The MT Adaptive Silviculture for Climate Change Study

Regeneration for the future at Coram Experimental Forest and Flathead National Forest

Managing post-fire vegetation workshop – 4 February 2021

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ASCC
Adaptive Silviculture for Climate Change

Adaptive Silviculture for Climate Change (ASCC)

Project Goal:

Co-develop robust, operational examples of how to integrate climate change adaptation into silvicultural planning and on-the-ground actions to foster resilience to the impacts of climate change and enable adaptation to uncertain futures

Manage for Persistence:
Ecosystems are still recognizable as being the same system (character)

Manage for Change:
Ecosystems have fundamentally changed to something different

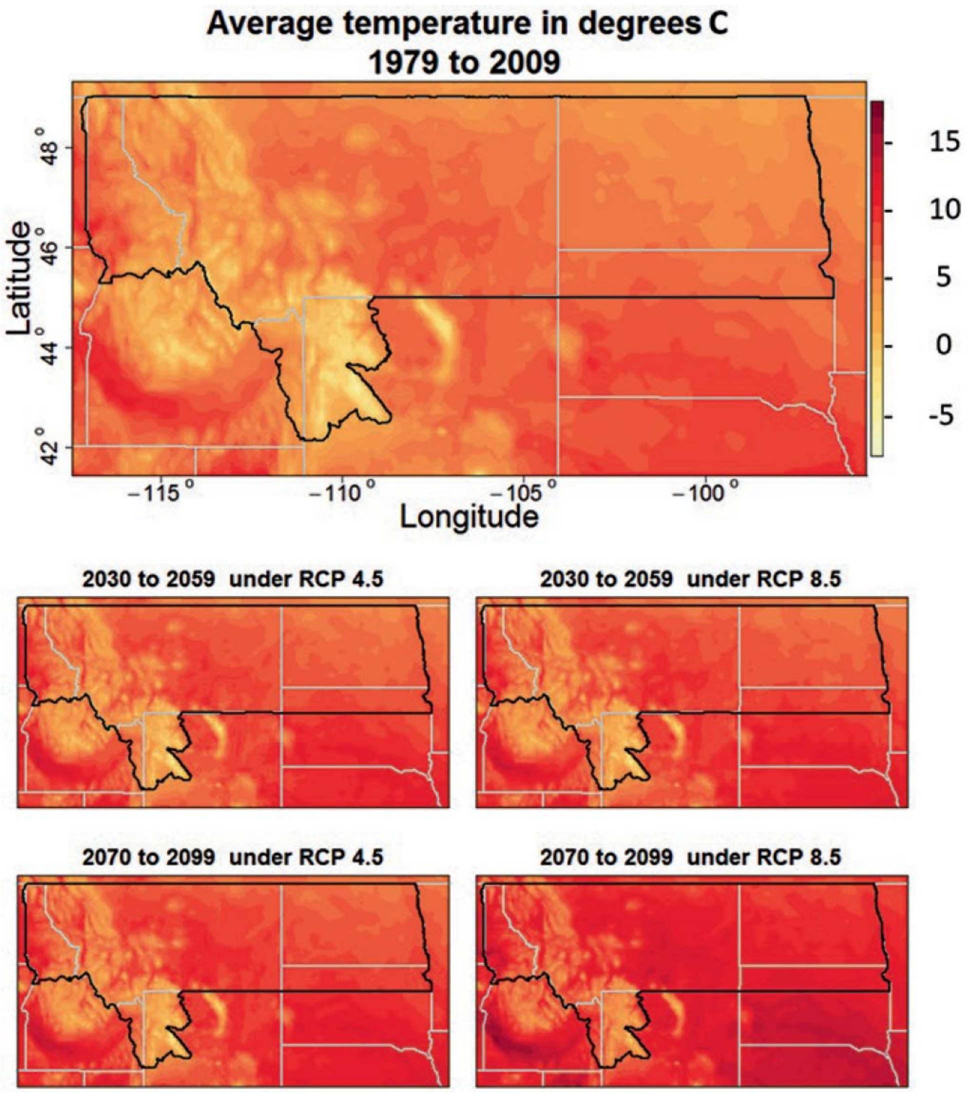
Sensu Millar et al. 2007

Characteristic Forest Ecosystems in the Northern Rockies

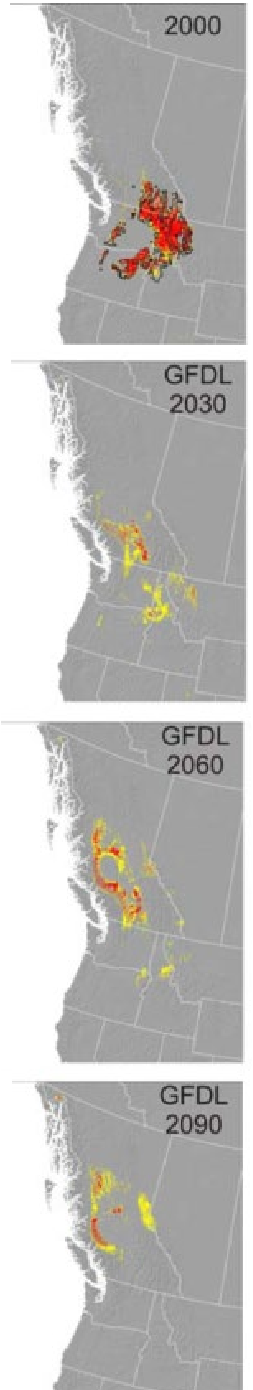
Location:
Northwestern Montana, Flathead County

Forest Ecosystem:
Western Larch cover type (SAF Type 212), a.k.a. western larch-mixed conifer

Projected Climate Change Impacts



Joyce et al. 2017



Rehfeldt and Jaquish 2010

<u>DIRECT impacts:</u>

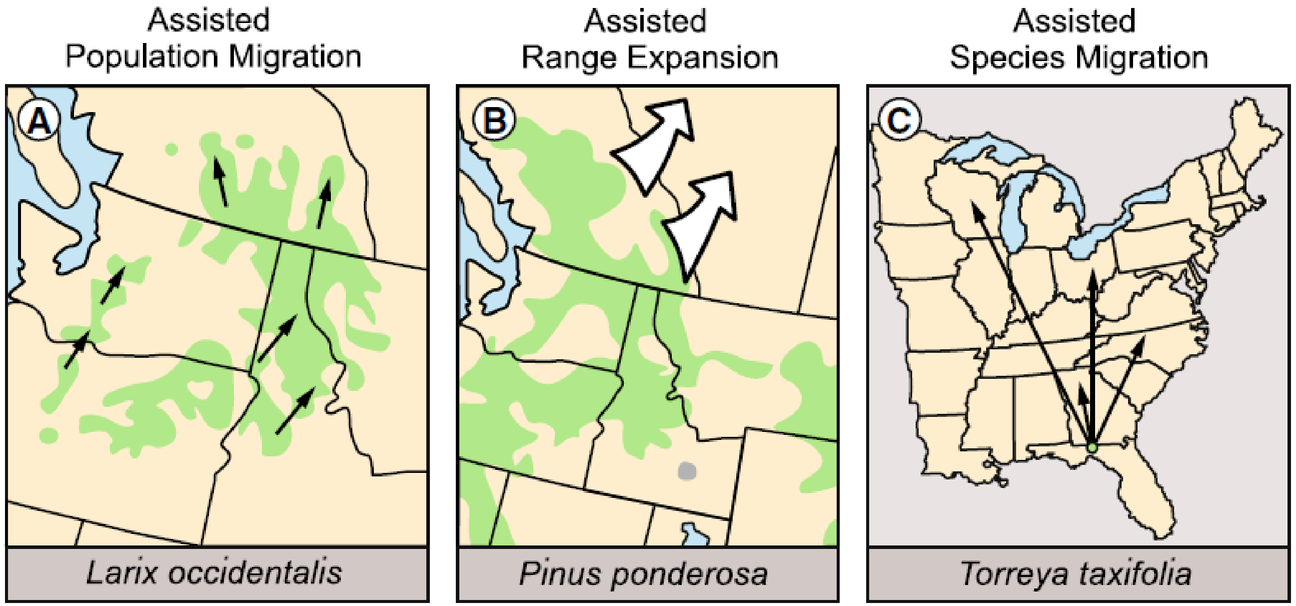
1. Temperature (+2.8 to 6.5 C)
2. Snowpack (higher winter max and spring min T)
3. Drought (maybe wetter winter but drier summer)

