Managing for Forest Resilience Part I

March 2020

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"One understanding is worth one thousand techniques."

Bill Dorrance, by Hilary Zaranek Anderson

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All natural resource management is site specific, involves tradeoffs among competing values, and involves systems that are highly unpredictable, so the approach is to provide principles of how ecosystems work, so that you can apply them in your own specific context, according to your own particular set of goals and priorities for your land.

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There is no one particular condition of a piece of land or forest that is scientifically “correct.” What is appropriate is based on value judgements of the particular individuals owning or managing the land, not science. Management approaches only have scientific legitimacy when they are directed at achieving a particular set of goals, on a particular piece of land.

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Forest Resilience

- Resilience can be thought of as achieving forest characteristics that simultaneously lower severe wildfire risk, lower insect and disease mortality, increase wildlife and biodiversity, allow adaptation to climate change
- By getting the forest “right” the impacts of disturbance on ecosystem benefits are reduced
- Integrated, or holistic, forest management

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Basic Paradigm

Referencing historic forest structure, processes, tree species and age class distributions to create contemporary forests that are more resilient to disturbance, climate change, and more ecologically diverse, while at the same time providing economic benefits to owners

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The idea is not because these historic forests were "natural" (humans and human created forests are natural too), but because there is increasing scientific evidence that these historic forests teach valuable lessons for how we can change our forests for the future to better meet the full suite of goals that human society has for its forests.

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Traditional Paradigm

Creating management and growth efficiencies by simplifying forest structure, maximizing growth on individual trees, elimination of disturbance, short rotations and the elimination of older trees and older forest structure with little concern with biodiversity, wildlife, or other ecological values

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Outline

First Night

- A new forest management paradigm?
- What did historic, pre-management, forests in our area look like?
- Why are historic forest structures and processes considered a better model for management today and going forward?
- General principles for creating resilient forests

Second Night

- Some specific approaches for managing for forest resilience
- Climate change
- Caveats about thinning / single tree selection
- Examples

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Why a New Forest Management Paradigm?

Changed public values
Science
Threats

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Increased inflluence of the science of ecology and conservation biology along with a change in public values about forests

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New Ecological Resource Management Paradigm

Management of our land and wildlife has been, and often still is, single-use oriented. However, we now have reached the stage in development of knowledge where the single-use concept is no longer valid or viable in land management. (From: Maser and Thomas, 1977)

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New Forest Management Paradigm

- Managing for multiple ecological objectives, not just the maximization of a single resource
- Change in approaches based on the latest ecological research, not tied to "traditional" methods, closer to the science
- Using natural disturbance patterns and processes as a reference ("natural range of variability"), with an emphasis on biodiversity conservation, fish & wildlife, and forest resilience
- Attention to scale
- Attention to social, ecological, and economic values

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Traditional Resource Management Paradigm

- Maximize a single resource benefit (e.g. timber, deer, fish) over time in a sustainable manner
- In forestry the focus was on simplifying forest structure to create management efficiencies and create forests that were easier to measure to predict growth & yield for wood fiber production
- Forestry focus on regeneration, and eliminating older, slower growing, trees to maximize wood production
- Forest protection (e.g. no fire)
- Scale independent—stand level management

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Problems with the Traditional Paradigm

- Fire/disturbance exclusion and the increasing density, extent, and species changes in forests
- Liquidating old growth and old trees to achieve a "normal forest"
- Simplification of forest structure
- Ignoring damage to other resources such as wildlife and streams
- Ignoring the public and changing social values

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Increasing evidence that historic forest structures, species and age-class distributions, and disturbance regimes created forests more resilient to disturbance and climate change and enhanced biodiversity

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Current Forest Issues and Threats

- Increased extent and density of western forests
- Change in tree species composition from more fire, disease, and drought tolerant species to those more susceptible
- Simplified forest structures, making forests more susceptible to disturbance and reduced biodiversity/wildlife potential
- Dramatic increase in the size and severity of wildfire
- Increased mortality from insects and disease
- Change: climate, social, science, forests

