WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Western Washington Forest Health

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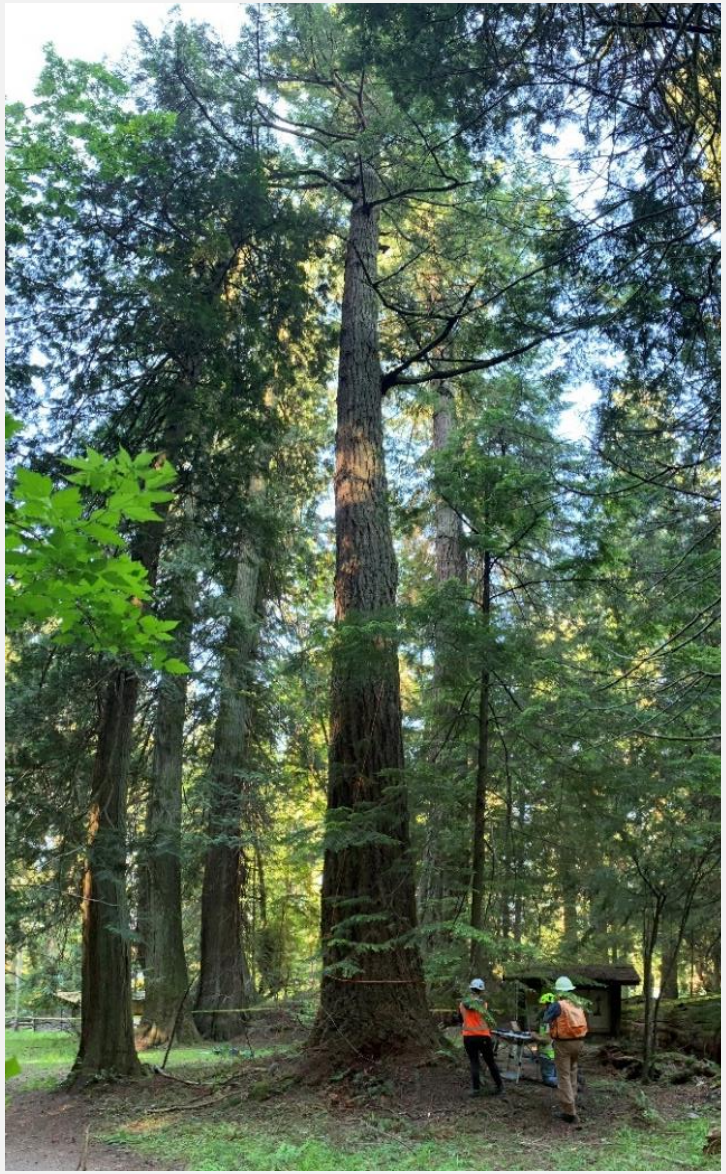
WDNR's Forest Health Group

Forest pathologists and entomologists for our state, industry, and private land

- Monitoring
- Technical assistance
- Research

www.dnr.wa.gov/LandownerAssistancePortal

Tree health vs Forest health



vs.

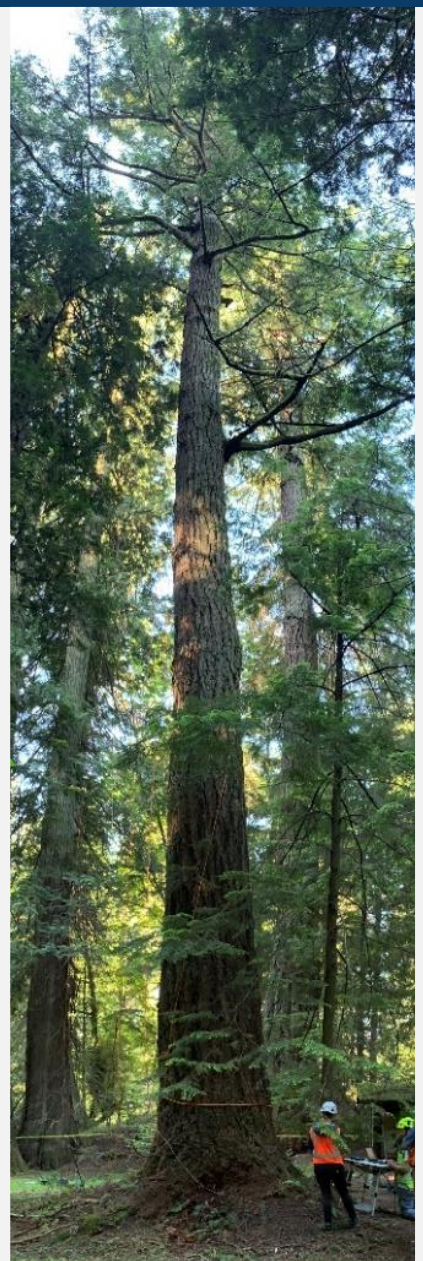
What does a healthy forest look like?

- Provides basic ecosystem services
- Meets landowner objectives
- Resilient to disturbances

Disturbance agents

abiotic (non-living)

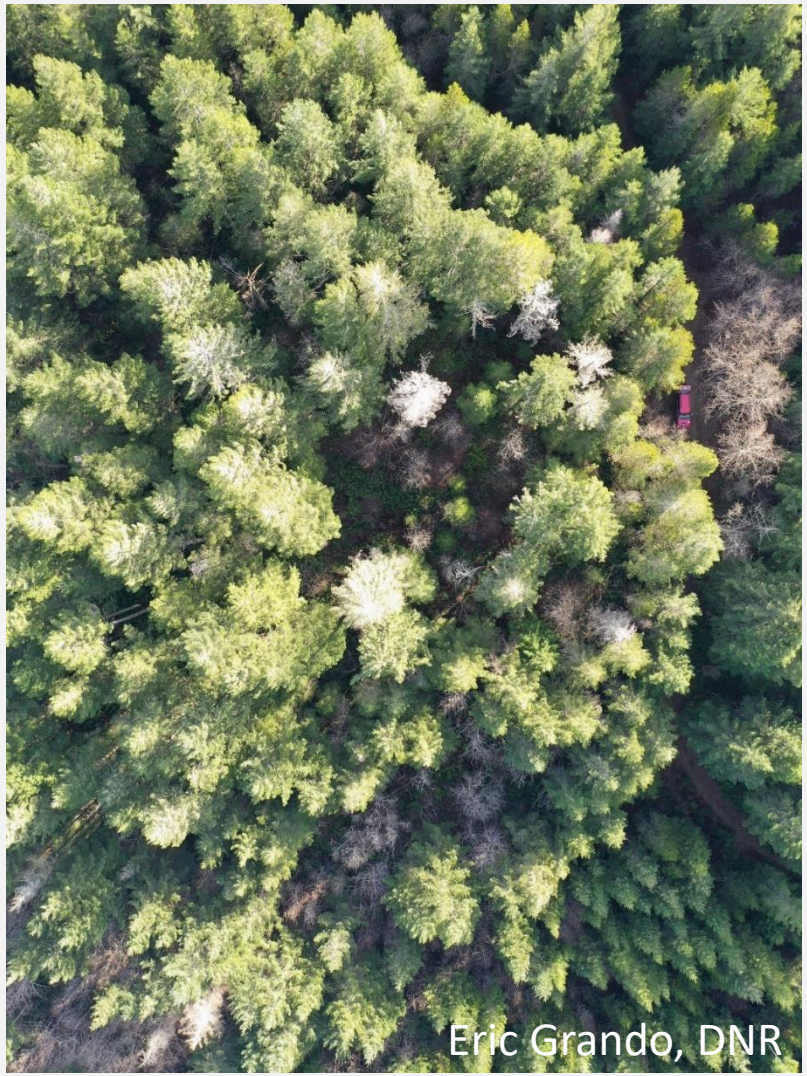
- mechanical damage
- temperature extremes
- moisture extremes
- low oxygen
- nutrient imbalance
- soil pH
- air pollutants
- herbicides



biotic (living)

- viruses
- bacteria
- fungi, oomycetes
- parasitic plants
- nematodes
- insects, mites
- other herbivores
- genetic abnormalities

Disturbance agents: Positive impacts



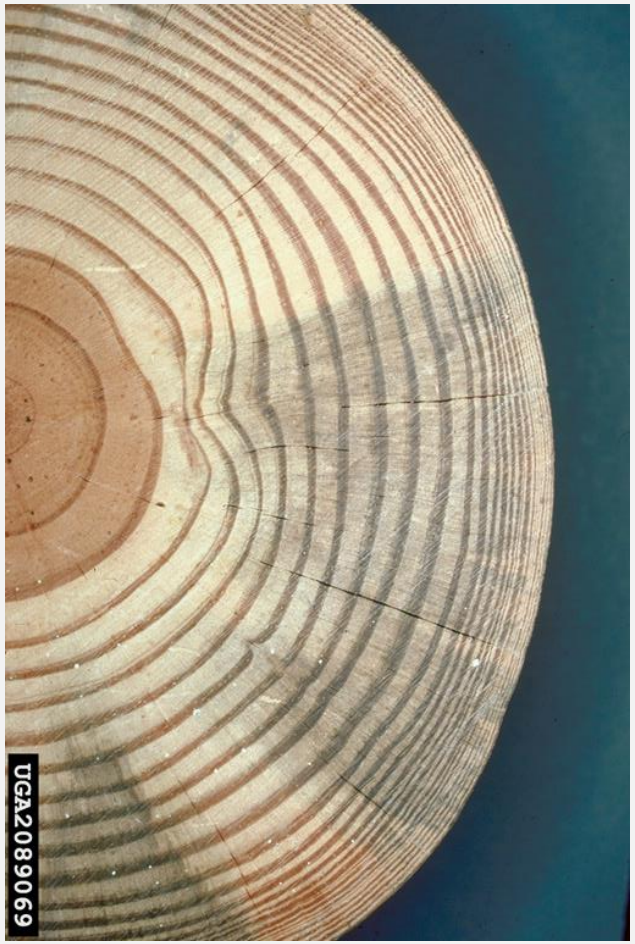
Natural thinning, wildlife habitat, decomposition, diversity