<u>INDIRECT impacts:</u>

1. Wildfire activity
   (freq, season, area burned)
2. Insects and disease
   (host stress, voltinism, spread)
3. Forest dynamics
   (replacement of sensitive species)

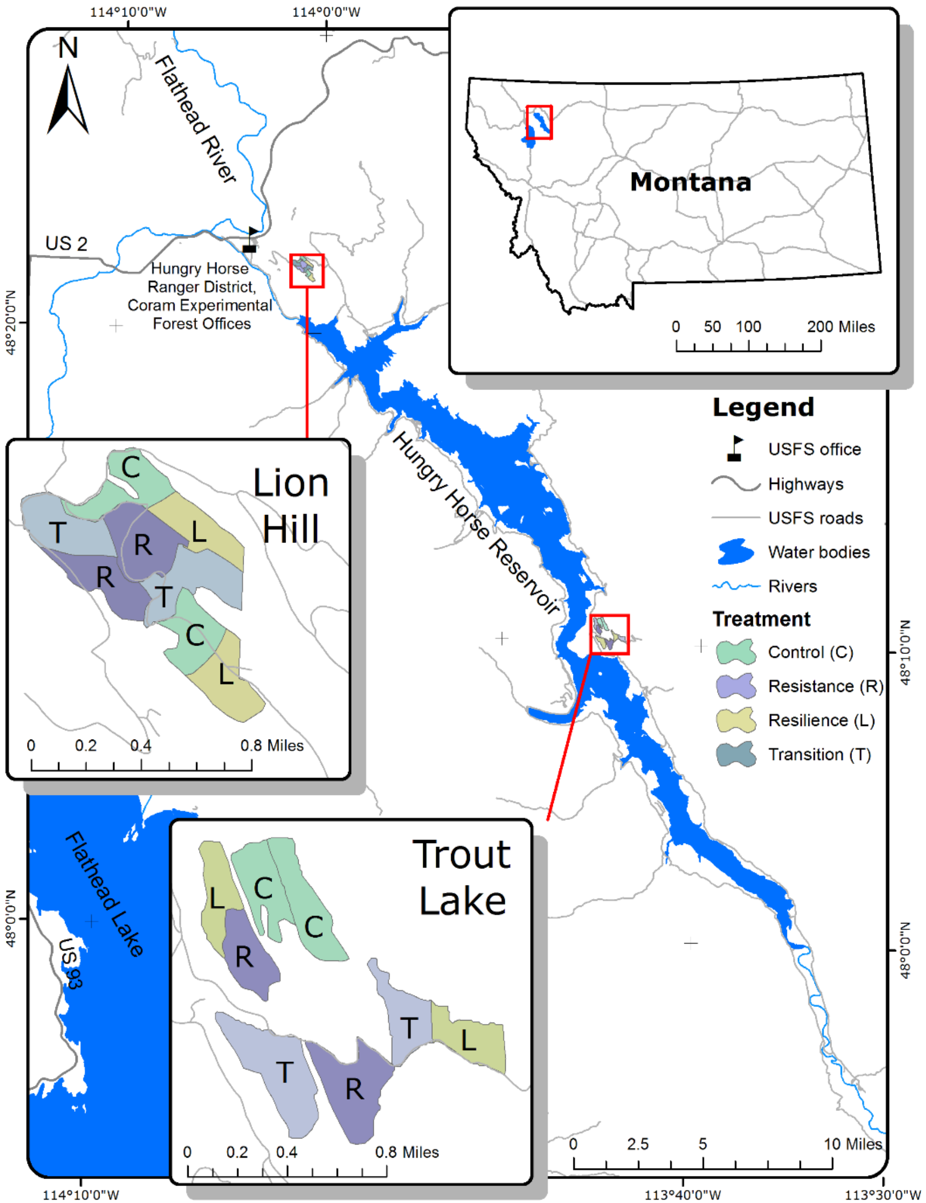
A Couple Pertinent Questions

1. What endemic tree species and seed sources will thrive as the climate becomes warmer and drier?
2. Will assisted migration better maintain forested conditions under future conditions?



Dumroese et al. 2015

ASCC in the Northern Rockies



Site Considerations:

