Advancing the Science and Management of Inland Northwest Forests

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Issues facing INW silviculturists

- Reforestation
- Productivity
- Forest health
- Ecosystem goods and services
  - Clean air
  - Watershed services
  - Fiber/Timber
  - Genetic resources
  - Wildlife habitat and diversity
  - Carbon storage
  - Recreation

- Within the context of:
  - Drought
  - Wildfire
  - Insects and pathogens
  - Climate change
  - Public perceptions
Drought across the Northwest

Above-average temperatures and below-average precipitation in 2015

Source: climateengine.org
Drought effects on forests

Increases in forest water stress affect forest productivity, forest health, and reforestation efforts

Asner et al. 2015. PNAS E249-E255
What will the future bring?
Future predictions

Expected increases in winter minimum temperatures and summer maximum temperatures with decreases in summer precipitation may cause more frequent, longer droughts.

MACA downscaled multi-model GCMs, RCP 4.5: http://climate.nkn.uidaho.edu/MACA
## Forest management adaptation measures

<table>
<thead>
<tr>
<th>Management objective</th>
<th>Adaptation measure</th>
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<tbody>
<tr>
<td>Reforest managed forestland</td>
<td>Emphasize species/populations with genetic ability to tolerate wide range of conditions</td>
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<td>Maintain species productivity</td>
<td>Thin stands to reduce water use</td>
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<td>Conserve genetic diversity</td>
<td>Control undesirable plant species likely to become more competitive</td>
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<td>Enhance adaptive capacity</td>
<td>Silvicultural systems maintain genetic/species diversity</td>
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<td>Incorporate knowledge of species vulnerability in silvicultural decisions</td>
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<td>Develop reliable process models for predicting future stand development</td>
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Emphasize genetics to tolerate wide range of conditions: western larch improved family field trial

Field performance of top improved western larch families from IETIC orchard

Test family differences in drought tolerance and growth (greenhouse)

Examine family responses to site quality and presence of non-tree competition
Density management to maintain/improve vigor
Hydrology-oriented silviculture

Mid-aged (~60 years) Mediterranean pine thinned to different densities:
- Control: 600 tpa
- Low: 300 tpa
- Med: 190 tpa
- High: 70 tpa

Reducing density:
- Lowered tree water use, loss from surface evaporation, and total water loss
- Increased loss from understory & upper soil
- Increased soil storage

Adapted from: del Campo et al. 2014. EJFR 133: 879-894
Hydrology-oriented silviculture

Reducing density:
- Increased average tree growth per unit of water used (WUE)
- Only heavy thinning increased water used per tree
- “Sweet-spot” is medium thinning: increased WUE but not total water use over the control
Density, water loss, and water stress (loblolly pine in Arkansas)

Thinning to low densities increased soil evaporation and tree water stress on these drought-prone sites.

Bose, Nelson, and Kane. *In Review.*
Effects of understory vegetation on water and stress

What if resources (water, nutrients) are captured by non-tree understory vegetation following thinning?

Lower tree density increased understory transpiration and soil evaporation in European oak stands

Early competition management improves long-term productivity

Effects of early competition on stand growth and yield were still evident after 32 years

Early competition management improves long-term productivity

Early competition removal to enhance vigor and growth through age 37 in Ponderosa pine
Will increased tree stress and increased vigor of competing vegetation cause shifts in competition thresholds?

Future Research Directions

• Strategies for managing water use and water-use efficiency
  • Response to thinning and understory control
  • Silvicultural prescriptions based on minimizing water loss, enhancing water-use efficiency, and improving productivity

• Strategies for promoting early tree establishment and growth
  • Changing competitive dynamics
  • Deploying genetics adapted to current & future site conditions (drought-resistance & growth)
Questions?