

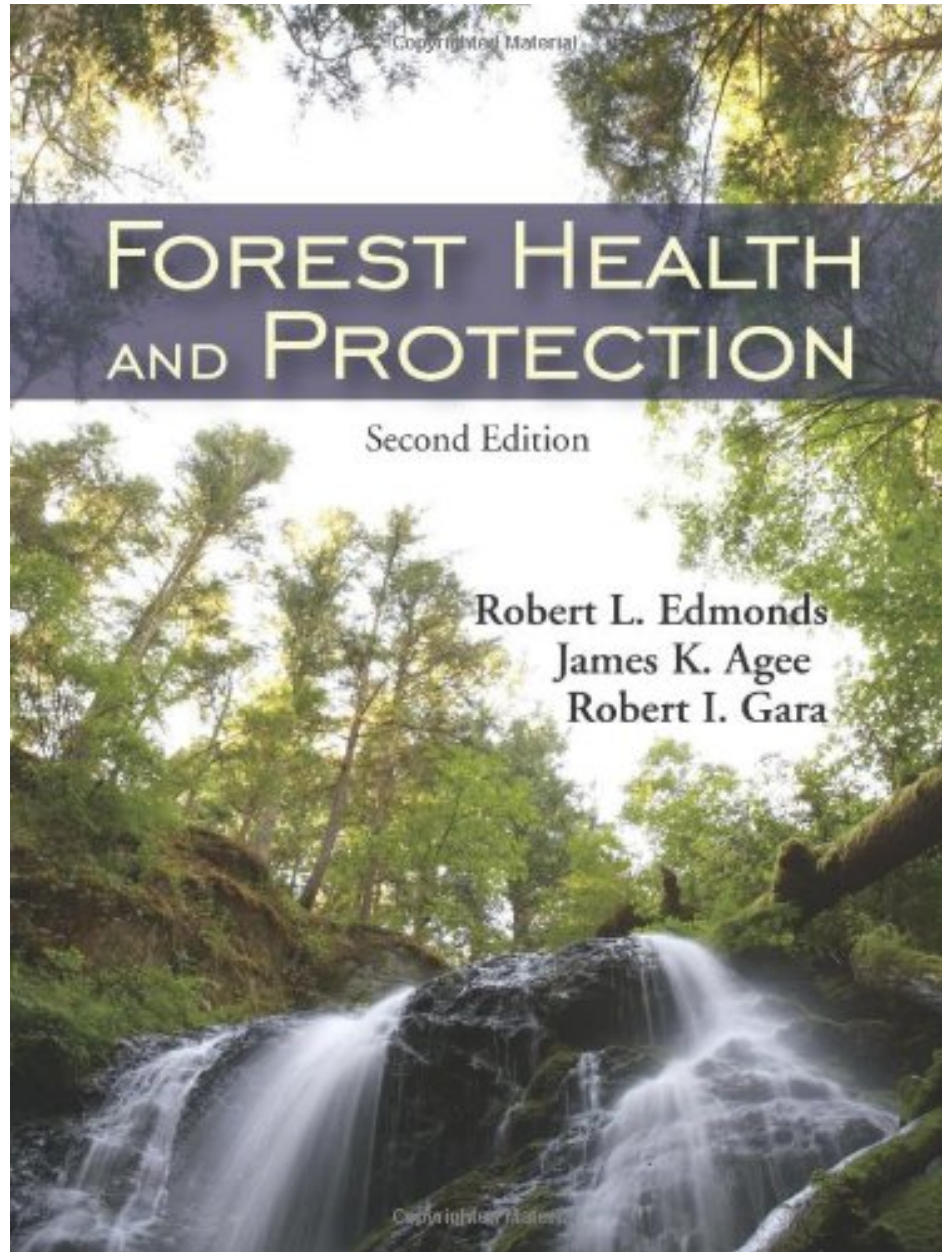
Forest Health: Effects of insects, diseases, fire, drought and animals on forest productivity in Washington

ESRM 323

Spring 2018

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School of Environmental Forest Sciences
University of Washington



2010.
Waveland Press,
Long Grove, ILL.

Forest Health Highlights in Washington—2016



*Celebrating 70 years
of Aerial Survey*

USDA Forest Service
Pacific Northwest Region
Forest Health Protection

Washington State Department of Natural Resources
Forest Health Program

February 2017

http://www.dnr.wa.gov/Publications/rp_fh_2016_forest_health_highlights.pdf

Major insects in the Pacific Northwest

Defoliators

Western spruce budworm

Douglas-fir tussock moth

Western hemlock looper

Bark beetles

Mountain pine beetle

Western pine beetle

Fir engraver

Turpentine beetle

Douglas-fir beetle

Other

Sitka spruce weevil

Balsam wooly adelgid*

Gypsy moth* - urban trees

* Introduced

Major Diseases in the Pacific Northwest

Root and butt diseases

Laminated root rot

Annosus root and butt rot

Armillaria root disease

Black stain root disease

Port Orford Cedar Root disease*

Schweinitzii root and butt rot

Foliage diseases

Rhabdocline needle disease

Swiss needle cast

Larch needle cast

Dothistroma needle cast

Poplar rust*

Stem and branch diseases

Dwarf mistletoes

Sudden oak death*

White pine blister rust *and stem rusts

Stem decays

* Introduced

Maple decline

Impact of Diseases and Insects - *Forest management/human activities have generally made diseases and insects worse*

Effects on Forest Productivity

- Mortality/loss of basal area
- Reduced growth
- Reduction of merchantable wood quantity (decay) and quality
- Delayed regeneration; inadequate stocking (reduced #trees/acre)
- Site deterioration - build up of pathogens and insects