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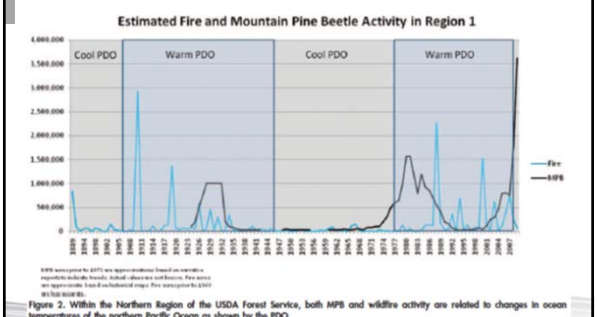

Figure 2. Within the Northern Region of the USDA Forest Service, both MPB and wildfire activity are related to changes in ocean temperatures of the northern Pacific Ocean as shown by the PDO.

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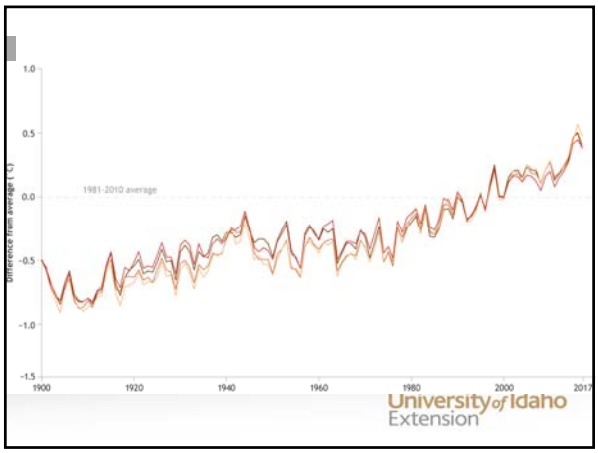
1.0
0.5
0.0
-0.5
-1.0
-1.5
1981-2010 average
1900
1920
1940
1960
1980
2000
2017
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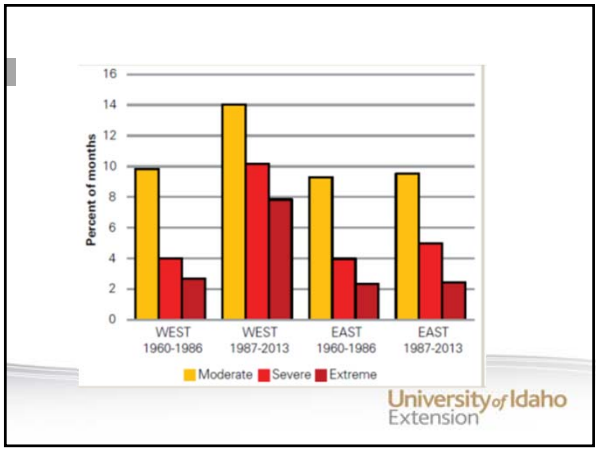
Percent of months
16
14
12
10
8
6
4
2
0
WEST 1960-1986
WEST 1987-2013
EAST 1960-1986
EAST 1987-2013
Moderate
Severe
Extreme
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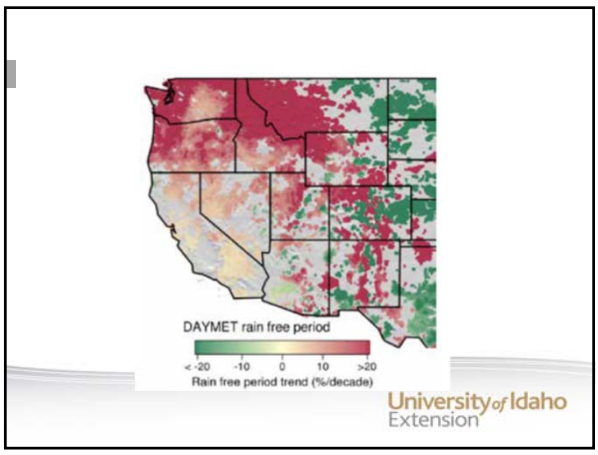
DAYMET rain free period
< -20
-10
0
10
>20
Rain free period trend (%/decade)
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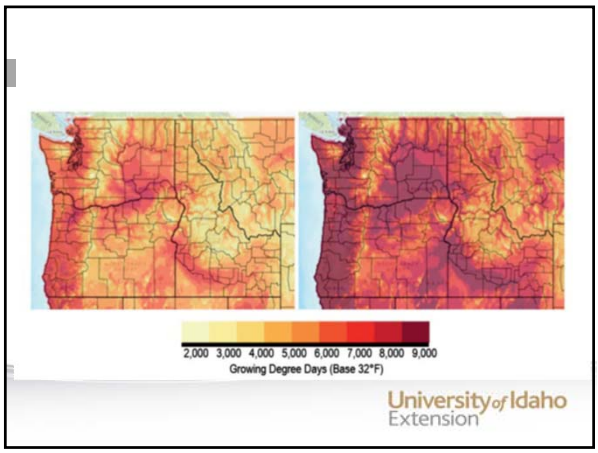
2,000 3,000 4,000 5,000 6,000 7,000 8,000 9,000
Growing Degree Days (Base 32°F)
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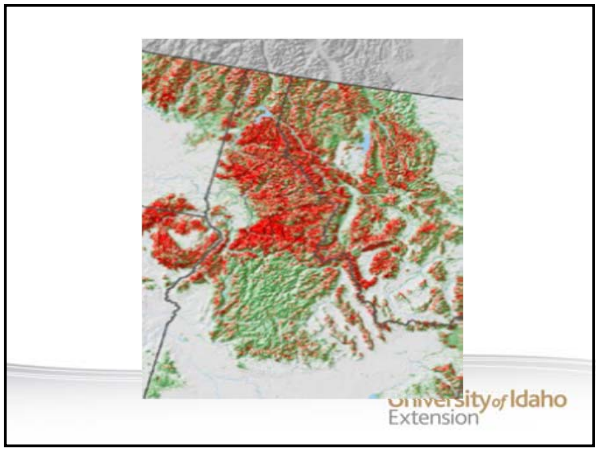
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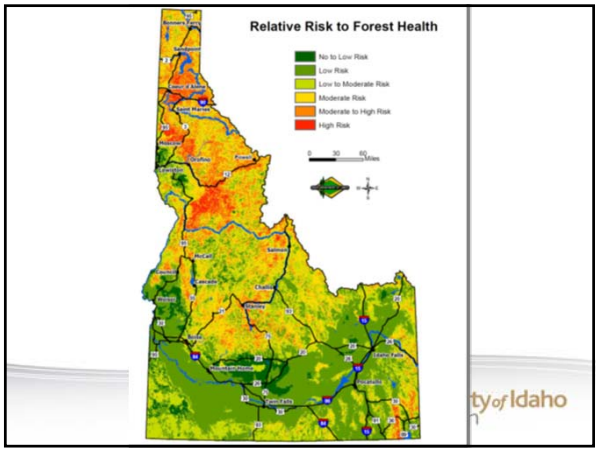
Relative Risk to Forest Health
No to Low Risk
Low Risk
Low to Moderate Risk
Moderate Risk
Moderate to High Risk
High Risk

