Climate change and insect pests of trees



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Climate change impacts in PNW

- Increasing CO_2
- Increasing average temperature and duration
- Decreasing precipitation in summer and increasing (rain but not snow) in the winter

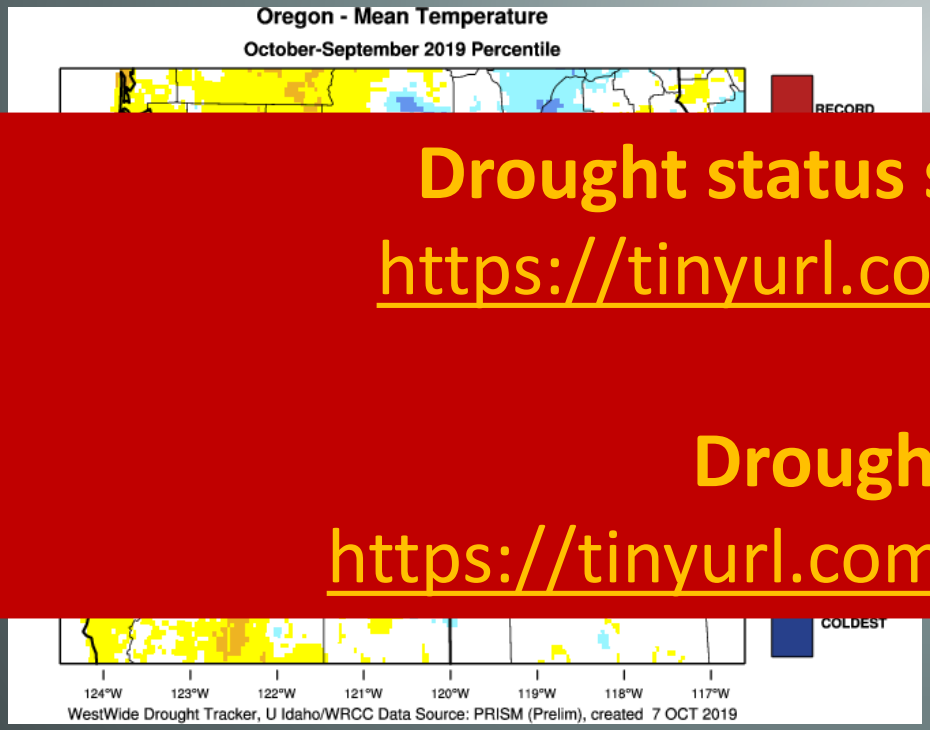
Less skiing and more wildfires

