Silvicultural Strategies for Climate Change Adaption in the PNW
Overview

- Adaptive mindset: uncertainty, risk management, & resilience
- Strategies: what is different?
- Case studies from 3 different forest types
Adaptive Mindset

Shifting from optimizing for growth to managing for resilience.

Basic risk management to reduce exposure to higher uncertainty:
• Diversify portfolio
• Buy more insurance
• Give up higher financial returns ➔ lower risk of losses
• Increase resilience to known and unknown stressors
• Manage for systems that are less prone to big crashes
• Monitor change, adapt, and respond quickly

• Forest ecosystems in PNW are adapted to change
• Foresters are observant, creative, adaptive problem solvers.
• Silviculture has gone through lots of evolution.
Adaptive Mindset

Challenge of Time: What time period to manage for?
Overview

- Adaptive mindset: uncertainty, risk management, & resilience

- Strategies: what is different?

- Case studies from 3 different forest types
1. Increase monitoring efforts & response capability

2. Understand your site: Climate, soils, topography, and suitable vegetation types

3. Planting site adapted species & using different seed sources: shift to greater drought tolerance

4. Manage for diverse forests

5. Manage density

6. Maintain & increase soil water storage

7. Control invasive species

**What is different than what I already do?**
1. Increase monitoring efforts & response capability

- Informal & formal
- Tracking seedling trials, mortality, etc.
- Share information with partners: ground data for larger scale monitoring
- Additional time & management cost
1. Increase monitoring efforts & response capability

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Phone/Tablet based monitoring
DNR protocol & public website with results
1. Increase monitoring efforts & response capability

- Anticipate & plan for responses:
  - Mortality
  - Need to replant
  - Reframe salvage:
    green & dead tree treatments
Strategies

1. Increase monitoring efforts & response capability

- Anticipate & plan for responses:
  - Mortality
  - Need to replant
  - Reframe salvage:
    - green & dead tree harvests
  - Opportunities for new planting
Strategies

2. Understand your site

- Climate
- Soils
- Topography: aspect, solar radiation
- Identify vulnerable forests on your ownership
- Determine site adapted vegetation types, current and future
Strategies

2. Understand your site

- Climate:
  - Lots of climate websites with downscaled projections
  - Different degrees of change & species projections: different models & uncertainty
  - Filter through site factors & local knowledge: soils, microsites, etc

Making sense of projections for a specific place

ClimateNA_MAP

-- An Interactive Platform for Visualization and Data Access

Coordinates Input (click on the map or type in coordinates)

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<th>Value</th>
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Quick Tutorial | Help | Calculate

Annual Variables | Seasonal Variables | Monthly Variables
Strategies

2. Understand your site
- Climate:
  - Local effects

https://climatechange.ecoshare.info/walter-climate-diagram-tool-package/
Strategies

2. Understand your site

- Climate: What does it mean for vegetation?

Species Potential Habitat Tool

1. Select Species
   - Douglas-fir

2. Select Species Distribution Record
   - 1961 - 1990

3. Select Modeling Conditions
   - Select a future time range and a model

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</table>
Strategies

2. Understand your site

- Soils: water holding capacity, nutrients, rooting depth.
Strategies

2. Understand your site

- Soils: dig some pits!! Construction, roads, etc.
Strategies

2. Understand your site
   - Integrating climate, soils, & topography/solar radiation

Deficit = amount of drought stress due to lack of water when solar radiation is high

AET: amount of water transpired ~ productivity
2. Understand your site

- Deficit

https://deptofnaturalresources.box.com/s/35fo42x05zr88mr3n1rf4h3zuq9mx14j

Strategies

Making sense of projections for a specific place
2. Understand your site

- AET

Making sense of projections for a specific place
Strategies

2. Understand your site
   - Climate: lots of climate websites
   - Soils
   - Topography: solar radiation
   - Site adapted vegetation types, current and future

   - Higher AET ~ growth?
   - But higher moisture stress!

Making sense of projections for your site
Strategies

2. Understand your site
   • Identify vulnerable forests on your ownership:

   Climate - topography
   Soils - Veg Types

   Dense Hemlock ➔ Outwash Soils

   Large Cedar ➔ Shallow Soils
Strategies

2. Understand your site

- Identify vulnerable forests on your ownership:

  Dense Hemlock ➔ Outwash Soils

  Large Cedar ➔ Shallow Soils

  Moderate Density DF ➔ Deep Soils
Strategies

3. Planting site adapted species & using different seed sources: shift to greater drought tolerance
4. Manage for diverse forests:
   - Species composition, age classes, & structural conditions

Old/large trees:
   + Fire & drought tolerance, less transpiration, genetic variability, habitat
   - Windthrow potential, adaptability to new climate, large & tall crowns (water)

Young trees:
   + More plastic, adjust crowns, faster growth, shorter (wind, water), replaceable
   - Higher water use, lack habitat characteristics,
Strategies

4. Manage for diverse forests:
   • Species composition, age classes, & structural conditions:

   Multi-age, multi-species, multi-cohort stands:
   + Lower insect/pathogen risk, resilient to wind, variable response to drought.
   + More options for intermediate harvests → response to partial mortality
   + Higher habitat & aesthetic value

   - Less fire resistant
   - Require uneven-age management approaches: higher management costs
4. Manage for diverse forests:
   • Species composition, age classes, & structural conditions