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wildlandfire.com.
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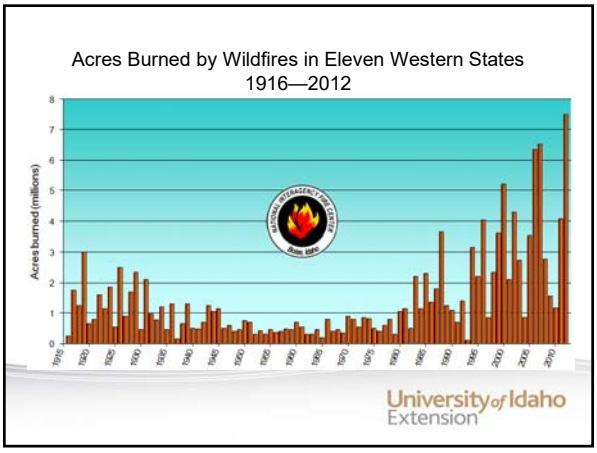
Acres Burned by Wildfires in Eleven Western States
1916—2012
Acres burned (millions)
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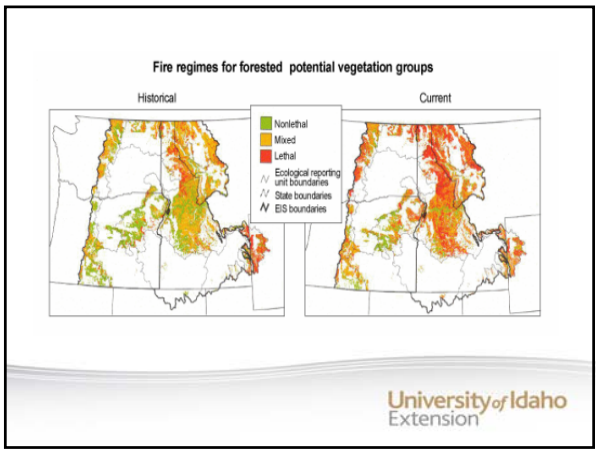
Fire regimes for forested potential vegetation groups
Historical
Current
Nonlethal
Mixed
Lethal
Ecological reporting unit boundaries
State boundaries
EIS boundaries
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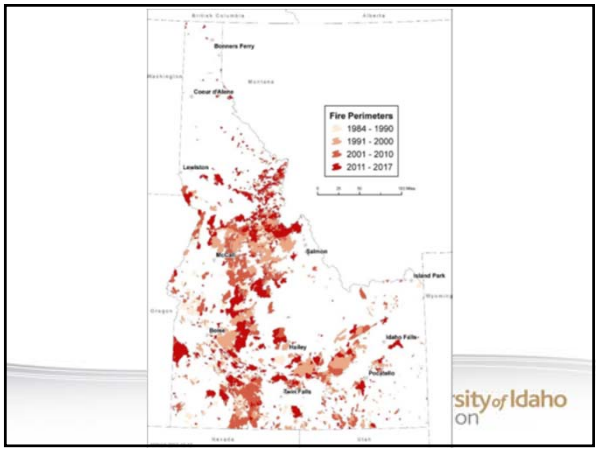
Fire Perimeters
1984 - 1990
1991 - 2000
2001 - 2010
2011 - 2017
Bonners Ferry
Coeur d'Alene
Lewiston
Salmon
Island Park
Idaho Falls
Twin Falls
Nevada
Utah

