ROOT DISEASES: LAMINATED ROOT ROT ANNOSUS ROOT & BUTT ROT

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What is root disease?

- Caused by fungi that live underground
- Attack and kill tree roots
  - Limiting water and nutrient uptake
- Some cause decay in roots and butt
  - Weaken trees
  - Cause windtrow and breakage
- Most spread below ground via root to root contact
- Increase susceptibility to bark beetle attack

Root Diseases

- Natural Disturbance Agents
- Diseases of the site
- Persist on site through forest rotations
- Can be thousands of years old.

Root Diseases

Decay Organisms

- Laminated root rot
- Annosus root disease (and butt rot!)
- Armillaria root disease

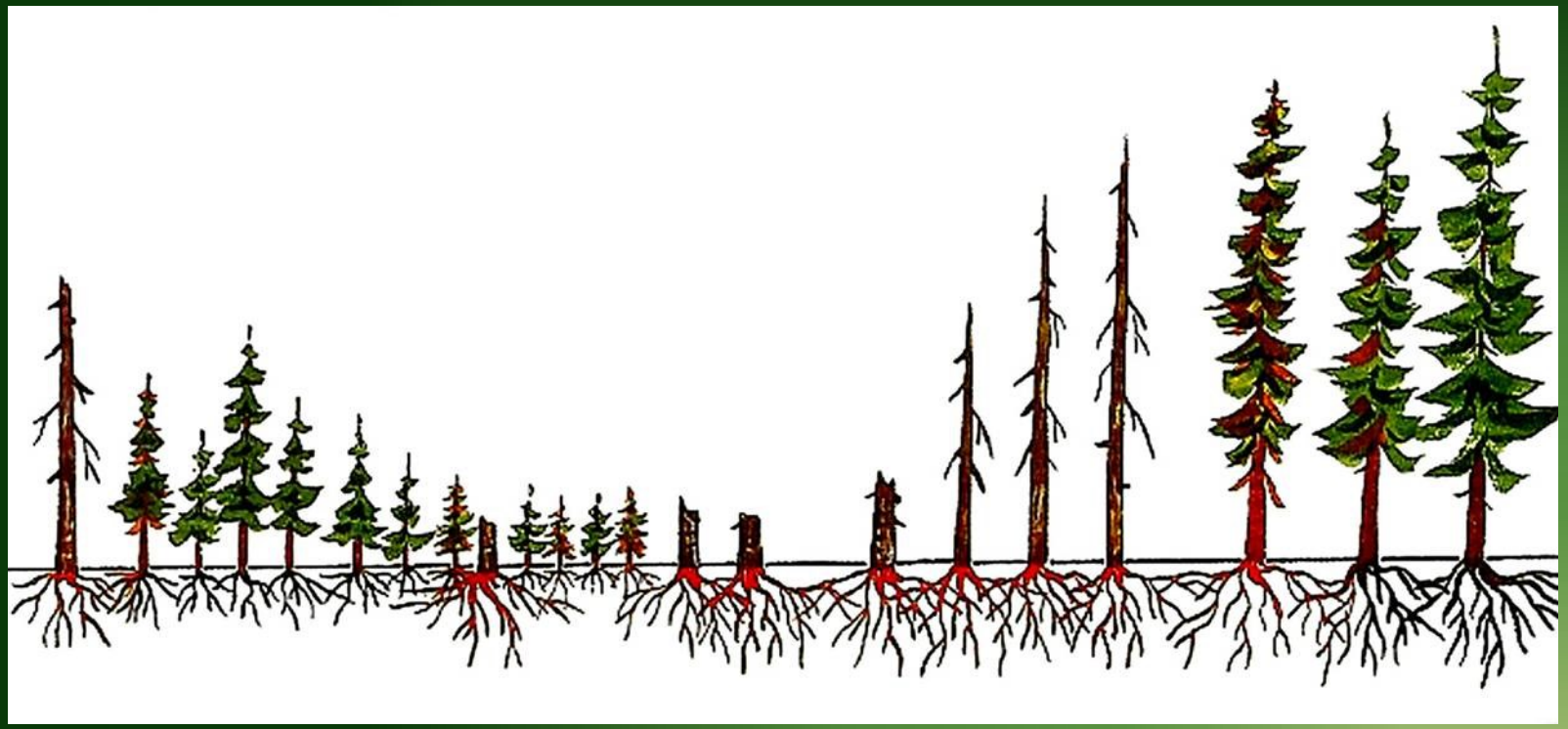
Vascular Wilt Root Diseases– Generally not a problem in this area

- Black stain Root Disease
- Port-Orford-Cedar Root Disease

Root Disease Spread

- From dead wood or stumps to trees
- After fire or final rotation harvest the fungi can persist on site in dead root systems
- It then spreads to the next generation of trees when roots come into contact with the inoculum source.
- The viability and longevity of the fungus on site depends on stump size and regenerating species

