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Chapter 2:
Vegetation Module

Forest Restoration in the Northern Sierra Nevada:
Impacts on Structure, Fire Climate, and Ecosystem Resilience.

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Objectives

The vegetation module of the Plumas-Lassen Administrative Study is focused on studying how changes in the forest canopy affect ecosystem functioning. Aspects of ecosystem function studied include understory microclimate, and growth and competition of shrubs and juvenile trees, and understory diversity. The module objectives are:

1) determine the effects of reduction in tree canopy cover on microclimate, fuels dryness, and other factors contributing to flammability of the forest understory, and

2) determine effects of reduction in tree canopy cover on light, soil moisture, and other factors influencing composition and growth of the understory plant community.

Research approaches include stand-level experimental manipulations, measurement of plant growth and survival along existing environmental gradients, and assessment of impacts of routine (i.e., non-experimental) forest management activities.

Research activities 2005

Group selection impacts in East-Side pine: stand scale. A project was initiated on the Beckwourth Ranger District to determine ecosystem effects of group selection harvesting in patchy East-Side pine types. The study took place in two areas where group-selection harvesting projects (the Red Clover and Stony Ridge projects) had taken place in 2002 and 2003. Measurements of microclimate, soil water, and plant community were taken along paired transects inside and outside of group selections and natural gaps. Our hypothesis was that the canopy openings associated with group selection silviculture would significantly affect the regeneration environment by drying out surface soils.

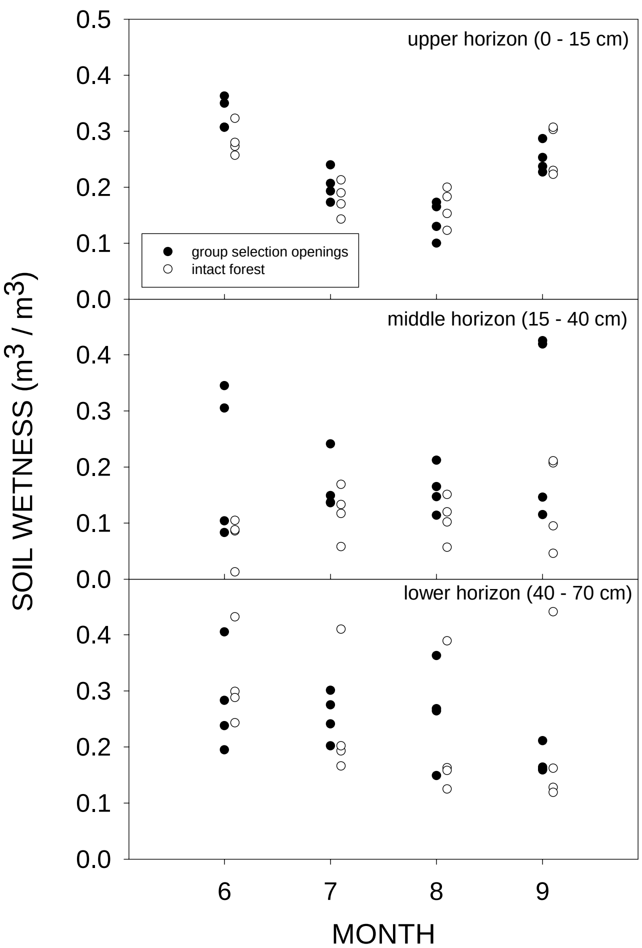


Figure 1. Volume soil wetness in group selection openings and nearby intact forest in the Red Clover project area. Each data point is a mean of readings at three locations along a transect. Readings were taken from June-September 2005.

These hypotheses have not been well supported by the data. Soil wetness appears to be slightly higher in group selection openings during the early season, at least in the 0-15 and 15-40 cm soil layers. Nevertheless, mortality of planted seedlings was high in the Stony Ridge project area, approaching 35% during the one season of this study.

Group selection impacts in East-Side pine: landscape scale (Seth Bigelow and Sean Parks). We are investigating whether group selection silviculture disrupts landscape connectivity and increases fragmentation of a patchy, ecotonal East-Side forest. Four areas in which group selection harvests took place in 2002 and 2003 were located on aerial photographs (DOQQ's). The DOQQs were classified into binary (tree cover / non-cover) at the 1 m^2 scale, and percolation was tested for in a pre-treatment state, and after a simulated harvest had been applied by converting pixels from cover to non-cover in the area where the group selection openings were made (Figure 2) In a landscape percolation occurs when a cover type extends from one side of an area to another without breaks.