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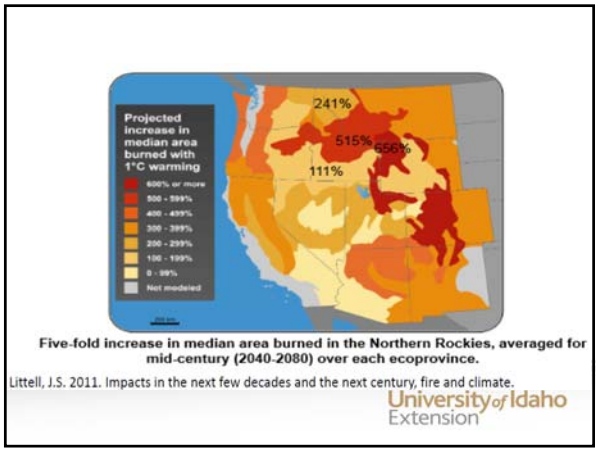
Projected increase in median area burned with 1°C warming
600% or more
500 - 599%
400 - 499%
300 - 399%
200 - 299%
100 - 199%
0 - 99%
Not modeled
241%
515%
656%
111%
Five-fold increase in median area burned in the Northern Rockies, averaged for mid-century (2040-2080) over each ecoprovince.
Littell, J.S. 2011. Impacts in the next few decades and the next century, fire and climate.
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1909

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31

1948

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32

1989

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"... landscapes have become dominated by dense, largely continuous forest that has profoundly increased forest vulnerability to wildfire and insect outbreaks compared to historical conditions. . . . In many cases, these disturbance agents now have access to largely unbroken closed canopy forests extending from ridge-top to ridge top." (Franklin et al. 2008)

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"When wildfires occur, they now encounter few or no natural fuel breaks; effectively, large wildfires and insect outbreaks can move across landscapes in ways that were uncommon in the past . . . " (Franklin et al. 2008)

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In summary, we have too many trees, and trees of the wrong species, in the wrong places, and in the wrong spatial arrangement – these conditions, paradoxically, threaten the sustainability of our forests and the values we expect from them.

Not every open space should have a tree on it!

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Questions?