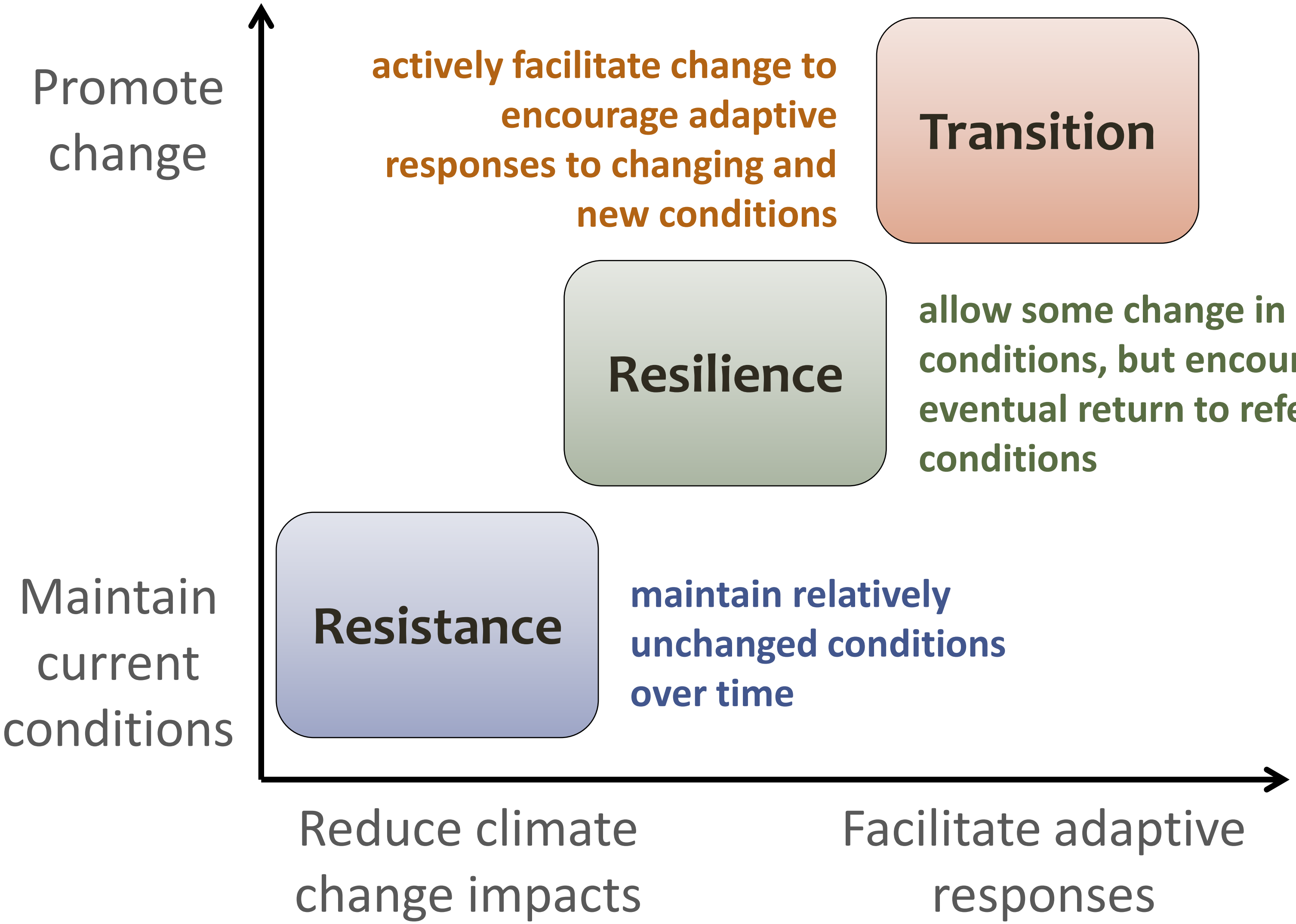
- Representative of 1,000,000 acres in Forest Service Region 1
- Clearcut 50-60 years ago
- Natural western larch regen or augmented by planting
- Pre-commercially thinned 30-40 years ago
- Sites are located 40 miles apart
- Elevation: 3,720’ – 4,240’

Attribute	Mean
Trees (stems ac^{-1})	261.0
Basal area (ft^2 ac^{-1})	106.5
QMD (in)	8.7
Larix basal area (%)	70.8
Height (ft)	62.4

Collaborating personnel from:

- Flathead National Forest
- Rocky Mountain Research Station
- University of Montana

ASCC is Testing a Spectrum of Adaptation Options



How do we get there?

Desired Future Conditions

- What are the broad stand characteristics that we want for the future?

Objectives

- What are the management objectives necessary to move the stand toward the DFCs?

Tactics

- What specific silvicultural activities (in the next 5 years) will we initiate to achieve these objectives?

DESIRED FUTURE CONDITIONS
Ideal future stand will be: • Productive for local economy • Most resistant and resilient to future drought • Resistant to fire (able to avoid widespread crown fire and mature tree mortality) • Resistant and resilient to insects and disease • A provider of wildlife habitat and forage • STRUCTURE: Two-aged, with improved structural and spatial heterogeneity • COMPOSITION: Dominated by fire- and drought-tolerant species: western larch, western white pine, ponderosa pine
OBJECTIVES
Management objectives to reach DFCs: • Increase or sustain tree and stand wood productivity • Promote development of large-diameter, long-lived trees (10-16 TPA) for timber value and fire resistance • Mitigate moisture stress • Reduce probability of torching by reducing surface and ladder fuels • Reduce probability of crowning by reducing canopy fuels • Maintain or improve wildlife habitat and forage production • Maintain or reduce presence of insects and disease in trees • Enhance genetic diversity to buffer against insects and disease • Enhance species and genetic diversity by increasing the proportion of future-adapted (to fire and climate.) species and genotypes through natural and artificial regeneration • Enhance age-class, spatial, and structural heterogeneity to improve resilience to disturbances