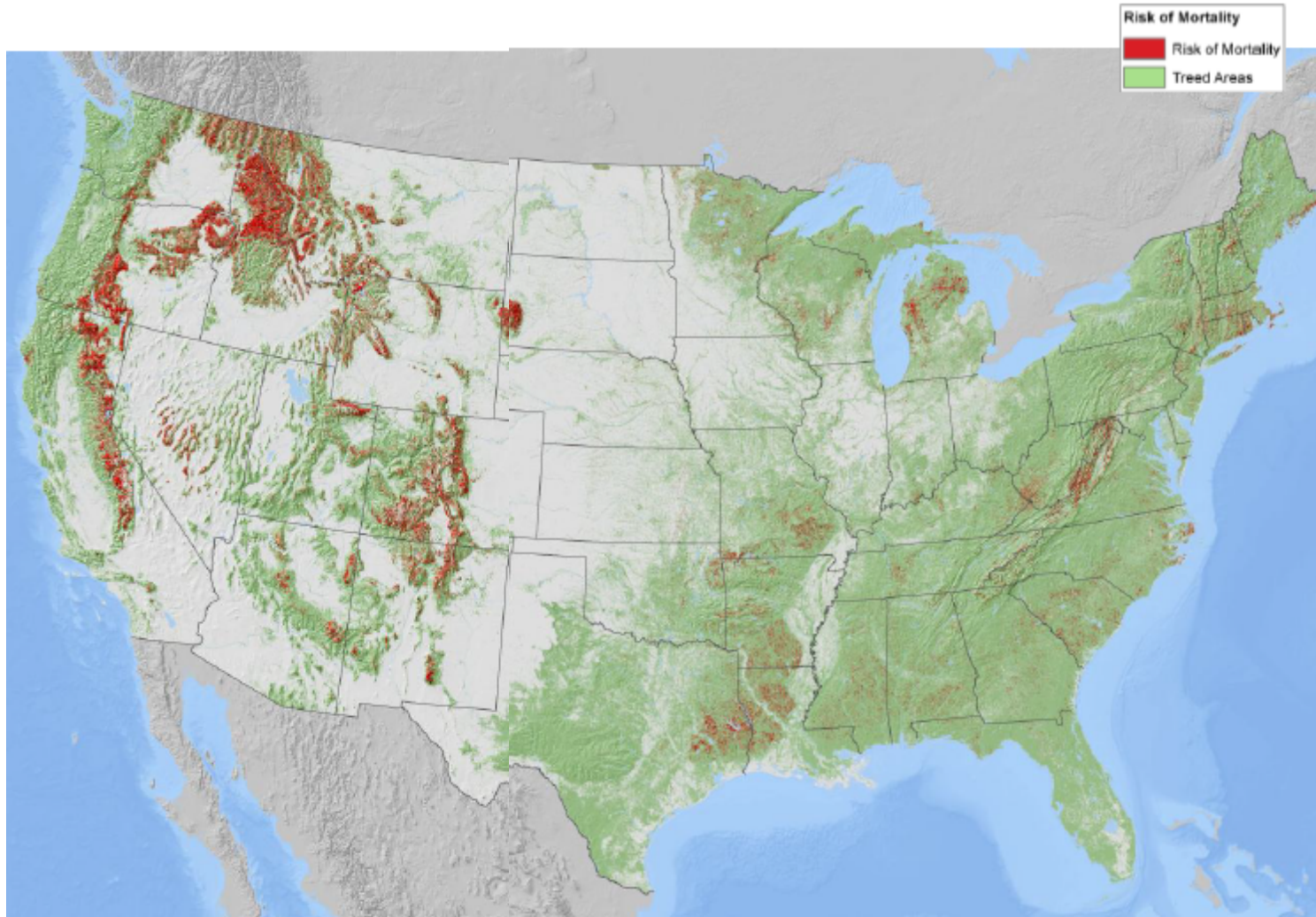
Ecological effects

- Changes in species succession
- Creation of biodiversity
- Decomposition and nutrient cycling

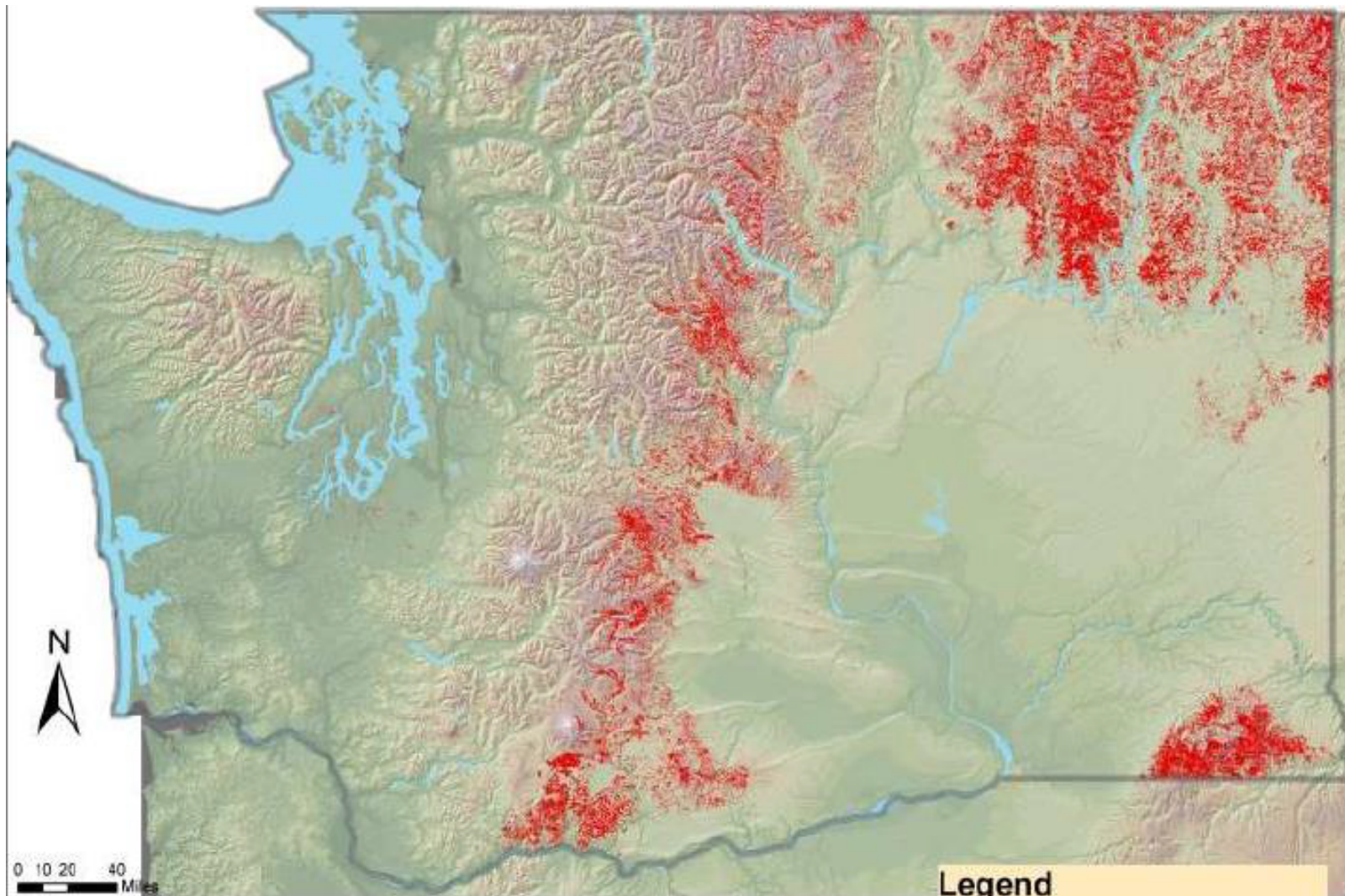
Human effects – death and property damage

US Forest Service Risk of Mortality to insects and diseases - 2012

National 2012 composite insect and disease risk




US Forest 2013-2027 prediction for basal area loss >25% from insects and diseases in Washington



Data Source: 2013-2027 National Insect and Disease Forest Risk Assessment, USDA Forest Service. Areas in red represent forestlands where 25% or more of the total tree basal area is expected to die over a 15 year time frame (2013-2027) from insects and diseases. (2,698,828 acres in Washington).