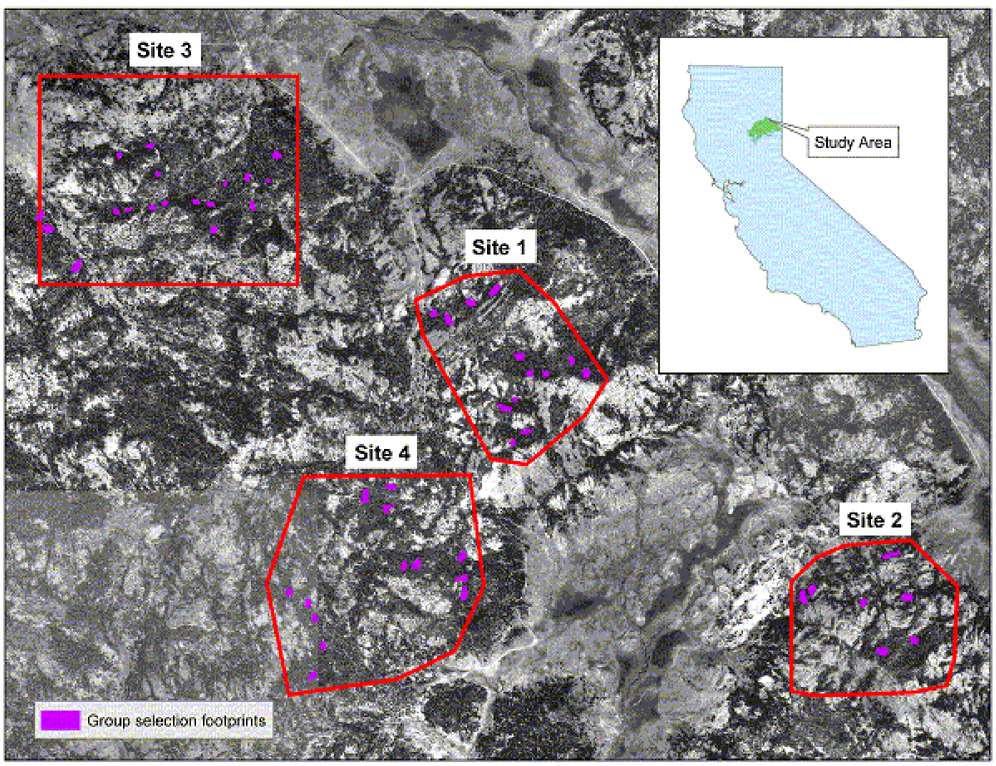


Figure 2. Aerial photograph of study landscape on Beckwourth Ranger District of Plumas National Forest. Photo was taken prior to group selection harvest: location of treatments is superimposed. Prior to treatment, sites 1, 2 and 4 percolated and site 3 did not. Application of group selection disrupted canopy cover connectivity in site 2, changing it from percolating to non-percolating.

Three of the four sites percolated prior to group selection harvest, and harvest changed one of these three sites from percolating to non-percolating. The significance of non-percolation has not been definitively established in the conservation literature, but may be associated with decreased ability of some animals to travel through landscapes. We are developing guidelines for simplified determination of when management actions may disrupt landscape connectivity.

Study on Effects of Experimental Thinning and Group Selection on Forest Structure, Fire Climate, and Plant Communities in West-Side Mixed-Conifer Forest. We continued to collect pre-treatment data in nine 22-acre plots and three 2-acre plots for this study. Data relevant to fire climate include 1) air temperature and humidity (at 0.2 and 2 m above ground), and windspeed (continuous monitoring), and 2) moisture in duff and 1000-, 100-, and 10-hr activity fuels at 2-4 week intervals. Data relevant to plant community development included 1) visual assessment of plant growth and species composition at 100 sampling points in each plot, 2) measurement of light penetration through the shrub layer at the same points, and 3) soil temperature (2 cm below mineral soil surface) and soil wetness in the 0-15 cm, 15-40 cm, and 40 – 70 cm horizons.

We worked with the staff of the Mt. Hough Ranger District and Annie Buma of the Act 2 Team to produce an Environmental Analysis (EA) for the treatments required for the canopy thinning and group selection. (The EA is required because one of the planned treatments brings canopy cover down to 30% and thus falls outside of the forest standards and guidelines on several parts of the experimental plots totaling less than 11 acres.) Trees to be thinned on the experimental plots were marked by a Mt. Hough RD team. A formula for determining spacing ratios to achieve canopy cover targets based on the assumption of triangular spacing was developed by Seth Bigelow (formula and derivation are given in the appendix). Once this formula is validated by peer reviewers we expect that it will be a useful tool for planning and implementation of thinning projects.

Study on mortality rate of mixed-conifer saplings with respect to soil conditions and canopy cover (*Seth Bigelow, Carl Salk, and Malcolm North*). The third census of the 500 saplings in this study took place this season; mortality rates are exceedingly low at well under 5% per year for all species. The study will be complete after the 2006 field season.

Study on stand structure at spotted owl nesting and activity sites. The vegetation module crew coordinated data collection on and participated in surveys of owl nesting and activity sites using Forest Inventory and Analysis protocols. Results are presented in the owl study section.

