



Forest Health on Intensively Managed Forests: Swiss Needle Cast and other stories.

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Extension

The forest disease complex: Douglas-fir Plantations in NW Oregon

- “ Swiss needle cast
 - . Ascomycete foliage disease
 - . Growth loss
- “ Black stain root disease
 - . Ascomycete vascular wilt disease
 - . Mortality
- “ Laminated root rot
 - . Basidiomycete live wood decay
 - . Growth loss and mortality



Swiss Needle Cast of Douglas-fir

Caused by: *Phaeocryptopus gaeumannii*

Specific to Doug-fir, native

Possibly a *Mycosphaerella* species

Ascomycete, Dothidiales

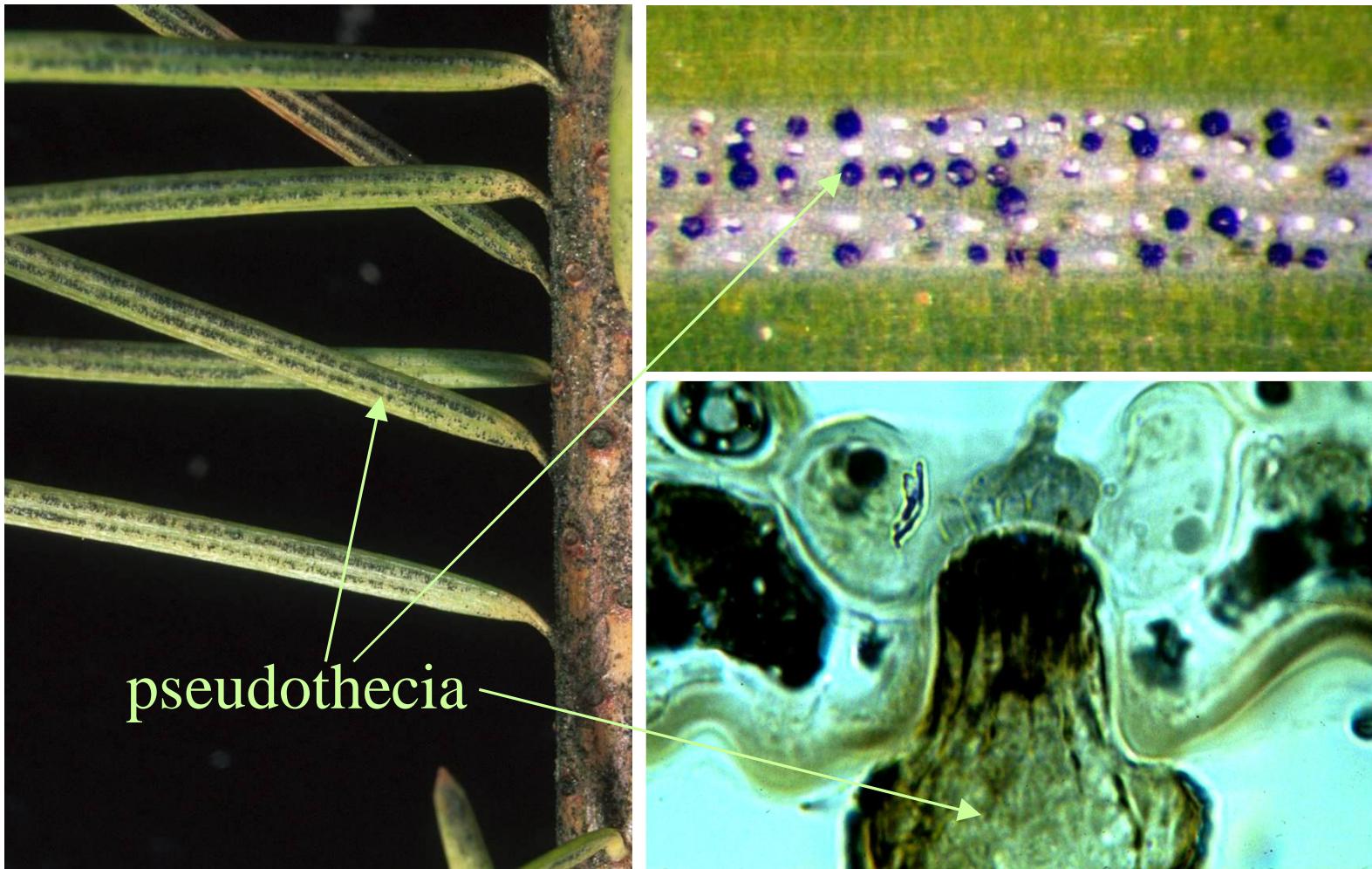
Only sexual reproduction, no asexual spores.

Spores disperse May – August

Only current year foliage is infected.



Phaeocryptopus gaeumannii



Photos Stone/Hansen lab



Swiss Needle Cast symptoms

Yellowing foliage
(chlorosis)

Especially in spring
before bud-break

Early loss of
needles (casting)

Mortality rare

Visible symptoms of the stand



Growth Impacts: Foliage Retention is Key!

Maguire, Mainwaring et al.

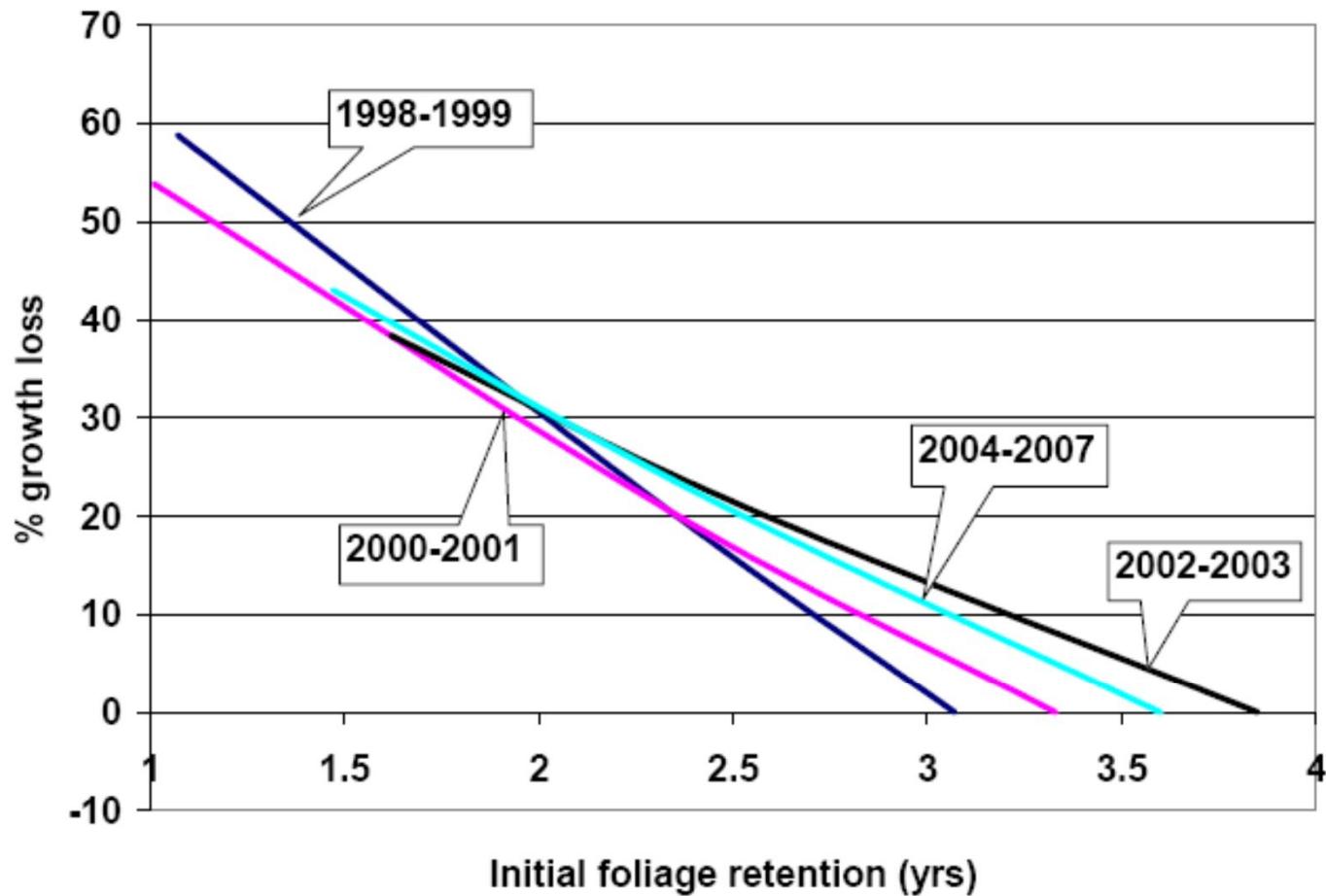
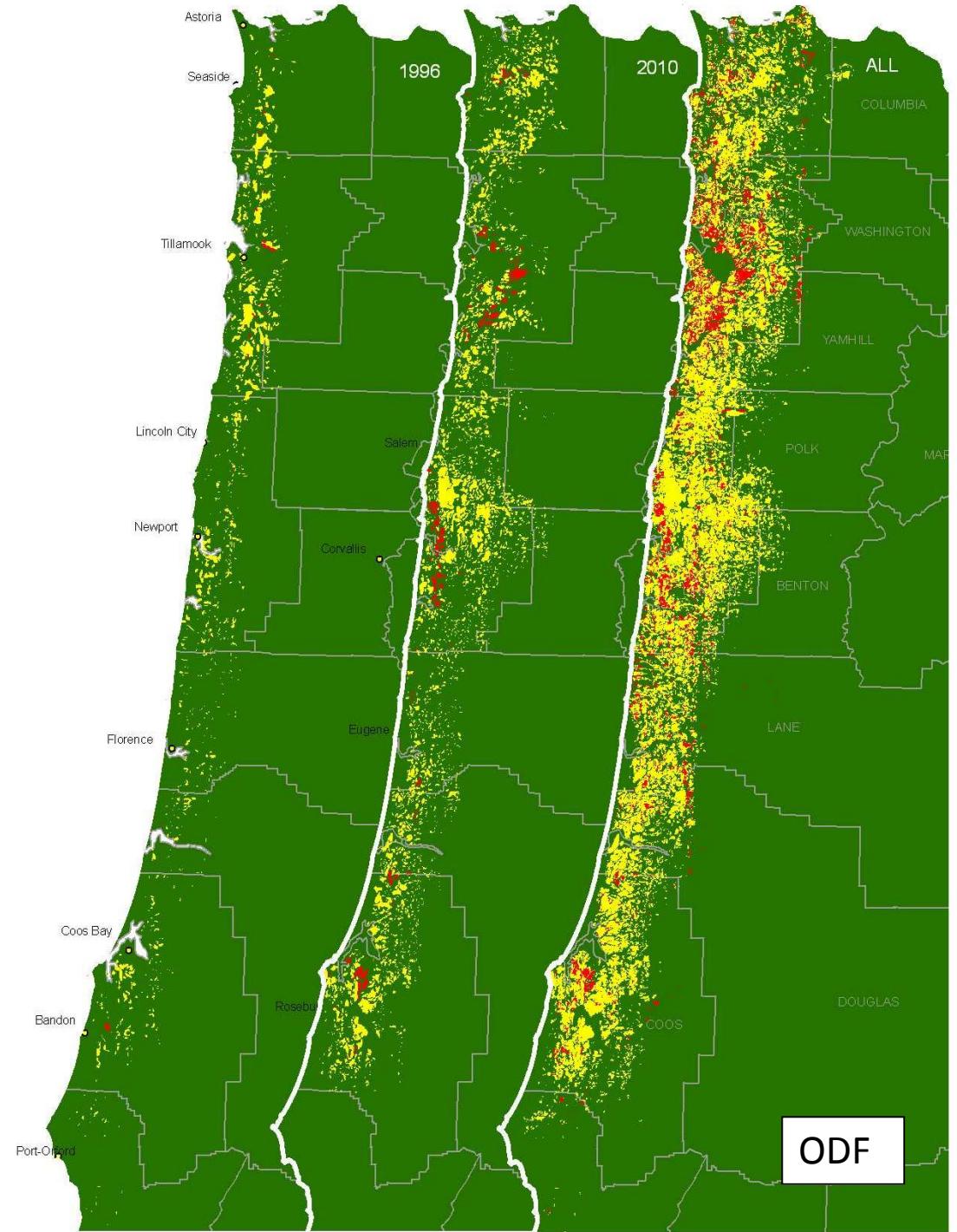