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What Did Historic Forests in Our Area Look Like?

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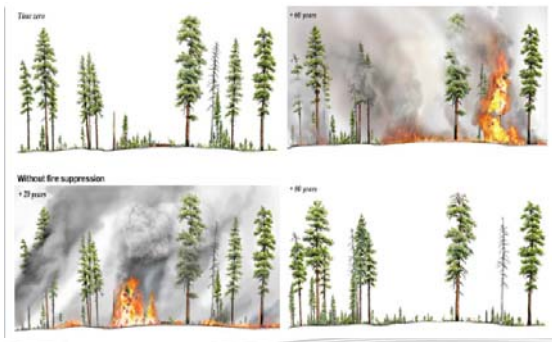

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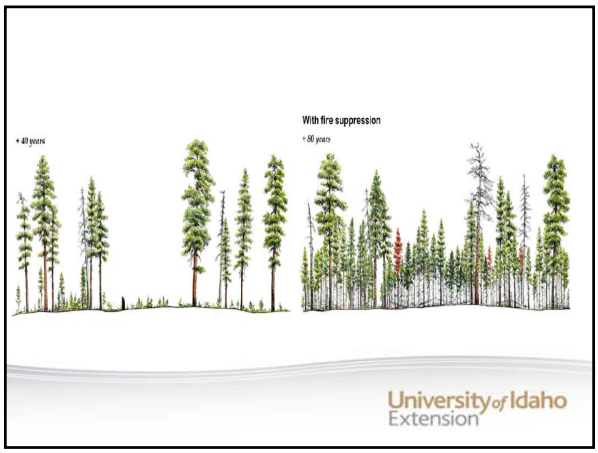
With fire suppression
+ 40 years
+ 90 years
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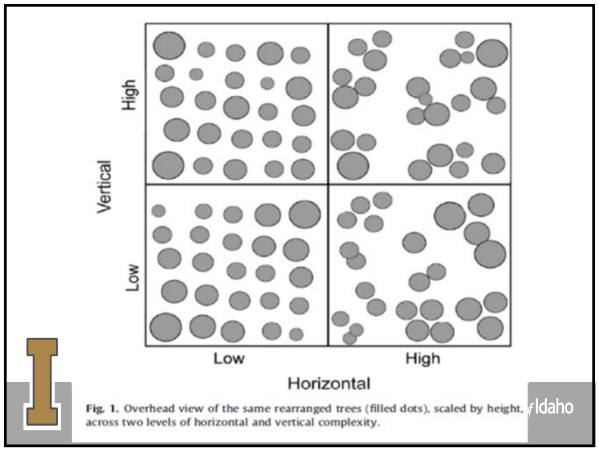
High
Vertical
Low
Low
High
Horizontal
Fig. 1. Overhead view of the same rearranged trees (filled dots), scaled by height, across two levels of horizontal and vertical complexity.

