# How forest management influences interaction between vegetation and water





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## Outline

## Management effects on tree water use:

- Tree and stand ages
- Density/thinning
  - Understory vegetation
  - Trees
- Stand structure
- Species mixture

#### Limited data, in many cases only a single study

#### Stand/tree age



From Moore et al. 2004 Tree Physiology

## **Thinning impacts**

![](_page_3_Picture_1.jpeg)

Wind penetration

Maximum Temperatures

Humidity

Soil moisture

### **Density – understory vegetation**

## In drier climate:

Thinning "....might also increase soil and understory evapotranspiration"

Lechugaa et al. 2017

![](_page_4_Picture_4.jpeg)

## **Stand density**

![](_page_5_Figure_1.jpeg)

![](_page_5_Figure_2.jpeg)

![](_page_5_Picture_3.jpeg)

**Extreme exposure leads** to higher moisture stress of legacy trees after harvests.

## Thinning

![](_page_6_Figure_1.jpeg)

## Thinning

![](_page_7_Figure_1.jpeg)

# Under all water conditions, growth in thinned stands was greater than in unthinned stands.

From Sohn et al. 2016

### In years with average moisture conditions:

![](_page_8_Figure_1.jpeg)

Thinning benefits appear driven by the relative importance of water, light, and nutrients.

- On moist sites = water is not limiting
- On drier sites = a combination of water, nutrient, and light is limiting

![](_page_9_Picture_0.jpeg)

#### In western OR and WA:

Fertilization appears to increase stand leaf area, which leads to higher water stress. (Brooks and Coulombe 2009 and Cornejo-Oviedo et al. 2017)

### **Spatial considerations**

![](_page_10_Figure_1.jpeg)

Thinning benefits are limited to thinned area, do not spread downhill e.g., into unmanaged riparian areas.

From Ruzicka et al. 2014 ForSci

## **Benefits over Time**

![](_page_11_Picture_1.jpeg)

#### **Time consideration**

![](_page_12_Figure_1.jpeg)

## Thinning benefits are lower

- after multiple thinnings
- over time

Older (larger) trees are more sensitive to drought conditions.

From D'Amato et al. 2013

#### **Stand structure**

![](_page_13_Picture_1.jpeg)

"Structural diversity had no influence on increment stability during the extreme summer drought.."

Dănescu et al. in press ForEcolMan

### **Species mixture**

![](_page_14_Picture_1.jpeg)

In fully stocked stands: Species mixtures do not seem to differ from monoculture in terms of water use.

possibly due to
 interactions of species
 proportions and water use
 efficiency

From Moore, G. 2003 PhD-thesis, OSU

**To prepare forests for drought:** 

 Maintain stands below full stocking (overand understory), regardless of

 stand structure and
 species composition

Cannot "bank" thinning
 impacts limited in space and time

 Consider interplay between water, nutrients, and light