Figure 3. Implied relative growth losses for the four GIS growth periods. Ranges of foliage retention represent those measured at the start of each growth period.

SNC in Oregon

Douglas-fir plantations

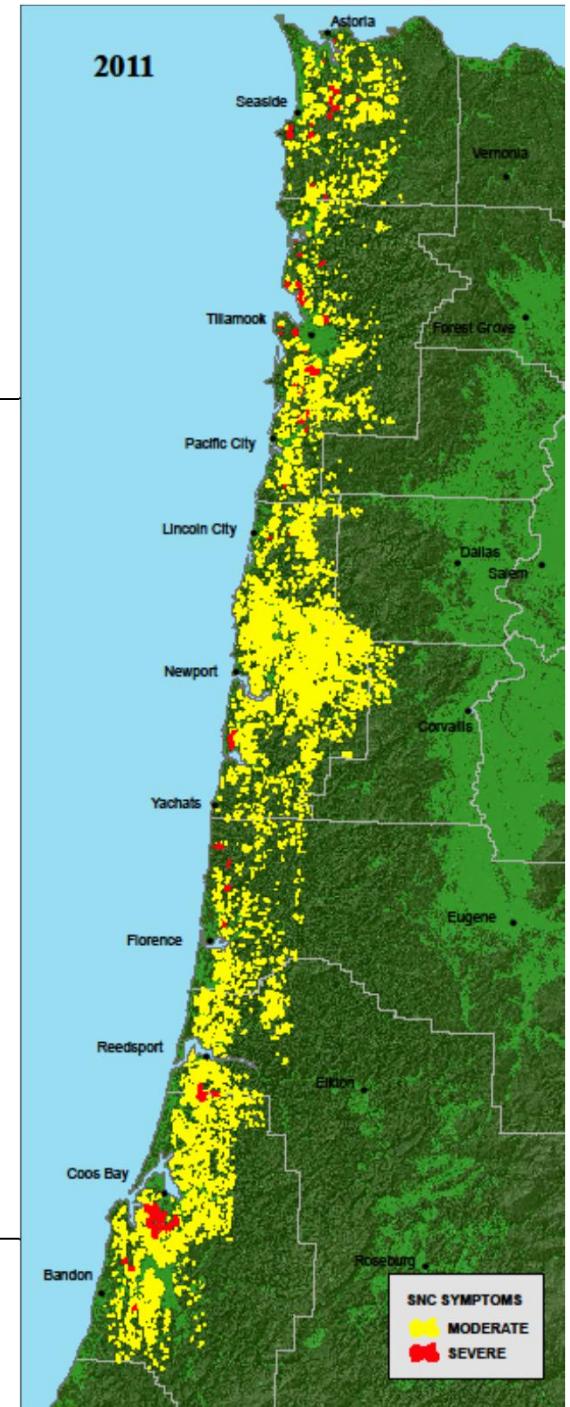
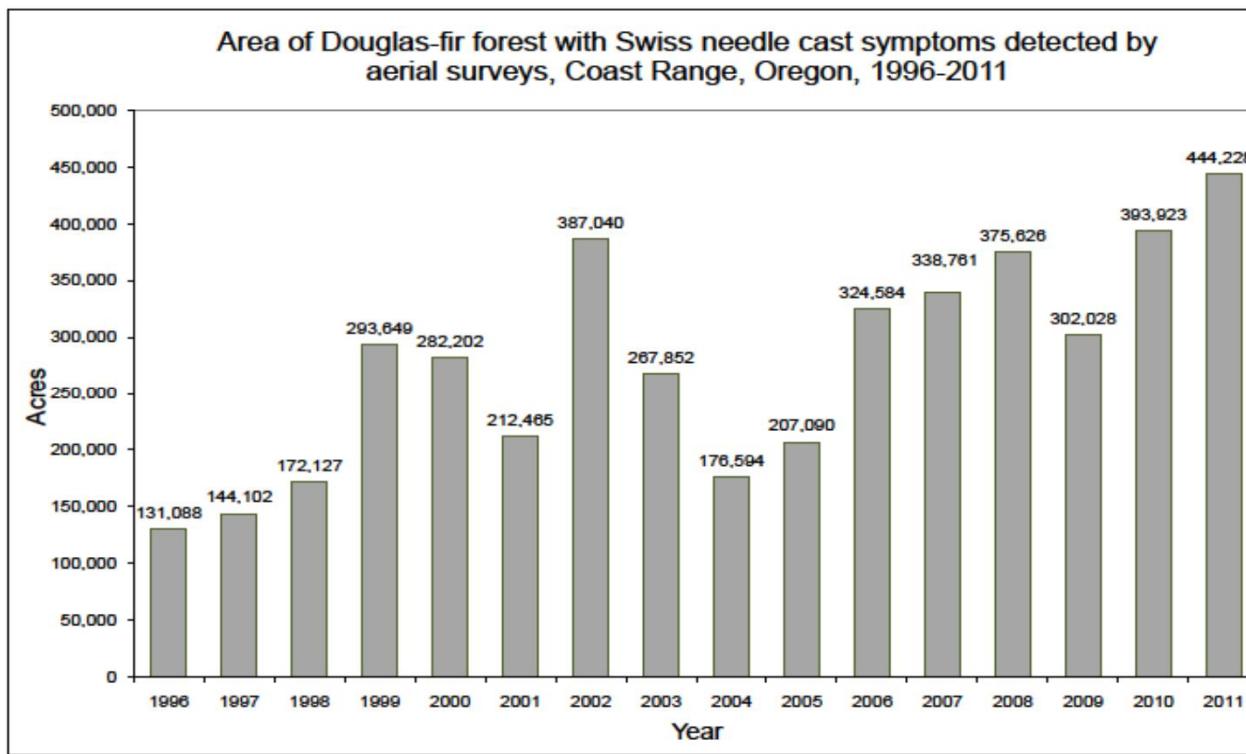
- " Emerged in the 1980's
- " Intensified in the 1990's-present.
- " Associated with coastal strip: distance from coast major factor
- " Epidemiology:
 - . Warm winter/spring temp
- " Coupled with
 - . Abundant moisture during spore dispersal in May-August



SNC in Oregon

2011: 444,228 acres visible in aerial survey

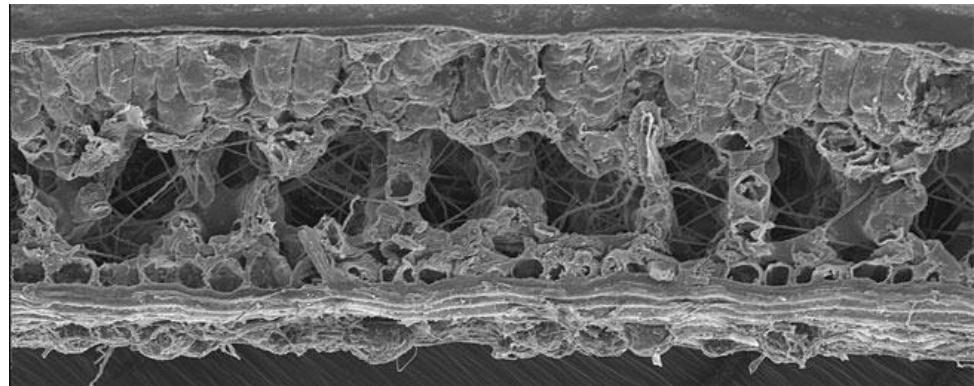
Highest acreage yet: continues to intensify



Figures and Data from Oregon Dept Forestry
Alan Kanaskie and Mike McWilliams

- " **YOU CAN FIND THE FUNGUS THAT CAUSES SWISS NEEDLE CAST (*Phaeocryptopus gaeumannii*) EVERYWHERE!**
- " It is:
 - . Native to North America
 - . Common everywhere Douglas-fir grows
 - . Only causes disease in certain geographic and stand settings
 - . Disease is caused when pseudothecia plug stomates of one and two year old needles and needles are lost prematurely
 - . Because it is everywhere, disease intensification depends on climatic and management conditions that interact with host and pathogen.