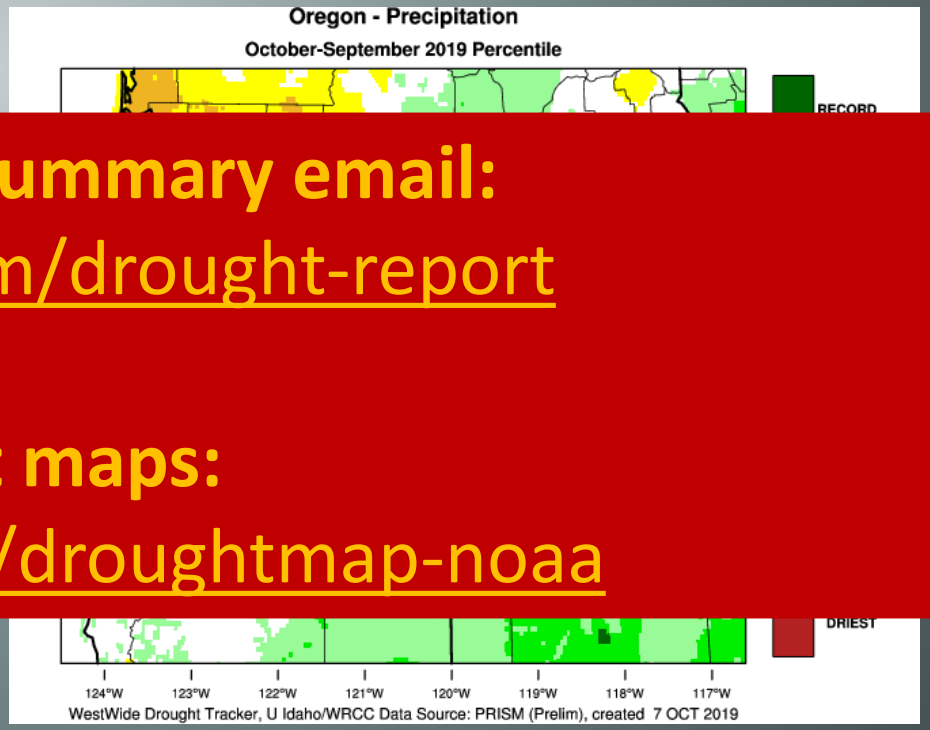
☹

Climate change: Drought

Drought =

1. extended **warm and/or dry days**
2. lack of consistent **precipitation (including snowpack)**





Drought status summary email:
https://tinyurl.com/drought-report

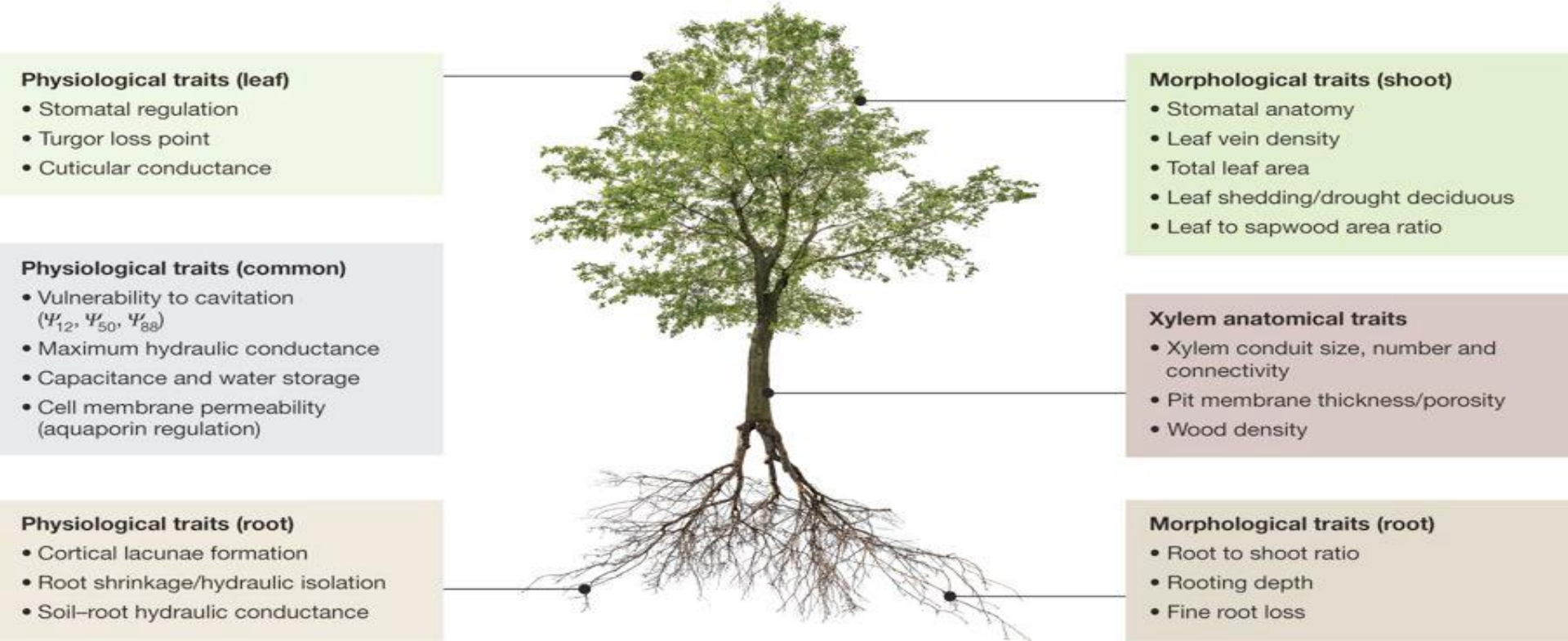
Drought maps:
https://tinyurl.com/droughtmap-noaa

