Managing for Forest Resilience Part II

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90

Outline

Second Night

- Monday night review
- Some specific approaches for managing for forest resilience
- Climate change adaptation strategies
- Considerations for wildfire risk reduction
- Caveats about thinning / single tree selection
- Examples

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Recap of Part I

- Heterogeneity / structural complexity/diversity: patches, clumps, openings, reduced stand densities; creates uniqueness based on site conditions
- The idea is to reference these conditions of historic forests to give us more options for managing our forests for greater resiliency to disturbance and climate change, while providing ecologic and economic benefits
- Adaptive management: forest management interventions should be looked at as experiments—plan, implement, monitor, repeat

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Recap of Part I

- Chronic managed disturbance vs catastrophic disturbance
- Importance of climate change and increasing moisture stress on trees, increasing mortality
- Forest architecture: art informed by science
- Forest continuity vs termination
- Managed wildness, the "messy" forest
- Paying attention to your land, learning about it, the silvics of the tree species you have, the wildlife; asking why?

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Elements of Forest Structure / heterogeneity:

- Species (seral or shade intolerant)
- Density (reduce, but not uniformly)
- Size/age (mixture, patches)
- Openings
- How to above factors are arranged in space (complex/strategic arrangement not uniform)

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Three Management Templates

- Larsen and Churchill
- Variable Density Thinning
- Free Selection

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Larsen and Churchill

- Emphasis on fire frequent and mixed conifer forests, including species such as D. fir, p. pine, and w. larch
- Survey of the scientific literature that reports on the structure of the historic conditions of these forests
- Are critical of fuel reduction and restoration treatments that employ uniform stand-level tree spacing
- Admit to problems with consistency in how these studies measured and interpreted structural elements

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Larsen and Churchill

Within-stand spatial pattern of fire-frequent forests:

- A mosaic of three elements: openings, widely-spaced single trees, and tree clumps manifest mostly at scales of less than 1 acre but also up to 10 acres
- Spatial aggregation (clumping) is the dominant spatial pattern
- Relative abundance and area occupied by these three elements within stands varies widely between and within forest types

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Types of Clumps in Fire-Frequent Forests

1) Dense patches of seedlings and saplings, with mean patch size of less than .4 acres
2) Clumps formed of overstory trees, with clump sizes ranging from 2 to 44 trees per clump and areas of 323 sq feet to 1 acre per clump, and 4 to 11 clumps/ac
3) Clumps of trees with a variety of tree sizes and ages

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"In [the] ponderosa pine – mixed conifer forests of the eastern Washington Cascades between 30% and 85% of trees occurred in clumps at an inter-tree distance of 6 m [aprox 20 ft] . . ." (Larsen and Churchill 2012)

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Other Within-Stand Structural Elements

- Widely spaced single trees; tend to be the largest trees
- Openings; most poorly quantified of the structural elements
- Tree density and degree of clumping tended to increase with available moisture

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There are fewer studies of tree spatial pattern in forests with moderate or mixed fire regimes, but the few that have been conducted are "consistent with a spatial structure composed of a mosaic of openings, single trees, and tree clumps with adjacent or interlocking crowns." (Larsen and Churchill 2012)

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Moderate severity fire forests:

- Fires generally create larger areas suitable for regeneration, thus regeneration is less strongly aggregated, and aggregated at larger scales (as large as 10 acres)
- Some overstory trees survive fire creating the persistence of tree clumps
- Typically have a wider range of within-stand spatial patterns and structural development

(Larsen and Churchill 2012)

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Summary for Fire-Frequent Forests from Larsen and Churchill

- Create or enhance a mosaic of openings, single trees and clumps of overstory trees either adjacent or interlocking crowns
- Retain live, old trees
- Leave larger clumps (more trees per clump) in second-growth stands
- Retain some clumps of seedlings and saplings where they do not function as ladder fuels
- When shade intolerant species have been eliminated from the site, consider planting some seedlings in a clumped pattern

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Variable Density Thinning

"goal . . . is to create structural and compositional heterogeneity throughout the stand, rather than to concentrate growth on selected trees and create spatially uniform stands, as in traditional forestry approach." (p. 30, Franklin et al. 2007)

