett. At a subsample of the vegetation plots, counts were collected and size of the dominant seedling of each species present was measured.
Status: Report on year 4 at McDonald. Manuscript based on years 10 and 13 published. No further evaluations pending.

PCT Study (Blodgett Only)
A precommercial thinning study of understory hemlock in buffer areas and immediately outside of the plots was established in 2009. For the study, 99 areas with dense regeneration were selected. One third was left unthinned. For the other plots, a dominant hemlock was selected and areas of 2- or 4-meters radius around that hemlock were cleared of other hemlock. Vegetation was also assessed within these circles prior to thinning.
Status: Measurements for years 0, 1, 3, and 9 collected on hemlock. Vegetation was re-evaluated year 9. Results published in Taylor MF paper. Journal article in preparation. Decision on further measurements pending.

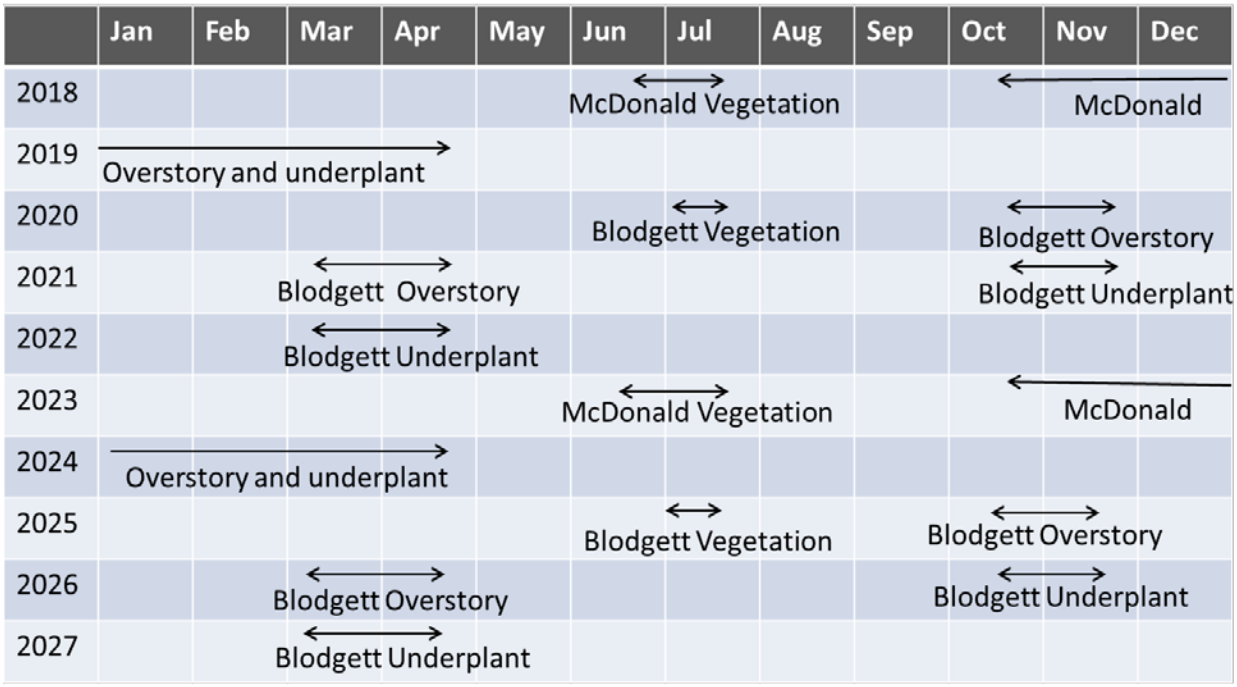


Figure 1. Timeline for field measurements for McDonald and Blodgett installations through thirty years after thinning.

Publications (not including presentations and posters)

Cole, E., M. Newton, and J.D. Bailey. 2017 Understory vegetation 15 years post-thinning in 50-year-old Douglas-fir and Douglas-fir/western hemlock stands in western Oregon, USA. For. Ecol. Manage. 384:358-370.

Priebe, J. 2016. Silviculture treatment impacts on understory trees and 20-year understory vegetation dynamics in mature Douglas-fir forests. M.S. Thesis. Oregon State University.

Taylor, A. 2016. Understory vegetation dynamics and midstory development following understory release treatments in northwest Oregon thinned Douglas-fir stands. M.F. Professional Paper. Oregon State University.

Newton, M. and L. Cole. 2015. Overstory development in Douglas-fir-dominant forests thinned to enhance late-seral features. Forest Science 61(4):809-816.

Nabel, Mark. R., M. Newton and E.C. Cole. 2013 Abundance of natural regeneration and growth comparisons with planted seedlings 10-13 years after commercial thinning in 50-year-old Douglas-fir, Douglas-fir/western hemlock, Oregon Coast Range**.** Forest Ecology and Management 292:96-110.

Newton, M., E. Cole, and J. Barry. 2009. "Waving wand" broadcast hand application of herbicides: technical basis and usage. Contributions in Education and Outreach N. 2. College of Forestry, Oregon State University Corvallis, OR.

Cole, E.C and M.Newton. 2009 Tenth-Year Survival and Size of Underplanted Seedlings in the Oregon Coast Range. Can. J. For. Res. 39:580-595

Curtis, R.O., D. S. DeBell, R. E. Miller, M. Newton, J. B. St. Clair and W. I. Stein. 2006 Silvicultural research and the evolution of forest practices in the Douglas-fir Region. General Tech. Rep. 696. USDA Forest Service, Pacific Northwest Forest Research Station. 172 p.

Newton, M. and E.C. Cole 2006 Harvesting impacts on understory regeneration in two-storied Douglas-fir stands. West. J. Appl. For. 21:14-18

Brandeis, T. J., M. Newton, G. M. Filip and E. C. Cole 2002 Habitat development in artificially made second-growth Douglas-fir snags. J. Wildl. Manage. 66(3):625-633

Brandeis, T. J. M. Newton and E. C. Cole 2002 Biotic injuries on conifer seedlings planted in forest understory environments. New Forests 24:1-11

Brandeis, T. J., M. Newton and E. C. Cole. 2001 Underplanted conifer seedling survival and growth in thinned Douglas-fir stands. Can. J. For. Research. 31:302-312

Brandeis, T. J., M. Newton and E. C. Cole 2001 A comparison of overstory descriptors for describing competitive influence on understory conifer growth. For. Ecol. Manage. 152:149-157