Spread- Tree to Tree



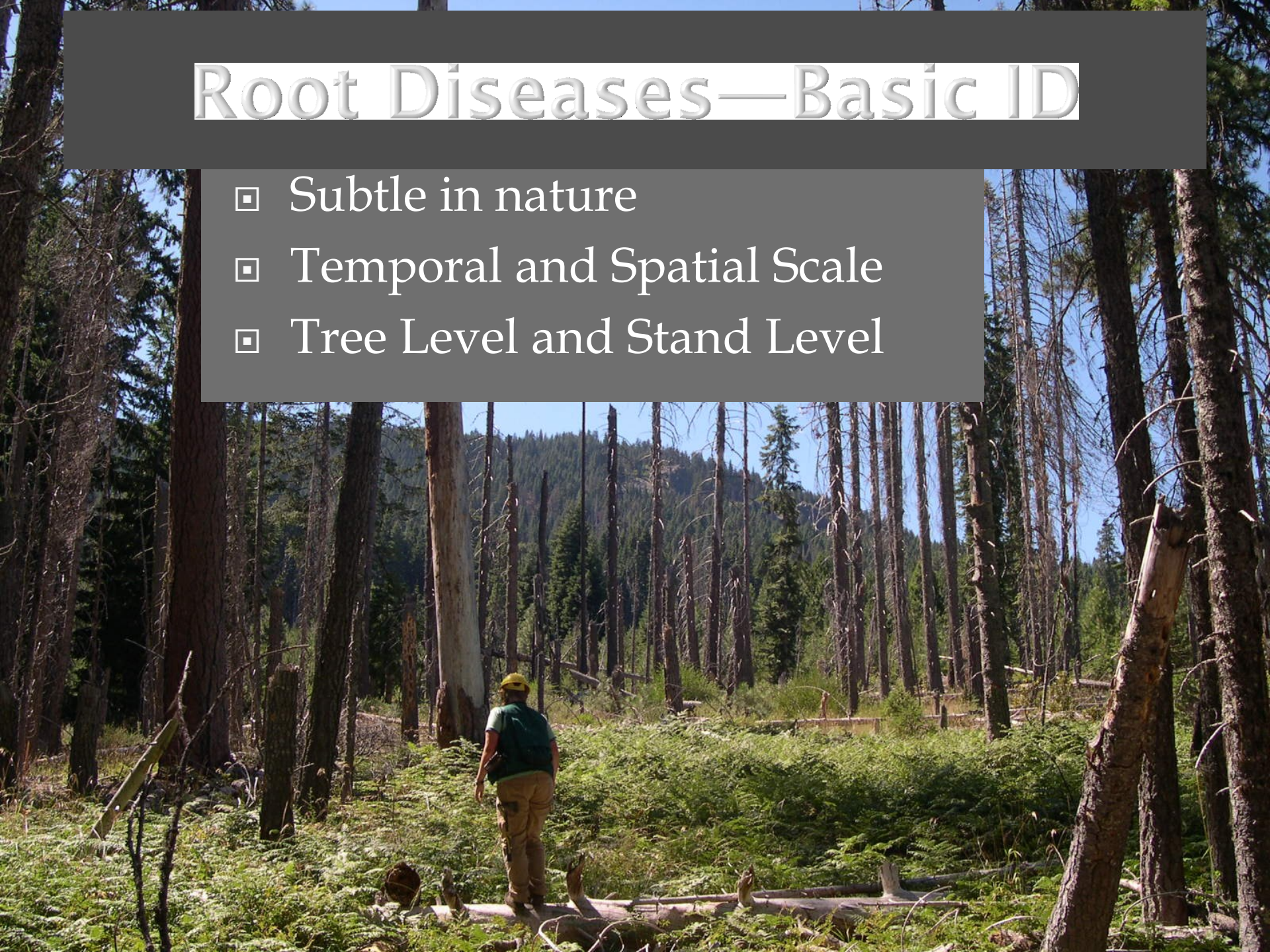
Tree to Tree spread

Root Diseases

- Co-evolved with their hosts,
- Range of host specificity
  - Generally white/grand firs and Douglas-fir are the most susceptible
  - Generally pines and cedar are the least susceptible
- Influence
  - Forest structure
  - Forest composition
  - Forest Function
  - Yield

Root Diseases—Basic ID

- Subtle in nature
- Temporal and Spatial Scale
- Tree Level and Stand Level



Root diseases

- Spread below ground
- On going spreading mortality
- Dead and Dying trees

Root Diseases–Single tree

- Chlorotic/fading crown

Root Diseases–Single tree

- Distress Cone crop
- Resinosus at base
- Check roots and surrounding trees

Root Diseases

- Predispose trees to bark beetle attack
- See small pockets of bark beetle mortality? *check for root disease*

Root Diseases

- Management options vary
- Management actions can increase or reduce impacts of root diseases
- In some places it is important to know what root disease you are dealing with… in others the management options may not differ between root diseases.