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Variable Density Thinning

" . . . Provide for unthinned areas (sometimes referred to as "skips") and heavily thinned patches ("gaps") along with intermediate levels of thinning and residual density through the bulk of the stand . . . The result is much greater spatial variability in stand densities and, consequently, greater structural complexity and heterogeneity of structure." (p. 30 Franklin et al 2007)

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Principles

- Horizontal, vertical, and temporal complexity
- Incorporating biological legacies into harvest prescriptions—e.g. large trees
- Small gap creation
- Gaps, skips, thinned—vary degrees of thinning
- Thinning can be used as an intermediate treatment to a final regeneration harvest

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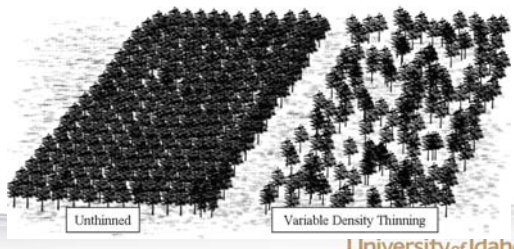

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Considerations for Gaps, Skips, and Various levels of Thinning

- Gaps can be located where there are forest health issues, mature commercial trees, and/or a desire to regenerate seral species such as pine and larch
- Skips can be located in areas that are difficult to access or regenerate, riparian areas, or old growth
- Degrees of thinning intensity can be based on aspect, species, forest health issues, site potential, and other factors

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Free Selection

(from Graham and Jain 2005)

- Multi-entry, uneven age system, where remaining structure and composition of forest is primary goal
- Use of a "vision" of desired condition relying on an integrated ecological view of how forests function rather than using precise stand structural guidelines or traditional stand metrics
- "A silvicultural system suited for maintaining forests with high cover and heterogeneity both in composition and structure"

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Free Selection

- "Combines elements of both even-aged and uneven-aged silviculture in and integrated manner to produce diverse stand compositions and structures."
- This hybrid system utilizes multiple tending and regenerating entries at various intervals to develop and maintained desired forest conditions."
- ". . . The full range of silvicultural methods from regeneration to thinning can occur at each entry"

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Free Selection

- Applicable to both moist and dry forests of western United States
- Very appropriate when the condition of the forest after treatment is most important such as maintaining conditions for wildlife, or maintaining a sense of "wildness" in the forest
- Can use to regenerate both shade-tolerant and shade-intolerant tree species

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Free Selection: Goals

- Maintenance of complex and interacting forest elements such as:
  - Presence of large/tall trees
  - Vegetation patchiness
  - Multiple canopies (vertical diversity)
  - Old trees and decadence
  - Down logs
  - Interspersion of a suite of vegetative structural stages

(from Graham and Jain 2005)

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Treatment Examples

- Moist forest near Priest River Idaho:
  - 120 y.o. high canopy structure, irregular
  - 16 tree groups/ac, ranging in size from 100 to 5,000 sq ft
  - Clumps contained mixture of species, tree sizes, snags, and decadence
  - Density within groups as high as 647 trees/ac, but overall mean density was less than 121 trees/ac

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Treatment Examples

- Dry forest near Boise Idaho:
  - Remaining 150-450 y.o. high canopy was irregularly distributed
  - Up to 7 tree groups/ac, ranging in size from 100 to 2400 sq ft
  - Tree density in some groups as high as 404 trees/ac, but overall density was less than 40 trees/ac

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Questions?