Disturbance agents: Negative impacts

Economic and ecosystem costs

Disturbance agents cause symptoms

Underdevelopment

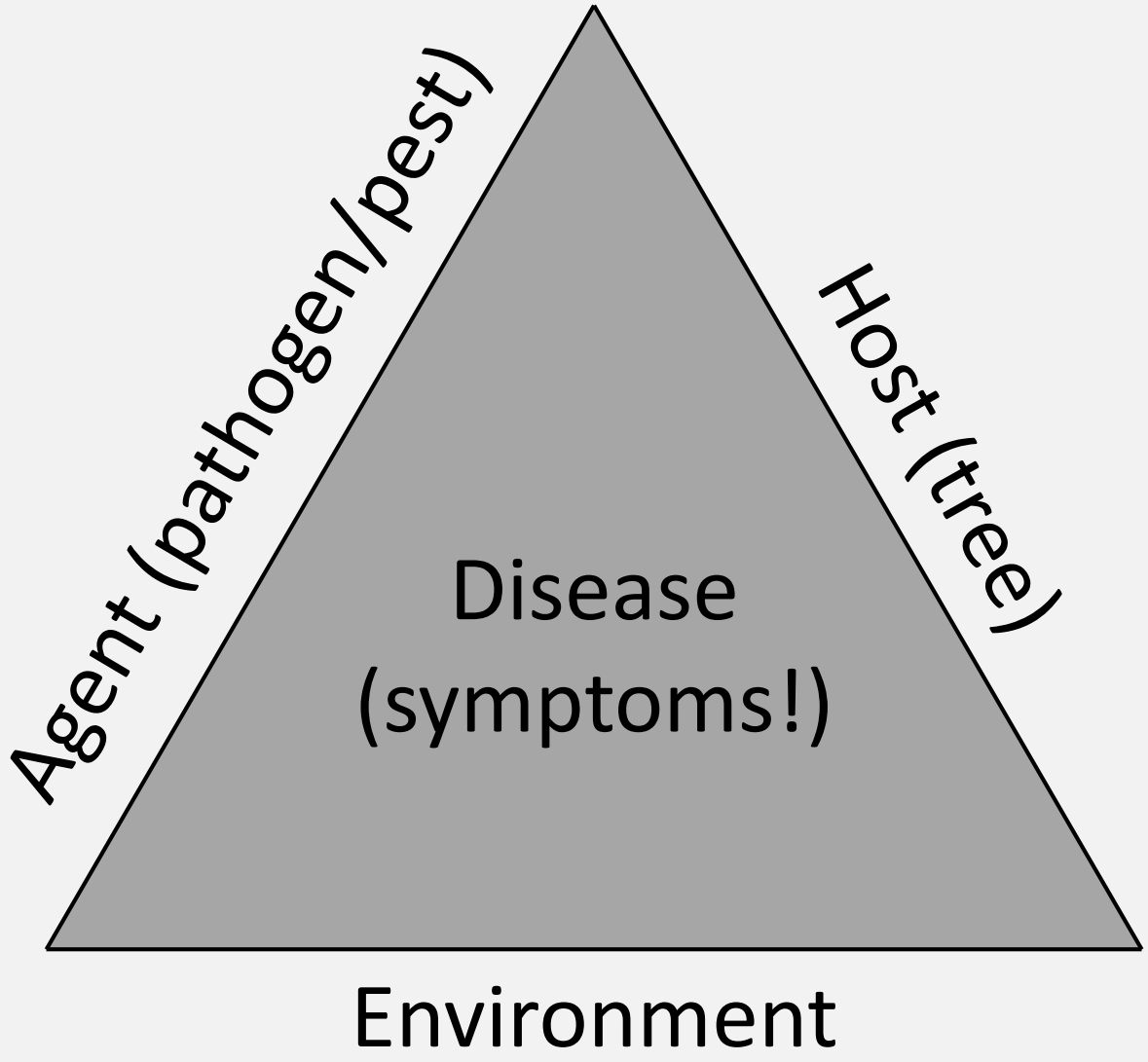


Overdevelopment

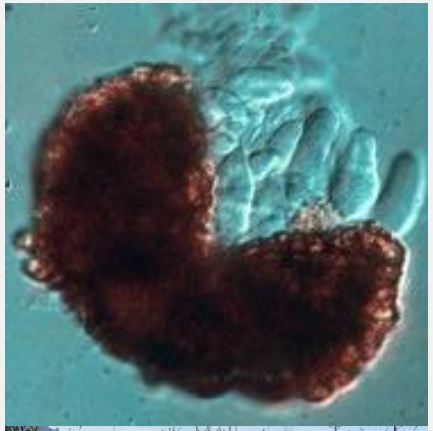
Necrosis (death)

of tissues, organs, or portions of the plant

Disease Triangle

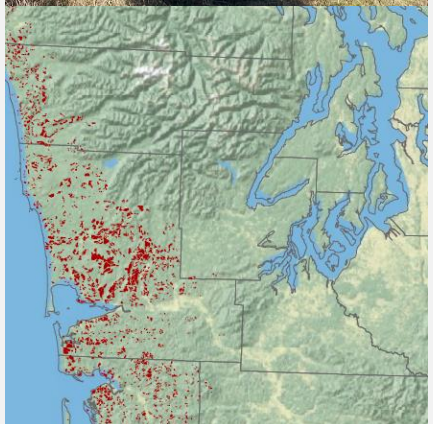


Disease Triangle Example



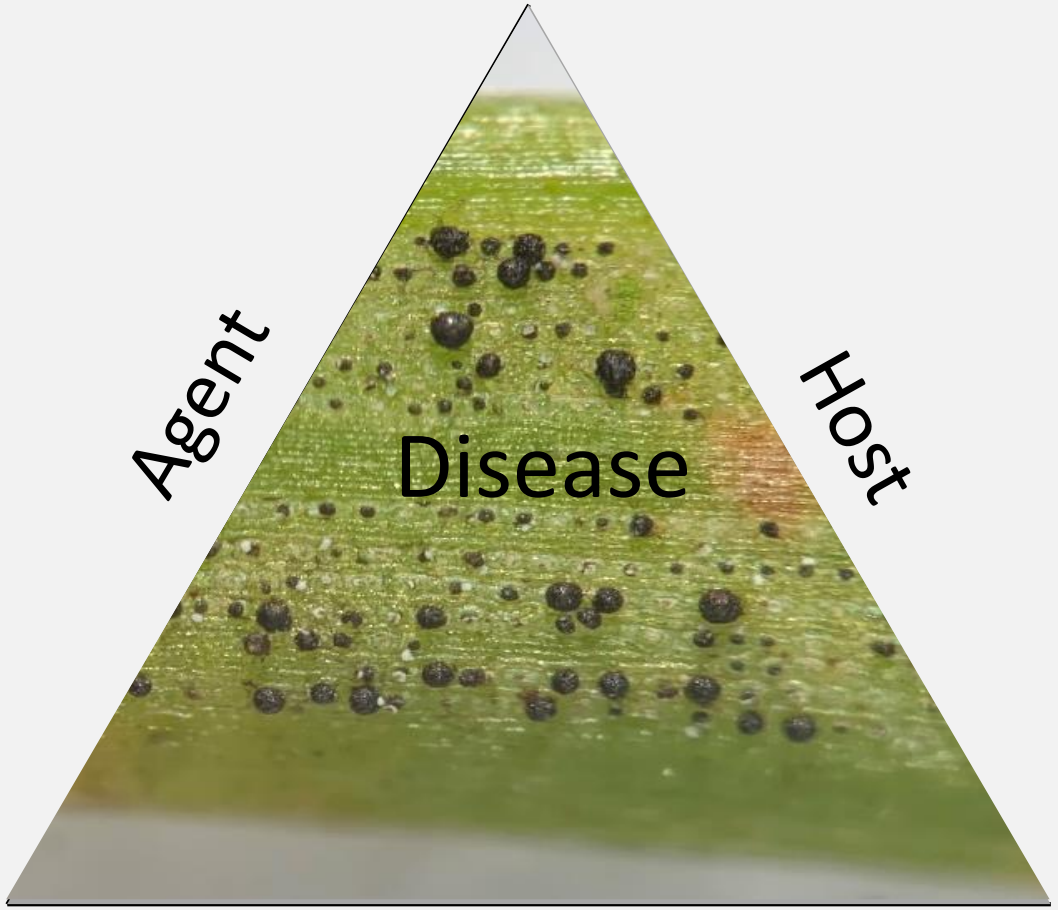
Agent:
Nothophaeocryptopus gaeumannii (fungus)

Host:
Douglas-fir



Environment:
Moist cool springs

Swiss needle cast



What is the most important disturbance agent?

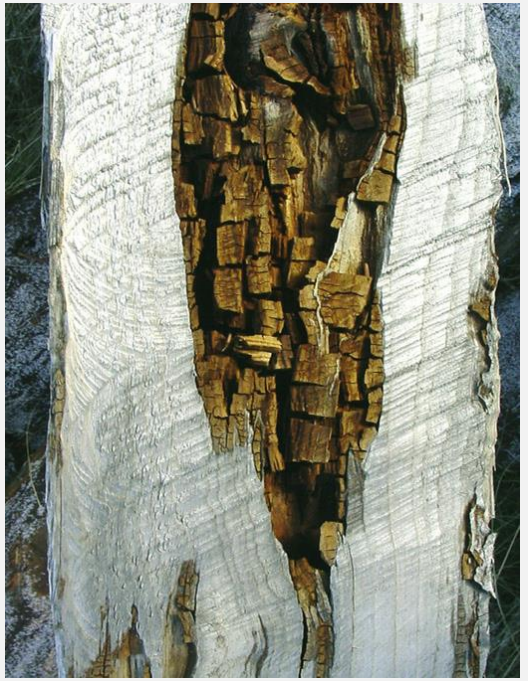
Examples

- Root rots
- Bark beetles
- Drought & heat

Rots

White rot

Brown rot



Root rot diseases

<- decayed roots

Healthy roots ->

Root rot stand symptoms

“pockets” of symptomatic trees

Several stages of slowly declining trees

Down trees in a “jacksaw” pattern

Regen of other species or young susceptible

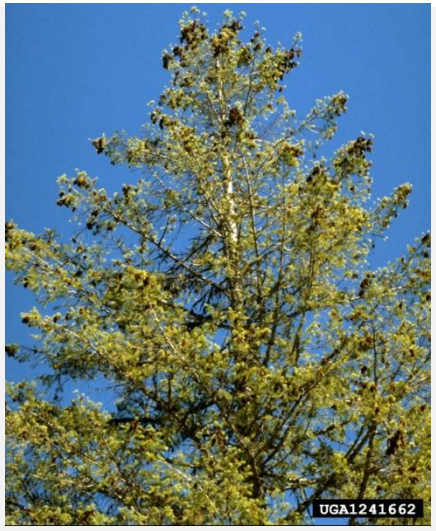
Root rot tree symptoms

Root-butt rot

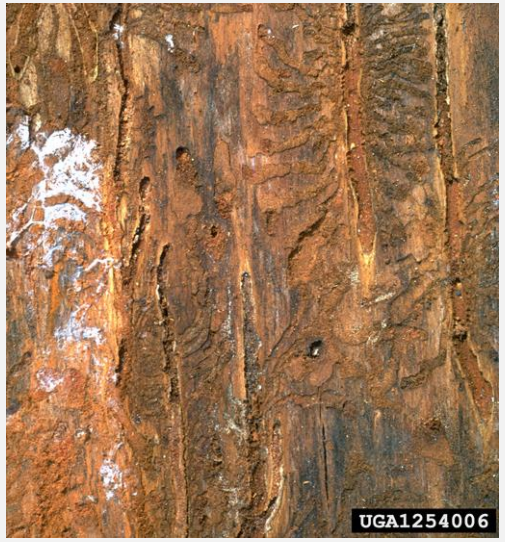
Resinosis on root collar

Thin and discolored crown

Reduced growth



Distress cone crop



Secondary bark beetle activity

Identify specific root rots

1. Determine which tree species are being impacted

Hosts	Laminated root rot	Armillaria root disease	Annosus root disease	Black stain root disease	Port-Orford-cedar root disease
Douglas-fir Westside	1[2]	2[3]	3	1	4
Douglas-fir Eastside	1	1	3	3	4
Ponderosa pine	3	2	2	3	4
Jeffrey pine	3	2	2	3	4
Lodgepole pine	3	2	2	3	4
Knobcone pine	3	2	3	3	4
Western white pine	3	2	3	3	4
Sugar pine	3	2	3	3	4
Whitebark pine	3	3	3	4	4
Grand fir	1	1	1	4	4
White fir	1	1	1	4	4
Noble fir	2	2	2	4	4
Pacific silver fir	2	2	1	4	4
Subalpine fir	2	2	2	4	4
Shasta red fir	2	2	2	4	4
Western hemlock	2	2	2[4]	3	4
Mountain hemlock	1	2	1	3	4
Western larch	2	3	3	4	4