SNC in Context



Leaf x-section
with hyphae.
(Jeff Stone)



Leaf undersurface
with stomates
plugged by
reproductive
structures.

Integrated Pest Management (IPM)

- “ IPM is typically designed to reduce pesticide amount introduced into the environment and save \$\$\$.
- “ IPM of SNC does not involve fungicides or other chemicals directly.
- “ More nuanced approach to IPM is needed.



Near Coos Bay

IPM through the Swiss Needle Cast Cooperative

- “ Distribution and Quantitative Impacts of Disease
- “ Epidemiology Research
- “ Risk and Threshold Assessment
- “ Predictive Models
- “ Monitoring
- “ Long term
 - . Tree Improvement
 - . Monitoring, Research



Distribution and Quantification of Disease Impacts

- “ Annual Aerial Survey
- “ Growth Impact Plots in NW Oregon
- “ Research Plots (PCT, and Comm Thin)
- “ Needle Retention Plots
- “ Cascades plots
- “ New network Planned for 2012/13 that will encompass the entire Coast Range

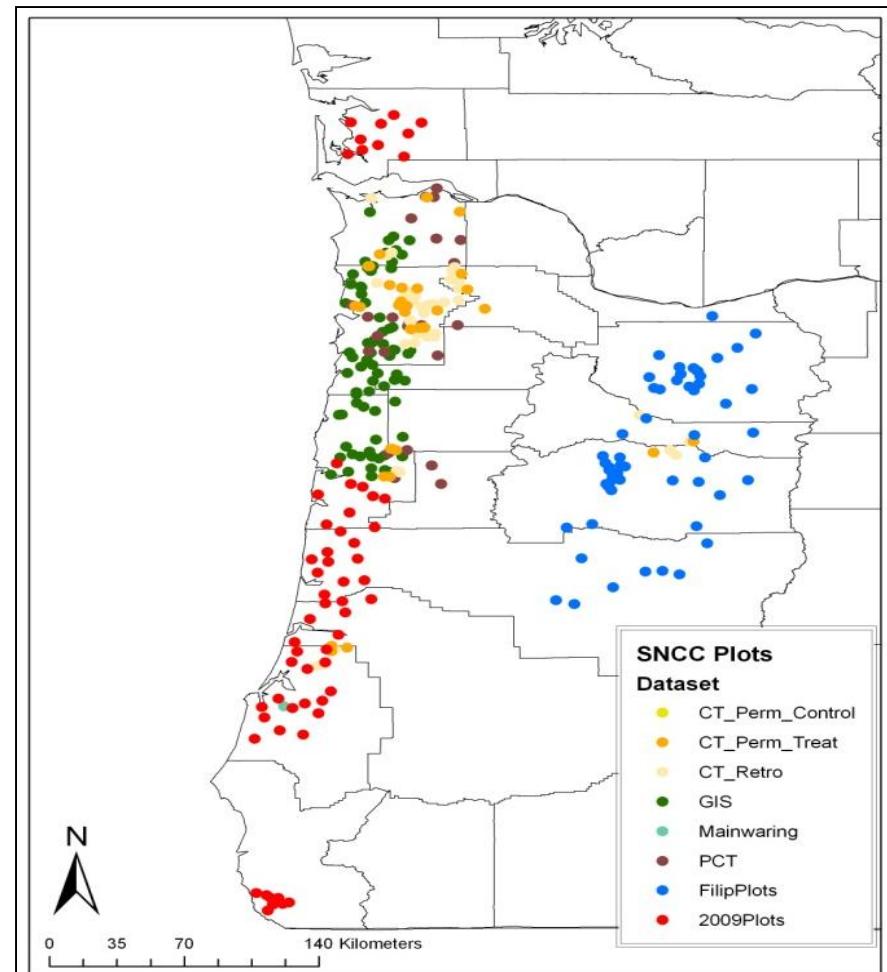
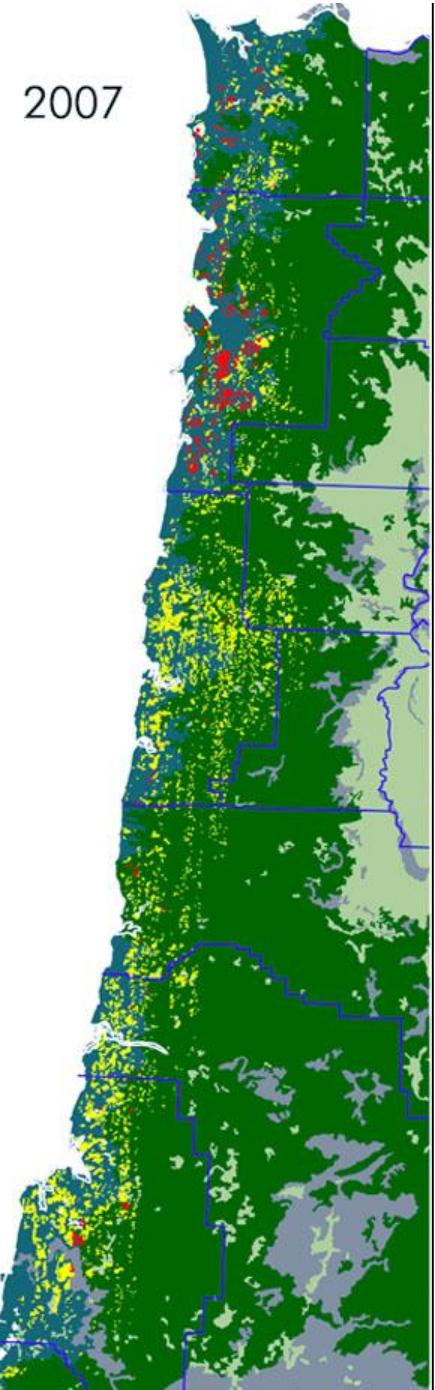
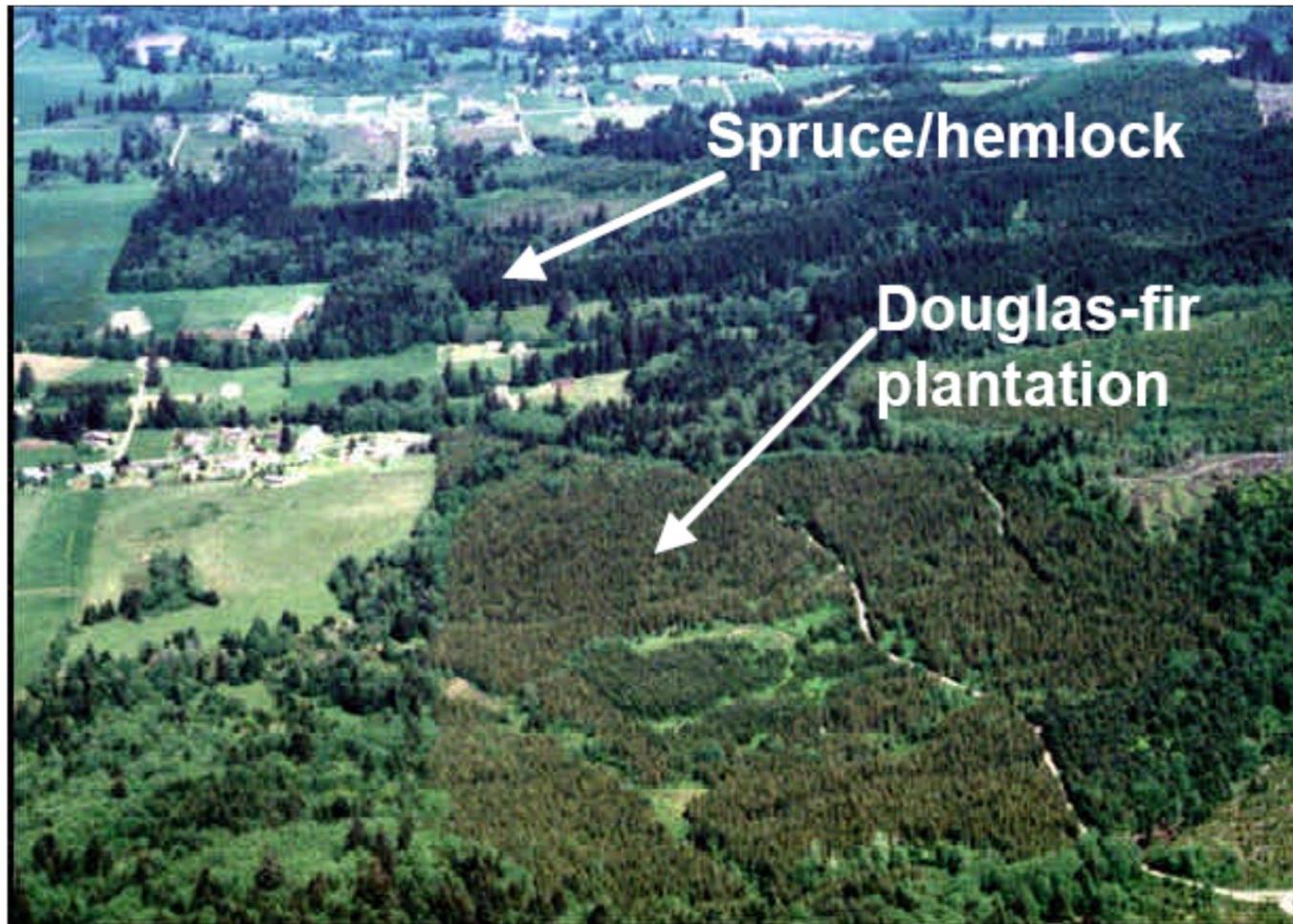