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Climate Change

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"Maintain/enhance species and structural diversity at multiple scales; protect forests from severe and uncharacteristic disturbances; and reduce impacts of existing stressors, such as insects and disease and invasive species:"

- *Developing desired conditions that are based on estimated natural range of variation*
- *Promoting retention and development of large/very large trees of species resilient and/or resistant to disturbance*
- *Species [tree] best adapted to potential changes in climate and disturbances*
- *Promoting diversity of forest structures at landscape level*
- *Protecting old-growth forest*
- *Promoting diversity of forest densities and reducing densities where appropriate . . . And maintaining the reduced densities over time.*

From: Appendix G: Summary of Climate Change Adaptation Strategies, Nez Perce-Clearwater National Forests Revised Forest Plan DEIS, P. G-7

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DISTURBANCE

- Disturbance is a good thing, but the "Goldilocks Principle" applies: the right kind, frequency, and severity of disturbance; however, severity and scale of disturbance expected in the future will be disruptive
- "Droughts of increasing frequency and magnitude are expected in the future, promoting an increase in wildfires, insect outbreaks, and nonnative species. These periodic disturbances, will rapidly alter productivity and structure of vegetation, potentially altering the distribution and abundance of dominant plant species and animal habitat." (Halofsky et al. 2018, p. i)
- Anthropogenic climate change accounted for over half of observed increases in fuel aridity from 1979-2015 across the western US forests, and an additional 4.2 million ha of forest fire area during 1984-2015, nearly doubling the forest fire area (Abatzoglou and Williams, 2016)

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MODELED EFFECTS OF FUTURE FOREST WILDFIRE CHARACTERISTICS

- Longer fire seasons
- Increased number of days with high fire danger
- Increased frequency of ignitions
- More frequent episodes of extreme fire behavior
- Increased frequency of large fires
- Increased area burned

[from Bollenbacher et al. 2014]

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GENERAL EFFECTS OF CLIMATE CHANGE ON VEGETATION

- Potentially narrowing the window for tree seedling establishment at lower elevations; at lower elevations "wave years" could become less frequent or almost non-existent eliminating regeneration
- Direct mortality to trees from increasing moisture stress
- Shift in the range of tree species, e.g. migration of p. pine and larch into traditional lodgepole, subalpine fir, and Engelmann spruce habitats
- Cone crops could be diminished, with fewer viable seed, at lower elevations
- "Earliest changes will be at ecotones between lifeforms (e.g. upper and lower treelines)" (Halofsky et al. 2018, p. ii)
- Expect shade-intolerant tree species to cope more effectively with climate than shade-tolerant species
- Expect persistent shifts in vegetation compositions and structures

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MANAGEMENT RESPONSES TO CLIMATE CHANGE: AN OVERVIEW

Forests:

- In general, recreate more historic (preEuroAmerican settlement) forest species composition and structure, increasing the diversity of spatial pattern and structure – ecological forest management approaches; restore age and size class diversity arranged in patches and patterns at stand and landscape scales
- reducing stand densities and shift species composition to favor more drought, fire, and disease tolerant species (shade-intolerant species such as p. pine, larch, w.w. pine); fuels treatment to reduce fuel continuity
- Promote seral species for site (e.g. p. pine on dry D. fir habitat type)

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GENERAL RECOMMENDATIONS FOR DRY FORESTS

- Reduce stand density and create greater structural heterogeneity with openings, gaps, clumps, age class mosaics
- Plant p. pine on sites where D. fir or g. fir has replaced p. pine
- Reduce ladder fuel and D. fir ingrowth
- Retain old growth or potential old growth ponderosa pine
- Push dry site D. fir habitat types to p. pine; on moister sites shift D. fir to w.w. pine and larch where they occurred historically
- Must have recurring disturbance to maintain openings, patches, heterogeneity

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GENERAL RECOMMENDATIONS FOR MIXED FORESTS

- Select against cedar, hemlock, grand fir except on wettest sites
- Plant/promote/retain p. pine, w. pine (rust resistant), larch
- D. fir intermediate – retain where D. fir is seral and on moister sites
- Create openings and gaps, reduce stand densities, create heterogeneity
- Larch may contract in range to more northerly aspects and soils that have minimum potential for moisture deficit; reduce stocking levels from current
- Must have recurring disturbance to maintain openings, patches, heterogeneity

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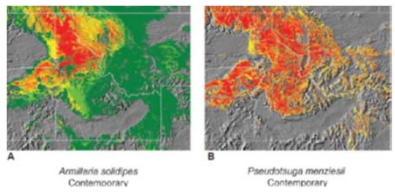

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Considerations for Wildfire Risk Reduction

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Wildfire Risk: Things to Consider

- Surface and ladder fuel reduction is most important treatment
- Thinning can increase surface fuel drying, increase surface fuels, and increase wind speeds in stand (thus surface fire risk), but if done correctly (remove treatment slash) is generally considered to reduce crown fire potential.