Legend

 NIDRM >25% basal area loss

Forest Health Problems – Eastside WA

- Insects – bark beetles, defoliators
- Diseases – root diseases, stem decays, dwarf mistletoes, white pine blister rust
- Fire – major problem (97% of fires)
- Drought
- Animal damage – bears, deer
- Wind – minor problem
- Air pollution – minor problem
- Climate change – drought, mortality
- Forest management - fire suppression
- Development – loss of forest land

Eastside WA



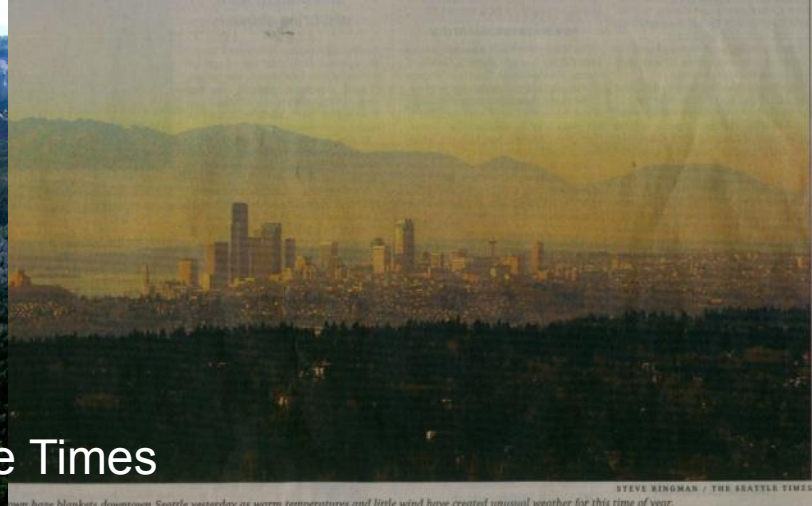
In east slope
Cascade forests
fire suppression
over last 100 years
has resulted in high
tree density, tree
species change,
drought stress,
increased root
disease, bark
beetles, defoliators
and mortality
Forest is now prone
to unnaturally high
intensity fires



Forest Health Problems – Westside WA

- Insects – not as many (Douglas-fir beetle, Sitka spruce weevil)
- Diseases – root diseases, foliage diseases, Sudden oak death, maple decline
- Fire – not a large problem
- Drought
- Animal damage – bears, deer
- Wind storms
- Rainstorms and erosion
- Air pollution – ozone
- Climate change -
- Forest management
- Development - loss of forest land

Westside WA



URBAN ECOSYSTEMS

Seattle Times May 13th, 2017 |
Lynda V. Mapes

FAREWELL, GIANT PINE: CLIMATE CHANGE KILLS A CHAMPION AT WASHINGTON PARK ARBORETUM

Actually climate change, red
turpentine beetle, and root disease
(probably Armillaria)

70 year-old *Pinus rigida* in Pinetum

The state's champion pitch pine towers over David Zuckerman, manager of horticulture at the Washington Park Arboretum. The tree has died and must come down. (Alan Berner/The Seattle Times)



Washington mortality and defoliation (more than half on federal lands)

Year	mill acres*	percent
2009	1.73	7.4
2010	0.94	4.2
2011	0.95	4.2
2012	1.08	4.8
2013	0.59	2.6
2014	0.54	2.5
2015	0.34	1.5
2016	0.45	2.0

1.2 million trees recently killed

* Washington has 22.4 mill. acres of forest

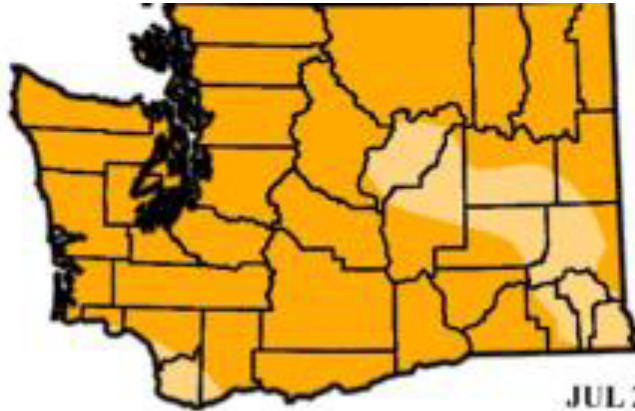
Acres affected by major insects, diseases and fire

	2012	2013	2014	2015	2016
Pine beetles	156,000	107,000	143,000	65,200	233,000
Spruce 100,000 budworm		571,000	178,000	93,000	99,000
Bears/ root diseases	200,000	183,000		108,000	77,000*
FIRE	259,000	153,000	360,000	1,089,000**	294,000

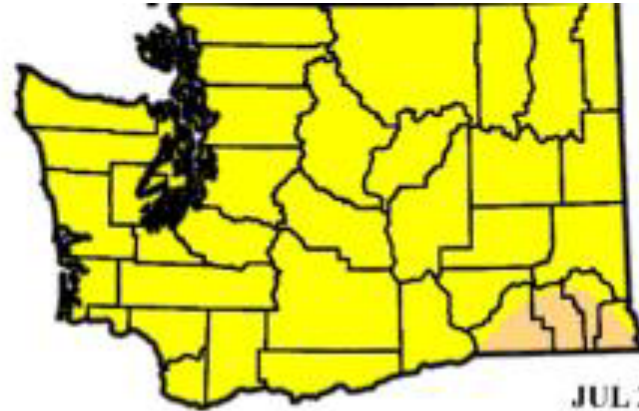
* Underestimated – hard to detect from the air

