Silvicultural experiments on Pringle Falls Experimental Forest

Creating Stand-level Prescriptions to Integrate Ecological and Fuel Management Objectives for Dry Forests of the Eastern Cascade Range

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Outline

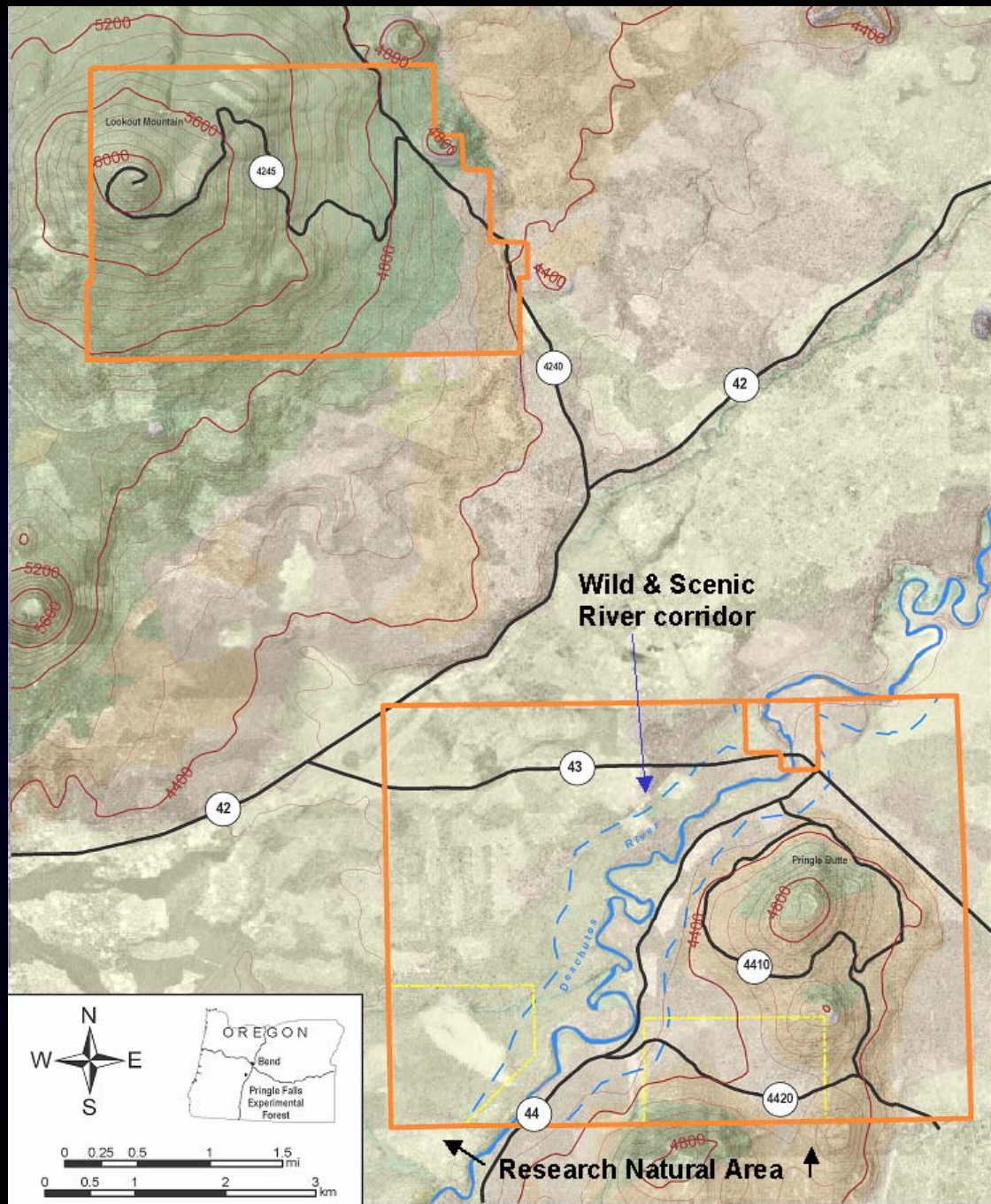
- Physical setting and history of Pringle Falls Experimental Forest (PFEF)
- Past and ongoing research focused on ponderosa pine
- New research opportunities in mixed conifer forests

Physical setting

- Distribution of ponderosa pine
- Network of experimental forests

Location

- Deschutes NF
- 4477 hectares (11,055 acres)