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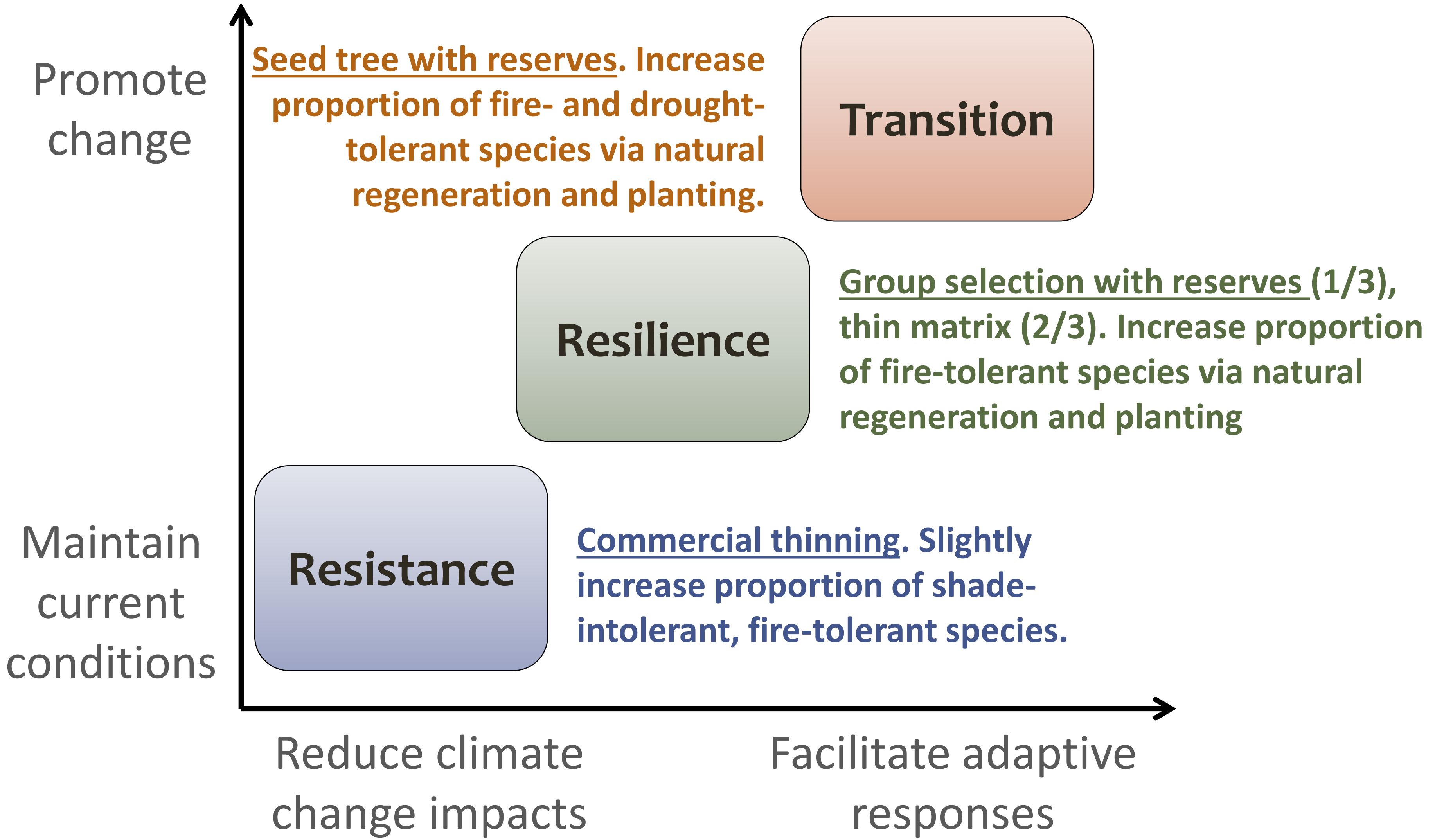
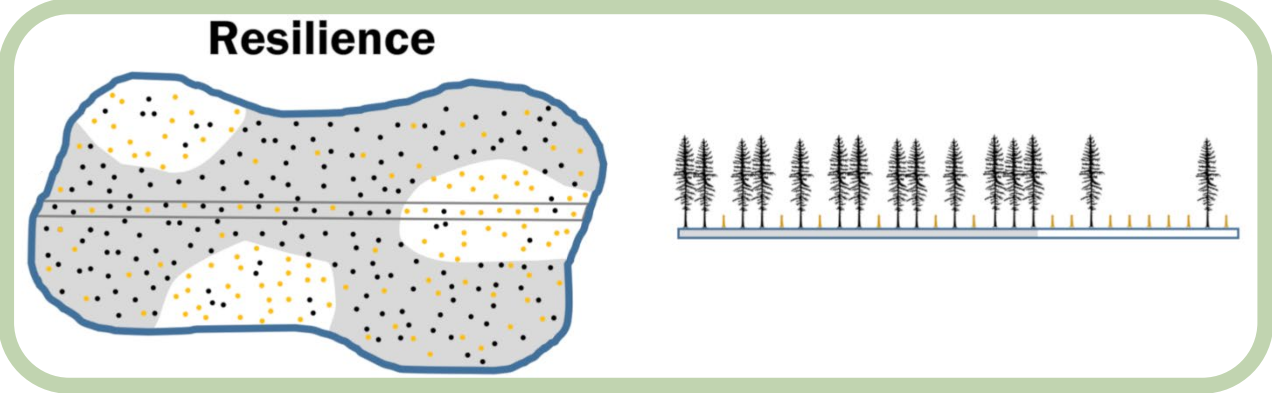
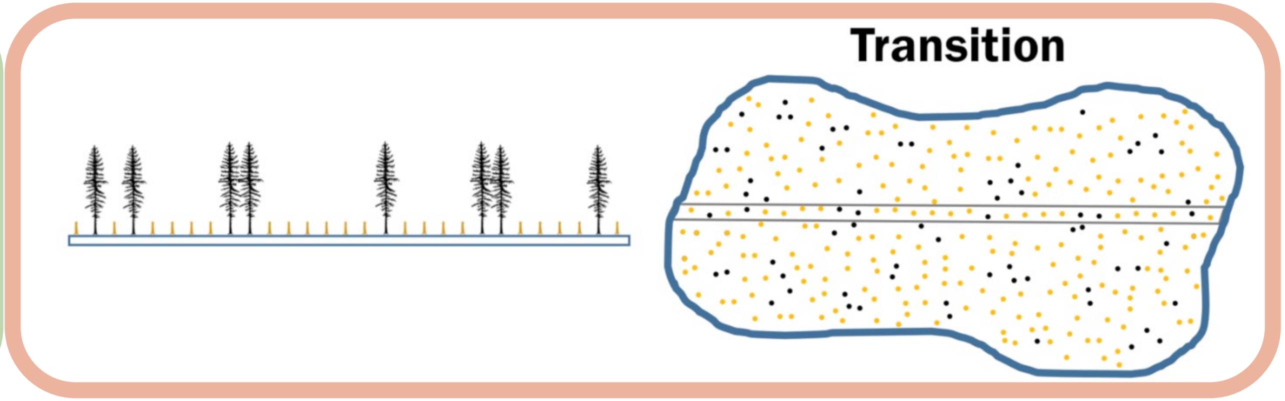


Structure modified, initiate regen flood!





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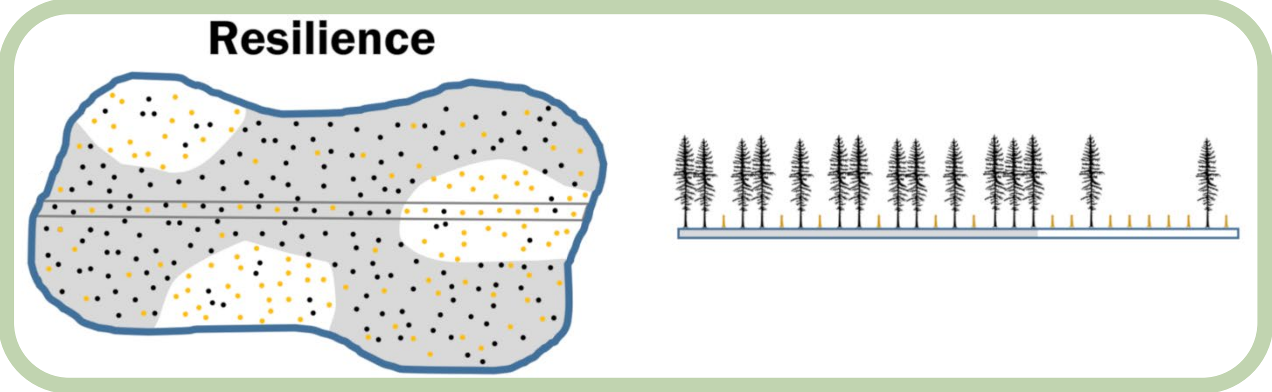
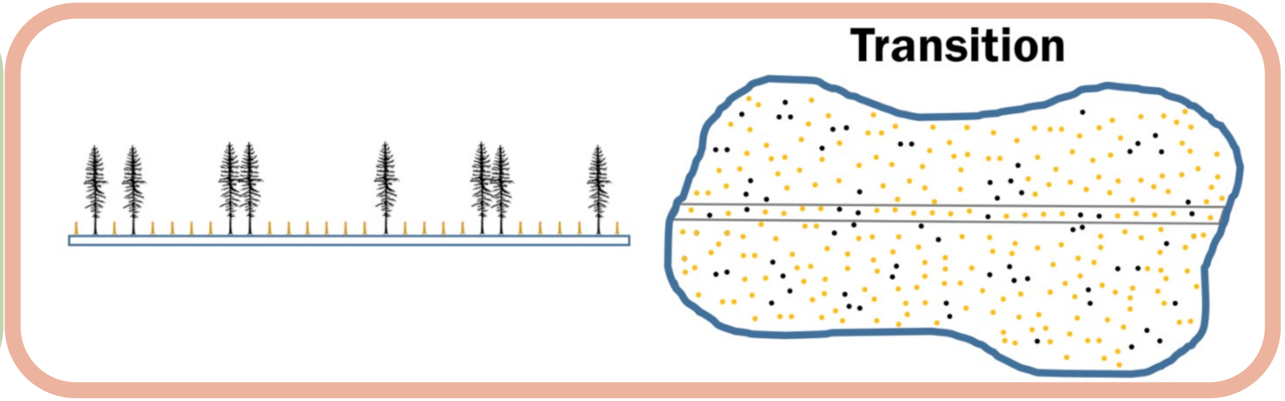
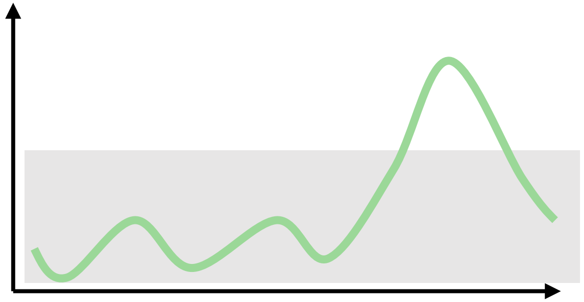
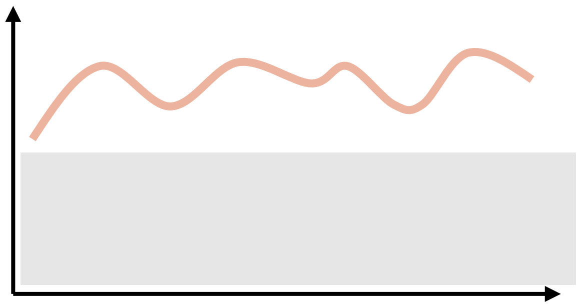