**Record

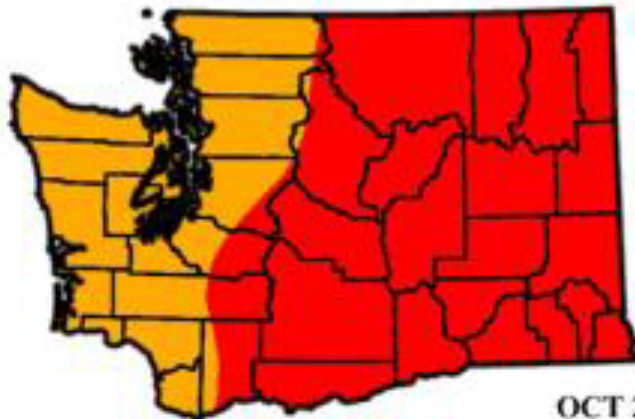
DROUGHT



JUL 2015



JUL 2016



OCT 2015



OCT 2016



Abnormally Dry



Severe Drought



Moderate Drought



Extreme Drought

More on Forest Diseases

Root and butt diseases

Laminated root rot

Armillaria root disease

Annosus root and butt rot

Port Orford Cedar Root
disease

Black stain root disease

Schweinitzii root and butt rot

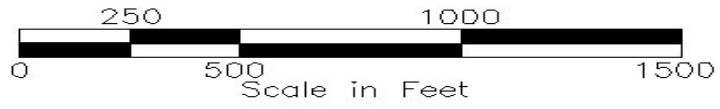


Laminated root rot pocket in second-growth Douglas-fir -
High mortality.

Laminated Root Rot



Figure 6f: Incipient decay in outer sapwood of Douglas-fir. Figure 6g: Laminated decay of Douglas-fir typi-



- + Root Rot Tree
- Root Rot 50' Buffer
- 25 Root Rot ID Number

	NORTHWEST AERIAL RECONNAISSANCE, INC. 28205 State Hwy. 3 NE POULSBORO, WA 98370 (360) 697-2266
	DATE: 10/27/98

PARCEL:
Pioneer Park

PREPARED FOR:
Mercer Island Parks & Recreation



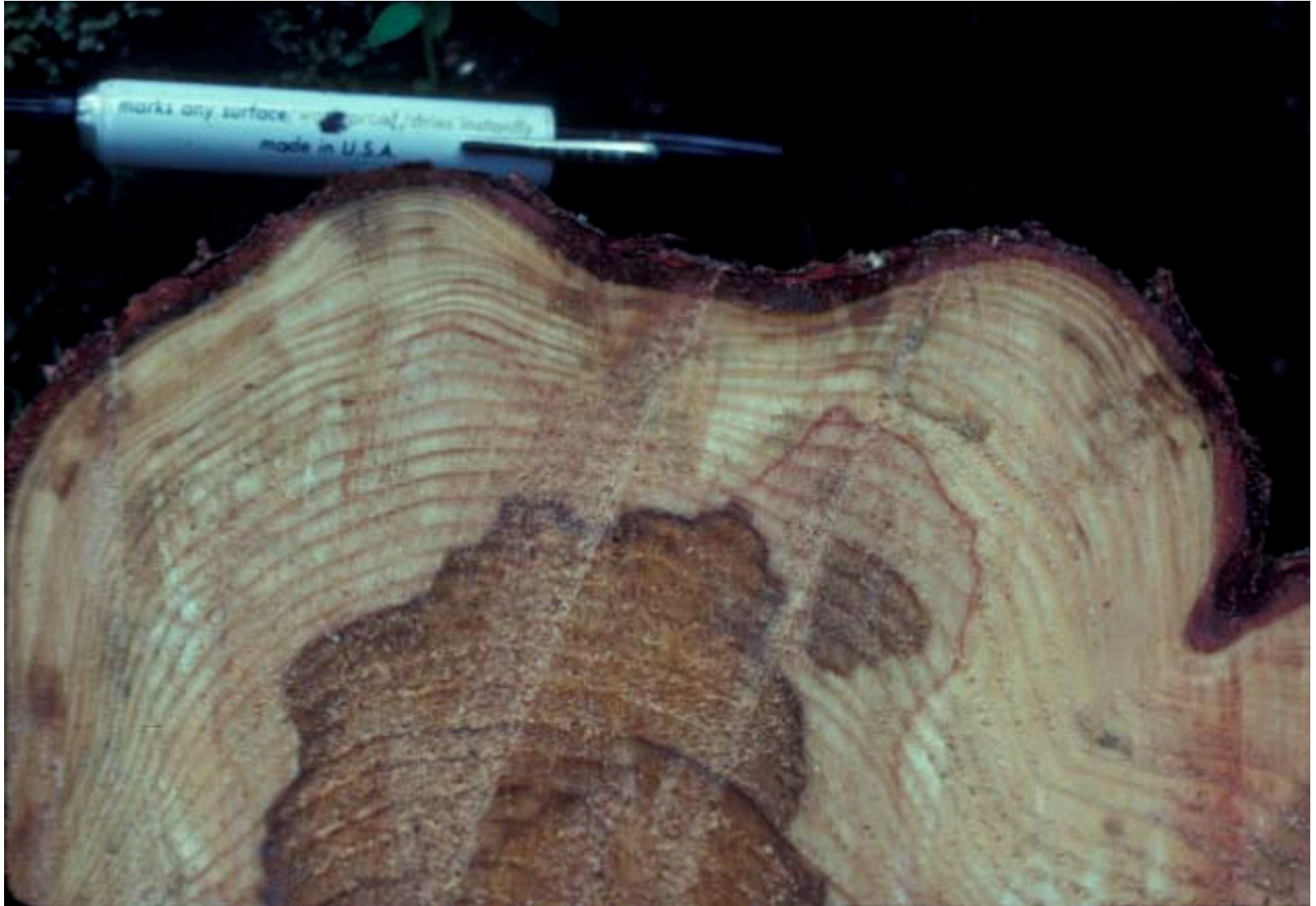
Figure 1f: *Armillaria* root disease center in a 80- to 100-year-old Douglas-fir stand (30 years after partial cutting). Figure 1g: *Armillaria* fruiting bodies around a diseased Douglas-fir stump. Figures 1h, 1i: Fruiting