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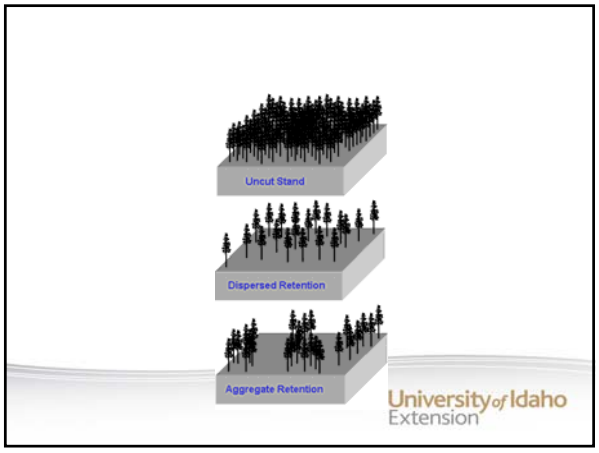
Uncut Stand
Dispersed Retention
Aggregate Retention
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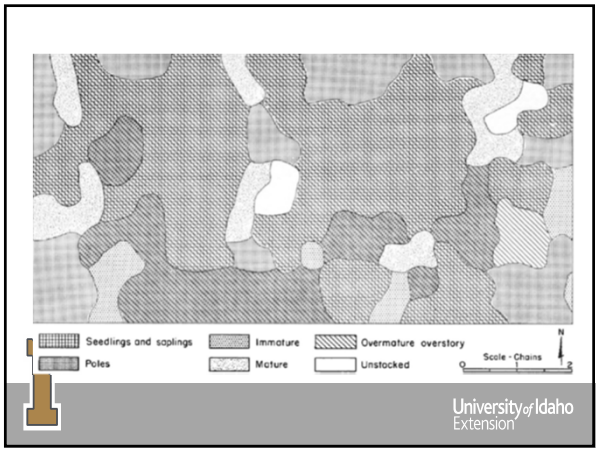
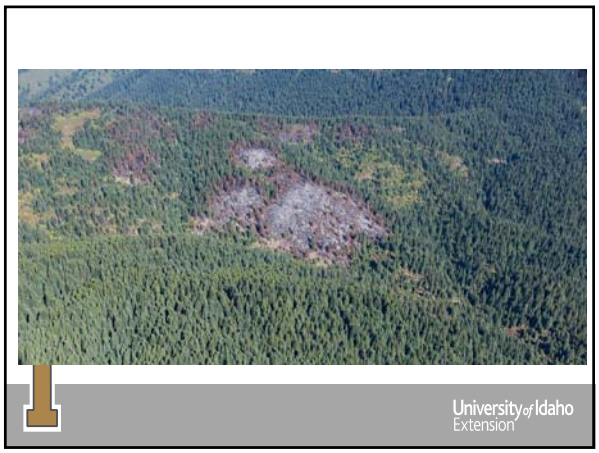

Seedlings and saplings
Poles
Immature
Mature
Overmature overstory
Unstocked
Scale - Chains
N

60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1934
2010
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Species Composition: Existing Vs. Reference

Species	Reference	Existing
White Pine	34%	3%
Larch/Douglas-fir	22%	16%
Ponderosa Pine	21%	0%
Grand Fir/Spruce	2%	57%
Lodgepole Pine	9%	1%
Western Redcedar	-	13%

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"*Historically, forests were spatially heterogeneous at multiple scales as a result of interactions among succession, disturbance, and other processes. Planning and management are needed at fine to broad scales to restore the key characteristics of resilience."* (From Hessburg et al. 2015)

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"*There is increasing evidence that spatial heterogeneity at multiple scales, in addition to forest structure and composition, is a critical component of ecosystem resilience.*" (Churchill 2013)

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"If . . . conditions today were those of pre-management era forests, we would have minimal concern for their capacity to adjust to the climate changes we are experiencing today." (Hessburg et al. 2015)

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What Are the Benefits of Referencing Historic Forests in a More Ecologically Oriented Forest Management Approach?

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What are some benefits to ecologically directed management?

- Biodiversity conservation
- Fish and wildlife
- Forest resilience to disturbance and climate change
- Restoring more historic fire regimes and reducing the incidence of severe wildfires
- Can produce large quantities of timber products

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BENEFITS OF ECOLOGICAL FOREST MANAGEMENT

"Irregular tree patterns, large openings, and resulting variation in surface fuels inhibit the spread of crown fire and perpetuate variable post-fire patterns . . . analogous to strategic placement of fuel treatments at larger spatial scales . . ."

"Heterogeneous stand structures impede the buildup of epidemic insect outbreaks by disrupting pheromone plumes and breaking up continuity of susceptible species, as well as age and size classes . . ."

". . . Openings create barriers to the spread of dwarf mistletoes and fungal pathogens . . ."

(Churchill at al 2013)

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BENEFITS OF ECOLOGICAL FOREST MANAGEMENT

". . . openings and frequent disturbances facilitate periodic tree regeneration in dry forests . . ." contributing to genetic diversity of trees

"Snow retention is highest where canopy openings are large enough [to] reduce canopy interception, but small enough to be shaded and protected from wind" thus contributing to water availability to the soil.

". . . Contrasting light, moisture, and soil nutrient environments in heterogeneous stands increase understory plant abundance and diversity."