LAMINATED ROOT ROT

Phellinus sulphurascens—Douglas-fir and fir form (formerly *P. weirii*)

*Primarily covered in this presentation

Phellinus weirii—cedar form

Geographic Distribution

- Western Oregon and Washington Forests
  - Cascades and Costal Forests
- Eastern Washington
  - More common on the Wenatchee NF not found as frequently on the Colville NF
- Northern Idaho and Western Montana
  - Found throughout Idaho and western Montana
- Surprisingly missing from most of California

Laminated root rot (Douglas-fir form) hosts

- Douglas-fir, White fir, grand fir, mountain hemlock
- Other true firs, western hemlock, Engelmann spruce, larch
- Ponderosa pine, lodgepole pine, western white pine, sugar pine, Western red cedar, incense-cedar.

- Severely damaged
- Moderately damaged
- Seldom damaged

Laminated Root Rot

- Does not grow through dead roots
- Is rarely established by spores
- Can infect most vigorous trees in a stand

Identification…Laminated Root rot center and characteristic decay

Identification

- Root rot pockets—live windthrown trees without a root system

Root Disease Symptoms

WINDTHROW

Identification

Crown symptoms

- Thinning foliage
- Chlorotic foliage
- Distressed cone crop
- Reduced height growth

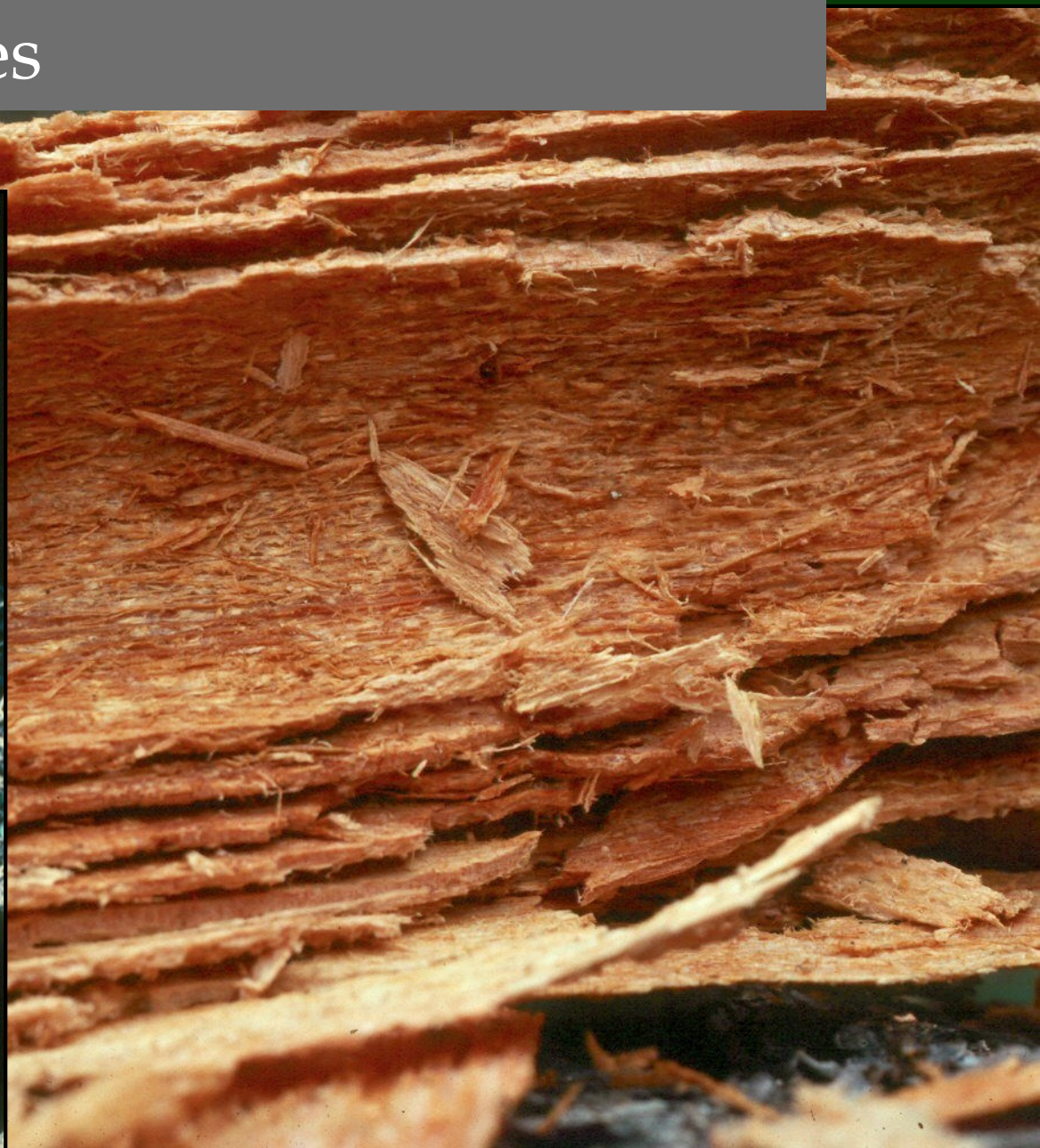
Identification

- External Root Appearance
- Ectotrophic mycelium

Identification

- Colonized Wood– Decay and Stain