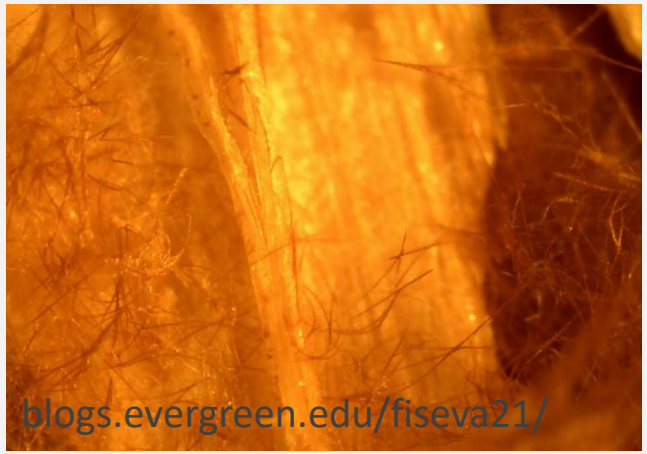
(see resources at end for full table)

Identify specific root rots

2. Examine roots for rot and for fungi!

Laminated root rot

Delamination



Setal hyphae (diagnostic!)

Ectotrophic mycelium

Fruiting bodies (uncommon)

Armillaria root rot

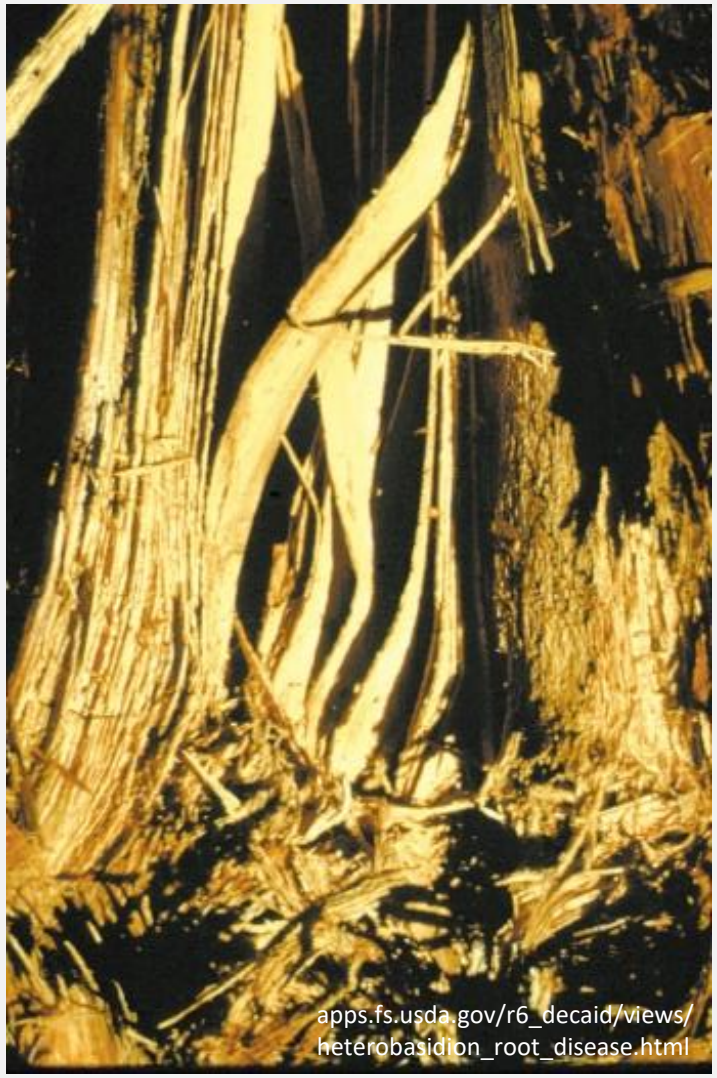
White rot

Thick white mycelial fans

Black rhizomorphs

Brown mushrooms

Heterobasidion root rot



Delamination

Stringy white rot

(~black flecks)

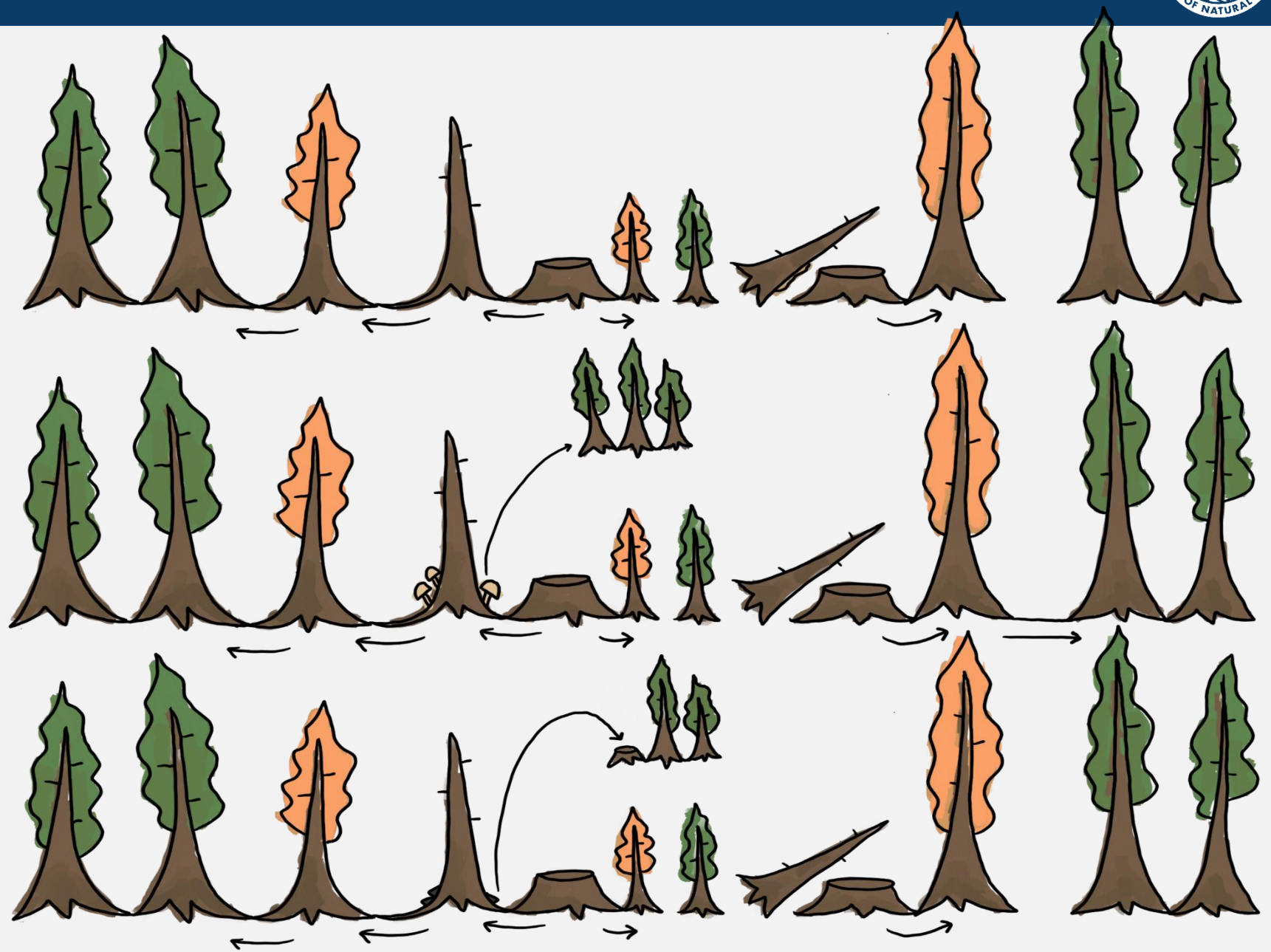
Conks (rare but diagnostic!)

Root rot life cycles

Laminated root rot

Armillaria root rot

Heterobasidion root rot



Root rot management

- Survey (know what and where)
- Manipulate tree species (encourage tolerant or resistant species)
- Minimize disease spread (manage symptomatic trees + buffer)
- Minimize soil inoculum (remove stumps and susceptible regen)
- Do nothing