Figure 1. SNC Plot Location

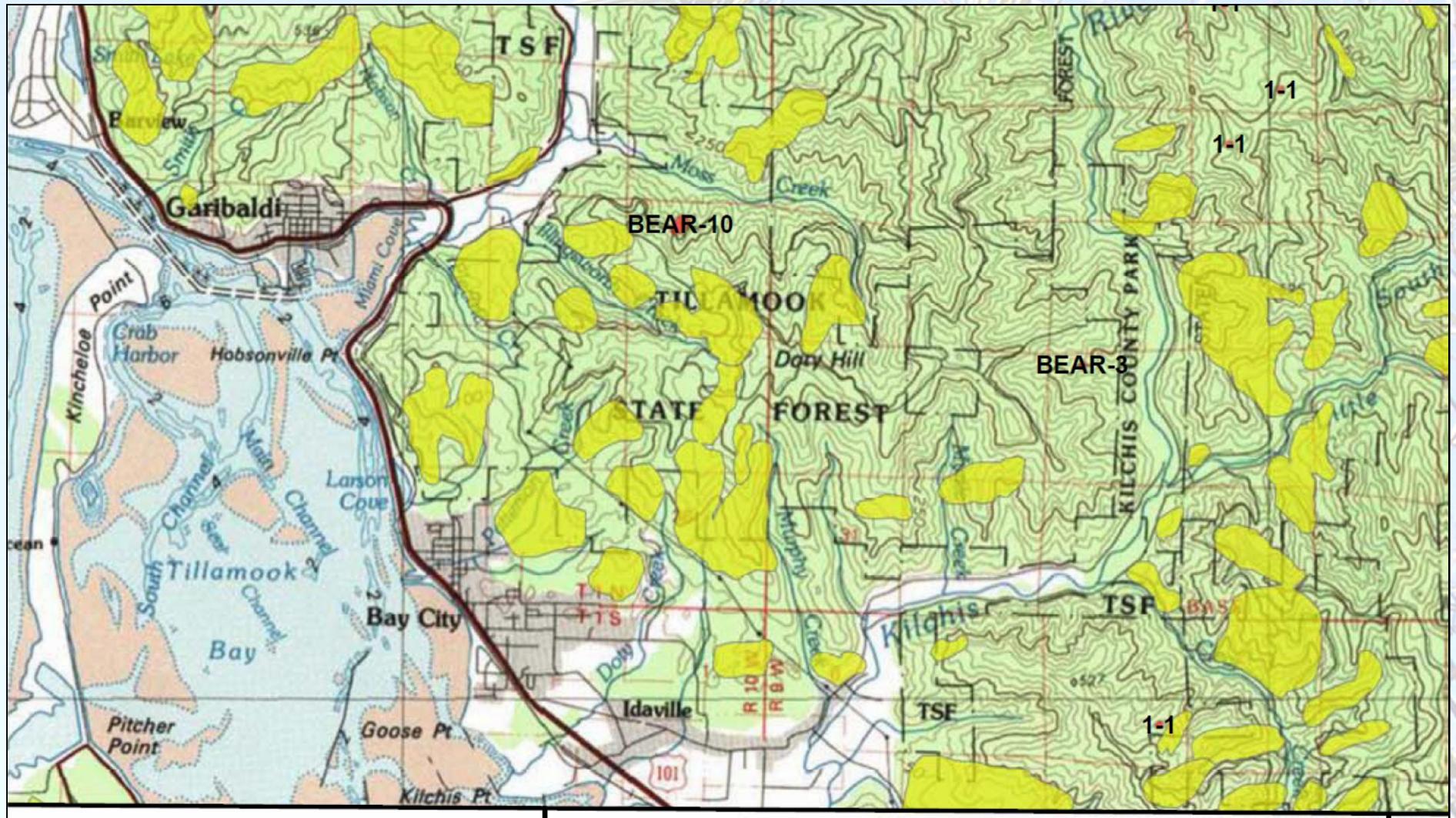


Aerial Survey USFS and ODF



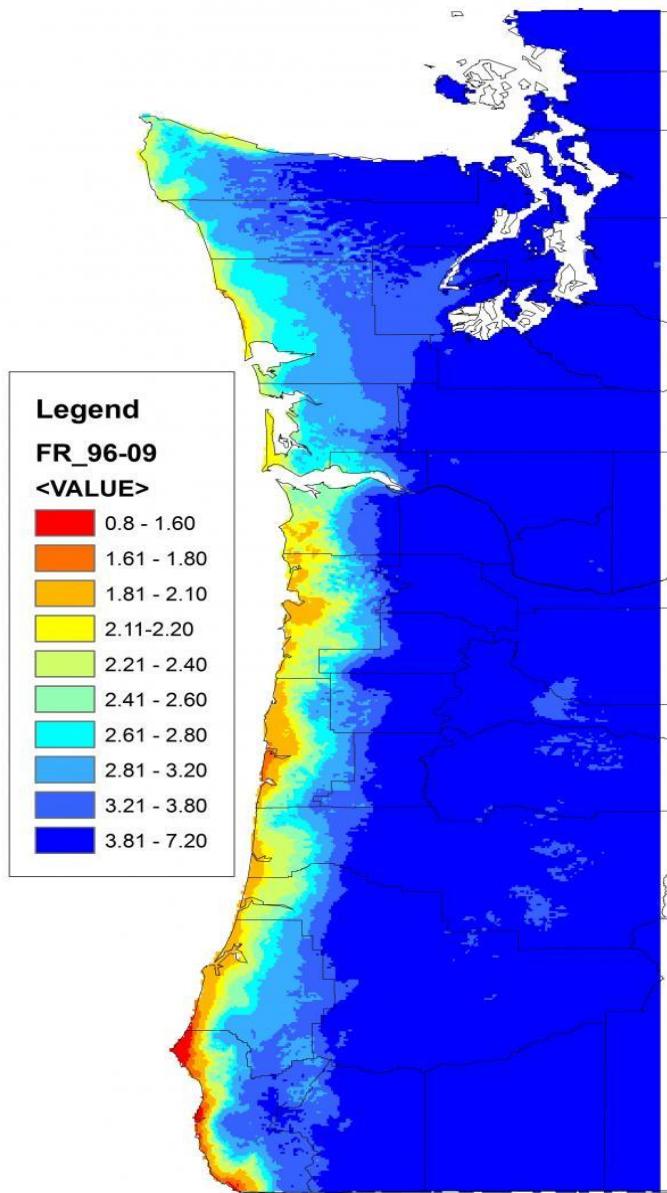
Figures from Oregon Dept of Forestry

Aerial Survey Data published annually on more detailed
1:100,000k maps (yellow is SNC):
<http://www.fs.fed.us/r6/nr/fid/as/quad09/index.shtml>



Modeling Disease Severity

- 3 modeling groups



Zhao, Mainwaring, Maguire and Kanaskie

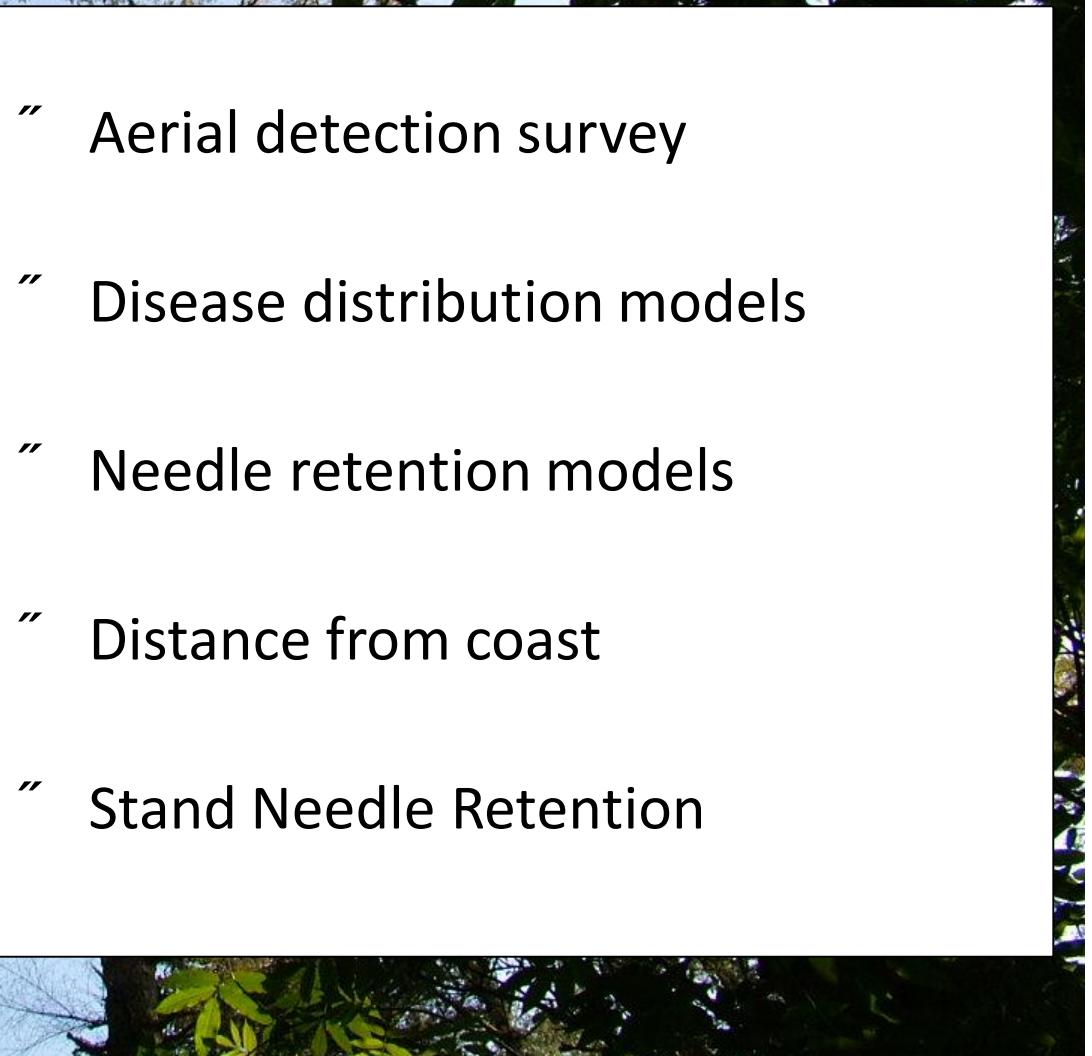
2011. Forest Ecology and Management

- " Climate and needle retention (SNC)
- " 85 annual seasonal and monthly climate variables explored.
- " Best correlation with needle retention:
 - . Temperature-based continentality index
 - . Mean annual precipitation
 - . Winter temperature
 - . Summer temperature
 - . Spring or summer precipitation



Assessing Stand Risk

Qualitative Estimates

- " Aerial detection survey
 - " Disease distribution models
 - " Needle retention models
 - " Distance from coast
 - " Stand Needle Retention
- 

Quantitative Impact Assessment Required for IPM Decisions.