(Churchill at al 2013)

Symbiotic mycorrhizal associations within tree clumps (Franklin et al. 2019)

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GENERAL APPROACH FOR REFERENCING HISTORIC FOREST STRUCTURE AND PROCESSES IN MANAGEMENT TO CREATE MORE RESILIENT FORESTS

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How You Conceptualize a Forest: A forest is not just a collection of trees

- Living system or crop
- Making a house a home
- Forest architecture and architect
- Mystery vs. a problem to be solved
- Intuition and naturalistic decision-making vs. quantification and formula

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CREATING RESILIENT FORESTS: GENERAL PRINCIPLES

- "Structure" of forests (spatial arrangement) as important as the trees, reference historic forest structures creating structural heterogeneity at all scales from stand to landscape
- Retain large, old trees of seral/fire resistant species: p. pine, larch, w. pine, D. fir
- Continuity of forest structure between pre- and post-harvest
- Use topography and current stand conditions as management template
- Nature is in constant flux, not stable, repeated disturbance to maintain heterogeneity

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CREATING RESILIENT FORESTS: GENERAL PRINCIPLES

- Creating a "messy" forest structure
- Natural disturbance and disturbance patterns are "random," but randomness is constrained by aspect, slope, forest type, climate, and weather conditions
- Reduce stand densities
- Promote seral tree species for site
- Reduce surface fuel and increase distance from surface fuel to base of tree crown (trade off for wildlife/biodiversity)

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CREATING RESILIENT FORESTS: GENERAL PRINCIPLES

Forest structure has two elements:

1. The types, number, and sizes of individual structural elements (e.g. trees and snags)
2. The arrangement of these structural elements in space

(Larson and Churchill 2012)

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CREATING RESILIENT FORESTS: GENERAL PRINCIPLES

"*Restore spatial heterogeneity by varying the treatment of the stand, such as by leaving untreated patches, creating openings, and providing for widely spaced single trees and tree clumps"* (Larson and Churchill 2012)

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CREATING RESILIENT FORESTS: GENERAL PRINCIPLES

"Empirical studies and reviews of spatial reference conditions generally conclude with recommendations to create random or aggregated tree spatial patterns . . . And some explicitly state that uniform tree spacing should be avoided . . "

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CREATING RESILIENT FORESTS: GENERAL PRINCIPLES

"Existing conditions, especially the presence of old-growth trees or major forest health issues, will influence the possible types, numbers and locations of pattern elements to be left within the treatment unit" (Larson and Churchill 2012)

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CREATING RESILIENT FORESTS: GENERAL PRINCIPLES

"*. . . landscape prescriptions should focus on increasing the frequency of variably-sized openings and successional patches . . .*"

(Dickinson 2014 in Hessburg et al. 2015)

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CREATING RESILIENT FORESTS: GENERAL PRINCIPLES

"*. . . the objective is to create structural and compositional diversity and heterogeneity throughout the stand, rather than to concentrate growth on selected trees and create spatially uniform stands, which is the case with usual stand tending treatments.*"

(https://www.nrs.fs.fed.us/fmg/nfmg/fm101/silv/p4_ecology.html)

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CREATING RESILIENT FORESTS: GENERAL PRINCIPLES

"*Adopting a mind-set of forest continuity rather than forest termination is helpful in opening yourself to the possibilities inherent in ecological forestry. You must put aside the notion that all forest stands must be terminated and new ones regenerated at some point in the future!*"

(https://www.nrs.fs.fed.us/fmg/nfmg/fm101/silv/p4_ecology.html)

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CREATING RESILIENT FORESTS: GENERAL PRINCIPLES

". . . The strategy calls for silvicultural treatments that retain and release older trees, reduce stand densities, shift composition toward fire and drought-tolerant tree species, and incorporate spatial heterogeneity at multiple spatial scales."

(Franklin and Johnson 2012)

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CREATING RESILIENT FORESTS: GENERAL PRINCIPLES

". . . Naturally regenerated trees seldom occur with regular spacing and the historical fine-scale disturbances that regulated the structures and compositions of moist forests rarely maintained uniform forest conditions; rather, trees would grow in small groups with interlocking crowns and often with one or more species in a group. . . ."

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CREATING RESILIENT FORESTS: GENERAL PRINCIPLES

"to manage for within-stand spatial variability requires re-conceptualizing "stands" as mosaics of variably sized canopy patches." (Churchill et al. 2013)

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Questions?

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End Night I

See you Wednesday!

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