Physical setting

- Representative of low to mid-elevation portions of High Cascades physiographic province
- Shield volcanoes (buttes) extending above ancient lake basin
- Soils derived from 2 m aerially deposited pumice and ash
- Mean annual precipitation 600 to 1000 mm

Forest types

- Ponderosa pine on most slopes
- Lodgepole pine on flats and benches
- Sugar pine, western white pine, grand fir, Douglas-fir, mountain hemlock on higher north aspects
- Riparian shrubs along Deschutes River

History of PFEF

- Selected in 1914 by Thornton T. Munger
- Created May 20, 1931 by act of Chief Robert Y. Stuart
- Established as a center for silviculture, forest management, and insect and disease research in ponderosa pine forests east of the Oregon Cascade Range

Stand structure in early 1900s

Early 1930s

Shevlin-Hixon and Brooks-Scanlon Company mills on Deschutes River in Bend each were cutting 200 million bdft a year

PFEF research mission, 1938

- Methods of cutting in old-growth ponderosa pine
- Methods of thinning, pruning, and other stand improvement in immature stands
- Methods to convert low quality lodgepole pine stands to a useful forest
- Methods of protecting forests against fire and insects
- Methods of range management to improve forage resources

Old-growth structure and dynamics

- Keen 1936. *Relative susceptibility of ponderosa pine to bark-beetle attack*. J. For. 34: 919-927.
- Keen 1940. *Longevity of ponderosa pine.* J. For. 38: 597-598.
- Keen 1943. *Ponderosa pine tree classes redefined*. J. For. 41: 249-253.

Silvicultural cutting methods

- Kolbe and McKay 1939. *Seven methods of cutting tested at Pringle Falls.* PNW RN 27.
- Mowat 1948. *Selection cutting reduces ponderosa pine losses at Pringle Falls.* PNW RN 45.
- Mowat 1961. *Growth after partial cutting of ponderosa pine on permanent sample plots in eastern Oregon*. PNW RP 44.

Methods of cutting studies

- Maturity selection developed to limit bark beetle losses
- Improvement selection developed in southwest to limit wind, lightening, and dwarf mistletoe losses
- Small tree component ignored in northwest, removed in southwest
- Controversy subsided by 1960 due to increased interest in even-aged systems

Transition to even-aged management in 1950-1960s

- Can overstory be removed and sapling understory retained?
- Can saplings be released to grow?
- Does shrub competition restrict sapling growth?

Ponderosa pine spacing study in 1959

- Overstoy of 20 tpa, 25 in. dbh
- Understory 7000 tpa, 1 in. dbh, 40-70 years old
- 5 tree spacings with 6 replicates

  6.6 ft. (1,000 tpa)

  9.3 ft. (500 tpa)

  13.2 ft. (250 tpa)

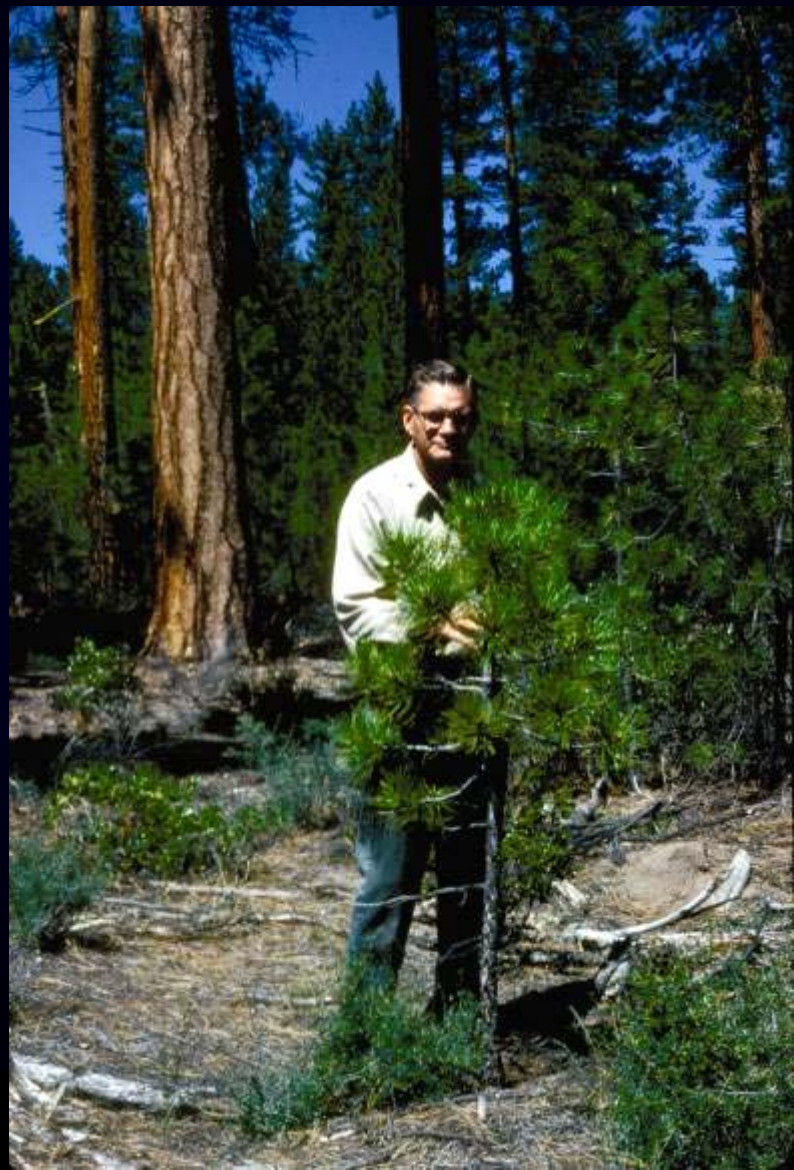
  18.7 ft. (125 tpa)