Armillaria root disease

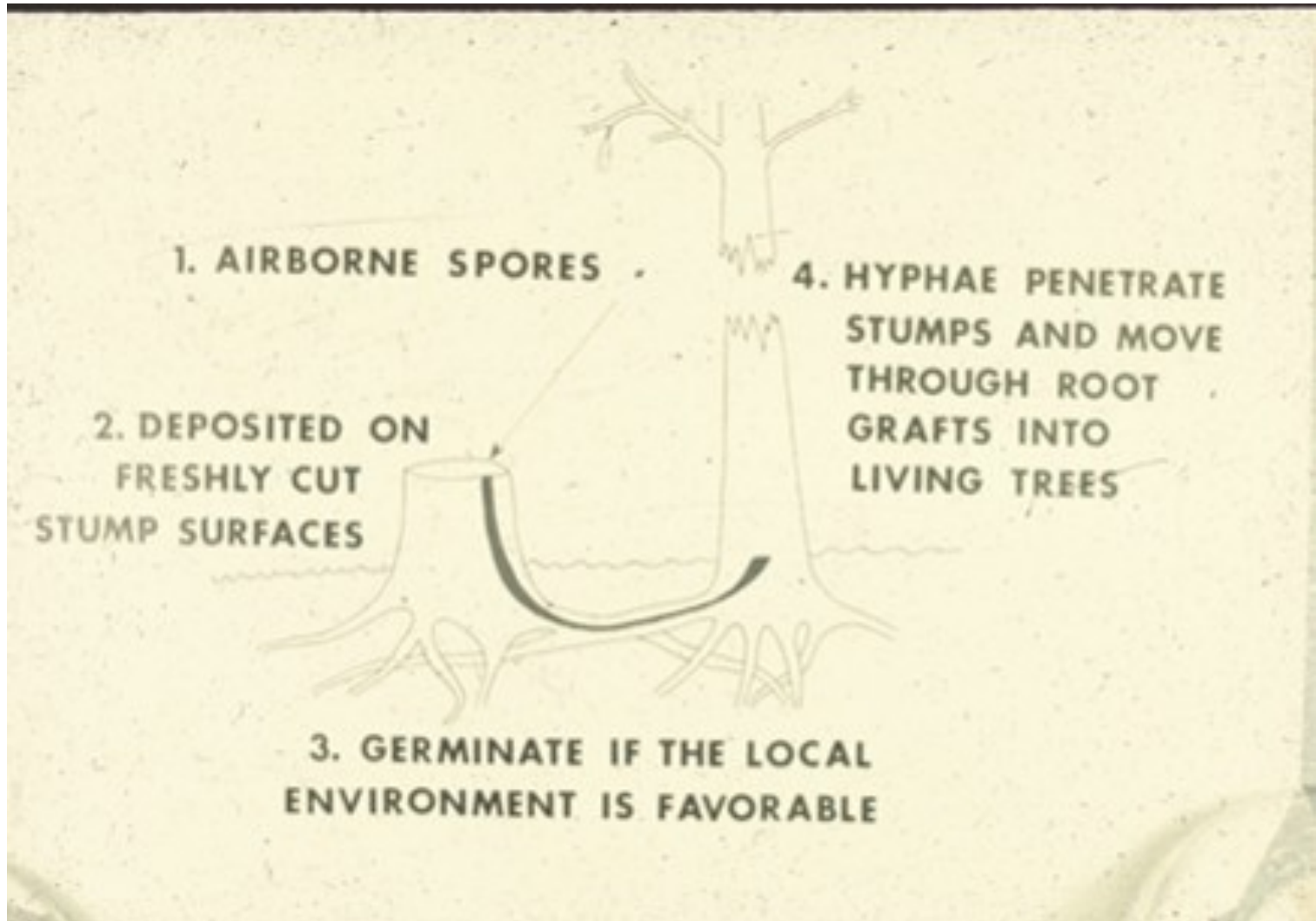


Armillaria rhizomorphs

Heterobasidion occidentale – root and butt rot



Incipient decay stain and wet wood on western hemlock 24

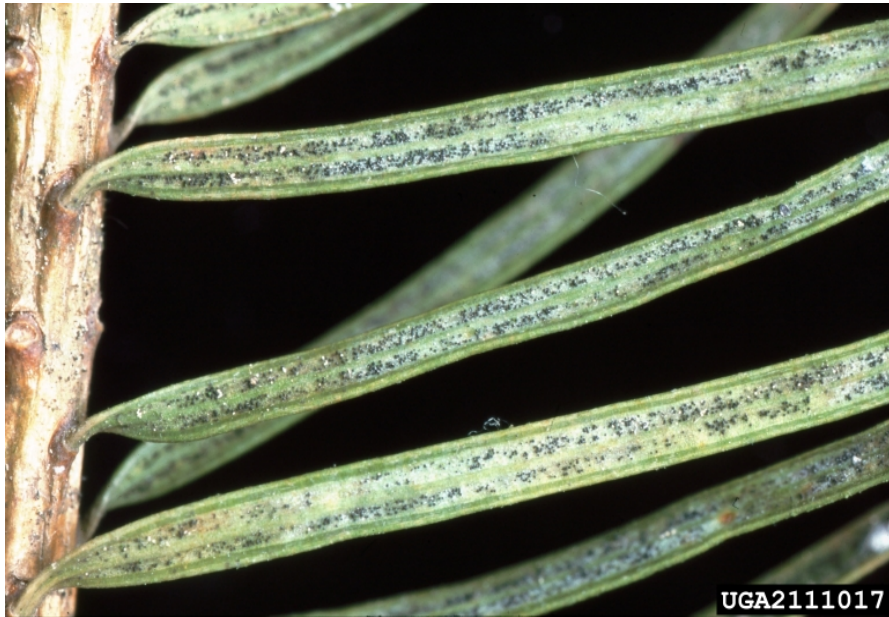




Heterobasidion is a big problem in true firs, spruce and pines in eastern Washington causing mortality.

Foliage Diseases

Swiss needle cast on
Douglas-fir



Larch needle cast



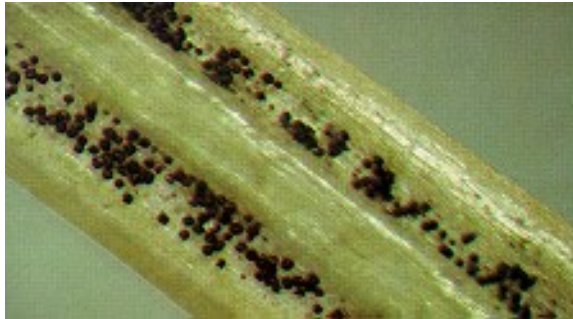
SWISS NEEDLE CAST - NATIVE DISEASE

Made worse by forest management practices



Defoliation from Swiss needle cast on Douglas-fir
Big problem in central coastal Oregon