- “ Permanent plots in your stand are a great way to keep track of growth.
- “ Stand assessments can be made by cruising and increment coring trees to determine past basal area growth.
- “ Must take into account density and site index, age etc, so use a growth model like ORGANON to estimate normal growth.
- “ Disease impacts are estimated based on deviation from normal.



http://www.cof.orst.edu/coops/sncc/Stand%20Growth%20Assessment%202.81.xls - Windows Internet Explorer

File Edit View Insert Format Tools Data Go To Favorites Help

A1 fx

http://www.cof.orst.edu/coops/sncc/Stand%20Growth%20Assessment%202.81.xls

 **OSU** Oregon State University
College of Forestry

STAND GROWTH ASSESSMENT TOOL

INTRODUCTION AND PROCEDURES

DATA ENTRY AND REPORT

CALCULATE SITE INDEX

CLOSE PROGRAM



UGA2251045

For questions or additional information contact Doug Robin with Oregon Department of Forestry or Doug Mainwaring with Oregon State University

Spreadsheet based tool.

Developed by OSU and Oregon Dept. of Forestry.

Stand growth assessment tool if available at the SNCC website:
<http://sncc.forestry.oregonstate.edu/stand-growth-assessment-tool>

Silvicultural Recommendations

ODF



- “ Typical Foliage Disease Plantation Management Recommendations Are Not Effective in the Zone of the SNC Epidemic.
- “ Canopy drying techniques, thinning, vegetation management has no effect on disease severity, negative or positive.
- “ Pruning not recommended due to foliage removal.
- “ Mixed species management may protect against heavy losses.
 - . Does not ameliorate disease.
- “ Integrate tools available through SNCC to manage Douglas-fir and predict impacts.

However, some recommendations for Pre-commercial Thinning

- “ Thin early in plantation (< 12 yrs)
 - . Opportunity to remove poor trees early
- “ Thin from below (favor larger trees)
 - . Larger trees may be more tolerant of disease
- “ Favor western hemlock, cedar or spruce if trees are same size or larger than adjacent Douglas-fir.

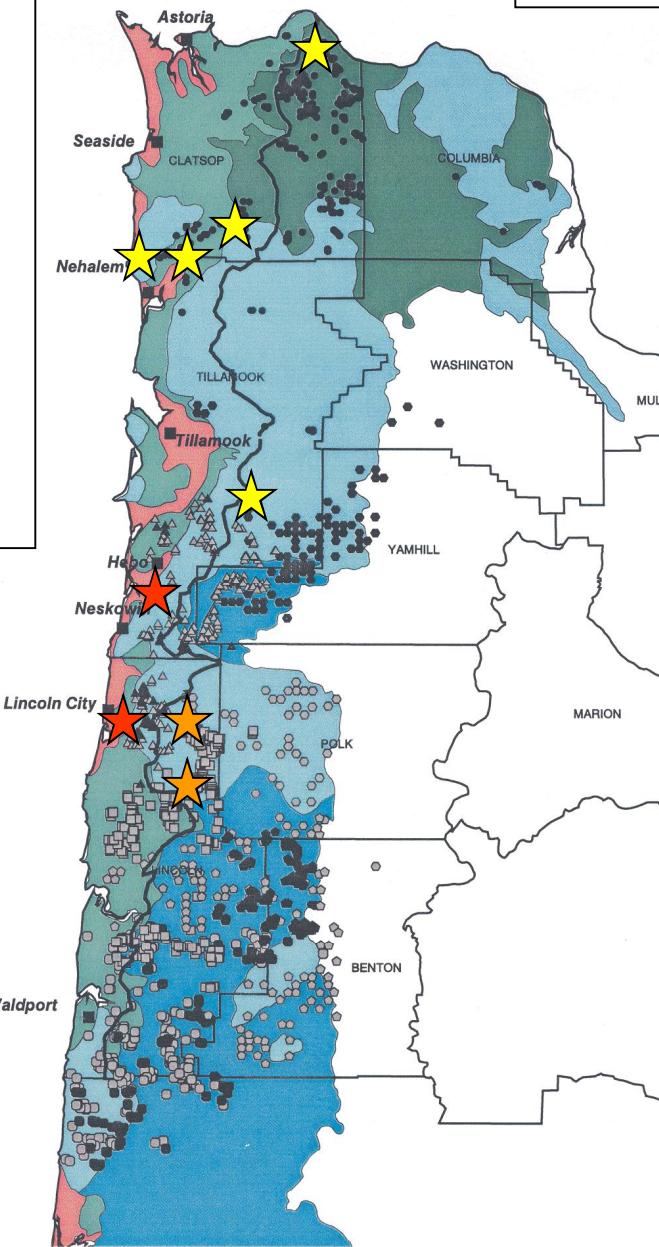


Tree Improvement

USFS/BLM and now especially

**NW Tree Improvement Coop
and sub-cooperatives.**

Keith Jayawickrama, Director



Progeny Test Sites Used

Yellow star: Nehalem
5 Progeny Test Sites

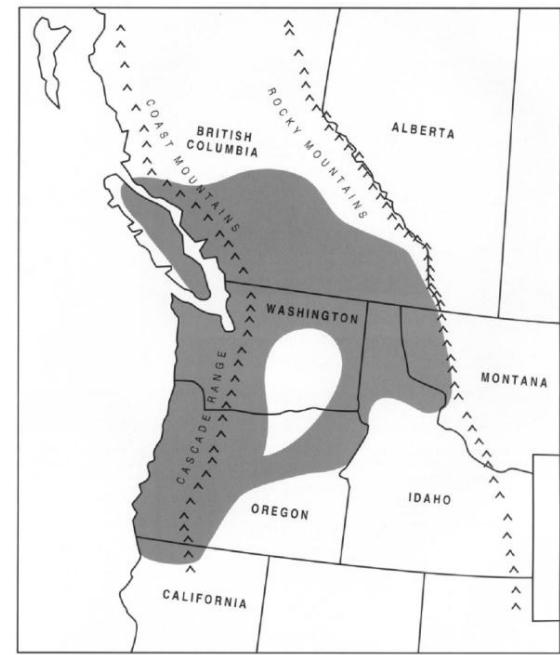
Red star: USFS
2 Progeny Test Sites

Orange star: BLM 12
2 Progeny Test Sites

Slide by: Randy Johnson

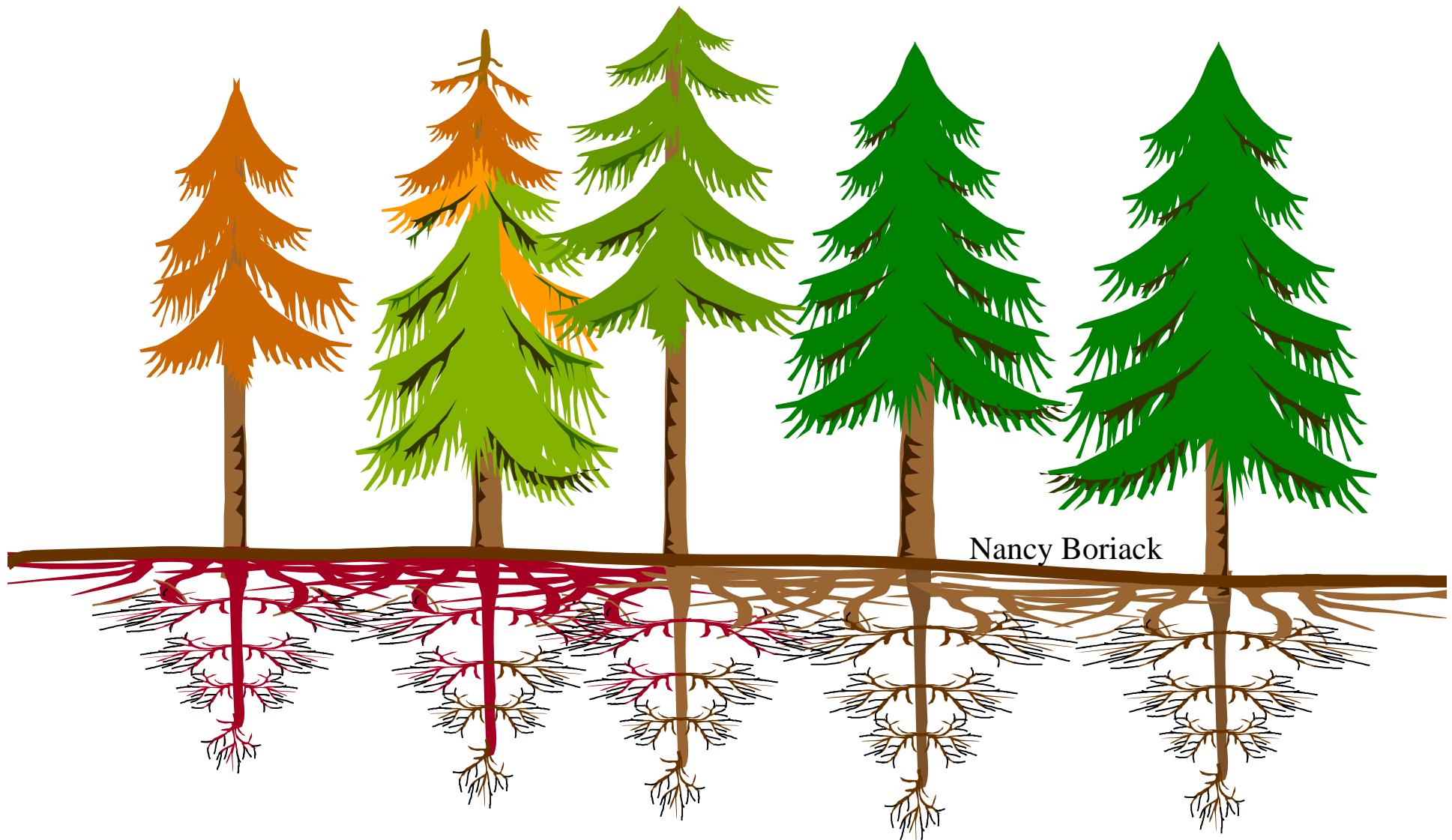
Laminated Root Rot

- " Caused by native root disease fungus: *Phellinus weiri* (Murr.) Gilbertson
- " Also known as *P. sulphurascens*
- " Basidiomycete:
Hymenochaetaceae.
- " Sporophores rare.
- " Wide host range, a different species causes butt rot in w. red cedar.
- " Spread primarily vegetative, ectotrophic mycelium at root contacts.
- " 5% or more of the DF type in western Oregon is occupied by laminated root rot centers



USDA Forest Service
Archives, USDA Forest
Service,
www.forestryimages.org

Diseased trees



Root to root contact

Healthy trees

Disease
pathway tree

Laminated Root Rot: Effects in Forest Stands



GAP-CREATOR
Root Disease Centers:
(Great for wildlife in second-growth.)