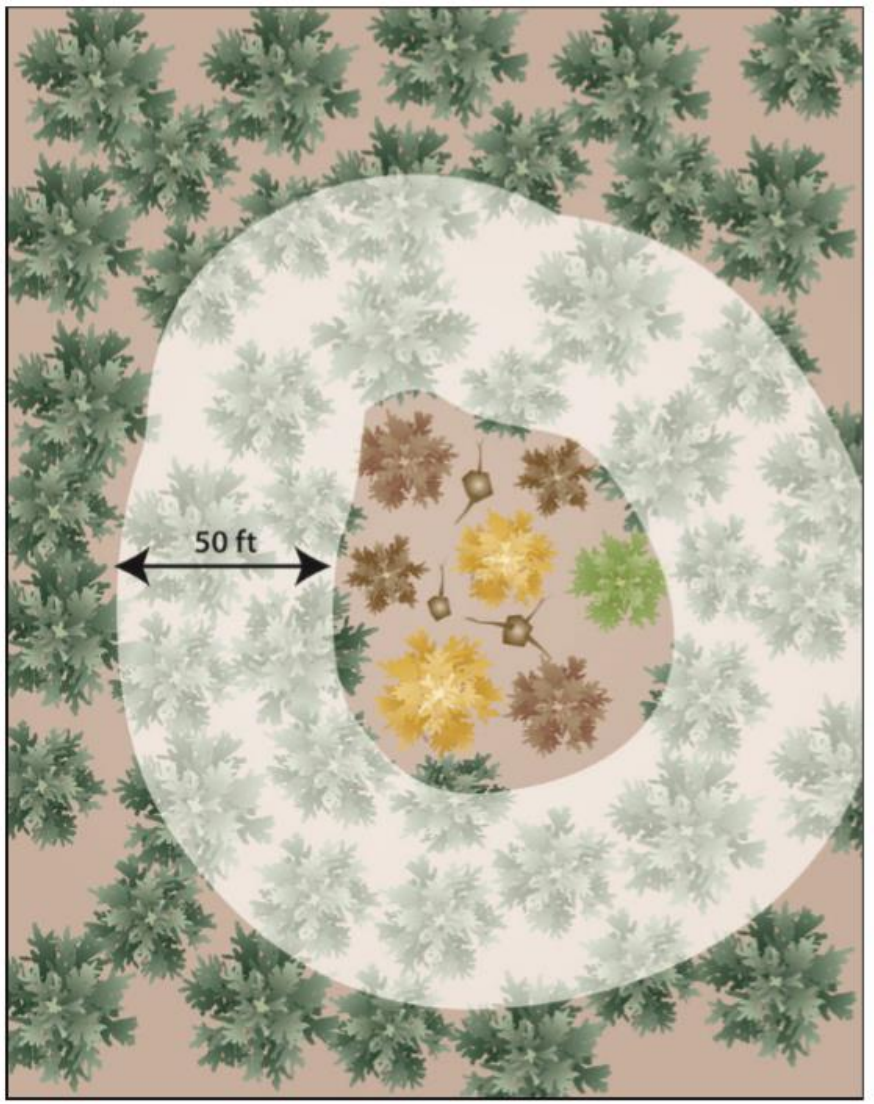


Illustration: Gretchen Bracher

Other root rots

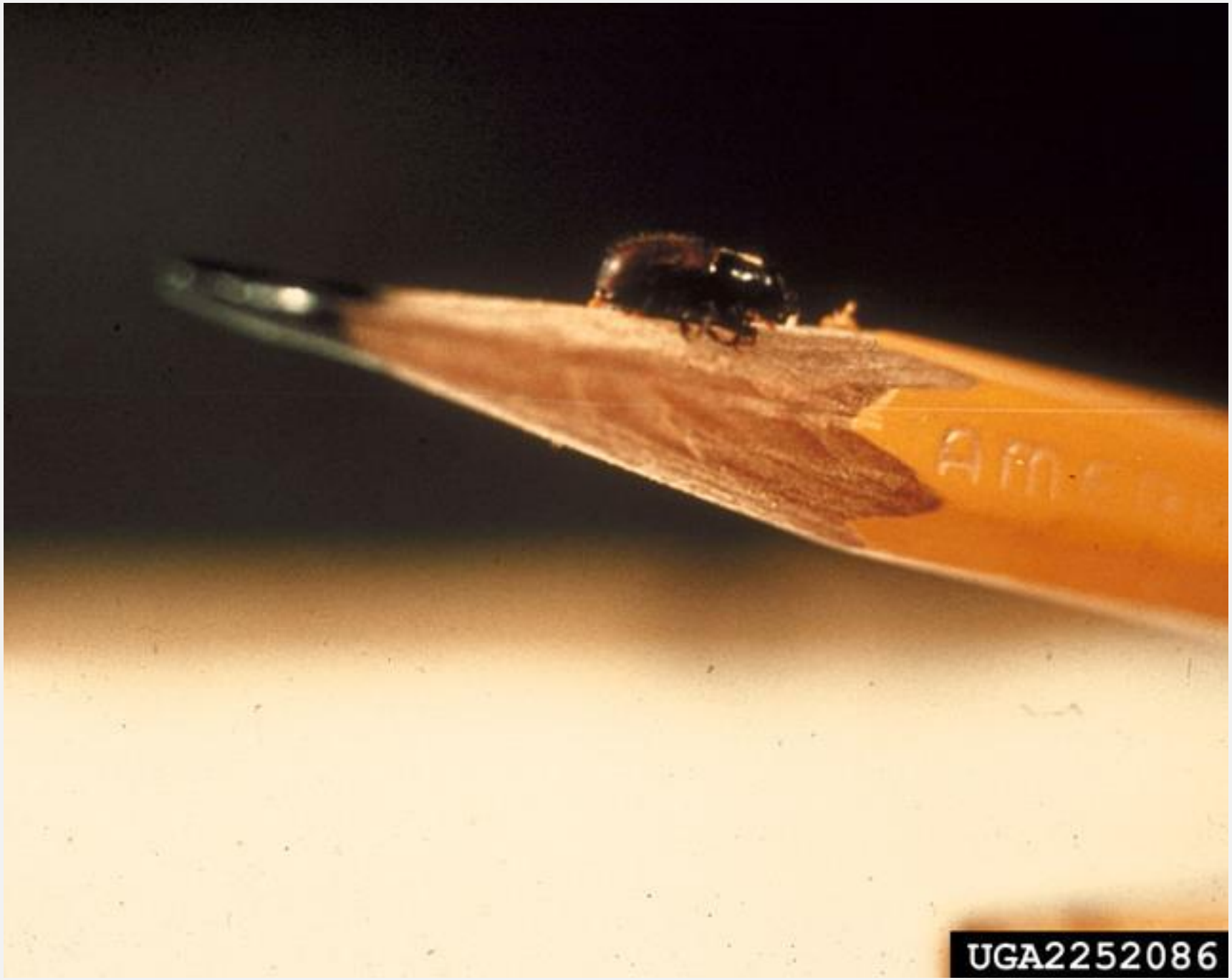
Black stain root rot *Leptographium wageneri* (Douglas-firs, hemlocks, pines)

Port-Orford root rot *Phytophthora lateralis* (Port-Orford-cedars)

Tomentosus root rot *Onnia tomentosa* (mostly Engelmann spruce, plus others)

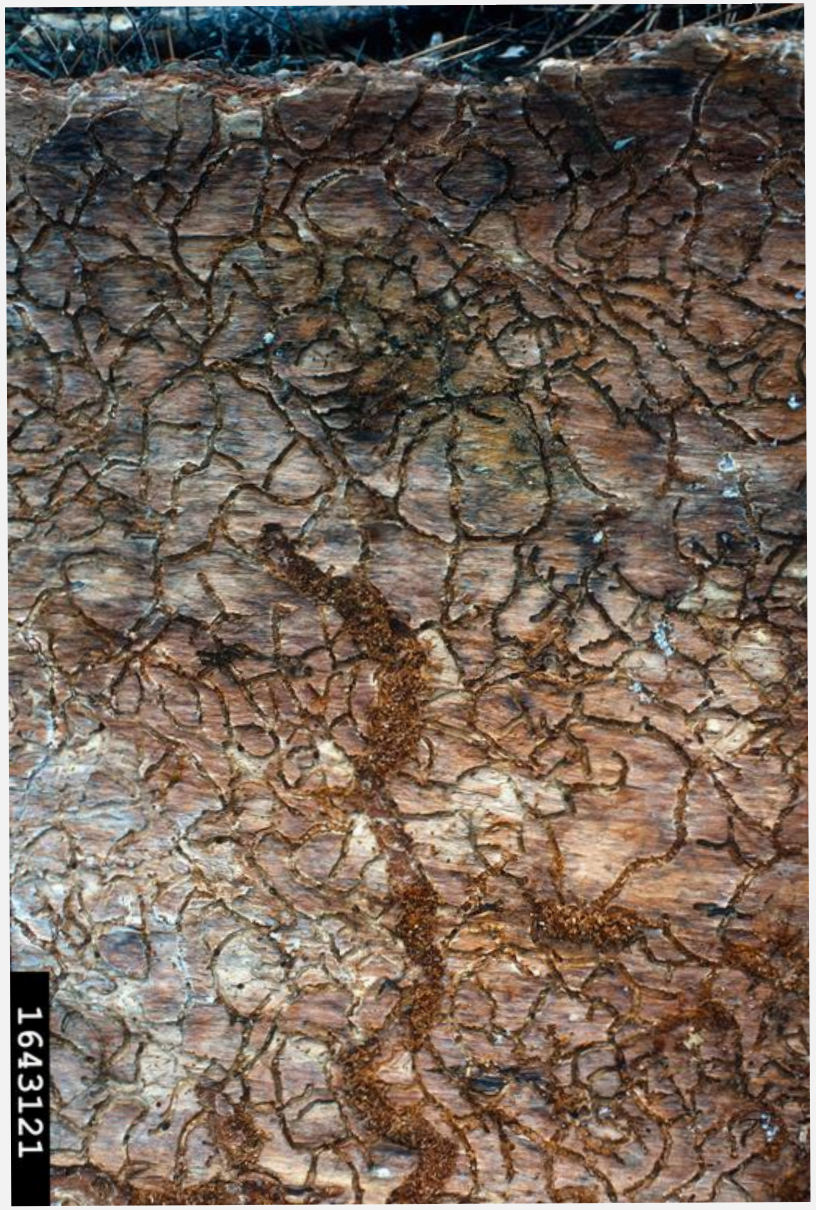
Schewinitzii root/butt rot *Phaeolus scweinitzii* (old growth Douglas-fir and others)