SWISS NEEDLE CAST ON DOUGLAS-FIR



Fruiting bodies (pseudothecia)
plugging stomates

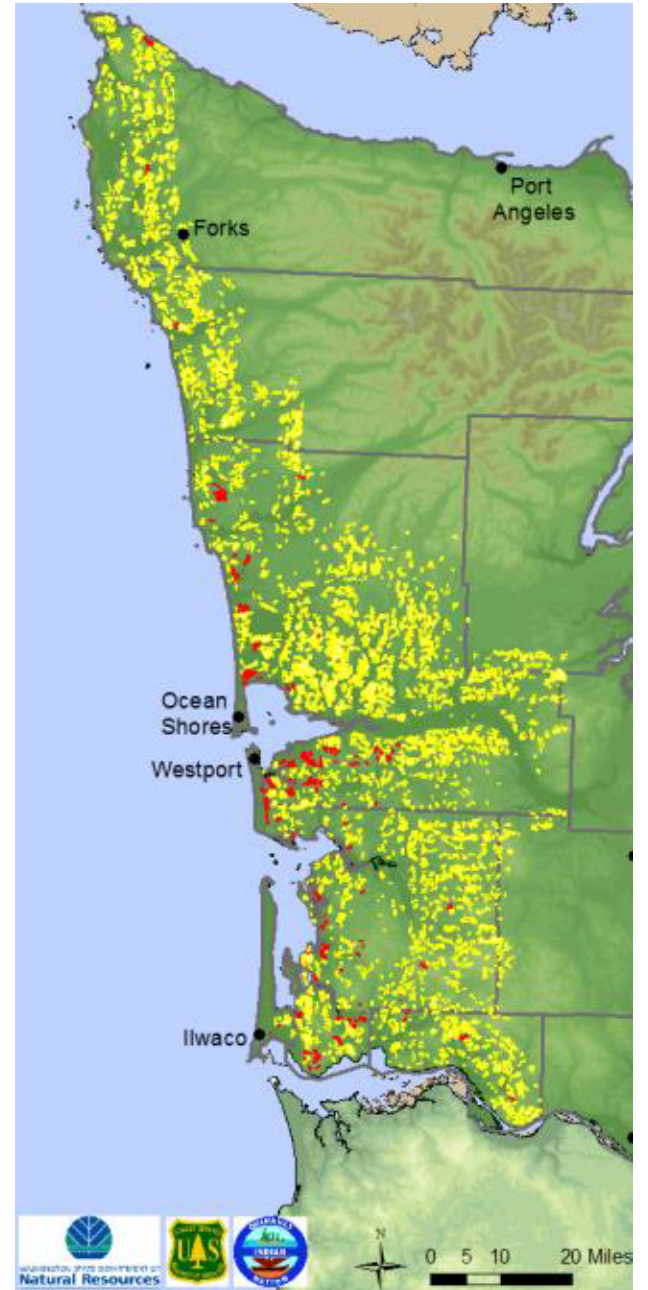
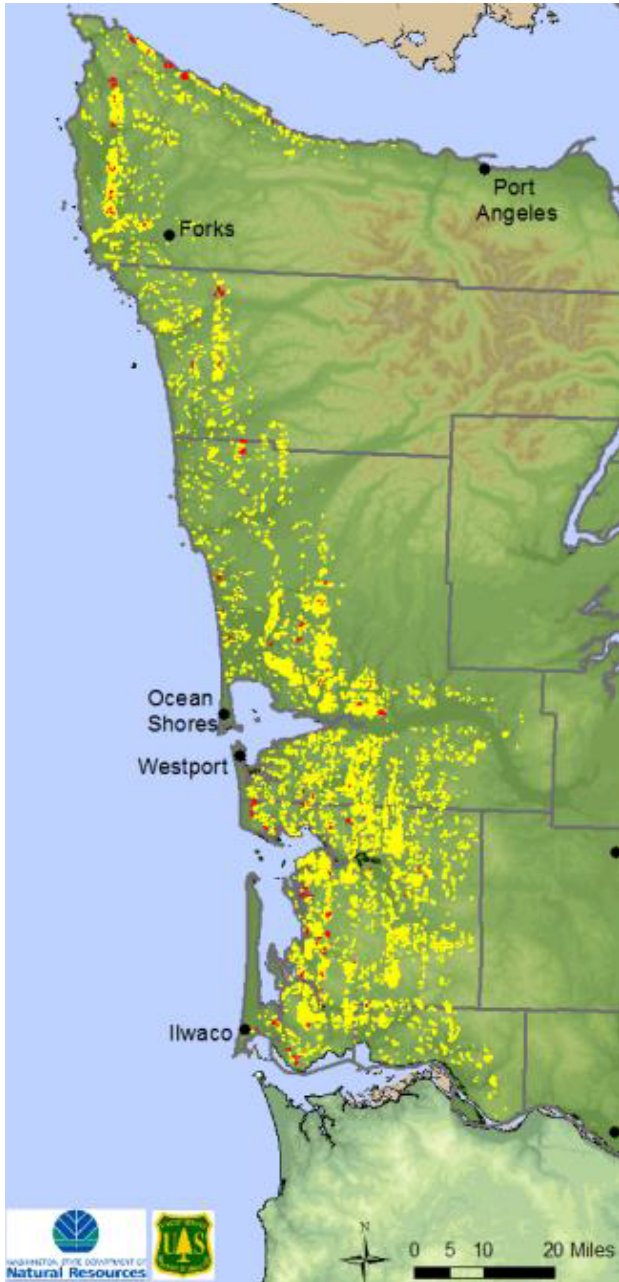


Heavily infected tree
with loss of foliage

Swiss needle cast

2012

2015



Stem and branch diseases

Dwarf mistletoe

White pine blister rust

Sudden oak death



Arceuthobium campylopodum plants on ponderosa pine branch



Brooming caused by ponderosa pine DM in Oregon



Douglas-fir dwarf mistletoe near Leavenworth, WA



High incidence of dwarf mistletoe in eastern Washington due to fire suppression and high grading over the last 100 years. Unhealthy? Very prone to crown fires due to ladder fuels 35

White Pine Blister Rust - Introduced



Mortality in white bark pine caused by the introduced white pine blister rust. Still continues > 100 years after introduction



SUDDEN OAK DEATH

An introduced disease caused by
Phytophthora ramorum



The current host list includes:

California black oak, coast live oak, Shreve oak, tanoak, rhododendron, California bay laurel, big leaf maple, madrone, manzanita, huckleberry, California honeysuckle, toyon, California buckeye, California coffeeberry, **Douglas-fir and coast redwood**

Also occurs in Germany, the United Kingdom, and the Netherlands.

What is the forest health strategy in Washington?