Outreach, Collaboration, Training, and Safety

Outreach

Vegetation module personnel gave three public research presentations at the 2005 Plumas-Lassen study symposium. A web page describing our research was prepared: www.fs.fed.us/psw/programs/snrc/forest_health/plumas_lassen_study_veg.shtml. Vegetation module personnel assisted in the 2005 Herger-Feinstein Quincy Library Group projects monitoring tour by presenting data on forest structure gathered in the as-yet-untreated plots that are part of the experimental canopy thinning and group selection study. Vegetation module personnel contributed to the Forestry Institute for Teachers II (FIT-II), presenting a research overview at an evening session and leading a day-long field research experience for FIT-II participants.

Collaboration

Module personnel continued to work with the staff of the Mt. Hough Ranger District to produce an Environmental Analysis (EA) for the treatments required for the canopy thinning and group selection study in accordance with the National Environmental Protection Act. The EA is required because the treatments exceed the standard and guidelines in some parts of the forest.

Training and Personnel Development

Seth Bigelow participated in a two-week course entitled likelihood methods in forest ecology at the Institute of Ecosystem Studies, Millbrook, New York. The four members of the 2005 vegetation crew did a two-day course on wilderness first aid, and one member of the crew did a 1-day course entitled Introduction to NEPA/CEQA for Botanists. Carl Salk, the GS-7 level crew leader, left the USFS after 2.5 years employment to attend the Graduate Program in Ecology at Duke University. Carl was awarded a National Science Foundation Pre-Doctoral Fellowship to support his planned research on tropical tree regeneration.

Publications

Work on a paper, entitled "Performance of western conifers along environmental gradients: unifying community, physiological, and silivicultural perspectives" is nearly complete and the manuscript will be submitted to Canadian Journal of Forest Research in February 2006.

Safety

No accidents occurred during the 2005 season.

Appendix A.

Derivation of general equation for predicting spacing ratios given a desired canopy cover

Seth Bigelow
November 10 2005.

A general formula for the factor by which tree diameter is multiplied to get intertree distance to achieve a desired canopy cover target assuming triangular tree spacing is

$$R = \sqrt{91 / C(\%)},$$

where R is the factor by which tree diameter is multiplied and C is canopy cover in percent. We'll assume even, triangular spacing, and we'll also assume that the radius of a tree's crown, in feet, is equal to half its DBH (in inches). So, a tree of 10" DBH would have a crown radius of 5 ft.

$$\text{Tree crown radius} = DBH / 2$$

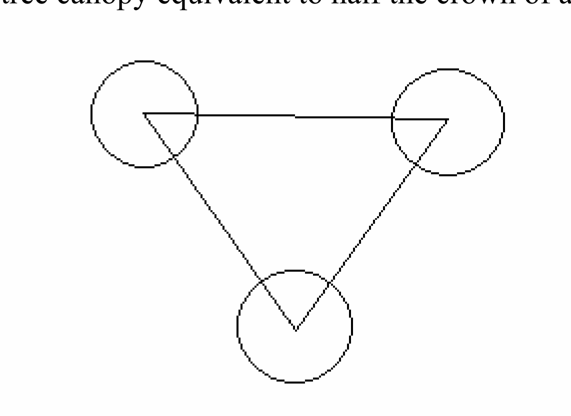
To solve the problem, let's define R as the ratio of intertree distance, D, to DBH, thus

$$R = D/DBH$$

We'll use this at the last step. And let's define canopy cover, C, as area of canopy cover (A_c) over area of ground (A_g), i.e.,

$$C = A_c/A_g$$

A triangular (equilateral) piece of ground with a tree at each apex would be covered by an area of tree canopy equivalent to half the crown of a single tree.



The area of a single tree crown is A_{ct}

$A_{ct} = \pi r^2$
$A_{ct} = \pi (1/2 * DBH)^2$
$A_{ct} = (\pi * DBH^2)/4$

So the area of the triangle covered by canopy (A_c) would be

$A_c = A_{ct} / 2$
$A_c = (\pi * DBH^2)/8$

Next we calculate the distance, D, between the trees at the apices of the triangle. The area of a triangle is ½ base times height, and in this case base (and hypotenuse) is equivalent to D. It's a equilateral triangle so we can solve for height: sin(θ) = opposite/hypotenuese, so

Opp = Hyp*sin(θ).

From the trigonometric concept of a unit circle, sin(θ) =sqrt(3)/2, so Opp=D*sqrt(3)/2, and

$A_g = 1/2\ D * (D * sqrt(3)/2)$, or
$A_g = D^2 * sqrt(3)/4$

Now, we can substitute these two findings into the canopy cover equation, $C = A_c/A_g$.

$C = ((\pi /8) * DBH^2) / (D^2 * (sqrt(3)/4)))$

Rearrange algebraically, and get…

$D^2/DBH^2 = \pi / (C*2*sqrt(3))$

Taking the square root of each side,

D/DBH = sqrt (π / (C*2*sqrt(3))

Recall that R = D/DBH. If we solve for π/(2*sqrt(3)), and change canopy cover (C) units to percent, we get

$$R = \sqrt{91 / C(\%)}$$