  26.4 ft. (63 tpa)

- Shrubs controlled in 3 reps

Growth of pine saplings

- Barrett 1965. *Spacing and understory vegetation affect growth of ponderosa pine saplings*. RN PNW-27.
- Barrett 1982. *Twenty-year growth of ponderosa pine saplings thinned to five spacings in central Oregon*. RP PNW-301.
- Oren et al. 1987. *Twenty-four years of ponderosa pine growth in relation to canopy leaf area and understory competition*. For. Sci. 33: 538-547.



Spacing study

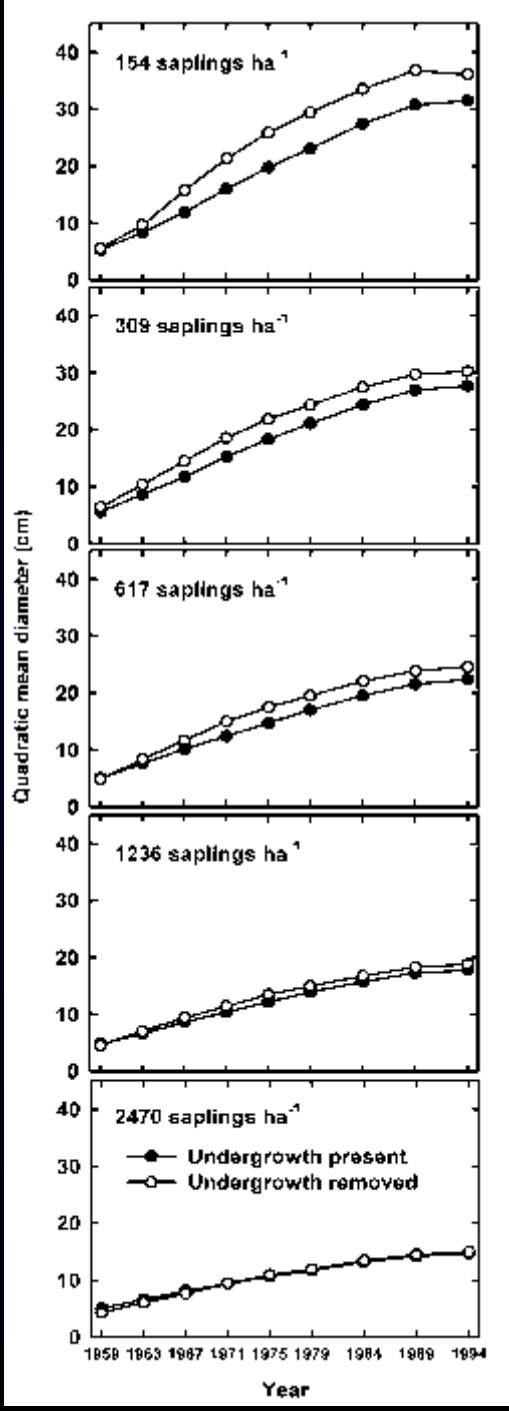
- Careful logging led to survival of regeneration and reduced regeneration costs
- Height and diameter growth of released saplings accelerated after about 4 years
- Increased spacing resulted in increased tree growth
- Removal of competing vegetation resulted in increased soil moisture and increased tree growth