Laminated root rot: delaminated wood—pits on both surfaces

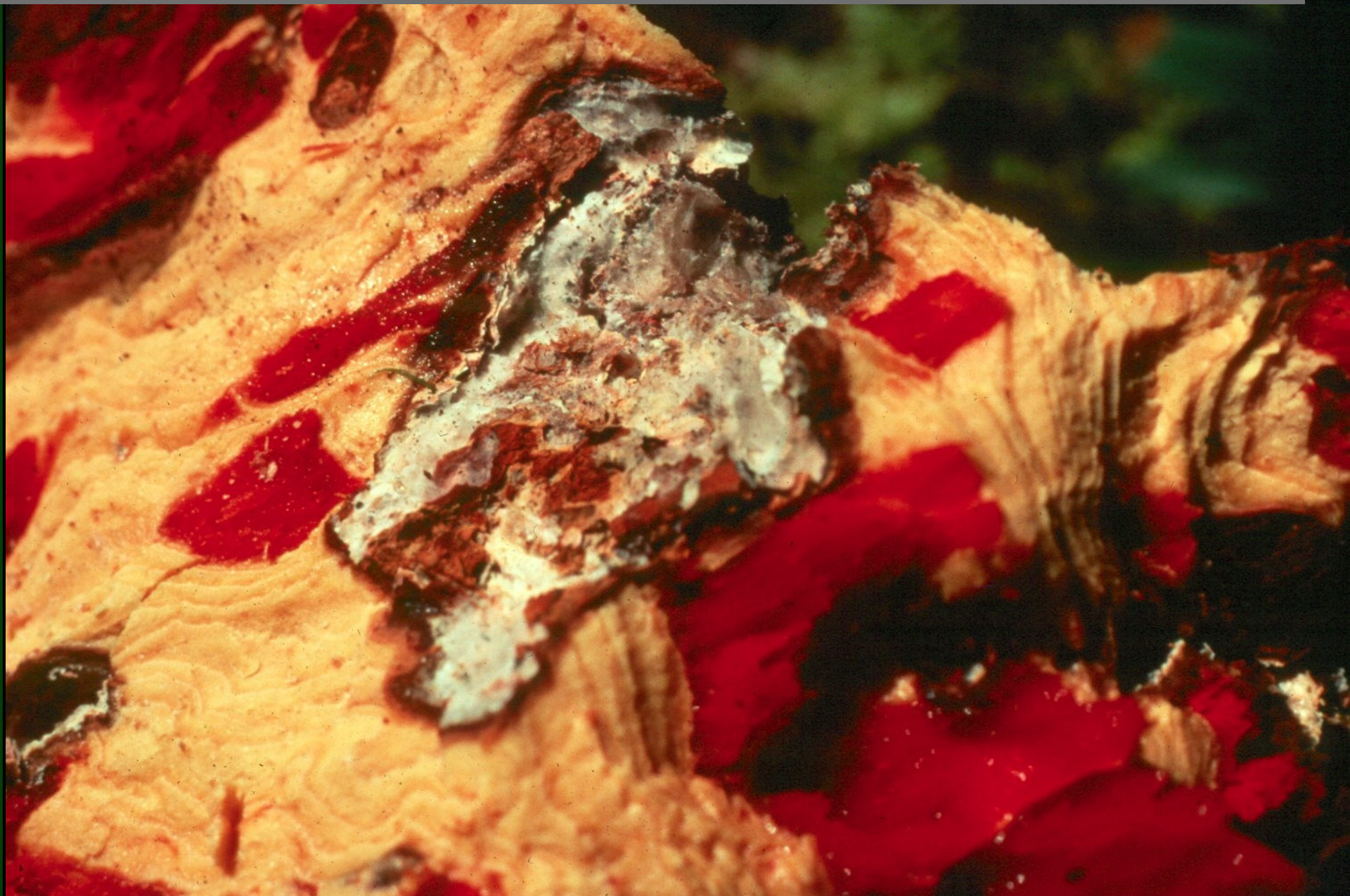


Identification

- Setal Hyphae—rusty red wiskers

Laminated root rot: Wefts of setal hyphae

Laminated root rot: Mycelial inclusion in bark



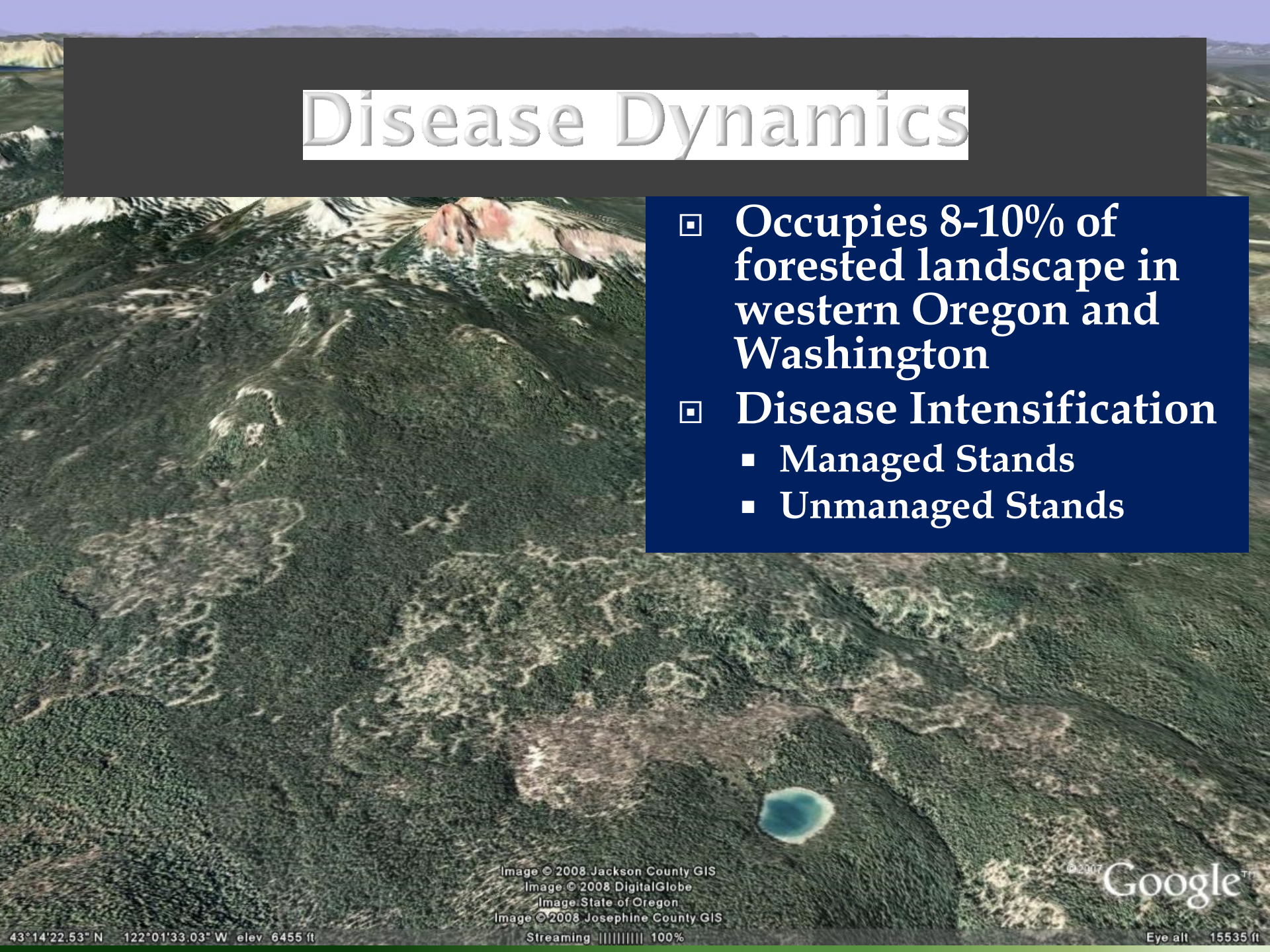
Laminated Root Rot: Crescent-shaped hollows

Crescent-shaped stain in fresh stump

Disease Dynamics

- **Distribution within a stand**
  - **Clumped discrete openings**
  - **Diffuse throughout a stand**

Disease Dynamics



- Occupies 8-10% of forested landscape in western Oregon and Washington
- Disease Intensification
  - Managed Stands
  - Unmanaged Stands

Disease Dynamics

- Interaction with Bark Beetles
- Douglas-fir Beetle!