Figures from: Thies and Sturrock. 1995.
PNW-GTR-349

Laminated Root Rot

- " Tends to be clonal.
- " Disease centers are usually occupied by single, individual clone.
- " Figure at right was done from 16 acre clearcut near Blyn, WA.
- " X = killed by *P.weiri*i.
- " Circle= infected.

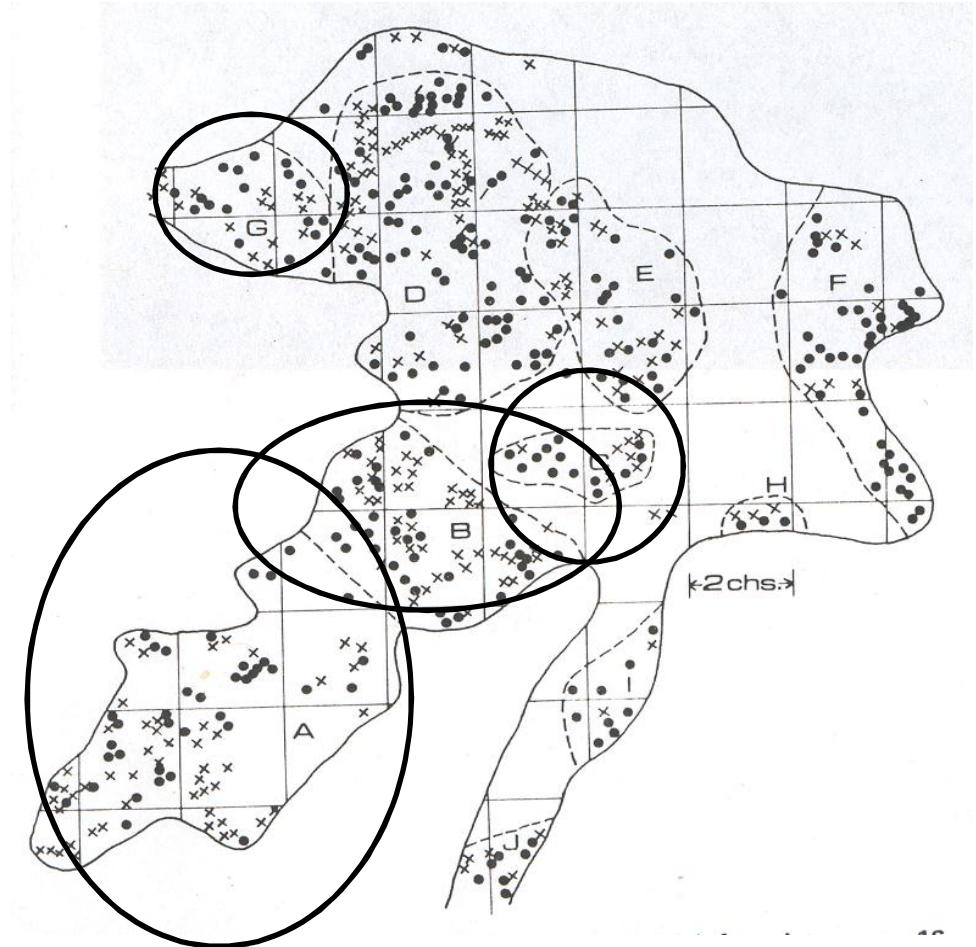
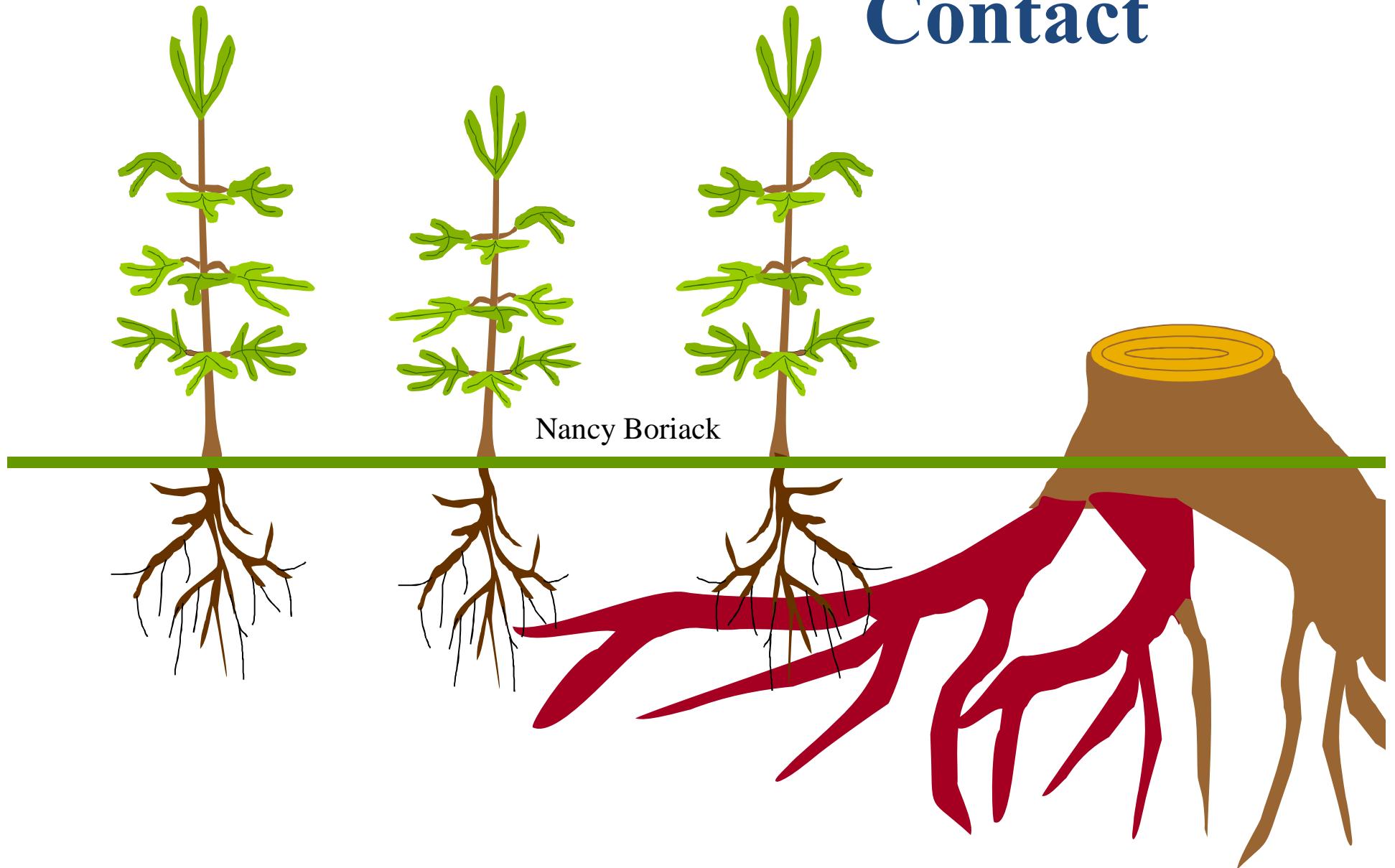


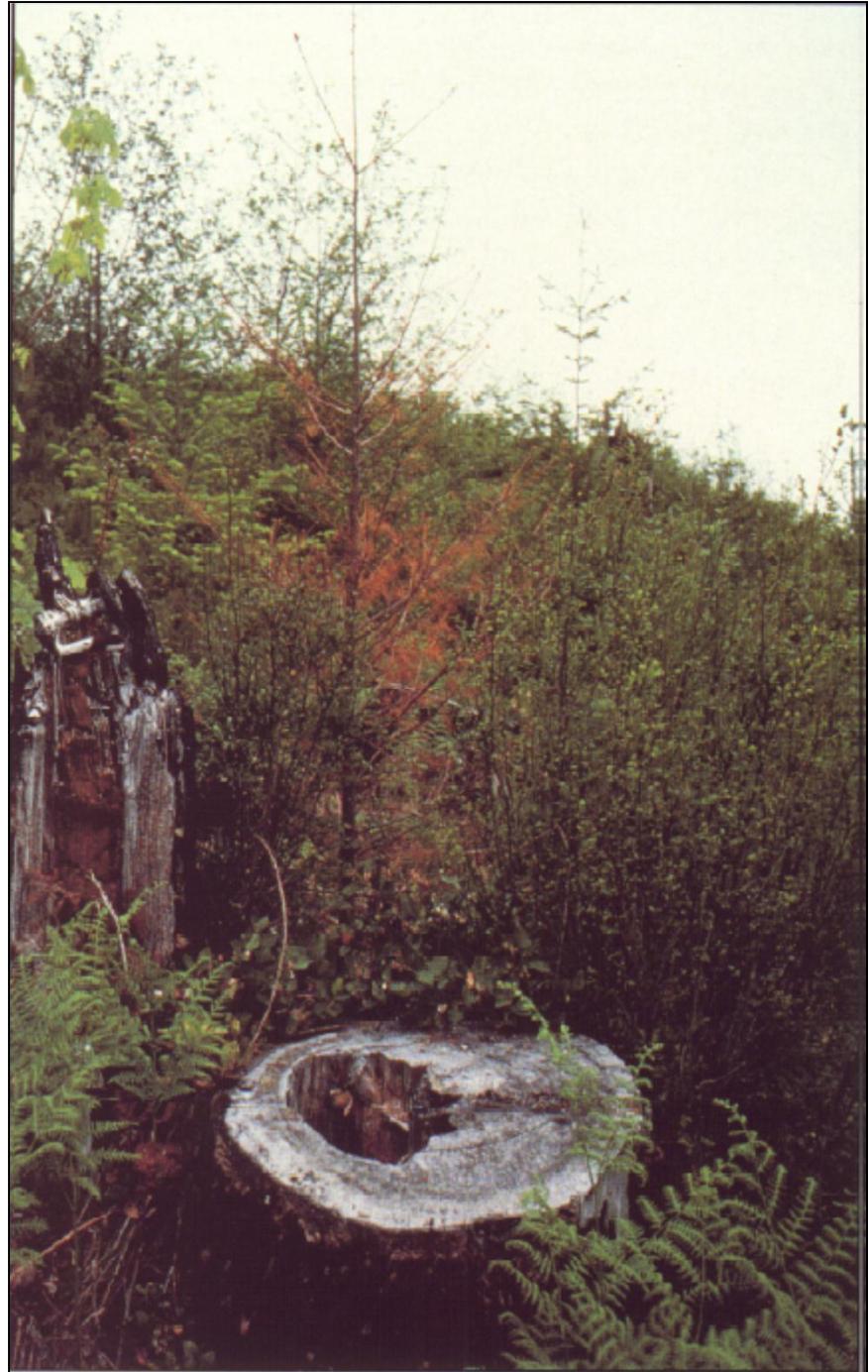
Figure from: T.W.Childs. 1970. USFS Res. Paper PNW-102.