1. Aerial Surveys

2. Forest Health Law

3. Forest Health Committees

- Technical Advisory Committee

- Root Disease Committee

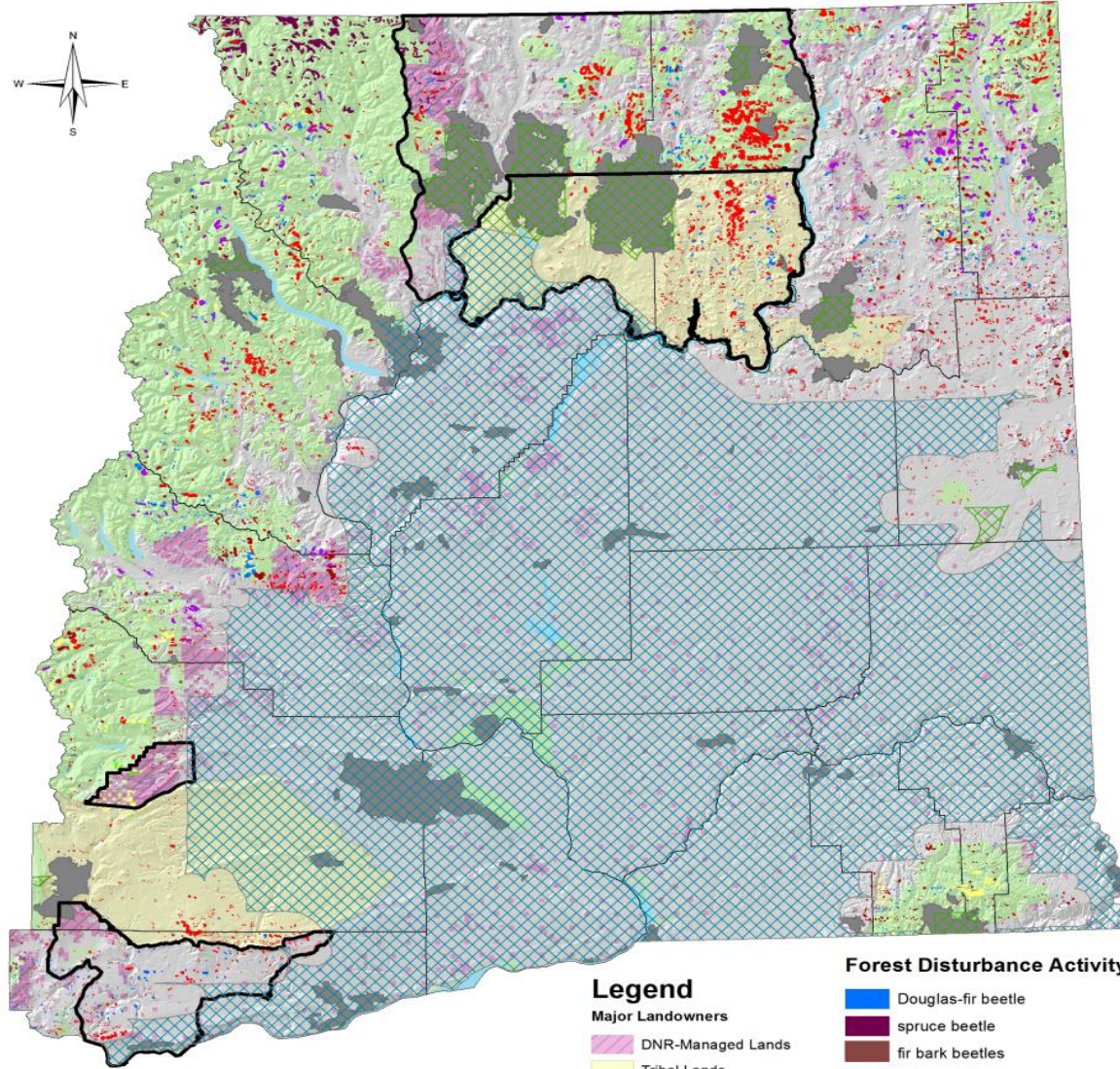
4. Available tools for managing forest health

Aerial surveys using an Aerocommander



The annual insect and disease aerial detection survey in WA is conducted by the USFS in cooperation with WADNR; flown at 90-150 mph at 1,500 feet. Two people observe a two-mile swath and mark on a digital sketchmapping computer any recently killed or defoliated trees.

Forest Disturbance Activity in Eastern Washington Based on 2016 Aerial Survey Data