Understory light
Soil moisture
Temperature

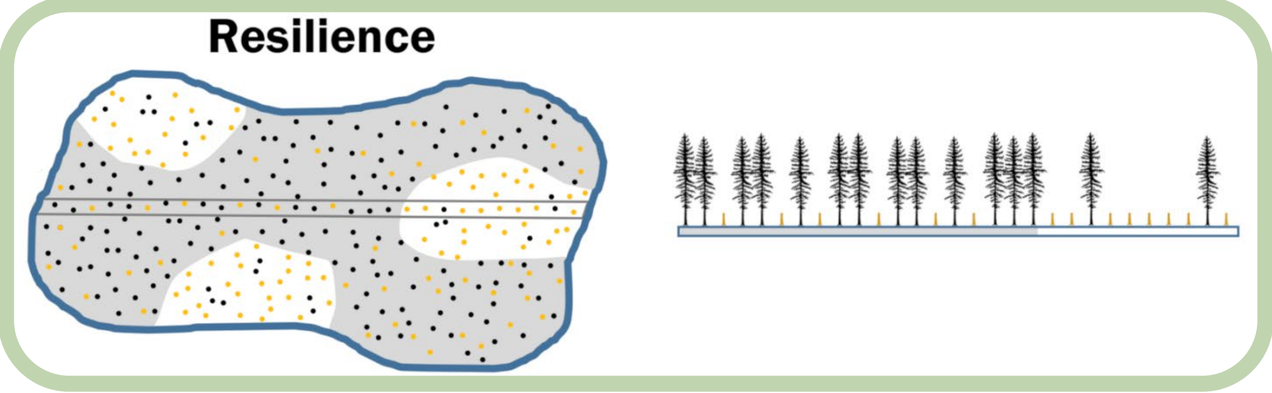


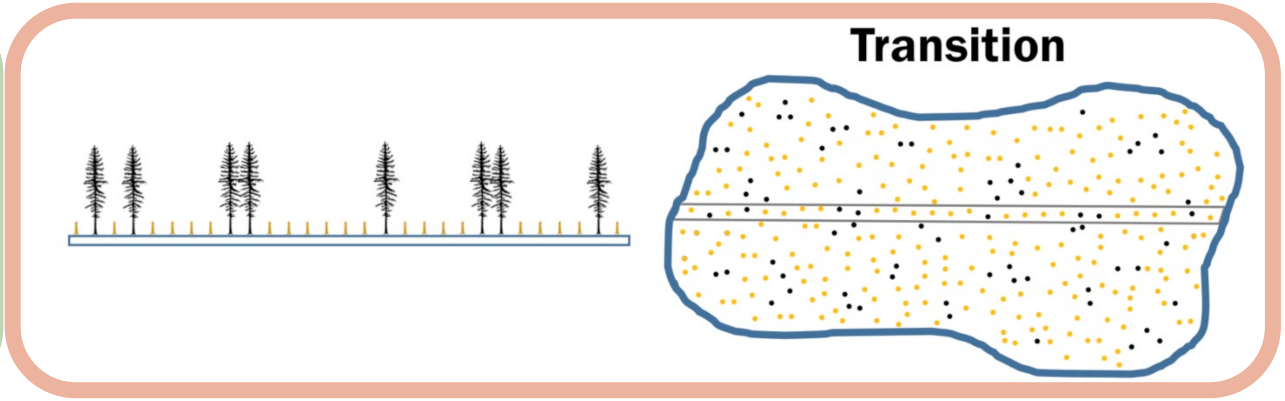


1. Natural regeneration

How much?

Structure modified, initiate regen flood!





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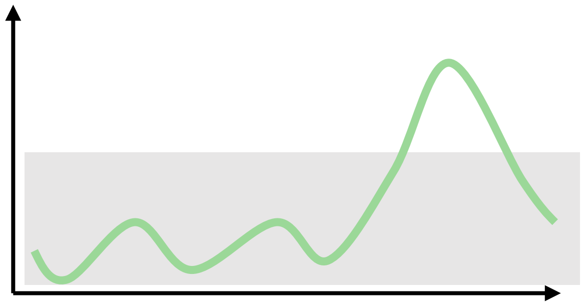
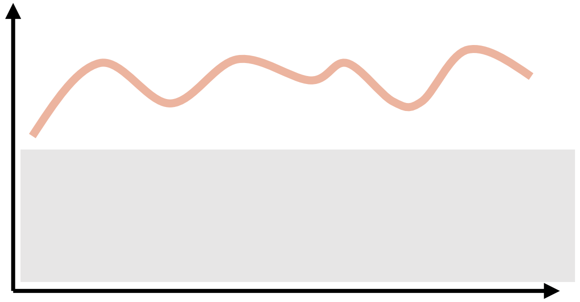