Spacing study continued

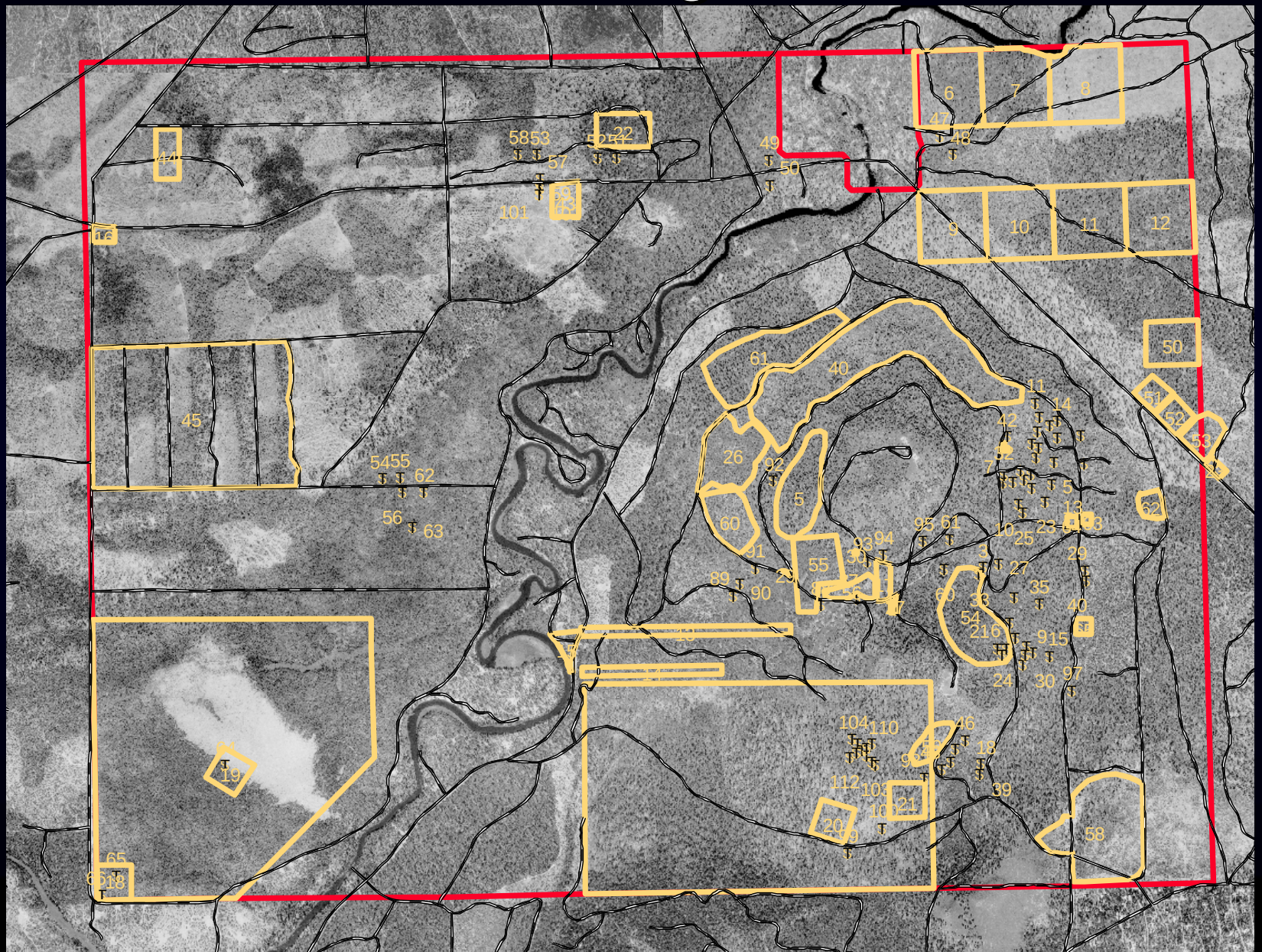
- Busse et al. 1996. *Changes in ponderosa pine site productivity following removal of understory vegetation.* SSSAJ 60: 1614-1621.
- Zhang et al. 2006. *Growth and development of ponderosa pine on sites of contrasting productivities: relative importance of stand density and shrub competition effects.* CJFR 36: 2426-2438.