Stump-to-Seedling Contact



Silvicultural Treatments on Laminated Root Rot Sites.

- “ Live with the disease?
 - . Silviculture
 - . Should always do what will minimize lateral spread of the disease
- “ Attempt eradication?
 - . Stump pushing
 - . Hardwood rotation



Silvicultural Treatments on Laminated Root Rot Sites.

" At harvest:

- " Survey and delineate root rot centers
- " Fungus may not be limited to root disease centers however...
- " Characteristic stain in stump at the time of felling is best indicator
 - . Mark stump with double cut for tree planters.
- " Plant disease areas with
 - . WV Ponderosa Pine
 - . W redcedar
 - . W white pine
 - . Incense cedar
 - . Hardwoods, red alder

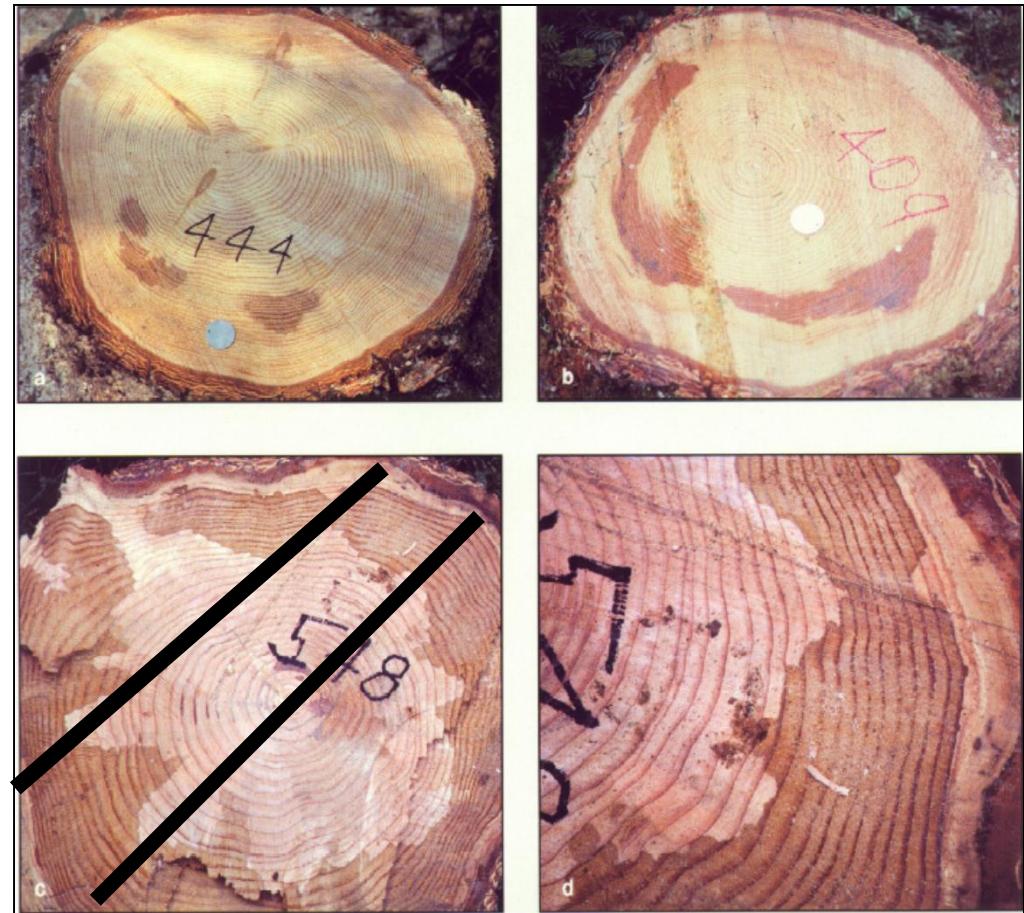


Figure from: Thies and Sturrock. 1995. PNW-GTR-349

Stump pushing/pulling



Figure 25—A large excavator with a standard bucket and an optional gripping thumb can be used effectively for stump removal.

Excavator with thumb

"Removing
(most) inoculum
from the soil.

"Only on flatter
sites (<20 %
slope) and
certain soils (not
clay).

"Many skeptics,
economics not
always easy to
estimate.

"Most studies
point to some
improvement in
root disease
losses compared
to controls.

Best Study in the PNW

Thies and Westlind. 2005.

W.G. Thies, D.J. Westlind / Forest Ecology and Management 219 (2005) 242–258

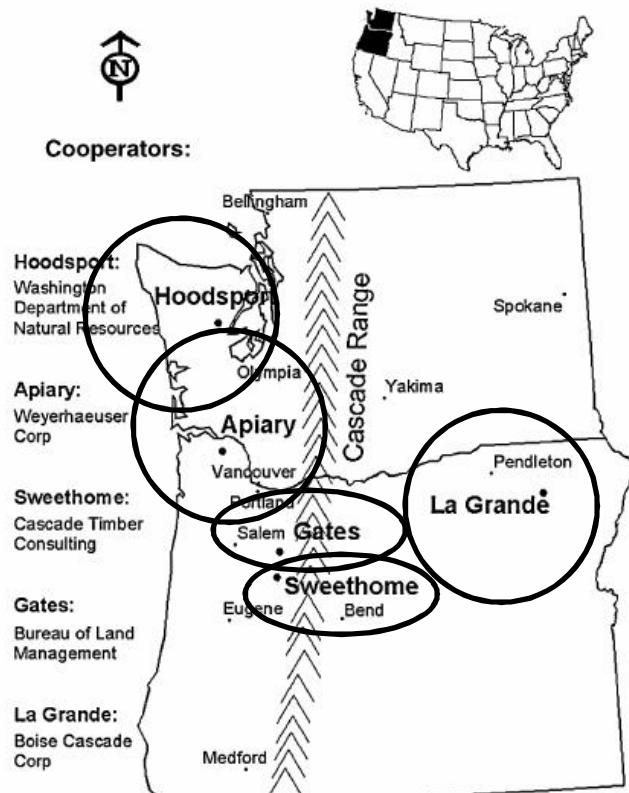


Fig. 1. Location of study areas.

- " Removed stumps with bulldozer. At 5 sites.
- " Fertilizer treatment included.
- " Followed for 27 growing seasons!

Mortality was significantly different from control plots

Treatment	Plot means and standard errors by study area				
	Apiary	Gates	Hoodsport	La Grande	Sweethome
Mortality due to LRR (%)					
S_0	7.21 (1.66)	3.47 (1.22)	22.29 (4.69)	4.16 (1.03)	11.40 (2.53)
S_1	1.91 (1.09)	0.32 (0.18)	6.80 (1.58)	0.65 (0.32)	2.08 (0.93)

S_0 = non-stumped plots

S_1 = stumped plots

Average Mortality:

Stumped: 2.4%

Control: 9.1%

No effect of fertilizer on mortality.

Silvicultural Treatments on Laminated Root Rot Sites: Pre-commercial thinning

- " Thin everything.
- " Identify early signs of the disease.
- " Around mortality pockets:
 - . Wide spacing
 - . Favor alternative species



- Windthrow of infected residual trees is the issue
- Most suggest minimizing stand entries beyond PCT.
- Stand entries can increase fungal aggressiveness, apparently.
- Option: Thin as normal, but thin lightly over disease areas and only if:
 - Final harvest within 10-15 years.
 - Area is not prone to high winds like on exposed ridgetops
 - And only if disease is not widespread and severe.