Ecological Role

- Stand openings
- Diversity
- Wildlife habitat (however, short term longevity of snags)
- Alters forest:
  - Structure
  - Composition
  - Succession

Stand Surveys

- Distribution
  - Diffuse
  - Centralized
- % of stand infected
- Stand Age
- Presence of Less Susceptible hosts

Stand Surveys

- How? When?
  - Pre-harvest--Ideal
  - Post-harvest—can be difficult
  - Regeneration Exams—might not show full disease presence
  - Pre-treatment Surveys (PCT, CT, etc)

Disease Management

- Without management:
  - Expected to survive on a site if managed for successive rotations of Douglas-fir, white fir, grand fir

Disease Management

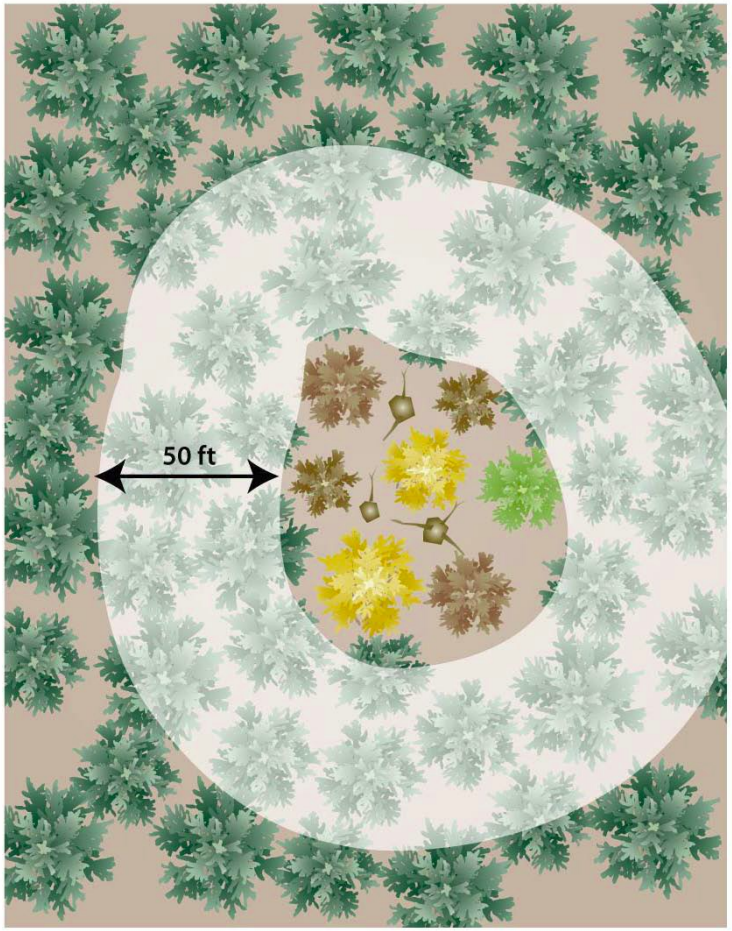
- Young Stands
  - Low levels of infection (<5%)- favor less susceptible species
  - High levels of infection
    - Defer thinning
    - Interplant

Disease Management

- **Commercial Stands– Thinning not recommended if highly susceptible species make up more than 30% of the leave trees**

Disease Management

- Buffer Cutting
- 15m or 25-50ft



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Disease Management

Inoculum removal

Disease Management- At stand Rotation

- Ideal time to manage LRR
- Favor less susceptible species
  - Larch
  - Pines
  - Western White Pine
  - Western Red Cedar
- If Disease severity is high
  - Over plant!

Summary--LRR

- Identification and Recognition of root diseases on site is important for long-term forest health goals
- Laminated root rot is here to stay!

- Douglas-fir and grand fir are the most susceptible
- Best management option is to manage for less susceptible hosts, pines, larch, cedar
- Know your site! Do your surveys!

Summary

Diseased Sites

- Favor tolerant species in existing stand and regeneration
- Thinning Douglas-fir and grand fir doesn't help
- Avoid susceptible species for a stand rotation
- Buffers are okay for LRR if it is in a discrete area in a stand.

ANNOSUS ROOT AND BUTT ROT

Heterobasidion occidentale (s-type or fir type)

Heterobasidion irregulare (p-type or pine type)

Formerly:
Fomes annosus or Heterobasidion annosum

Heterobasidion occidentale s-type or fir type

- Hosts:
  - True Firs
  - Hemlock
  - Douglas-fir (depending on location)
  - Cedar
- Significance of the disease and important hosts of *H. occidentale* varies geographically
- Can act as both a root disease and butt rot.

Heterobasidion irregulare
p-type or pine type

- Hosts
  - Ponderosa pine
- Primarily a root disease
- Significance of disease depends on where you are in the west, sometimes related to plant association e.g. more common in drier pine types in central and south-central Oregon

Butt Rot or Root Disease?