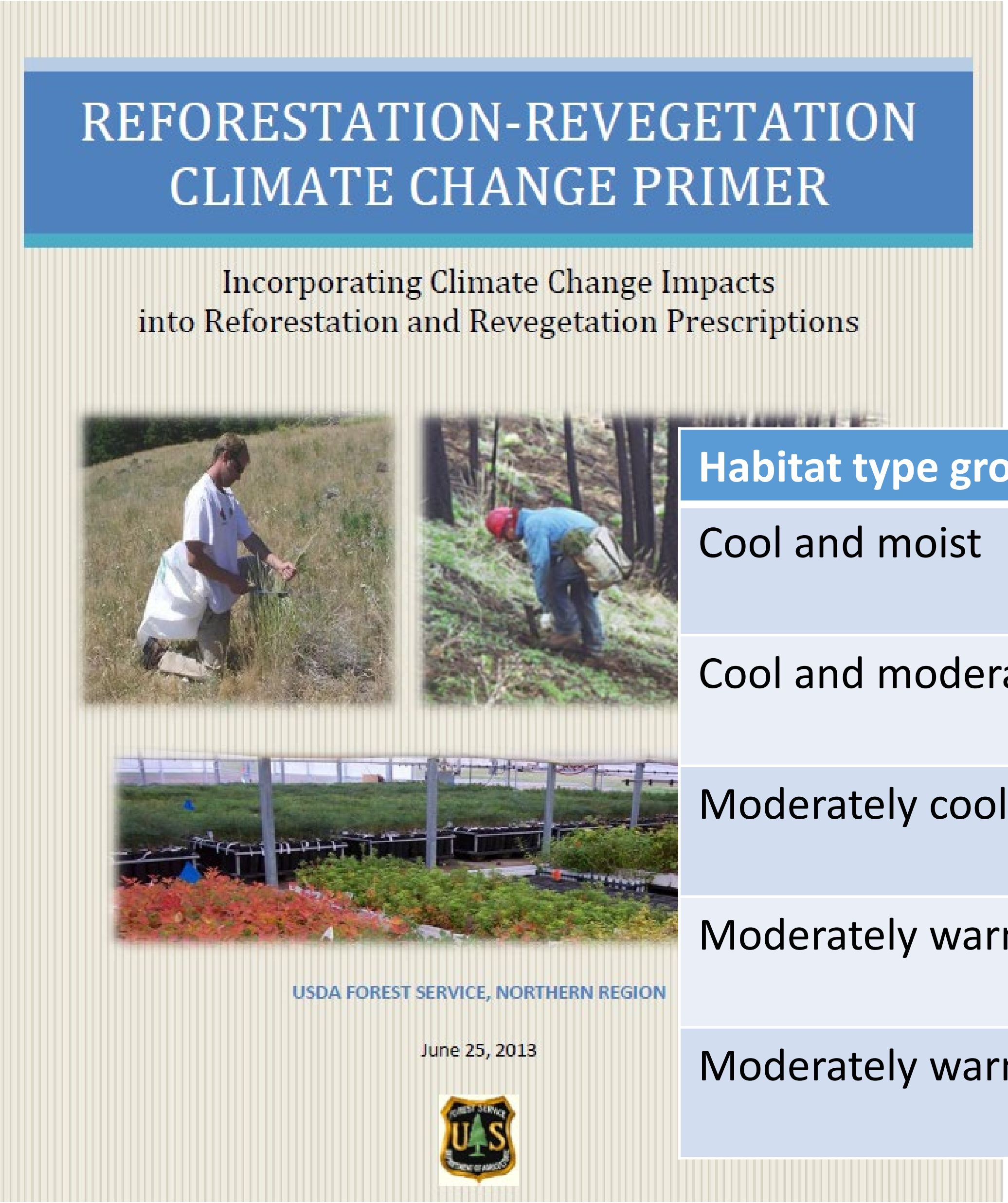


1. Natural regeneration
2. Artificial regeneration

- Increase genetic pool
- Increase success
- Adjust species comp.
- Use “improved” stock
- Regulate spacing

  300 TPA ≈ 12’ spacing

ASCC: what should we plant?

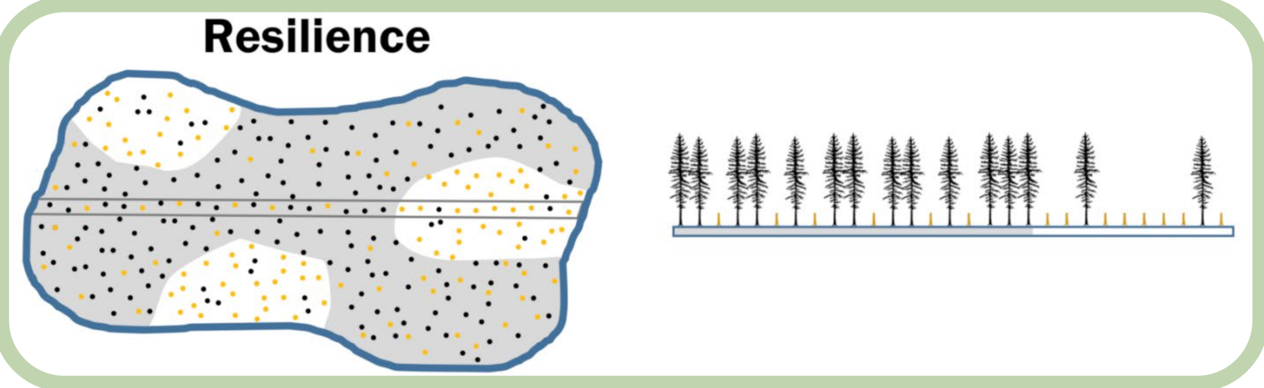


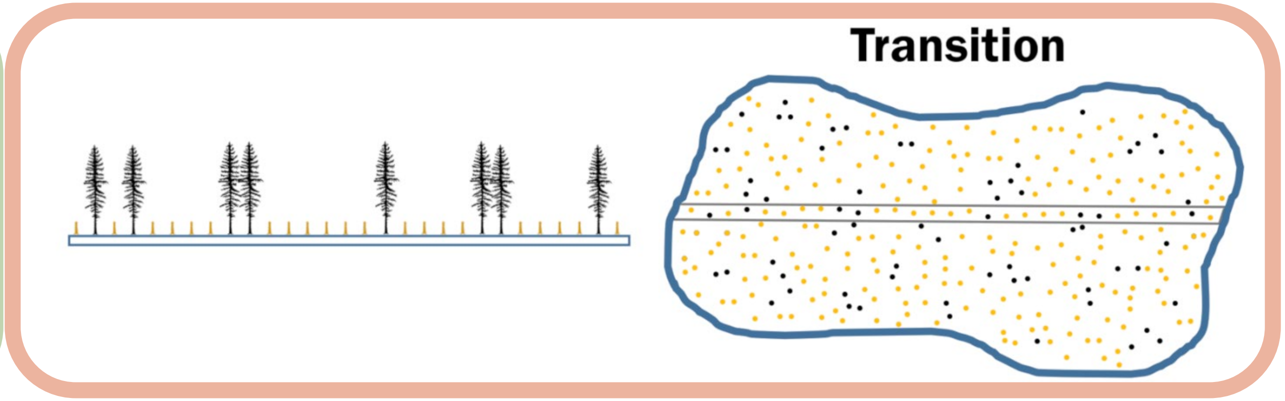
Habitat type group	Consider
Cool and moist	Lodgepole, spruce, subalpine fir. Avoid larch and white pine where dry, try Douglas-fir if not frosty.
Cool and moderately dry	Lodgepole. Larch and whitebark pine on moist microsites.
Moderately cool and moist	Ponderosa pine. White pine if root disease. Swap out lodgepole for Douglas-fir.
Moderately warm and moist	Ponderosa pine. White pine and larch on moister, cooler sites.
Moderately warm and moderately dry	Ponderosa pine. Western larch in deep soiled microsites.

ASCC: what should we plant?