**Even-age stands**
+ Can be necessary for mal-adapted stands, or stand replacing disturbances
+ Shorter rotations allow for shifting seed zones & species.
+ Simpler management & higher revenue when disturbance risk is low
+ Retention can add some benefits of multi-age stands
  - Less resistant to disturbance, higher risk
Strategies

4. Manage for diverse forests:
   - Species composition, age classes, & structural conditions

Need both uneven and even aged approaches:
Vary across ownership & landscape
Good insurance policy
4. Manage for diverse forests:
   - Gaps

   ➔ Plant new species, especially shade intolerants
   ➔ Increased snow retention & water yield.
   ➔ Non-tree plant diversity
Strategies

5. Manage density
   • Reduce moisture competition, increase vigor, & insect/pathogen resistance
   • Healthy crown ratios, stable height to diameter ratios.
   • Range of crown sizes. Large vs smaller crowns
5. Manage density
   - Density levels: light limited systems
Strategies

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Max Stocking (SDI)
DF: 580
WH-RC: 800
RA: 350
PP: 380
Strategies

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Lower thinning levels:
35 RD ➔ 20-30
Strategies

5. Manage density
   • Density levels: light limited → moisture systems

Lower thinning levels
   35 RD → 20-30

14” QMD:
   - 35 RD  115  TPA
   - 25 RD  85   TPA
   - 20 RD  65   TPA

20” QMD:
   - 35 RD  65   TPA
   - 25 RD  45   TPA
   - 20 RD  35   TPA
Strategies

5. Manage density
   • Density levels: varying density across stand
6. Maintain & increase soil water storage
   • Retain downed wood, slash, non-tree vegetation, & soil organic matter
   • Gaps and moderate canopy cover ➔ soil water & snow retention
   • Minimize soil compaction during harvests

7. Control invasive species
Overview

- Adaptive mindset: uncertainty, risk management, & resilience
- Strategies: what is different?
- Case studies from 3 different forest types
Case Study 1:

High Vulnerability:
Red Alder Stand on old ag field & drier site:

Alder mortality likely soon, major die off with drought.
Case Study 1:
Red Alder Stand on old agricultural field: sandy soils, dry site

Soils

Current Deficit

Future Deficit
Case Study 1:

Red Alder Stand on old agricultural field: sandy soils, dry site

Current: moderate DF site. Future dry DF?
Case Study 1:

Harvest now to capture revenue and have resources to replant the site

Variable retention, leave patches of alder ➔ future gaps, seed source
  Retain some/most maples, red cedar
  Retain Douglas-fir: seed sources & old cohort
Leave tops, slash on site, plus some pulp logs (or don’t sell pulp)
Case Study 1:

- Plant 20-40% of DF from different seed zones? Track during planting
- Plant white oak, ponderosa pine?
- Anticipate natural regen: Douglas-fir, madrone, red alder, maple.
- Shrub control, but not 100%.
- Planting density: higher & plan on PCT, or lower with no PCT?
- Monitor & be prepared for mortality if we have dry years.
Case Study 2:
Moderate Vulnerability:
Young, dense DF plantation near homes, with infill of hemlock & hardwoods

Moderate to dry site: outwash soils, but lower deficit.

In future, may support red cedar & maple, but not hemlock
Case Study 2:

- Thinning to maintain healthy crowns and vigor
- Low thinning density: (20-25 RD)
- Remove western hemlock
- Retain RA for next entry? Retain red cedar
Case Study 2:

- Thinning to maintain healthy crowns and vigor

- Add 10-20% in ¼ - 1 acre gaps
  - Plant gaps to diversify forest.
    ~25% DF from drier seed zones
    Red cedar?
    Western white pine, lodgepole pine, grand fir
    Maple, Madrone?

- Monitor, be prepared for additional planting, salvage over time.

Alternatives

1. Don’t thin: let grow for habitat, see what happens

2. Don’t thin: grow until early retention harvest, then plant with new seed zones.
Case Study 2:
- Leave slash in majority of forest
- Within 100-200’ buffer off access roads & home:
  - Remove/reduce slash. Minimize multistory structure. Be prepared to maintain this.
- Broadleaf species buffer?
Case Study 3:

Lower Vulnerability:

Mature mixed conifer-red alder forest on north facing aspect of drainage: Likely to support red cedar, maple, alder, may support hemlock
Uneven-age harvest: group selection + ITS
- Low to moderate thinning density: wind?
- Favor Douglas-fir and red cedar.
- Remove most hemlock, alder, some DF
- Retain some maple, cottonwood, alder: especially in riparian areas
- No harvest or ITS in wetter microsites

Case Study 3:
Uneven-age harvest: group selection + ITS

Gaps with range of sizes:
- Target hemlock/mature alder patches for gaps, plus some areas
- Plant new species/seed zones: DF in larger gaps, red cedar, w. pine, GF?
- Track gaps during & after harvest for planting
Monitor, be prepared for additional planting

Plan next entry in 10 – 20 years, expand gaps, new gaps, etc.

If big mortality event. salvage + green thinning

➔ Uneven-age: response potential after disturbance

Case Study 3:
Strategies

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Adaptive Mindset

- Forest ecosystems in PNW adapted to change
- Foresters are observant, creative, adaptive problem solvers.
- Silviculture has gone through lots of evolution.
  ➔ Climate change presents new challenges and opportunities.