BUTT ROT

- Wound colonizers
- Causing tree failure and wood loss???
- Common in western and mountain hemlock, true firs
- Found in Douglas-fir in Montana and Idaho– not thought to be a major player in DF in OR and WA

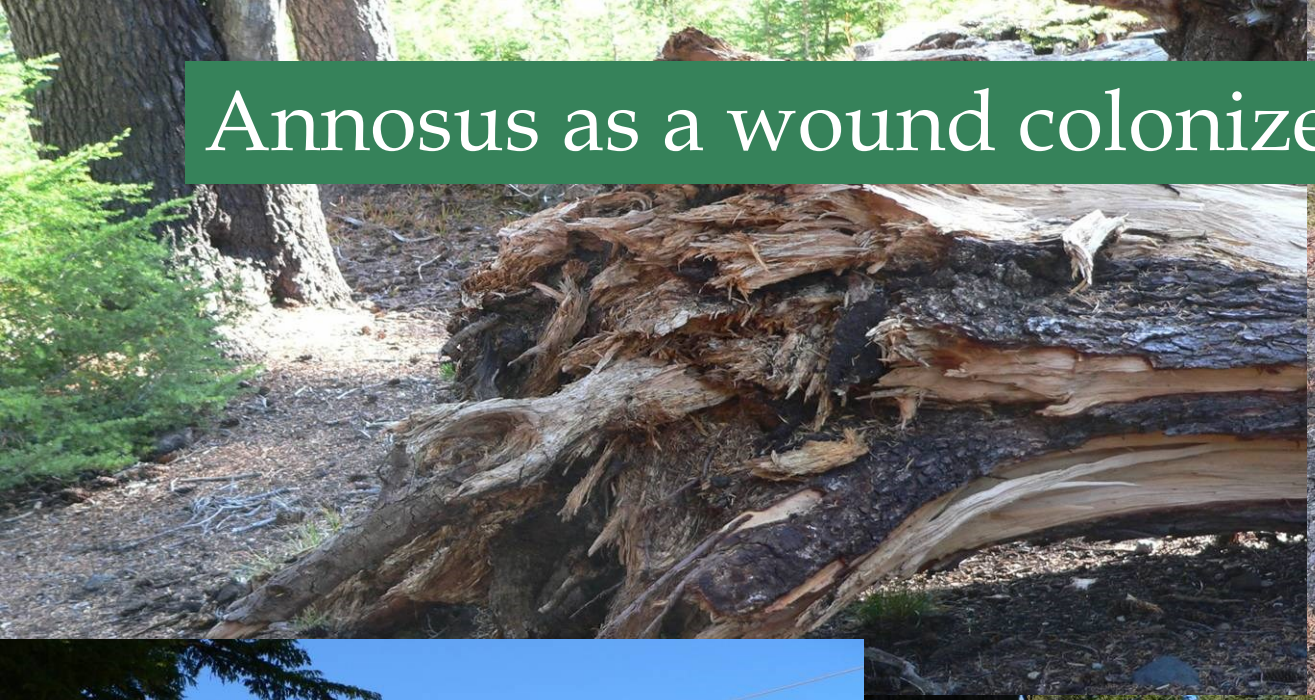
ROOT DISEASE

- Pine type- plantations with tree to tree spread and large residual stumps
- East side mixed conifer stands with white/grand fir

Annosus as a root disease

Commonly found acting with other root diseases

Annosus as a wound colonizer/butt decay



Infection Biology

- Sexual and asexual spores are present through out the year
- Infection courts
  - Wounds
  - Root infection via cut stumps
- Infected stumps and logs can act as sources of inoculum for decades
- Subsequent disease spread is through root to root contact.