Spacing study continued

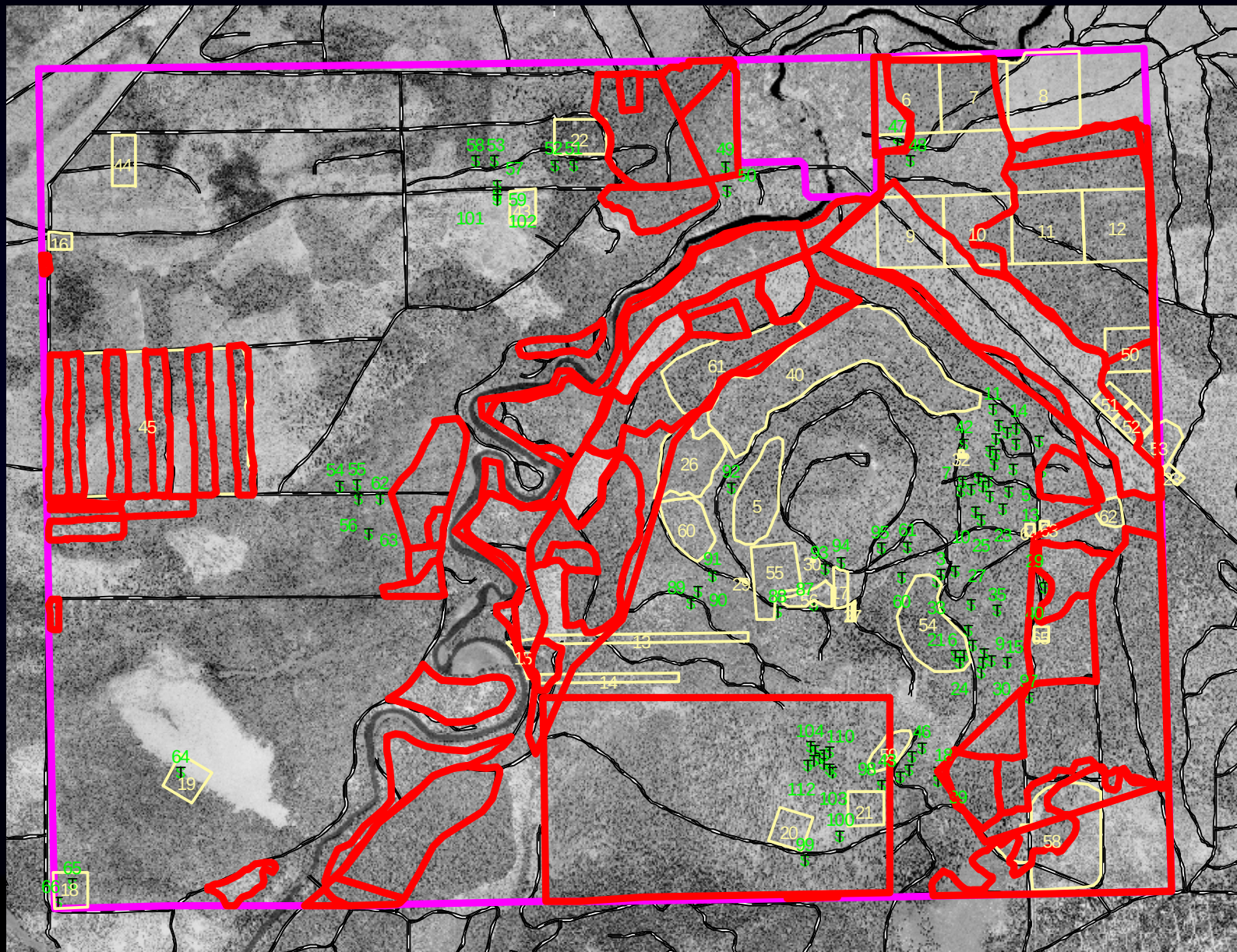
- Soil N and C greater with understory vegetation after 35 years
- Periodic volume growth declined from 1985 to 1994, similar to sites in northern CA because of confounding effects of mortality, drought, inter-tree competition, and insect defoliation.
- Tree-shrub competition shifted to tree-tree competition.