Bark Beetles



Bark beetle life cycle

Bark beetles damage



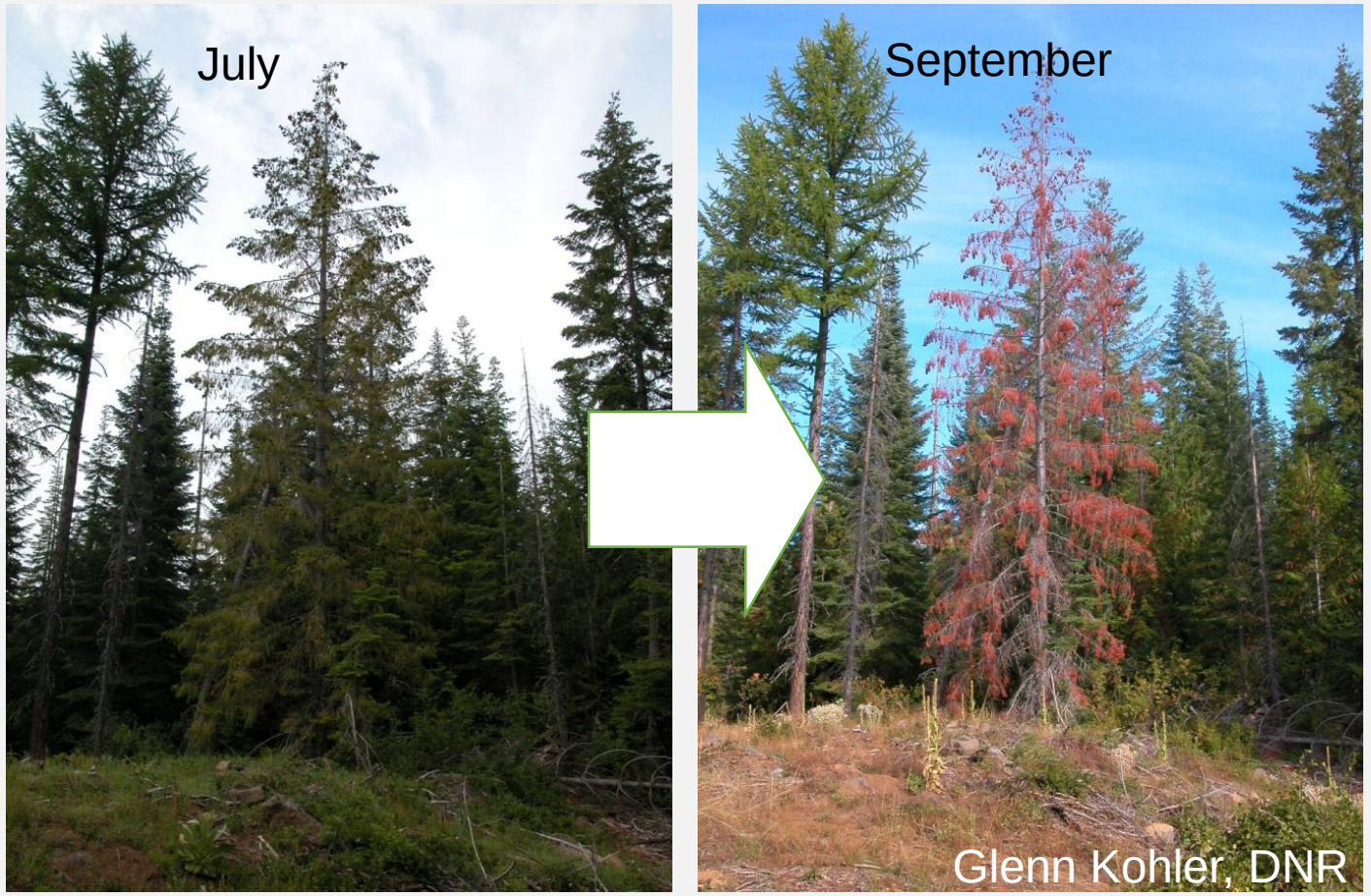
Bark beetle impact

- At low population levels, bark beetles generally attack weakened or freshly killed trees (“secondary”)
- Populations can build up when there are lots of stressed trees, allowing coordinated mass-attack of healthy trees (“primary”)

or

Bark beetle stand level symptoms

Clustered mortality, with impacted trees having similar diameter size



Rapid death, trees dying at the same time

Bark beetle tree symptoms & signs

Pitch streaming

Pitch tubes

Boring dust

Pouch fungus

Red crowns

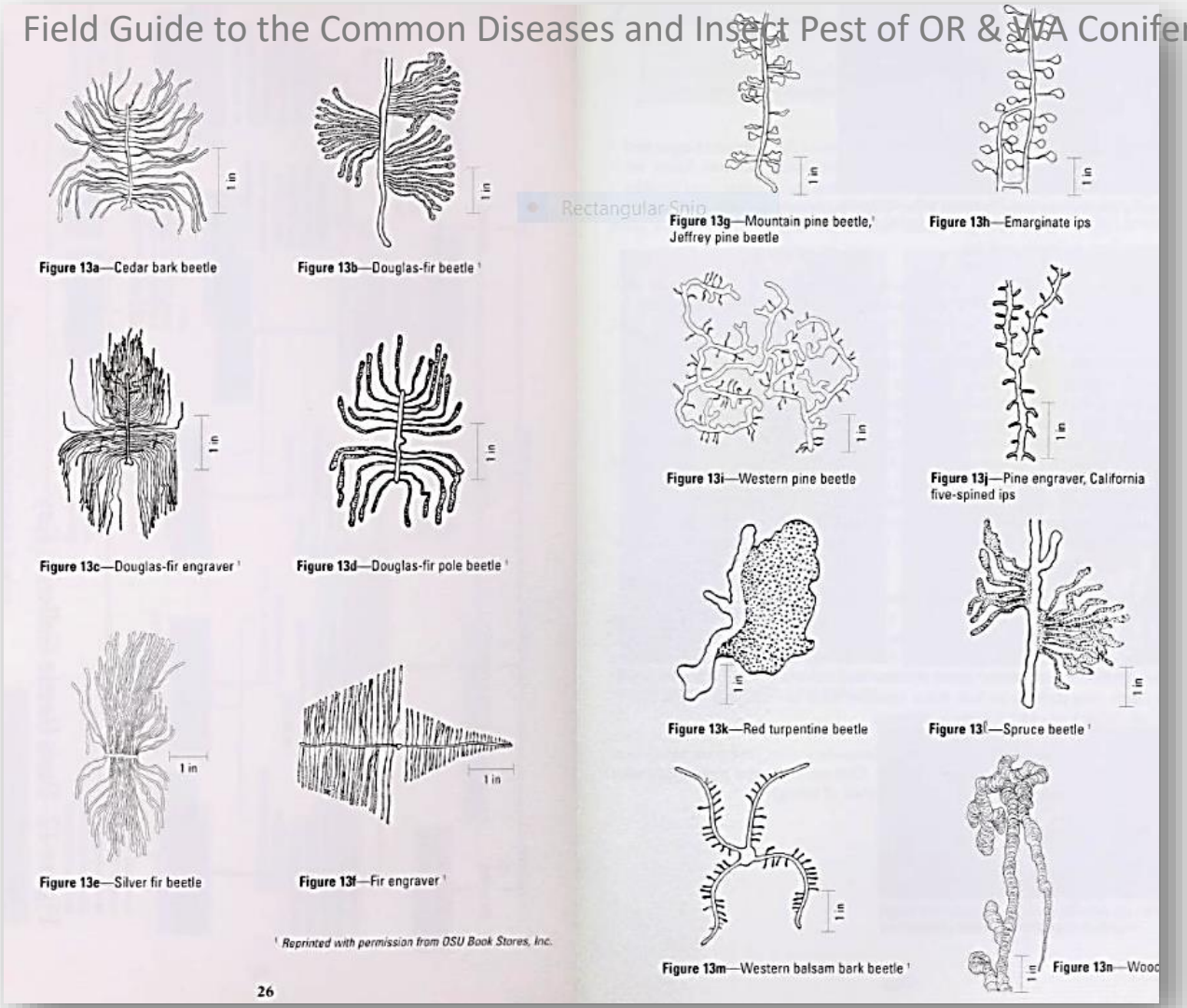
Galleries

Bark beetle ID

Species of tree impacted

Size of tree impacted

Field Guide to the Common Diseases and Insect Pest of OR & WA Conifers

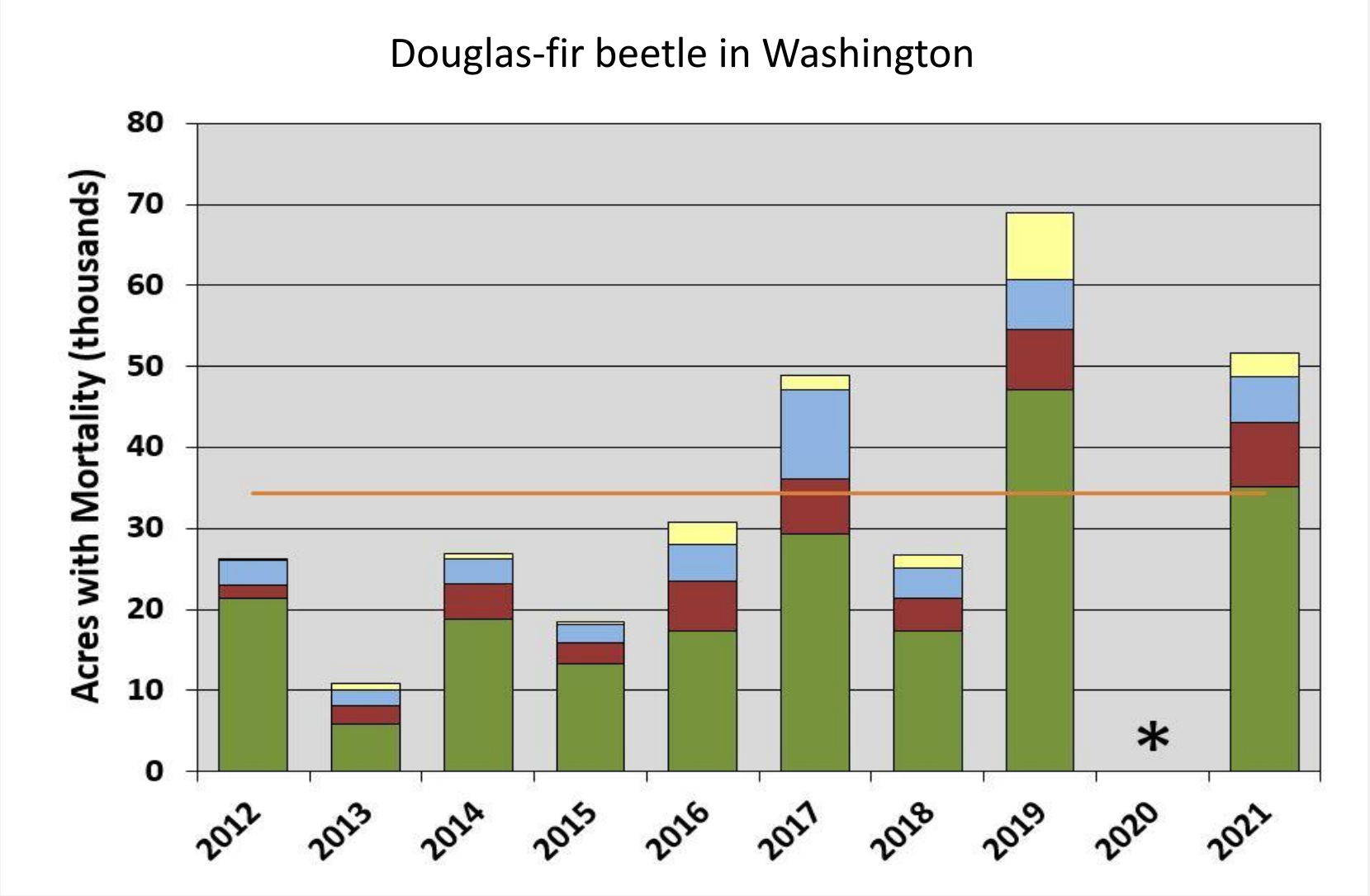


Gallery pattern

Current bark beetle trends

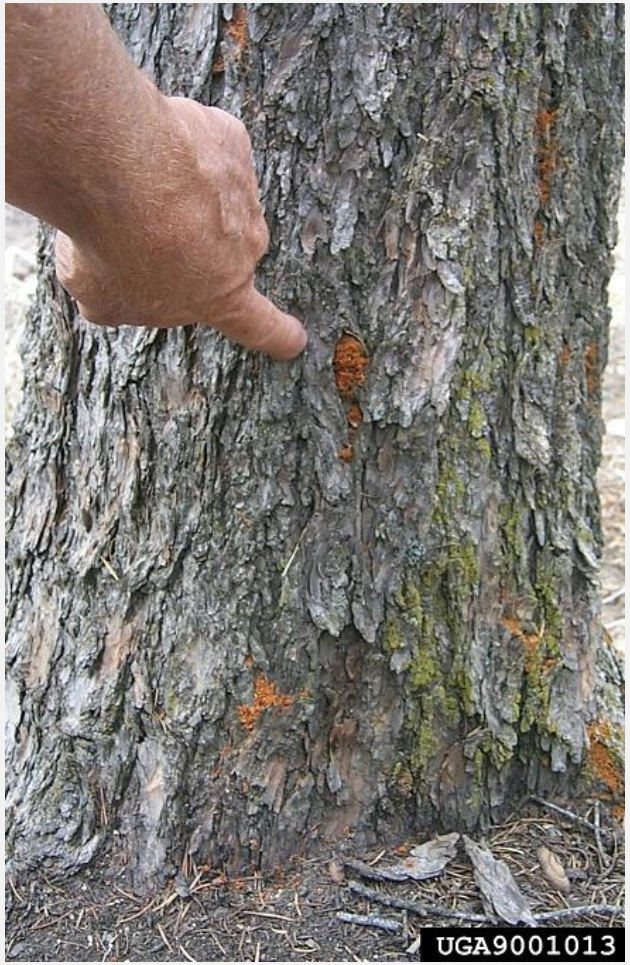
Increases related to:

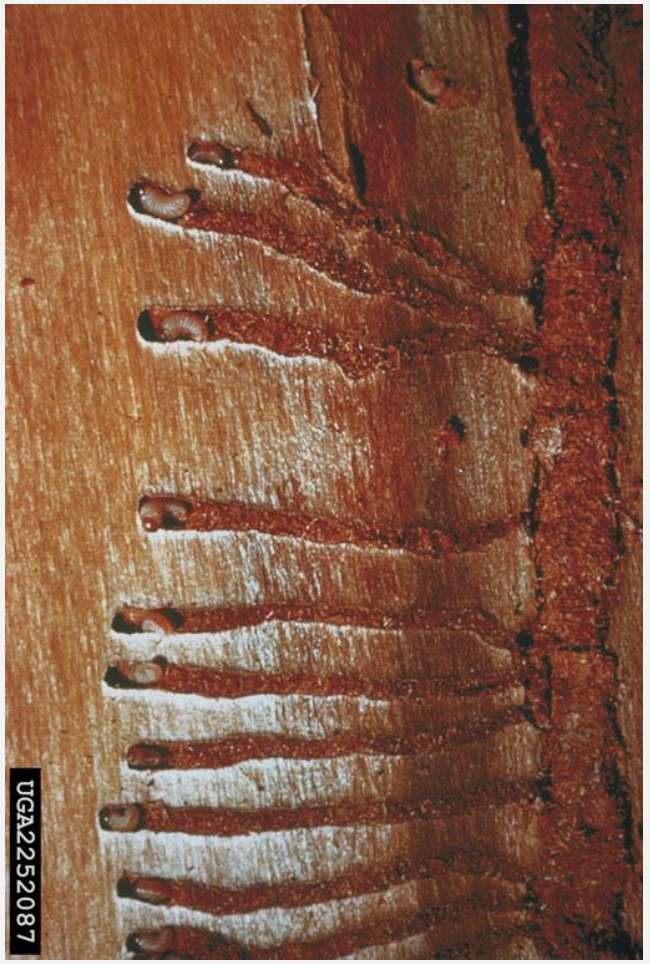
- Fire and storm damage
  - Douglas-fir beetle
- Drought
  - Western pine beetle
  - Ips
  - Fir engraver
  - Secondary bark beetles
- Stand density issues
  - Mountain pine beetle



Info: Glenn Kohler

Douglas-fir beetle: signs of an attack





Boring dust, pitch streaming, pouch fungus, and gallery pattern

General bark beetle management

Maintain tree vigor (reduce stress)

Remove large inputs of freshly dead trees

Pesticides protect don't cure

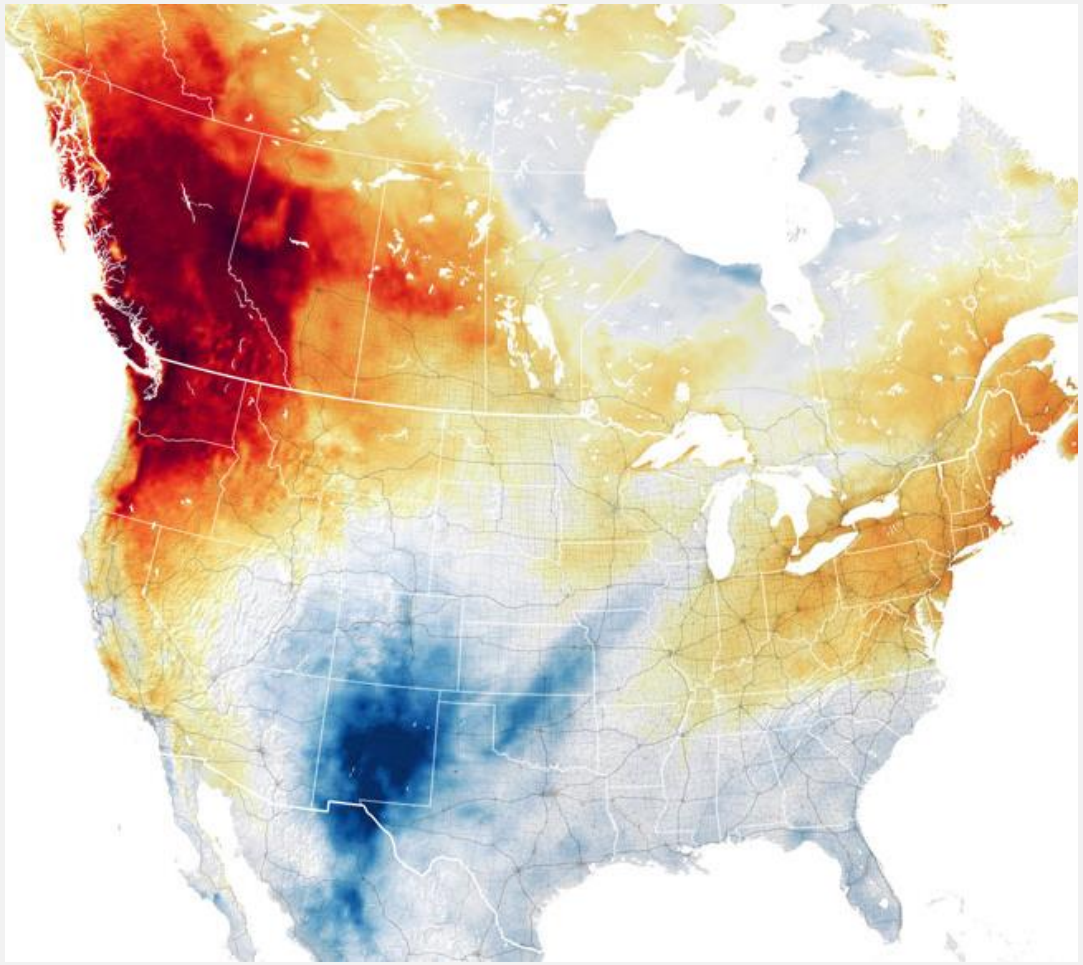
Other bark beetles

Fir engraver, *Scolytus ventralis*, mainly true firs

Western pine beetle, *Dendroctonus brevicomis*, ponderosa pine

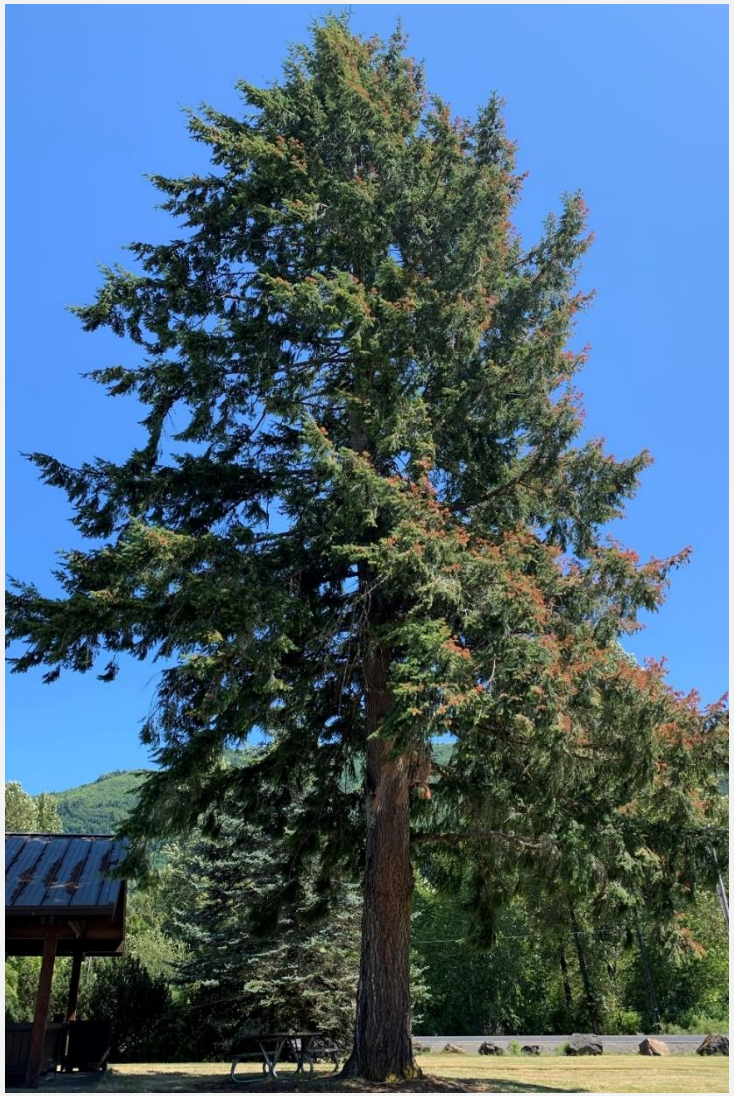
Mountain pine beetle, *Dendroctonus ponderosae*, pines

Heat



“Western North American extreme heat virtually impossible without human-caused climate change” (Philip et al. 2021)