Effects of climate change: Trees

- Moisture and heat stress
- Increased CO_2 = increased growth (⇧ H_20 need)
- Stomatal closure = starvation/reduced growth and function
- Less moisture and carbon allocation to secondary metabolites (i.e., defenses)
- Altered phenology = asynchrony
- Longer growing season
- Shifted distribution and/or range

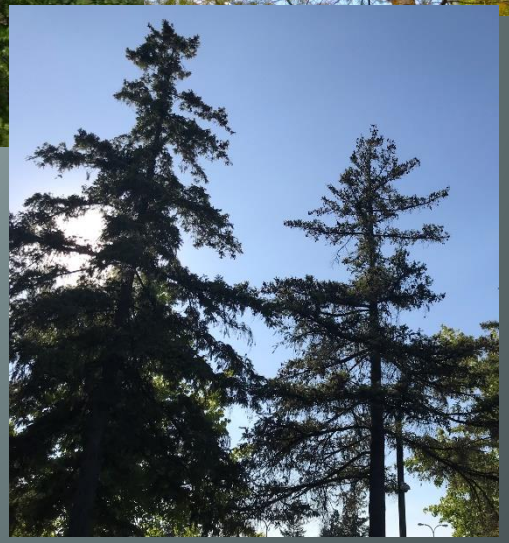
Drought mechanisms

- Collapsed vascular system
- Reduced roots
- Fewer resources for growth & defense (resistance and tolerance)



Drought signs and symptoms

- Topkill
- Branch tip dieback or flagging
- Thinning crown
- Stress cones
- Asymmetrical crown
- Leaf scorch
- Mortality across species
- Observe what species are thriving



Other factors interacting with drought

- Previous stress
- Soil type
- Aspect
- Topography and site microclimates (ridge, edge, draw effects
- Timing, duration, quickness of change
- Tree height
- Vegetation cover
- Winds

etc….

STRESSED TREES = SUSCEPTIBLE TREES

Effects of climate change: Insects

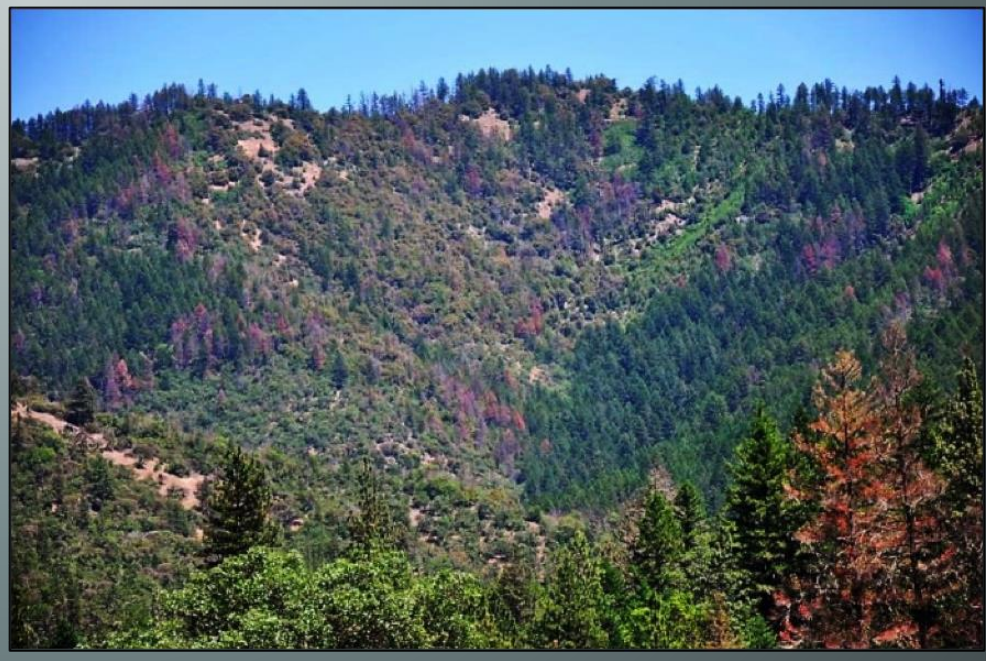
- Earlier emergence, later diapause
- Altered synchrony with hosts and natural enemies
- Longer feeding periods (=higher fecundity?)
- Shorter life stages and more generations possible
  ****Only over the loooong term – evolutionary process)****
- Reduced winter mortality (fewer late freeze events)
- Range shifts