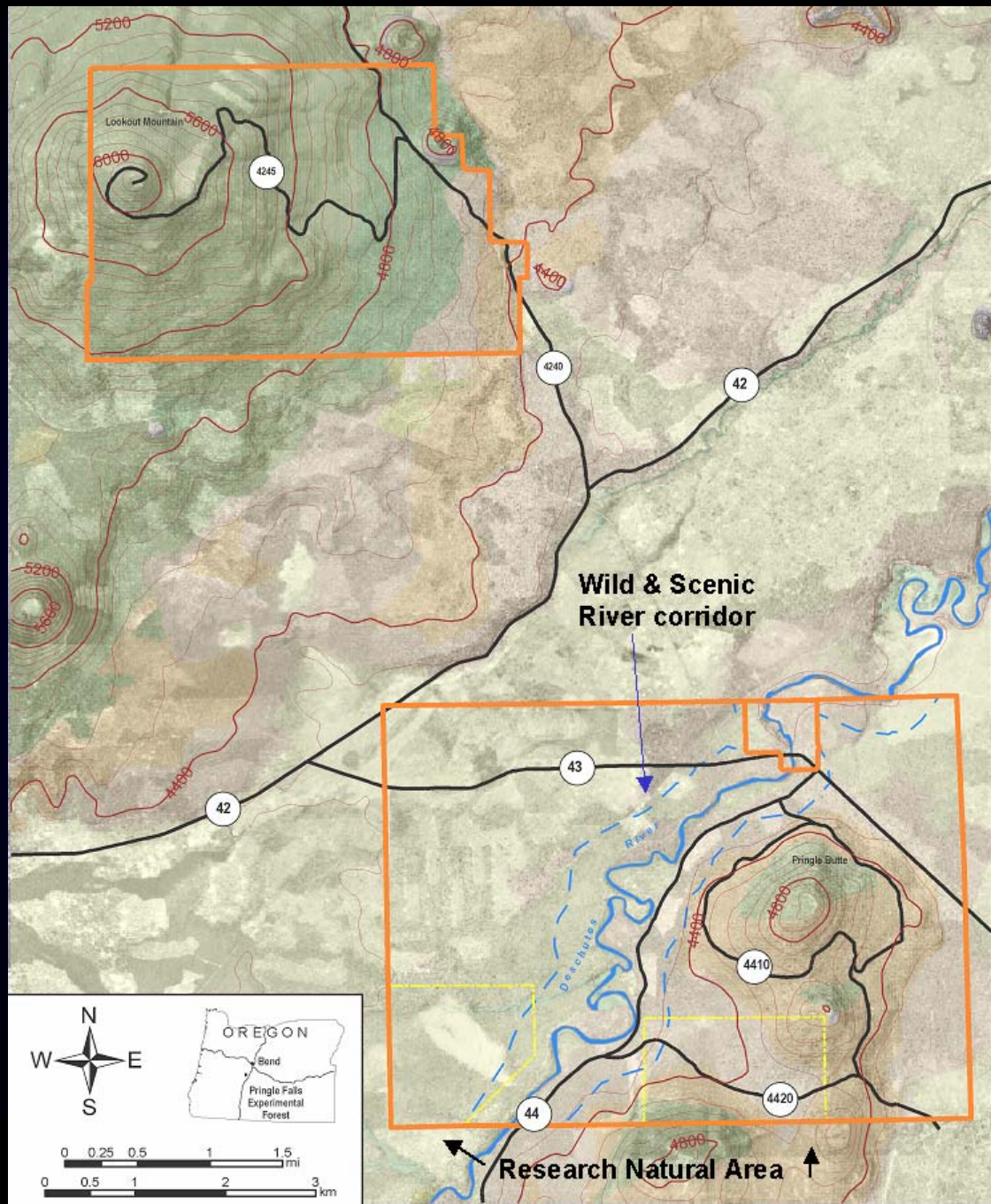
Past research at Pringle Butte, PFEF



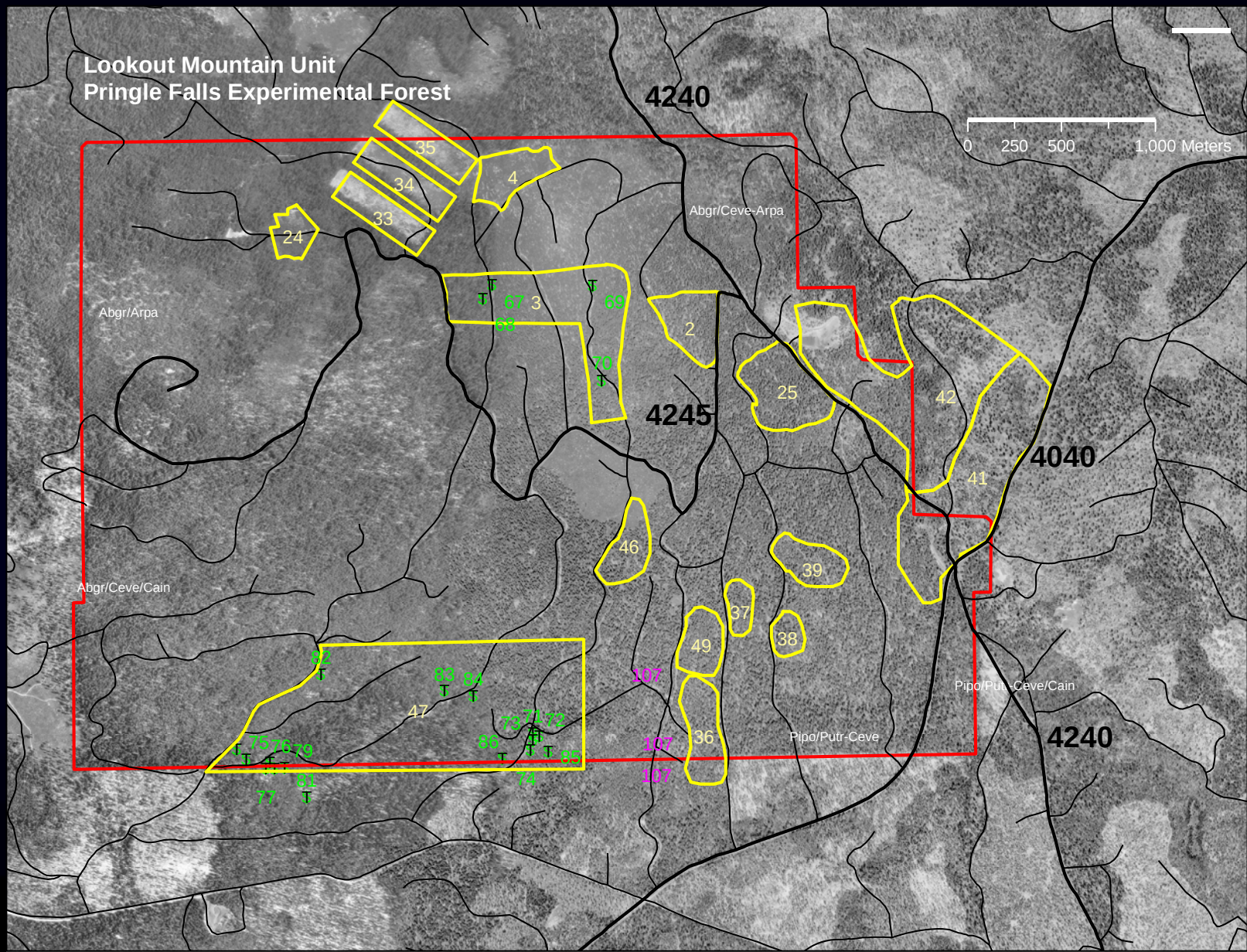
Restoration and fuel reduction



Lookout Mountain unit



Past research at Lookout Mountain



Current stand structure

- Closed-canopy forest, little major disturbance since stand-replacement fires in 1845 and 1890
- Buffer the *Levels-of-Growing-Stock Study* and the *Ponderosa Pine-Grand Fir Spacing Study* to prevent loss from insects and fire
- High and increasing probability that Lookout Mountain will support a landscape-scale western pine beetle/mountain pine beetle outbreak or wildfire

Forest dynamics after thinning and fuel reduction at Lookout Mountain

- Refine management options for restoring resiliency in ponderosa pine ecosystems
- Evaluate the effects of thinning and fuel reduction on long-term susceptibility to fire, insects, wind, climate change, and other forest disturbances

Proposed research questions

1. How does the residual stand structure resulting from a set of fuel reduction treatments interact locally with wind to cause additional structural changes?
2. How does the dominant shrub, giant chinquapin (*Chrysolepis chrysophylla*), respond to a set of fuel reduction treatments?