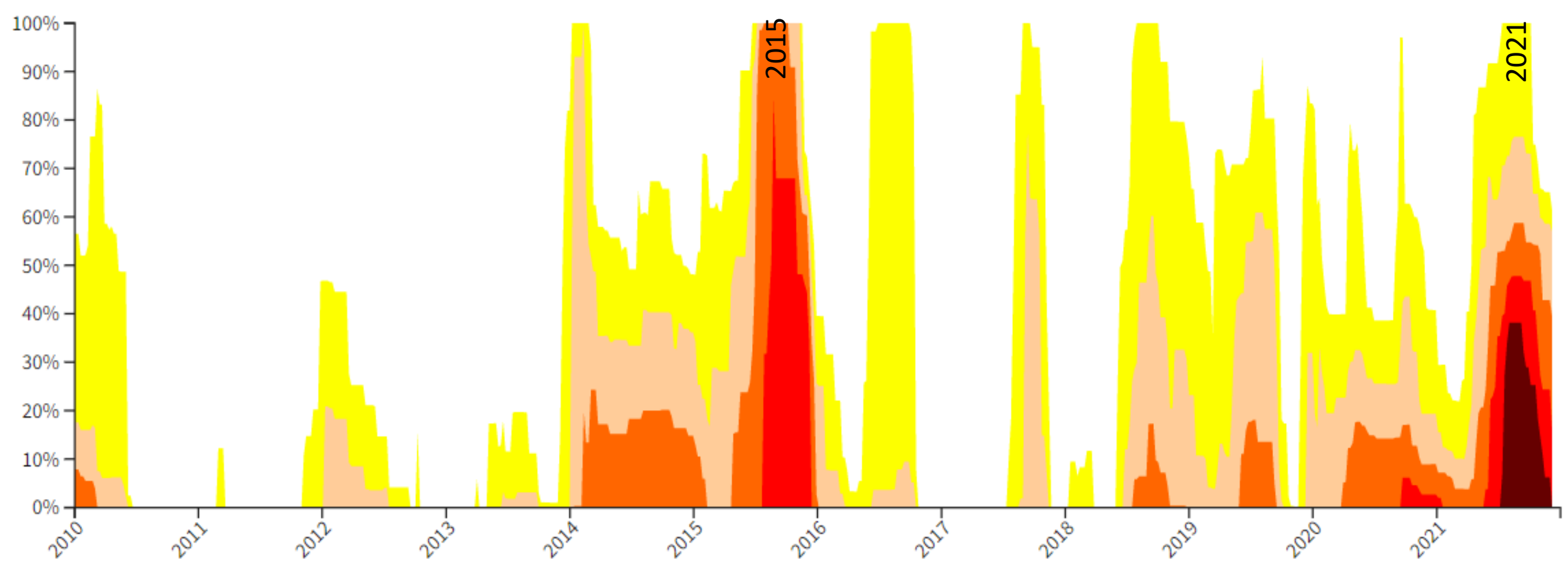
Heat scorch



Dry sunny heat = desiccated foliage and branches on SW side of tree

Droughts

Drought Status (WA)



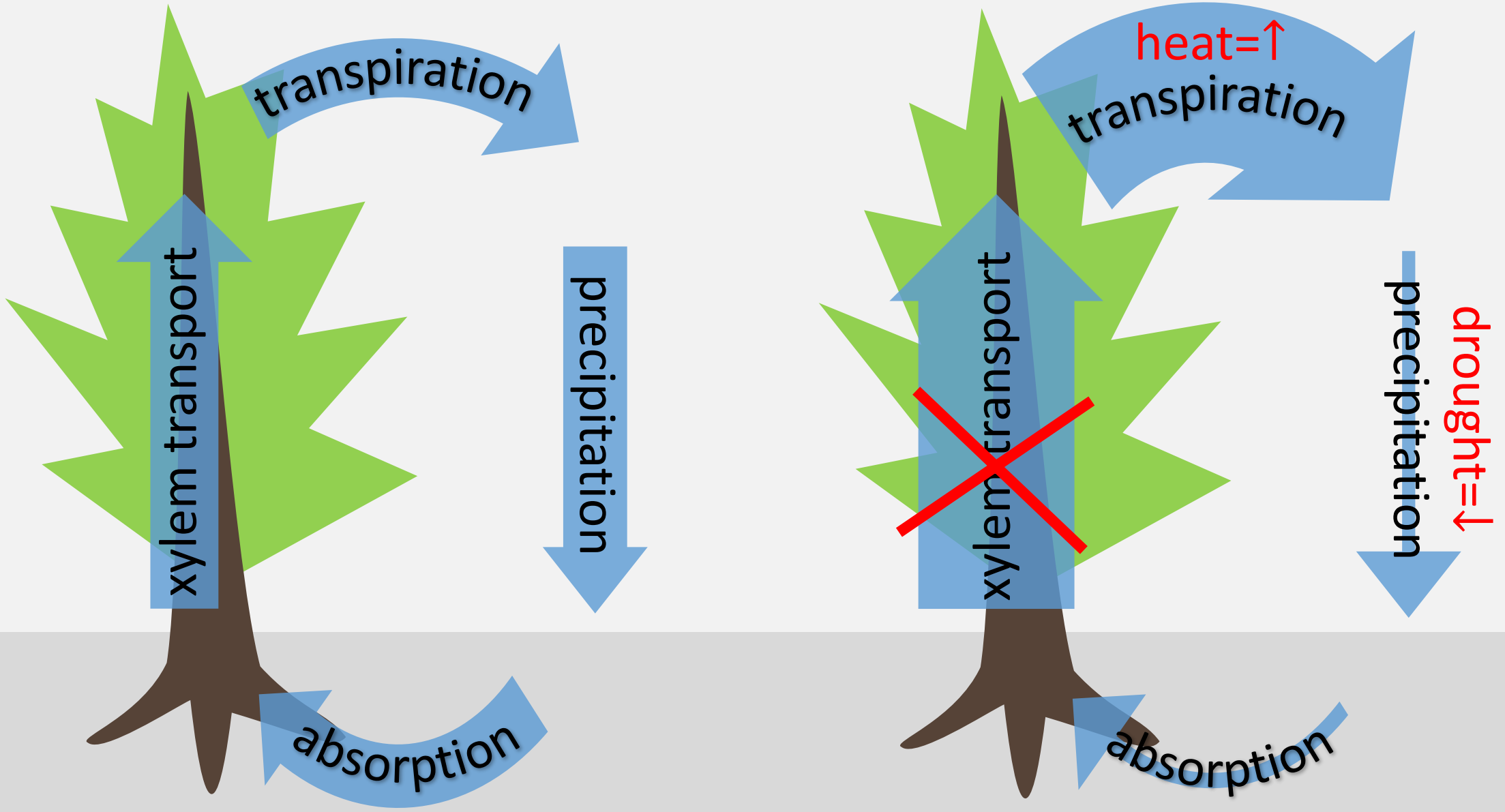
www.drought.gov/historical-information

Drought injury

- Top-down and outside-in injury
- Wilting, needle drop, branch dieback
- Many species affected
- Worse on marginal sites & well-drained soils
- Damage may be delayed

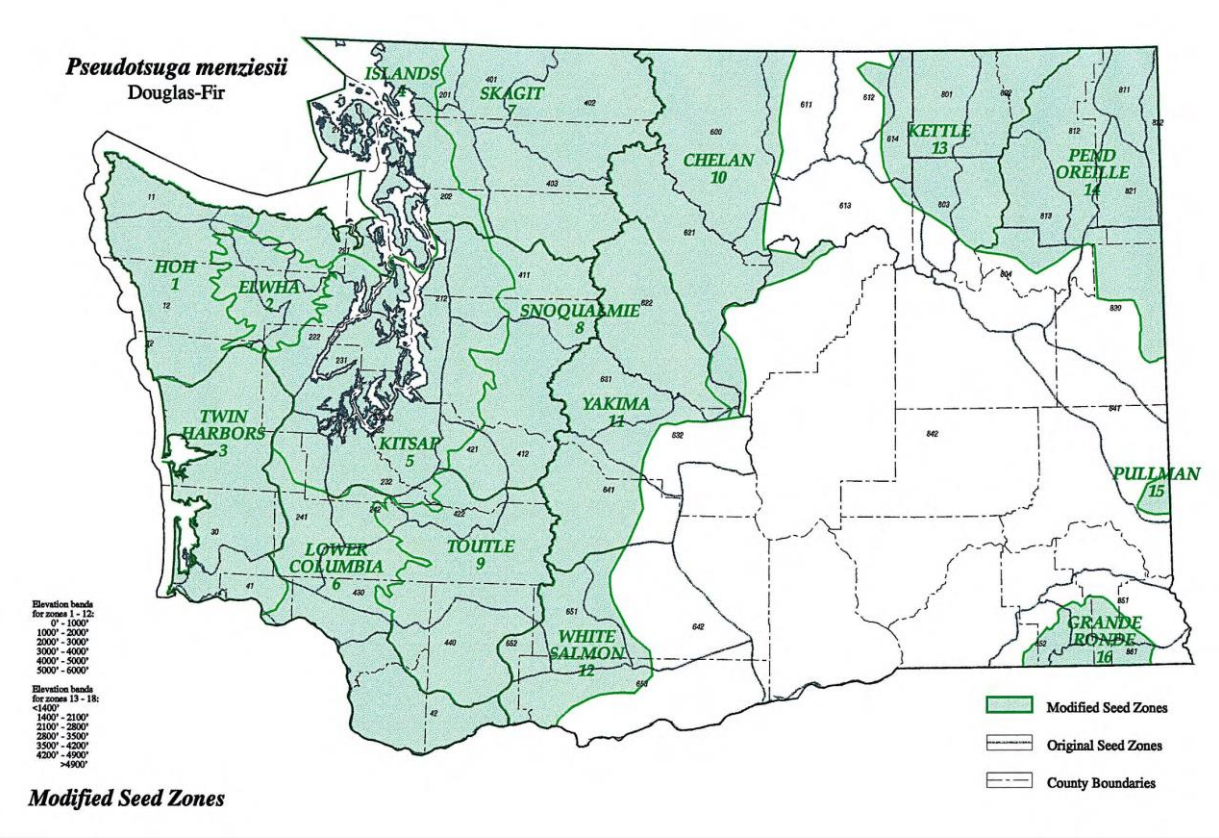
Dan Omdal, DNR

Heat AND drought!



Drought Management

- Right tree, right site



Seed Zone Map, WDNR

- Thin overstocked areas

Other observations

Many other things out there

White pine blister rust (*Cronartium ribicola*, invasive, on white pines)

Western gal rust (*Endocronartium* harknessii, on pines)

Heart rots (ex: *Porodaedalea pini*, red ring/white spec rot)

Hemlock dwarf mistletoe (*Arceuthobium tsugense,* on hemlocks)

Many other things out there

Powdery mildew of maples (native fungi)

Wood borers (native, secondary)

White pine weevil (*Pissodes strobi*, impacts spruce leaders)

Sooty bark disease

Coolly spruce gall adelgid (*Adelges cooleyi*, on spruce branch tips)

Western tent caterpillar (*Malacosoma californicum,* impacts broadleaf)

Sapsuckers (native birds, makes horizontal rows of holes in bark)

Bear stripping (damage when feeding)

What does our future holds?