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Wildfire Risk: Things to Consider

- Can use grazing to reduce and maintain low surface fuel loadings
- Larch, white pine, and ponderosa pine most resistant to crown fire (lower crown bulk density)

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Wildfire Risk: Things to Consider

- No guarantees, given extreme fire weather of high winds, low humidity, and dry fuels, fuel treatments can still be overcome by wildfire—but you can improve your odds through appropriate management
- Fuel breaks at strategic locations such as ridge tops, valley bottoms, along roads, and around homes and communities can provide additional risk reduction

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THINNING

AS PART OF AN ECOLOGICAL FOREST MANAGEMENT APPROACH

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BENEFITS OF THINNING

Reducing stocking rates reduces the competition between trees (sunlight, water, nutrients are limited)

Benefits of reduced competition:

- Increases growth rate of remaining trees
- Increased tree vigor and resistance to bark beetles and mortality

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OTHER REASONS TO THIN:

Reduces risk of crown fire
Increase sunlight to understory for forage production for wildlife and livestock
Change species composition
Improved genetics of stand and future natural regeneration
Capture mortality
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Aesthetics
You don't want to clear-cut

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RISKS OF THINNING:

Can increase root disease prevalence on susceptible species left on site
Increase in brush and noxious weeds
Wind-throw of remaining trees
Damage to leave trees from logging
Increases logging costs
Not suited for conversion to shade intolerant species
May not reduce moisture stress on trees

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SELECTING WHICH TREES TO CUT AND WHICH TO LEAVE WHEN THINNING

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CONSIDERATIONS:

Depends on management objectives

In general leave the tallest, healthiest trees—tree height is best indicator of superior tree genetics and best species for site (analogous to livestock breeding, breed the best, cull the worst) in an even aged stand.

In ecological forest management it is recommended to retain, large, older trees especially of seral, shade intolerant, species even though from a traditional forestry perspective these trees are considered slow growing and would normally be harvested to "release" trees capable of more growth

Retain clumps of species you want to maintain on site

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Smaller trees in a stand are not always younger. In an even-aged stand many smaller trees are suppressed, and may not release upon removal of the dominant and codominant trees. Look for signs of tree youth (e.g. vigorous growth) to discern regeneration from suppressed trees.

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OTHER SELECTION CONSIDERATIONS:

Percent crown (at least 30%)
Crown shape—indication of how fast tree is growing
Forked tops—can be genetic, weakens tree, broken tops invite infection
Insect and disease active, mistletoe
Species

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Note: "diameter limit cutting" – removing all trees over a given diameter – is one of the worst things you can do when thinning an even-aged stand, degrades to forest over time by taking the best trees and leaving the worst trees on the site.

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139

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140


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141


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142


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144

LOGGING CONSIDERATIONS WITH THINNING

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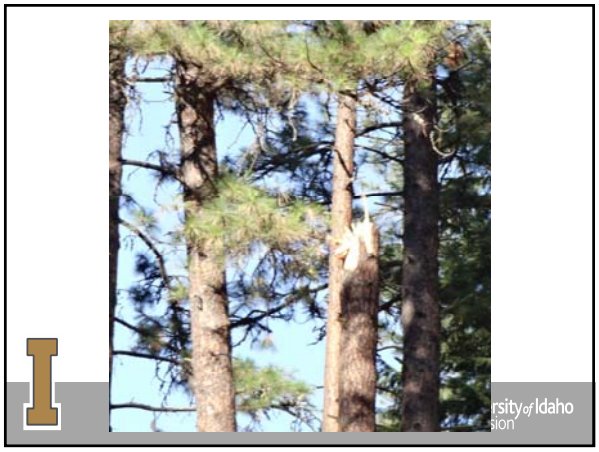
145

146

147



148

LOGGER'S PERSPECTIVE ON THINNING

Thinning is a hassle

Can't always easily cut marked tree and avoid damage to leave trees

Cutting the tallest, best trees is logger's preference as they pay more than the cull trees for the same amount of work

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EXAMPLE OF APPLICATION OF VDT AND FREE SELECTION

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Figure 2—Roost holes and Indian paint fungus conks in dead grand fir.

