Responses to Variable-Density Thinning for Forest Restoration

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Treatments

• **High Density** – 4.9 x 4.9 m
• +/- 1.2 m
• Choose RW, minor conifers
• RW clumps = 1 tree
• Leave some brush, small trees
Treatments

Low Density – 6.1 x 6.1 m
Localized Release

- Encouraging self-thinning

Treatments

Thinned to 3.7 x 3.7 m

Unthinned

15 m Circles
Efficiency of Implementation

**Implementation rate:** hectares treated, per person, per day

- Localized Release = **0.79** ha/pp/day
- High Density (4.9 x 4.9 m) = **0.56** ha/pp/day
- Low Density (6.1 x 6.1 m) = **0.53** ha/pp/day
Experimental Design

• Treatments randomly assigned within blocks (except some controls)

• 3 plots / treatment area

• 5 replicates (blocks) = 60 plots

• Plots established after treatment (Year 0), re-assessed after four years (Year 4)
Research Questions

After VDT treatments,

• How did treatments alter
  – tree species composition?
  – stand density & structural diversity?

• How fast did trees grow?

• How many trees sustained bear damage?

• How deep was slash (fuels) and did it change?

(+ planned work: understory light & vegetation; diversity index)
Species Composition

Low density thinning best promoted redwood and reduced Douglas-fir

![Bar Chart]

- **Localized Release**
  - Redwood: 0.4
  - Douglas-fir: 0.5
  - Other Species: 0.1

- **Low Density (6.1 x 6.1 m)**
  - Redwood: 0.3
  - Douglas-fir: 0.6
  - Other Species: 0.1

- **High Density (4.9 x 4.9 m)**
  - Redwood: 0.3
  - Douglas-fir: 0.6
  - Other Species: 0.1

- **Control**
  - Redwood: 0.3
  - Douglas-fir: 0.6
  - Other Species: 0.1
Stand Density

Low density thinning most reduced tree numbers and basal area
Bear Damage in Redwood & Douglas-fir

- Bears prefer redwoods
- Thinning leads to damage
Redwood Tree Size

**Average size of undamaged redwood** was slightly larger and more variable after localized release and high density thin
Undamaged Redwood Growth Rates

Tree BA increment was greatest, more variable for localized release
Dominant Tree Growth Rates

Diameter growth of largest 100 stems/ha (40 tpa) assumed to represent restored old-growth overstory (i.e., 50 largest RW & 50 largest DF/ha)

Localized release: favors RW while restricting DF
Slash Depth
Slash (Fuel Bed) Depth

• Slash depth highly variable across each treatment
Summary

As a result of VDT treatments,

• slash (fuel bed) deepest: LR > LDT > HDT >> Control
  (but dense Controls are also a fire hazard)

• bear damage among redwoods: LR ≈ LDT > HDT >> Control
  (good or bad for restoration objectives?)

• bear damage among Douglas-fir: LDT > LR ≈ HDT >> Control
  (good or bad for restoration objectives?)
Summary

As a result of VDT treatments,

- composition shift towards redwood: 
  \( \text{LDT} > \text{LR} > \text{HDT} \)

- structural diversity:
  \( \text{LR} > \text{LDT} \approx \text{HDT} > \text{Control} \)

- redwood dbh growth:
  \( \text{LR} > \text{LDT} \approx \text{HDT} > \text{Control} \)

- efficiency
  \( \text{LR} > \text{HDT} > \text{LDT} \)

Creating complexity isn’t always expensive
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