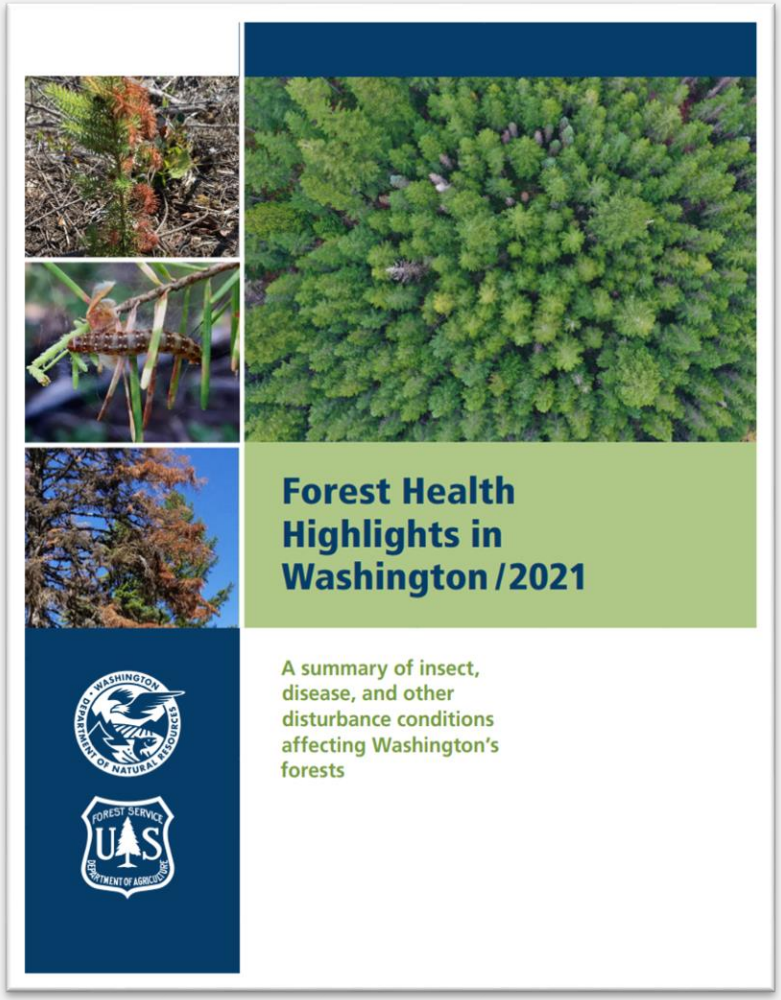
- Non-native species are huge risk
- Increase in abiotic stressors (climate change)
- More secondary pests/diseases
- Range shifts/shrinkage of trees

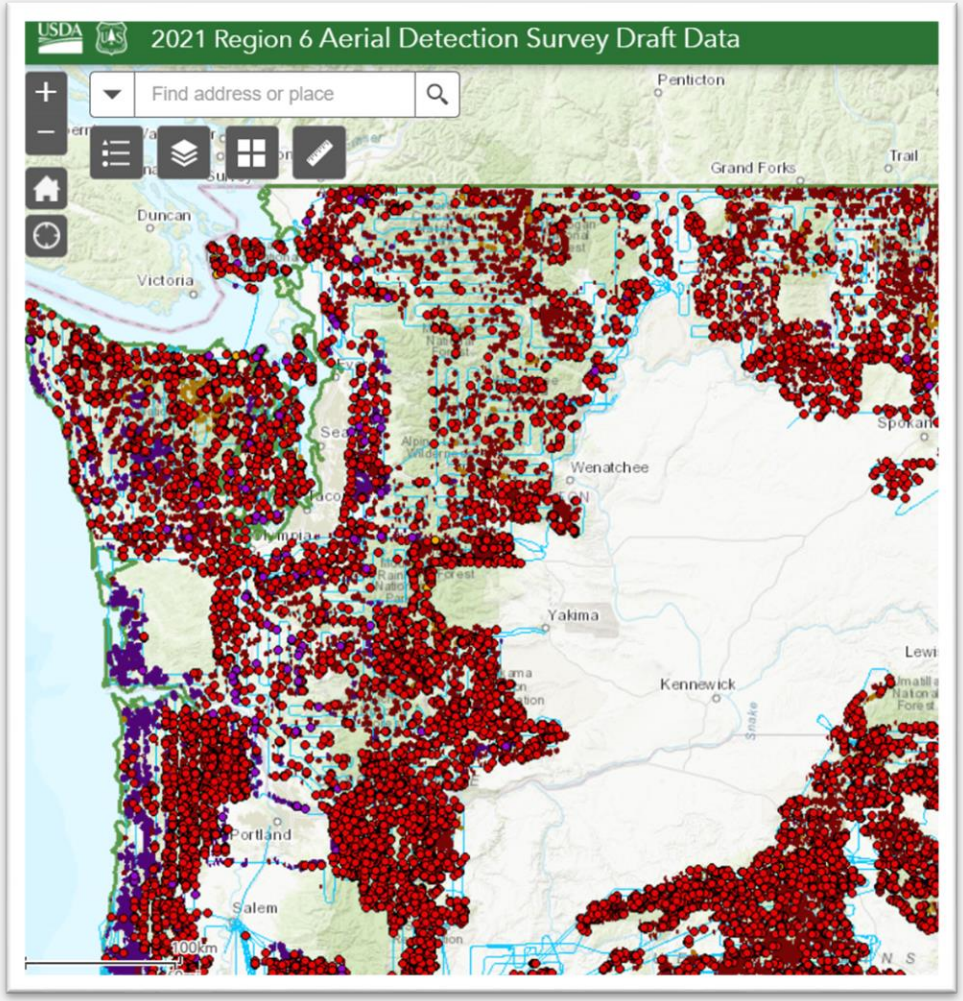
Overall

- Goal: Resiliency
  - Diversity
  - Tree vigor
- Be aware that nothing in a forest is static!

DNR Resources

- "Annual Forest Health Highlights Reports"
- "Annual Aerial Detection Survey Data"



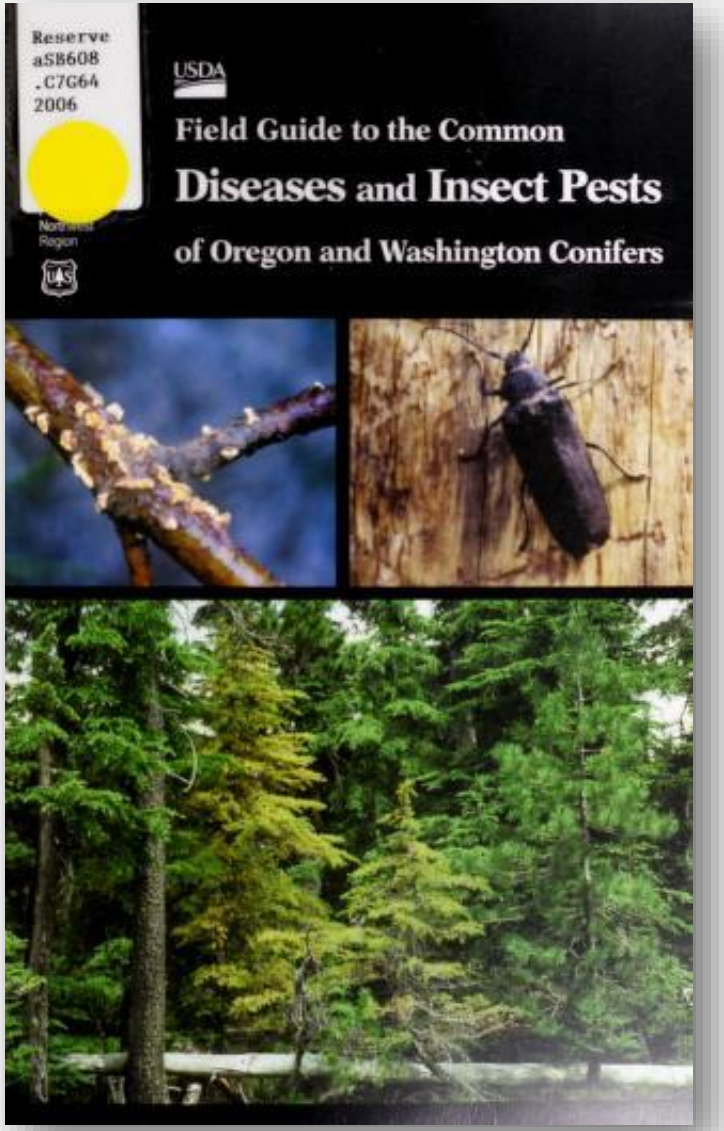


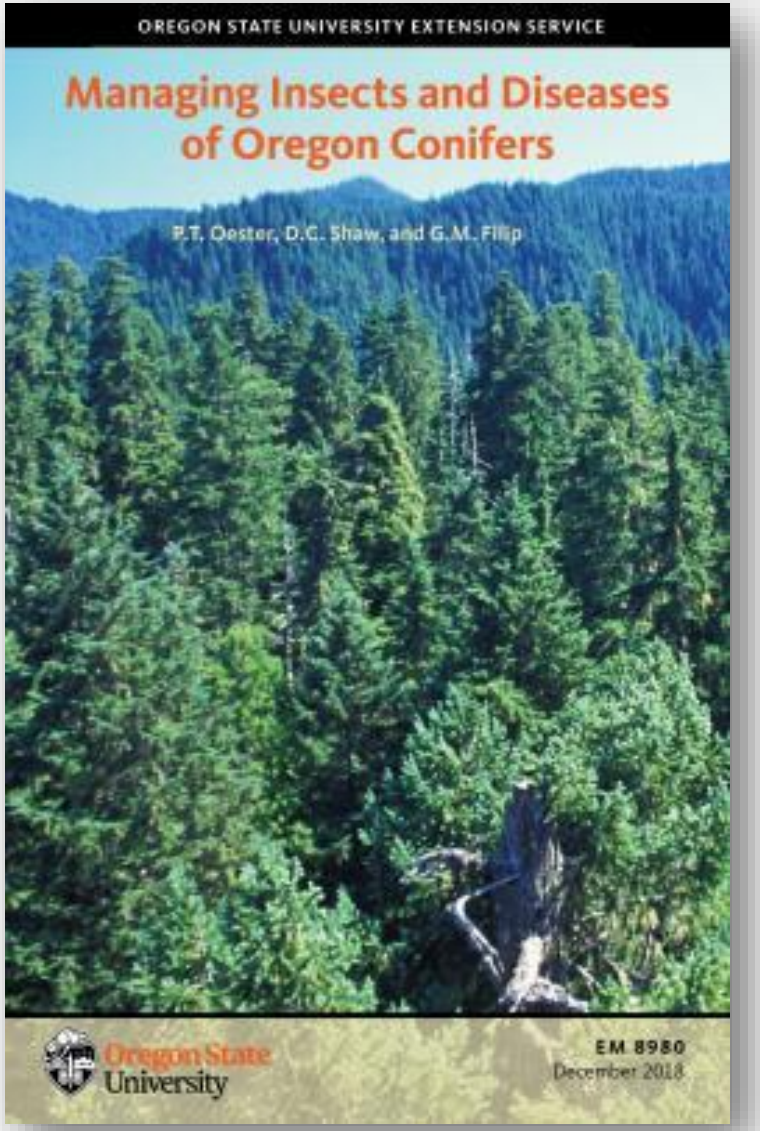
www.dnr.wa.gov/insectsanddisease#annual-forest-health-highlights-report

https://www.fs.usda.gov/detail/r6/forest-grasslandhealth/insects-diseases/?cid=stelprdb5286951

ID & Management Resources

- "Field Guide to the Common Diseases and Insect Pest of OR and WA Conifers"
- "Managing Insects and Diseases of Oregon Conifers"





https://archive.org/stream/fieldguidetocomm0106gohe

https://catalog.extension.oregonstate.edu/em8980

Thank you & questions!

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