- Future stands? Trees that perform well in future climate, resistant and resilient to future disturbance!
- Generally speaking, species expected to move up in elevation and latitude (Rehfeldt et al. 2006, Harsch et al. 2009, etc.)
- Alternatively, evidence that sometimes species move down in elevation (Crimmins et al, 2011; Flanary and Keane 2019)
- Adaptive management: question assumptions, diversify portfolio

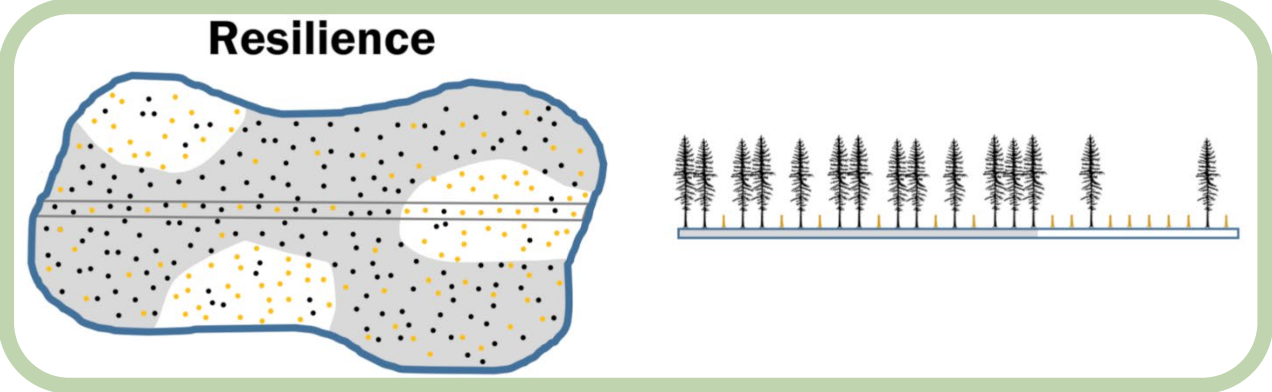
ASCC: what should we plant?

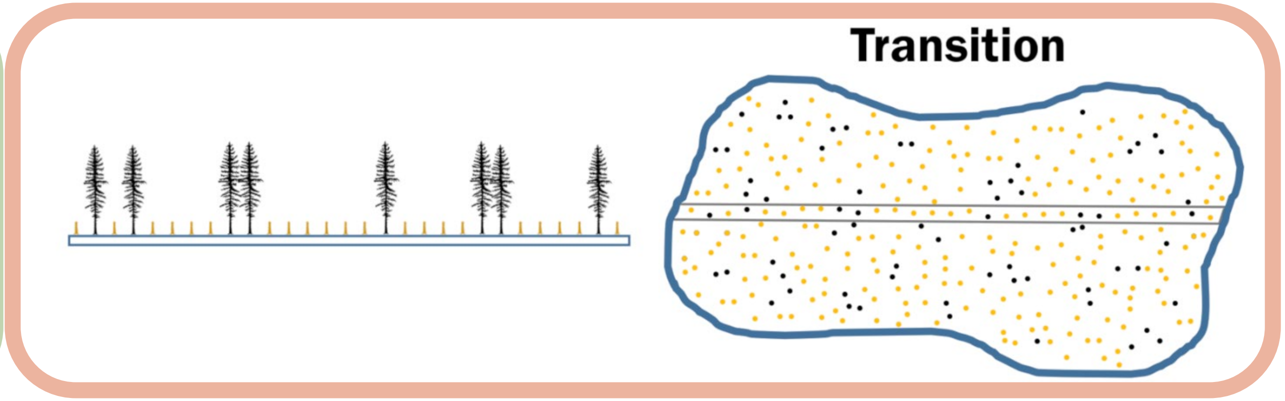




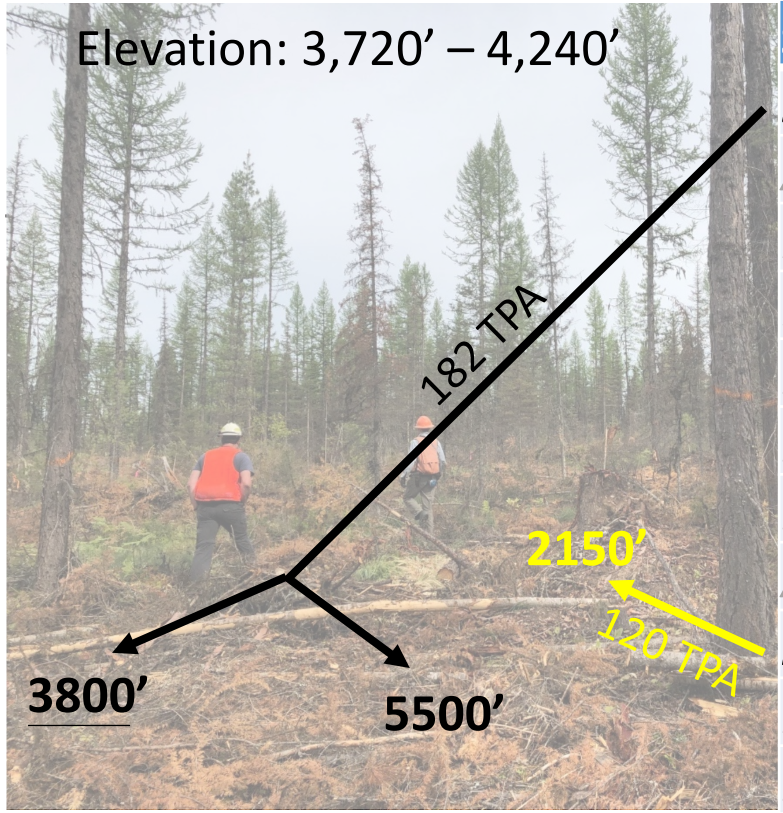
Species	Total
Larix occidentalis	72%
Abies lasiocarpa	7%
Pseudotsuga menziesii	7%
Betula papyrifera	5%
Pinus contorta	4%
Picea engelmannii	2%
Populus balsamifera	2%
Abies grandis	< 1%
Pinus monticola	< 1%
Populus tremuloides	< 1%
Pinus ponderosa	0%

ASCC: what should we plant?





3 stock types



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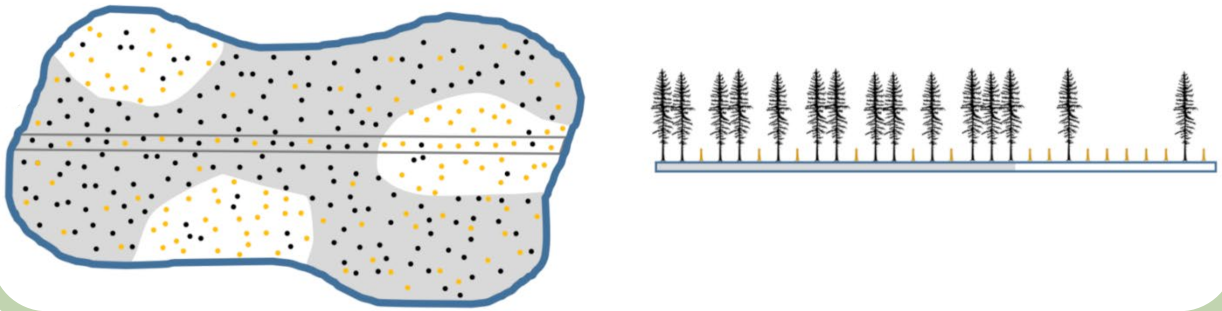
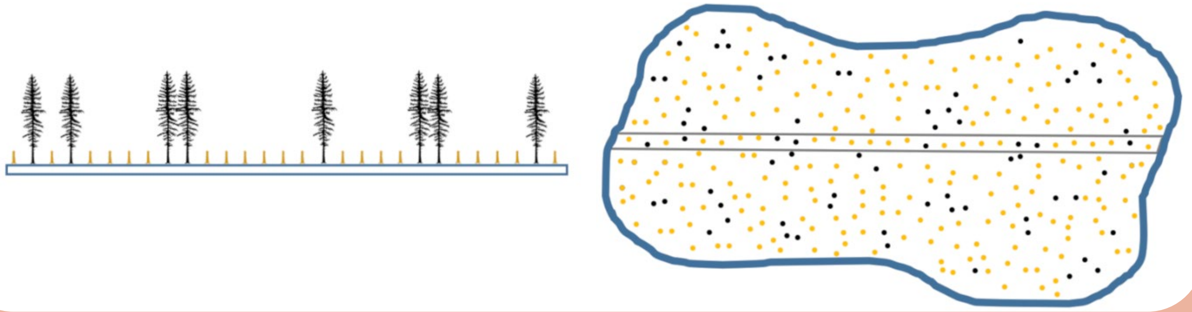
ASCC: what should we plant?