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159


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160


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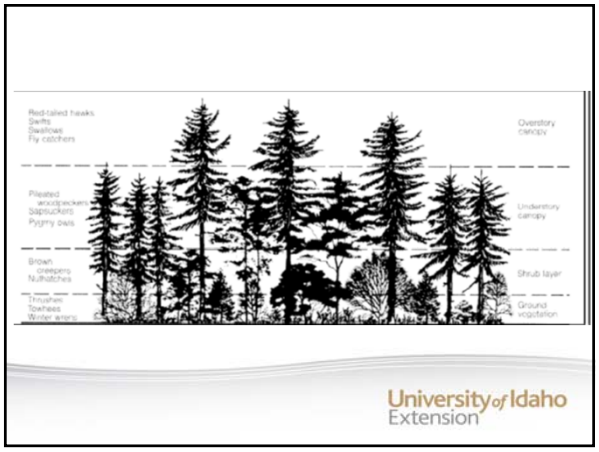
161

162


Red-tailed hawks
Swifts
Swallows
Fly catchers
Overstory canopy
Pileated woodpecker
Sapsuckers
Pygmy owls
Understory canopy
Brown creepers
Nuthatches
Shrub layer
Thrushes
Towhees
Ground vegetation
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163


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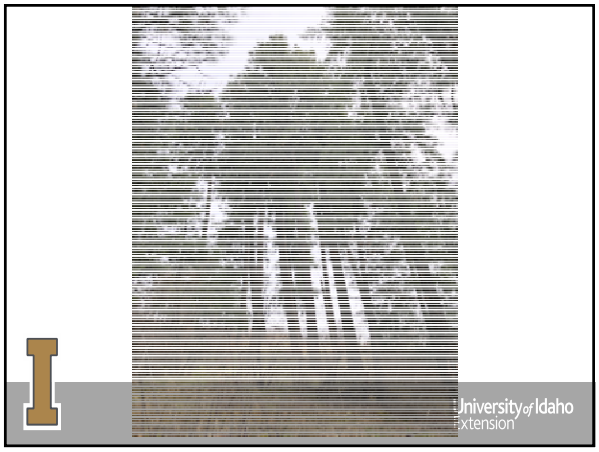
164

165

166

167

168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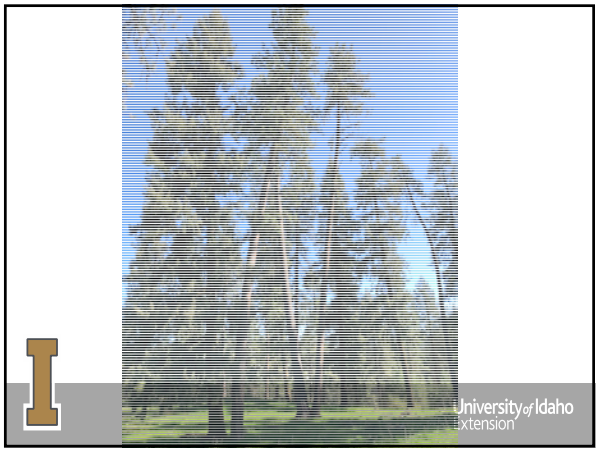
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170

171

172

CONCLUDING THOUGHTS

- Get a feel for your land and forest to develop a vision for your property and what you want to achieve
- Recognize that all resource management is a balancing act, with trade offs—e.g. wildfire risk, economics, wildlife habitat, infrastructure, safety, forest health, sense of place/wildness
- Humans are natural too, and our landscape directed change is as natural as any other, but we can learn from historic forest structure and the science of ecology how to better achieve our goals for our forests, including their sustainability into the future
- Need for further research and application studies, especially using forests in our area

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173

QUESTIONS?

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174

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175

Please remember to return your evaluation that Meladi will send you tomorrow.

Thank you for attending!

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176