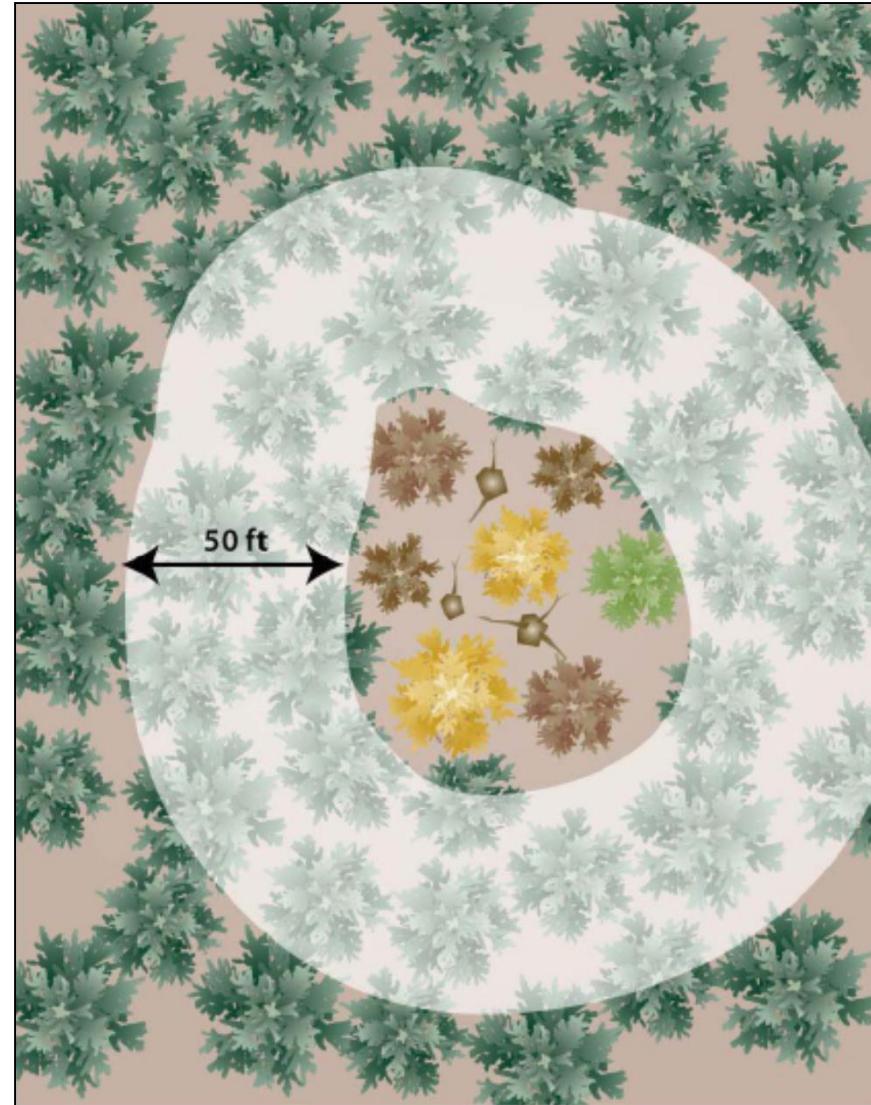
Silvicultural Treatments on Laminated Root Rot Sites: Commercial Thinning Options (not)



Silvicultural Treatments on Laminated Root Rot Sites:

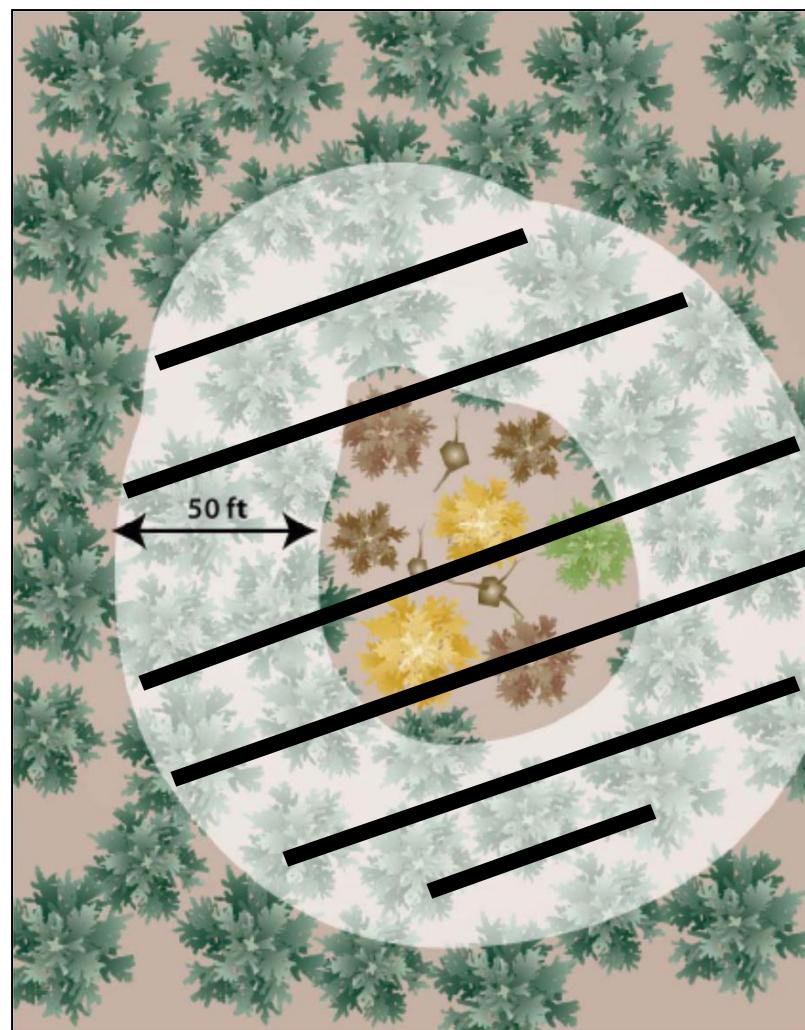
Intermediate Treatments: Commercial Thinning or Sanitation/Salvage Options

- “ Thin around the infection centers (leave them alone)
- “ Leave 50 ft buffer
- “ Final harvest will take everything



- “ Salvage centers and 50 ft buffer to prevent spread.
- “ This type of treatment could compound windthrow, so avoid high wind hazard sites.
- “ Separate infection center from residual stand with non-host tree species.
- “ Plant alternative species within patch.
- “ PCT early and remove Douglas-fir that seeds into the center.

Final Option: Patch cut/salvage





Black Stain Root Disease
-Leptographium/Ophiostoma
wageneri var. *pseudotsugae*
-Mortality agent

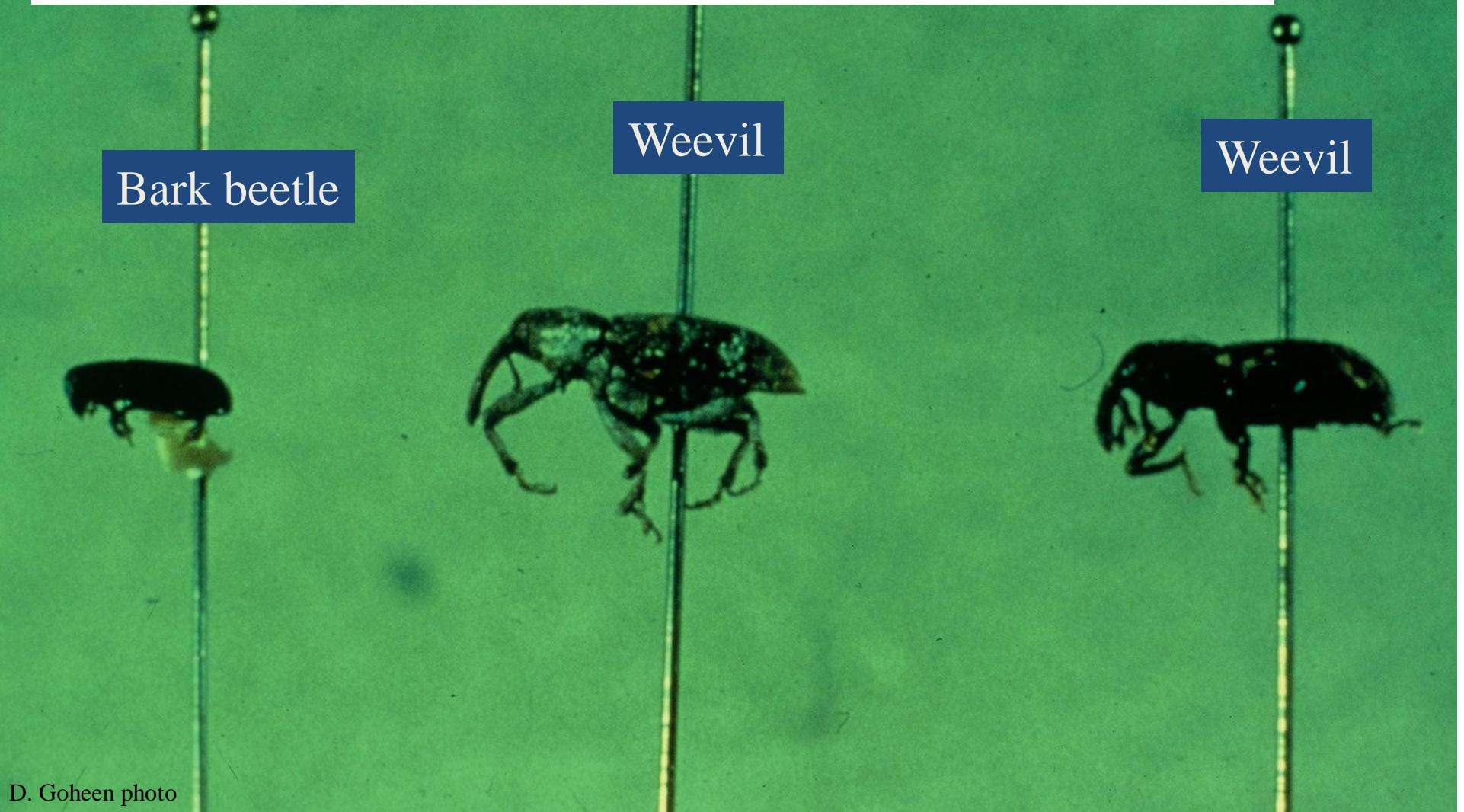


Black stain is vectored by root feeding insects.

Bark beetle

Weevil

Weevil



- Spreads by insects and locally by root grafting.
- Insects target stressed trees, wounded roots.
- Fungus requires wound for entrance into xylem.
- Most common in young (thinned) plantations of Douglas-fir.
- Especially on compacted soils and roadsides.
- Full region impacts/extent not known.

Black Stain Root Disease



Black Stain Management

- “ General:
 - Survey the area, if disease is present locally, then consider management.
- “ Wait to thin, prune, or do roadside and tree wounding activities
 - until after July and before December
 - to avoid attracting insects.
- “ Avoid wounding roots in intermediate treatments.
- “ Favor resistant species (anything but Douglas-fir).





Summary:

Geographical location of plantation?
Zone of SNC along coast?
Black stain in area?
Laminated root disease centers present in stand?

SNC

IPM with tools provided by SNCC.
JOIN SNCC to assist monitoring and long-term epidemiology and mensurational impacts assessments.

Laminated root rot
Disease of the site: silviculture

Black stain
Prevention is key

Alternative species are an option, but no tree species is free of issues.



Push-felling, to uproot the tree at the time of felling is thought to be an alternative



Figure 26—An excavator can be used to push-fall trees.

Experimentation with chemicals (didn't really work)



Figure 27—The fumigant chloropicrin being pumped into predrilled holes in a *Phellinus weiri*-infested stump.