Resilience



Transition



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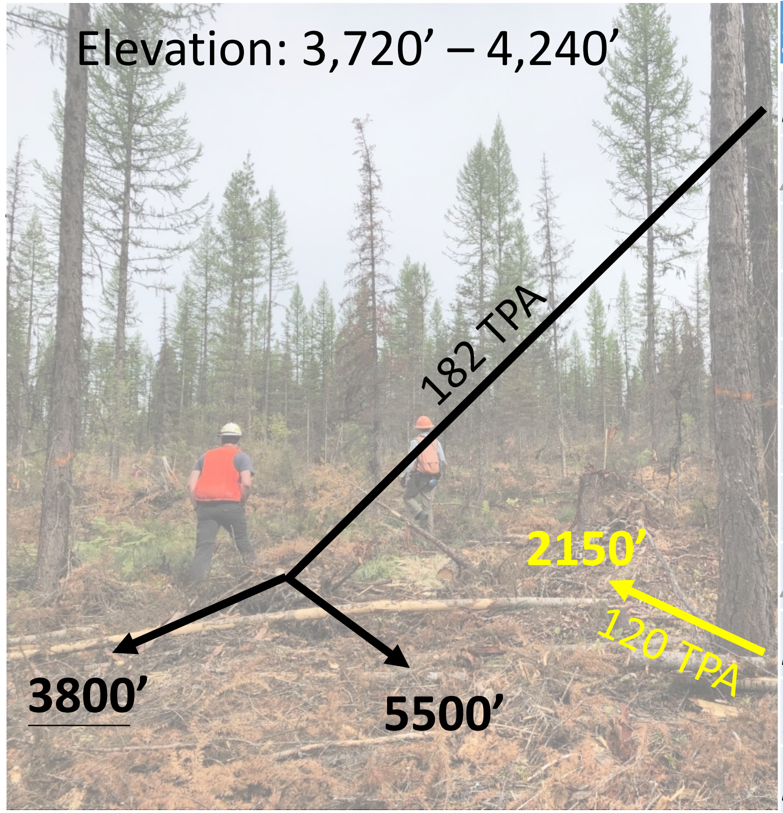

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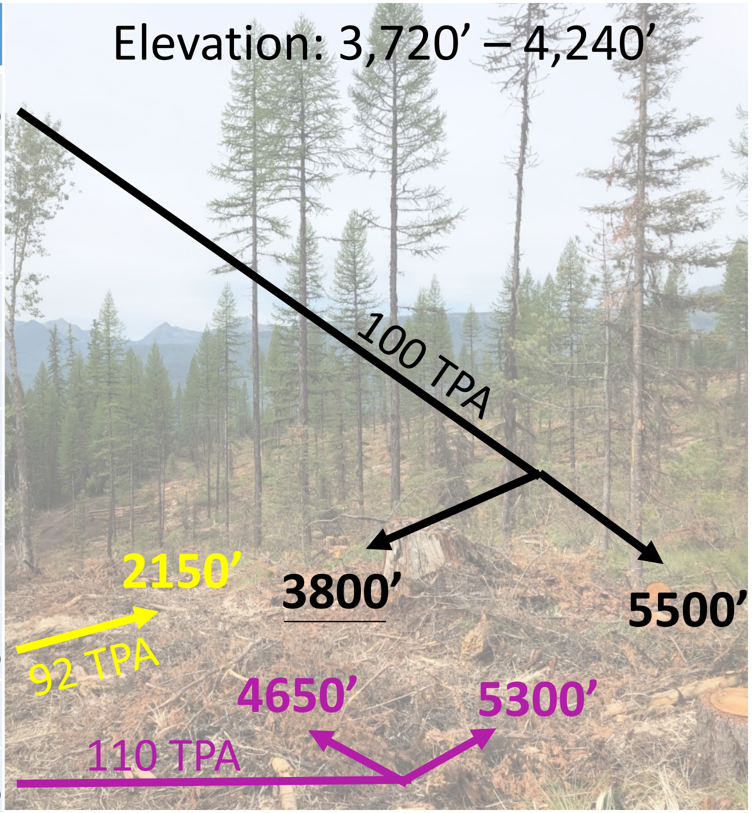

5 stock types

Benefits and implications of a flooded system

- Increase regeneration success
- Both natural and “improved” gene sources
  - De la Mata et al. 2017 – PP plantation genetics study
- Improved adaptive capacity
- Must monitor – this won’t be easy
- Must PCT – and this might not be either!
  - Selection attributes, ladder fuels

Stay tuned!

adaptivesilviculture.org

APPLIED RESEARCH

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silviculture

Initiating Climate Adaptation in a Western Larch Forest

Justin S. Crotteau, Elaine Kennedy Sutherland, Theresa B. Jain, David K. Wright, Melissa M. Jenkins, Christopher R. Keyes, and Linda M. Nagel

Western larch forests are iconic in the interior northwest, and here we document the preemptive steps that scientists and managers are taking to steward these forests into the future. Changing climate is forecast to have acute and chronic impacts on growth and disturbance in western larch forests. A group of scientists and managers in the northern Rocky Mountains have teamed up with the Adaptive Silviculture for Climate Change Network in an experiment to proactively manage forests for climate adaptation. The collaborative group developed a gradient of adaptation treatments (i.e., resistance, resilience, and transition) focused on climate change at Coram Experimental Forest and the Flathead National Forest. Treatments are scheduled, and monitoring will follow to fuel future research and to help guide regional managers who seek to learn from our treatments. We conclude with predictions of future dynamics in these stands and emphasize the value of landscape heterogeneity and the necessity of long-term monitoring for silvicultural experiments.

Keywords: *Larix occidentalis*, adaptive management, experimental silviculture, disturbance mitigation, Adaptive Silviculture for Climate Change

Western Larch Forests

The western larch (*Larix occidentalis* Nutt.) forest type (SAF Cover type 212; Eyre 1980) is a prominent icon in the interior northwest, occupying 1.7 million acres (4.2 million hectares) in great swaths of cool and moist, midelevation sites (Oswalt et al.

Extensive western larch forests in the northern Rocky Mountains provide many ecosystem benefits such as pleasing aesthetics, cultural significance, timber for local communities, habitat for wildlife, recreation opportunities, and clean water.

Historically, western larch forests have been both resilient to and

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