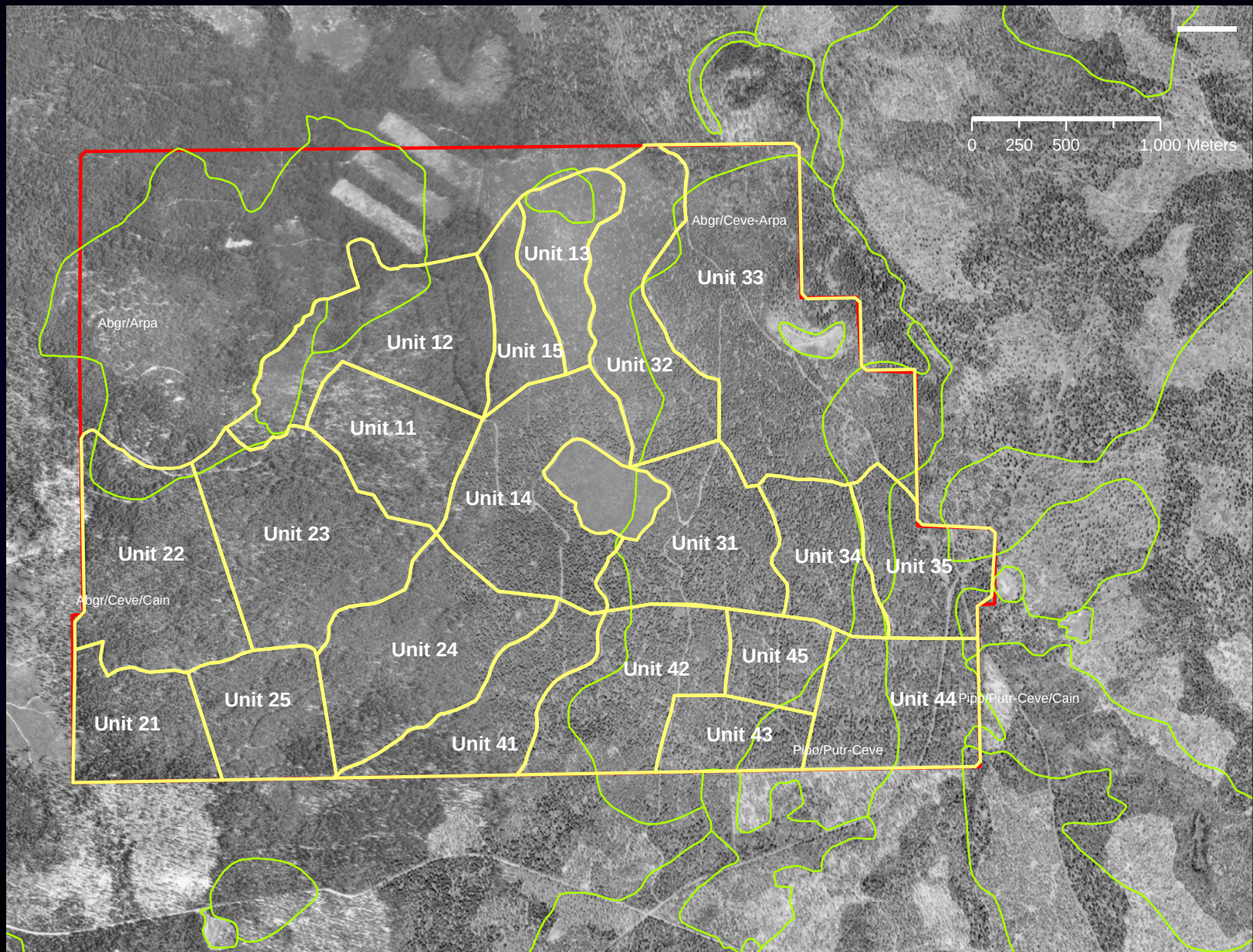
Research questions

3. What set of fuel reduction treatments best accelerate the development of large trees while reintroducing natural disturbance processes that provide greater ecosystem resiliency?
4. What is the influence of climate change interacting with a set of fuel reduction treatments on vegetation dynamics and forest structure?

Research questions

5. Can single cohort stands be readily converted to multi-cohort stands?
6. Do multi-cohort stands share the same risks of multiple, interacting stresses as single-cohort stands?

Lookout Mountain study design



Proposed treatments

1. Thin from below to the Upper Management Zone (UMZ), mow and underburn
2. Thin from below to 75% of UMZ, mow and underburn
3. Thin from below to 50% of the UMZ, mow and underburn
4. Regeneration cut to 75% of the UMZ to begin transition to a multi-cohort stand structure
5. Retain for near-term the current structure

Northern Spotted Owl habitat

- Opportunity to assess changes in forest structure over time
- Shifts in vegetation patterns with changing climate
- Shifts in vegetation structure with treatments

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