Case studies: spruce aphid

Mild winter resulting in an increase in exotic, established Sap-sucking insect in Sitka spruce along north coast

Case studies: flatheaded fir borer

Drought and fire damage resulting in subsequent mortality from native, woodboring beetle



Case studies: Douglas-fir beetle

Storm events resulting in blowdown attract native, bark beetle to infest and spread to adjacent trees, increased outbreak risk during droughts

Insects most associated with drought

Douglas-fir

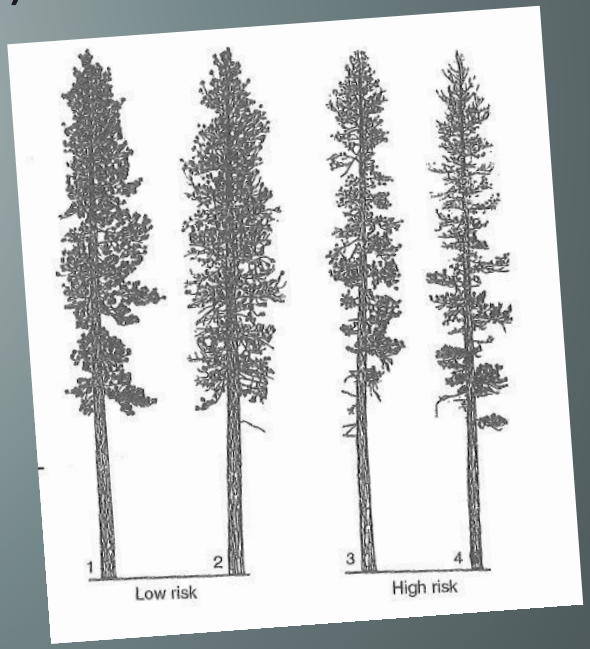
- Doug-fir beetle (>10” dbh, attracted to blowdown)
- DF pole and engraver beetles (small diameter)
- Flatheaded fir borer

True fir

- Fir engraver (mostly grand fir in the Valley)

Pine

- Ips (3-8” diameter, attracted to fresh slash)



Trees are also still at risk *after* attacks due to reduced tolerance

Effects of climate change: Diseases

- Temperature and moisture changes (+/- influence on pathogen presence or virulence)
- Altered phenology (spore release, insect vector synchrony, etc.)
- Pathogens are better adapted for evolution (short lifespan, quick and prolific reproduction) than their long-lived hosts
- Altered distribution and range (ability to travel in wind, water, soil, equipment, etc.)

Case studies: diseases

Temp and moisture affect survival, reproduction, spread, infection:

Sudden Oak Death, Swiss needle cast, dothistroma needle blight, white pine blister rust

Case studies: diseases

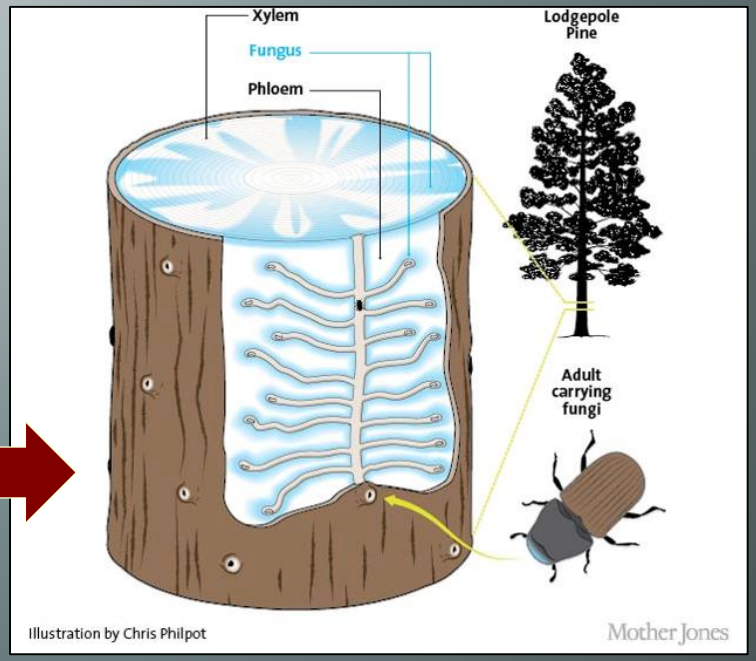
Temp and moisture affect host resistance:

Armillaria, diplodia/sphaeropsis shoot blight, pitch canker

Case studies: diseases

Impacts on vectors:

Walnut twig beetle, elm beetles, ambrosia beetles, etc.