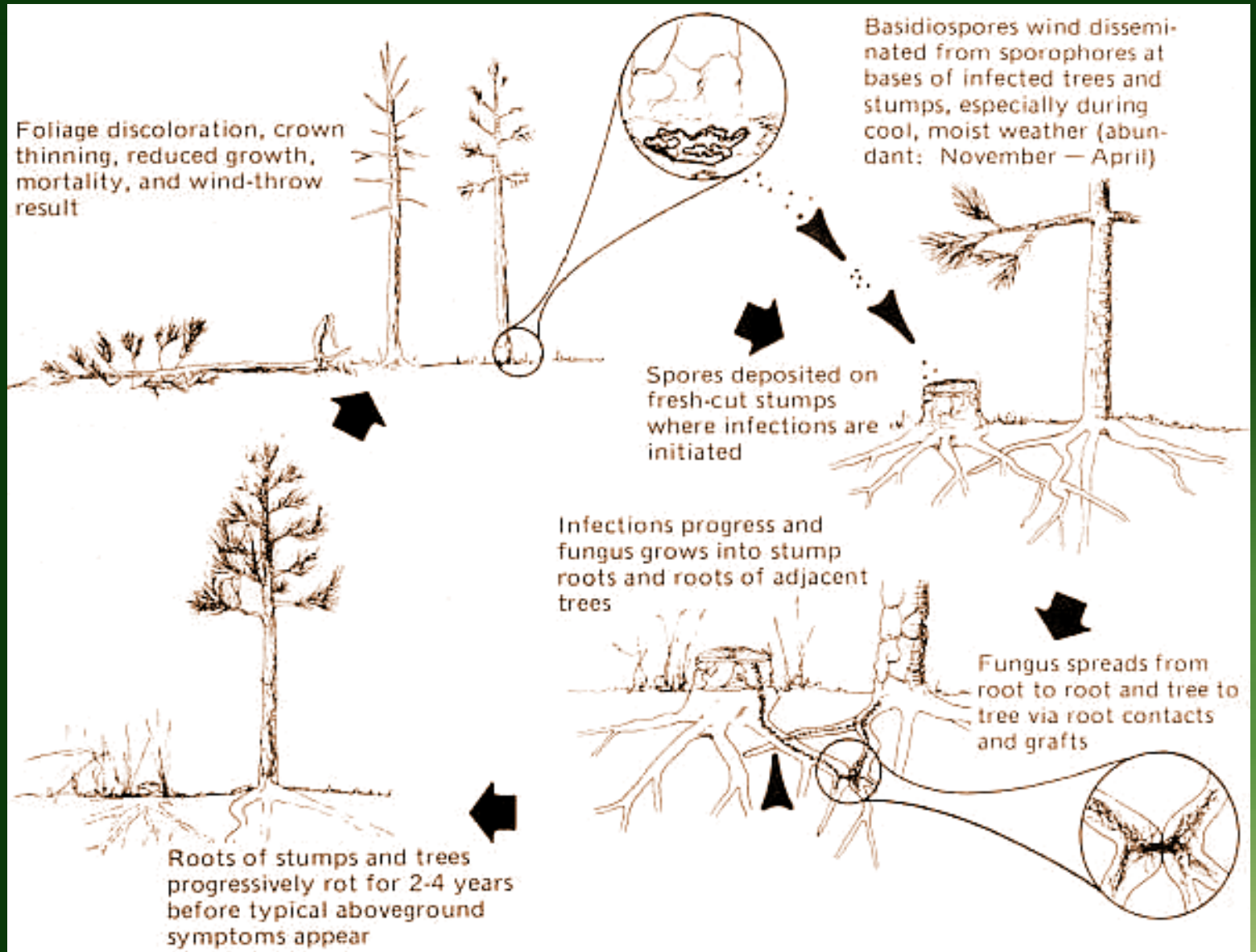


Fig. 17. Generalized life cycle of *Heterobasidion annosum*, the cause of annosum root rot (formerly, *Fomes annosus* — cause of annosus root rot).

Figure taken from The State Of Florida. Note the time frame may be slower in the PNW.

Identification

- By far the most difficult root disease to identify!

- Fruiting body/Sporocarps
  - Found on windblown trees under roots… If you are in a moist site
  - Found in stumps
  - Found as “button conks” at root collars of saplings

Identification- sporocarps

Conks:

- Typically perennial
- Generally Shelf-like
- Pore layer white to cream colored
- Sterile margin
- Pores are small and typically round

Button conks
at the duff line in
smaller trees

Annosus Root Rot: Also spreads by ectotrophic mycelium

Identification--Decay

- Decay- Annosus Root Rot: Laminated decay with pits on one surface

Identification:

Advanced decay spongy white with black flecks

Annosus Root Rot: Spongy white advanced decay

Potential Stand Impacts

- Growth Loss and Mortality:

  The western hemlock scenario on the west side:
  - Reduction in height growth-not significant in <40yr old infected western hemlock
  - Decay volume loss- at stand age 50 decay can be up to 21 feet and 20% of the total tree volume
- Overall impacts:
  - Windthrow leading cause of mortality in hemlocks
  - Predisposes ponderosa pine and true fir of the right size to bark beetle attack
  - Increased susceptibility to drought and other stressor agents

Management options--prevention

- Wound prevention!
- Minimize wounding during entry
- Utilize bump logs on skid trails

Management options--prevention

- Stump treatment on high risk sites
- Treatment in stands without high incidence

- Sporax, Timbor, or recent registered boron product
- Generally treat host stumps of 14” and greater in size.

Management Options

- Wound prevention
- Inoculum removal?
- Reduced entries
- Species manipulation
  - Favor ponderosa pine, western white pine, larch, and cedar
  - Douglas-fir in OR and WA
  - Favor against Douglas-fir in ID

Summary- Annosus root disease

- A root-rot pathogen that generally intensifies after stand management activities
- Wound prevention during stand entries is key for reducing economic losses
- Protect high value or special use sites by using approved stump treatment or removal
- Species manipulation!!!!!!!!

Questions?