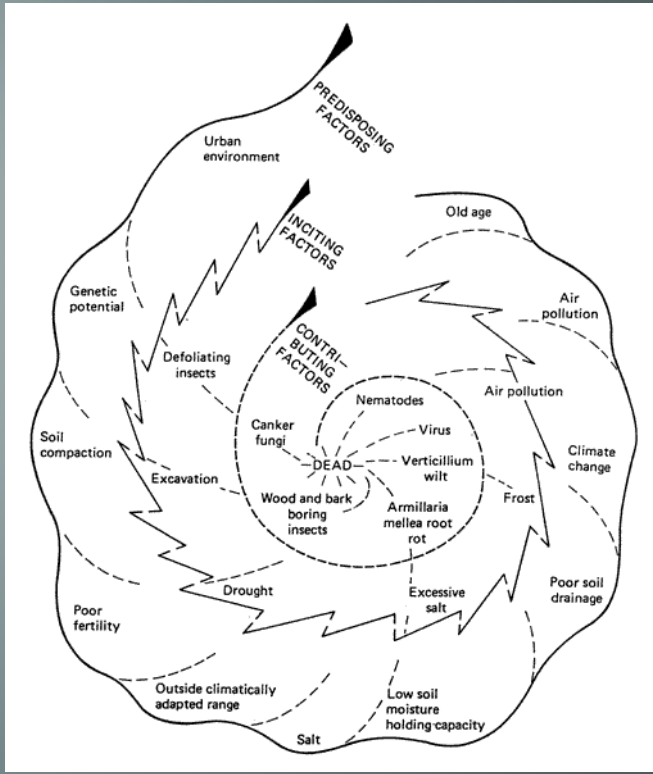
Case studies: tree declines (abiotic?)

- Redcedar ???
- Bigleaf maple ???
- Grand fir ???

Decline building in intensity

Manion Spiral:

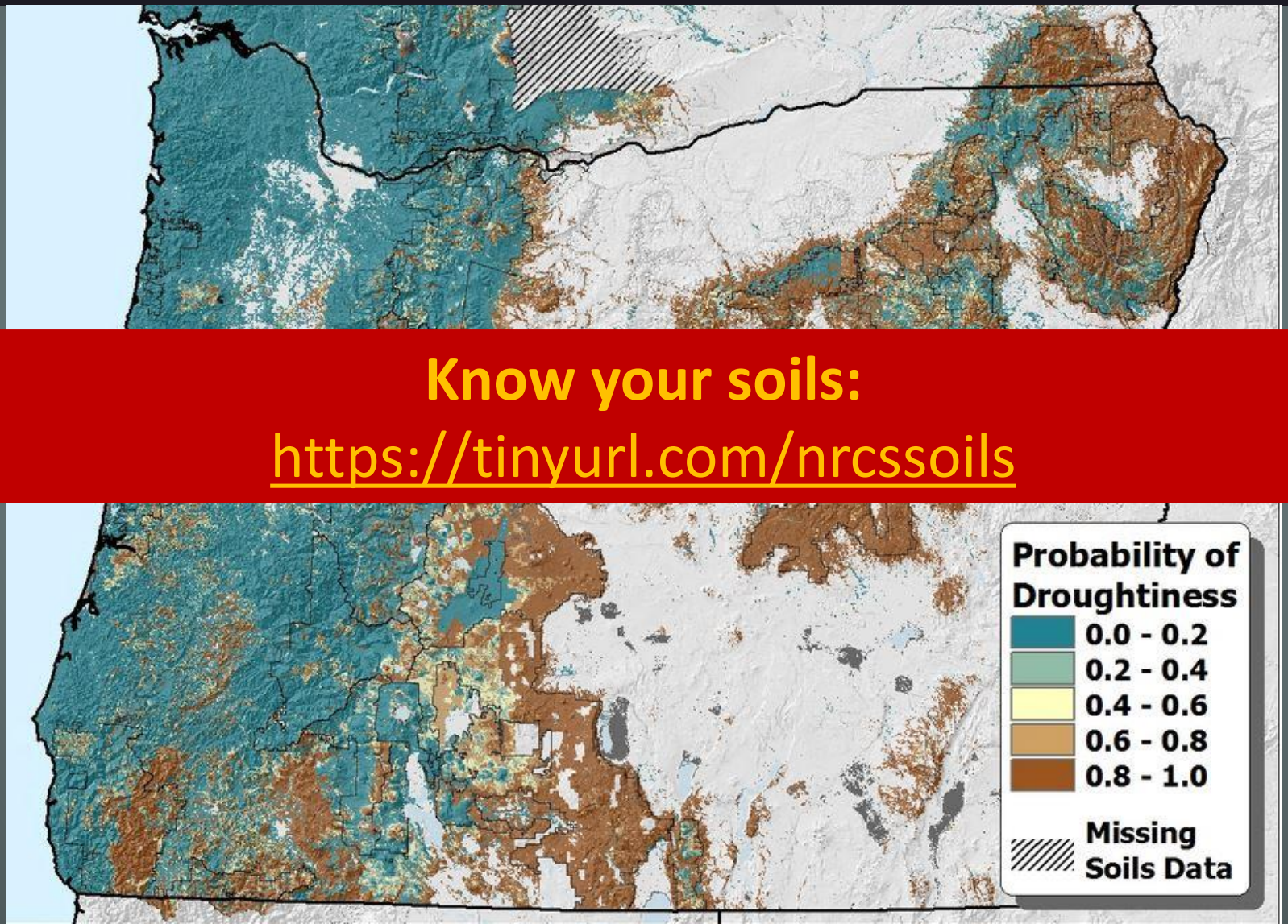
- Trees can go into a decline if there is first a factor that will predispose the tree to decline, followed by an inciting factor to trigger the decline, and finally a contributing factor that could eventually kill the tree
- Most documented decline examples are resulting from several factors
- Example: drought stresses trees → wildfires occur in the environment → insects take advantage of influx of drought and fire damaged trees (1-2 punch to tolerance and resistance)



General climate change management

1) Don’t assume this is a short-term problem
2) Plant the right species in the right place
3) Promote resilience
4) Anticipate and plan for associated I&D risks
5) Manage pine slash and Doug-fir blowdowns
6) Increase diversity
7) Don’t fertilize
8) Manage understory weeds
9) Long, slow (maintained) irrigation
10) Thinning (windthrow and soil drying are post-thinning risks)
11) Avoid extensive work and mechanical damage during droughts

Soil drought predictions



Know your soils:
https://tinyurl.com/nrcssoils

RESOURCES

General:

- USDA Pacific Northwest Climate Hub (http://climatehubs.oce.usda.gov/northwest)
- Climate Change Resource Center (http://www.fs.usda.gov/ccrc/)
- TACCIMO (http://www.taccimo.sgcp.ncsu.edu/tbl_sector_list.php)
- ANREP Climate Science Initiative (https://sites.google.com/site/anrepclimate/home)
- Engaging Private Forest Owners on Climate Change Issues (http://www.nap.edu/catalog/18807/climate-change-education-engaging-family-private-forest-owners-on-issues)

Climate change basics:

- Climate Change Resource Center (http://www.fs.usda.gov/ccrc/climate-basics/education)
- NOAA Climate.gov (https://www.climate.gov/maps-data/primer/climate-data-primer)
- American Assn. for the Advancement of Science (http://whatweknow.aaas.org/consensus-sense/)

Adaptation/Mitigation

- Climate, Forests & Woodlands (http://articles.extension.org/climate_forests_woodlands)
- Oregon Forests and Climate Change (http://blogs.oregonstate.edu/orforestscc/)

Tools/Applications

- Drought monitoring survey (https://tinyurl.com/forestdroughtsurvey)
- Ecotrust: Forest Planner (http://forestplanner.ecotrust.org/)
- N. Institute of Applied Climate Science (http://www.adaptationworkbook.org/)
- Forest Forecasts (http://forestforecasts.org/)
- Rocky Mt. Research Station (http://forest.moscowfsl.wsu.edu/climate/species/index.php)