WILDFIRE



0 10 20 40 60 Miles

Legend

Major Landowners

- DNR-Managed Lands
- Tribal Lands
- Federal Lands

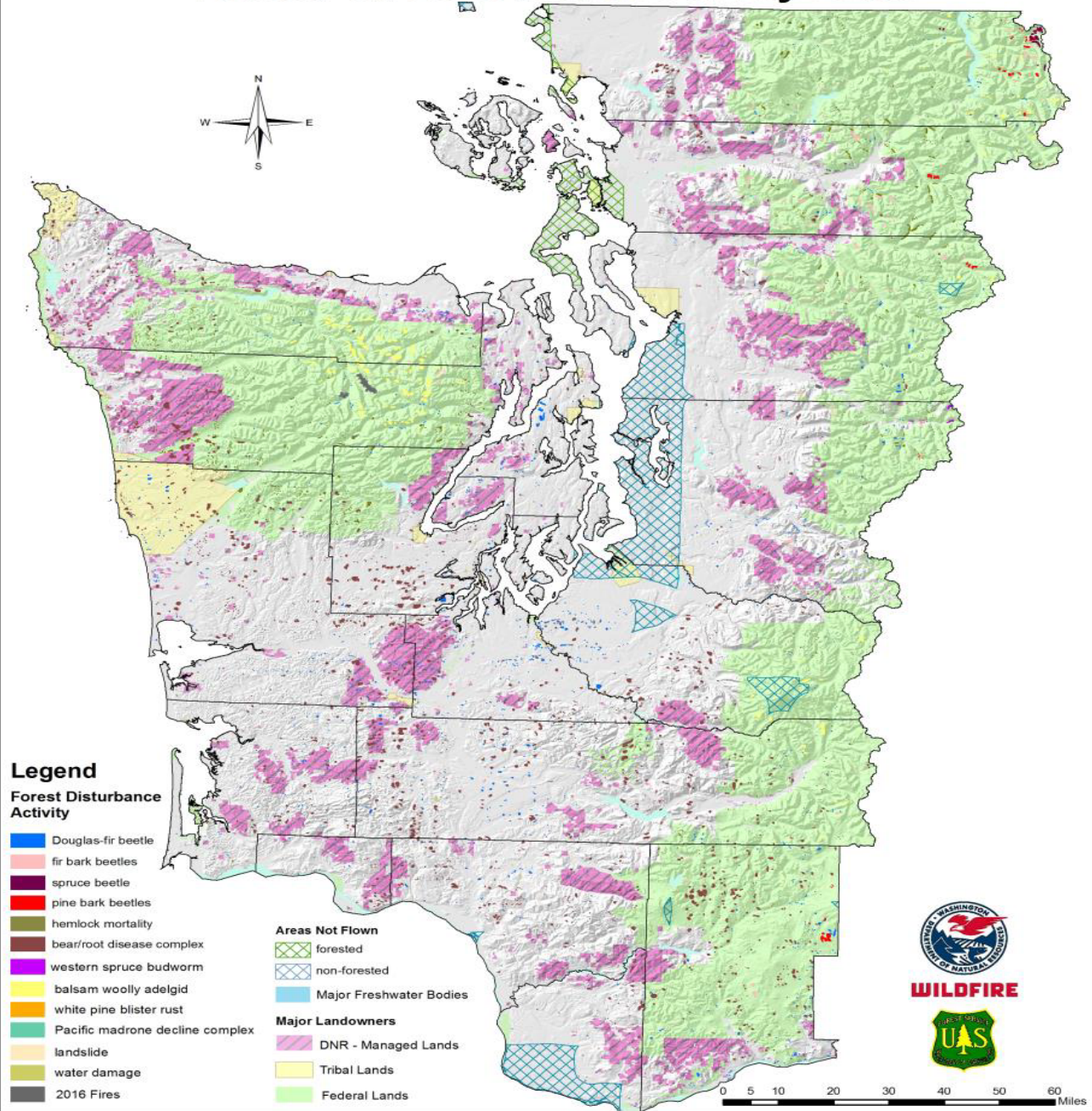
Areas Not Flown

- non-forested
- Not-flown Forested Areas
- Major Freshwater Bodies
- Forest Health Hazard Warning Areas

Forest Disturbance Activity

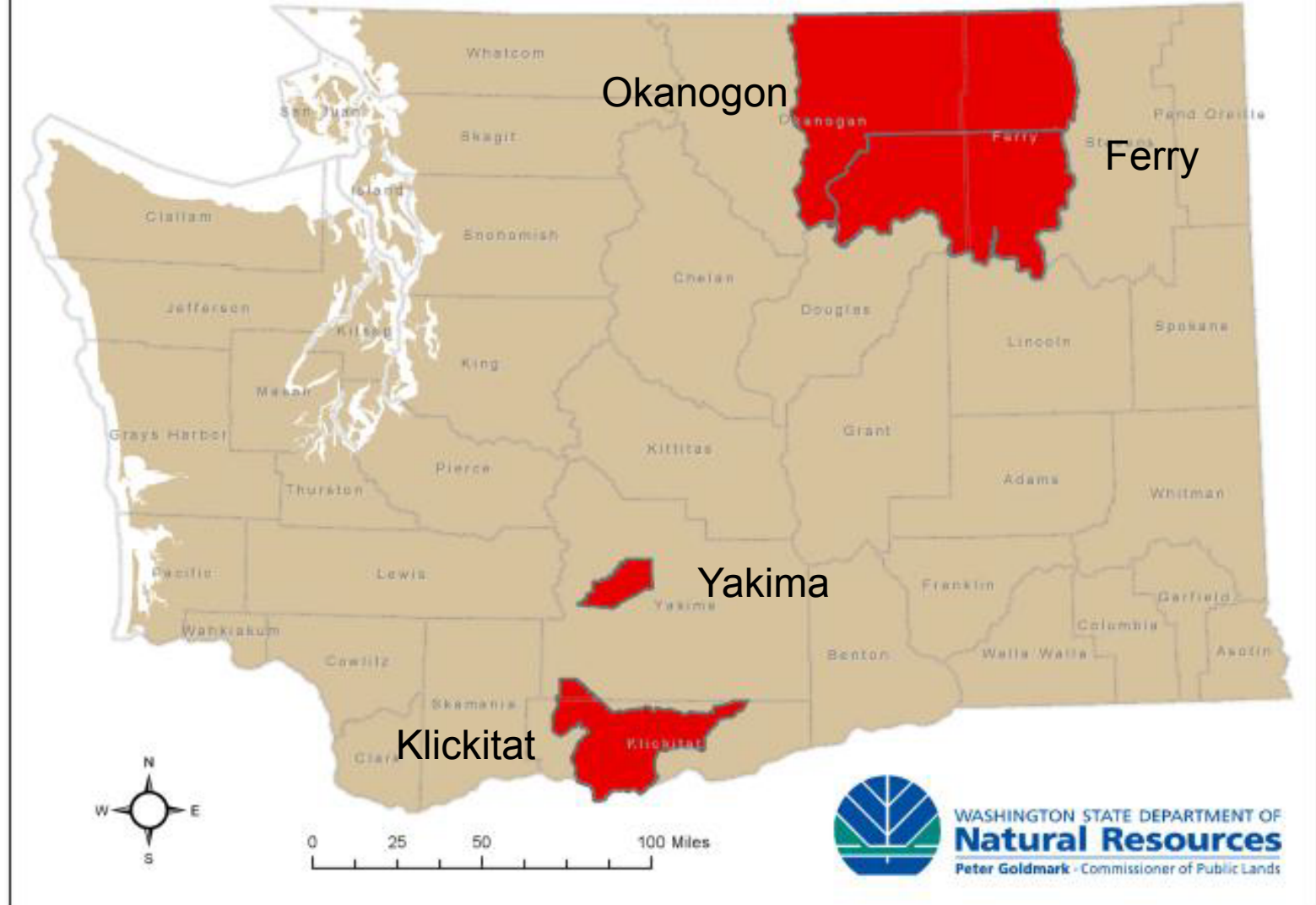
- Douglas-fir beetle
- spruce beetle
- fir bark beetles
- pine bark beetles
- bear/root disease complex
- western spruce budworm
- balsam woolly adelgid
- larch needle cast
- pine needle cast
- 2015-2016 Fires

Forest Disturbance Activity in Western Washington Based on 2016 Aerial Survey Data



2012

Eastern Washington Forest Health Hazard Warning Areas



DISEASE AND INSECT MANAGEMENT METHODS

1. **SILVICULTURAL** – thinning, fertilization, clearcutting, prescribed fire, alternative species, host removal, inoculum reduction (stump removal)
2. **CHEMICAL** – insecticides, fungicides, fire retardants
3. **GENETIC - BREEDING FOR RESISTANCE/ BIOTECHNOLOGY** – white pine blister rust
4. **BIOLOGICAL CONTROL** – Bt (Lepidopterans)
5. **QUARANTINE** – Sudden oak death, new insects and diseases
6. **DOING NOTHING**

What can we do?

East side

Reduce stress (reintroduce fire, thin the forest – biofuels may help to pay for this), salvage log?, change the species composition – may offset some climate change effects

West side

- Favor biodiversity/biological legacies, forest structure, etc.

Thinning for root disease, spruce budworm and balsam woolly adelgid control in the Teanaway





Stump removal for Armillaria root disease management near Goldendale, WA

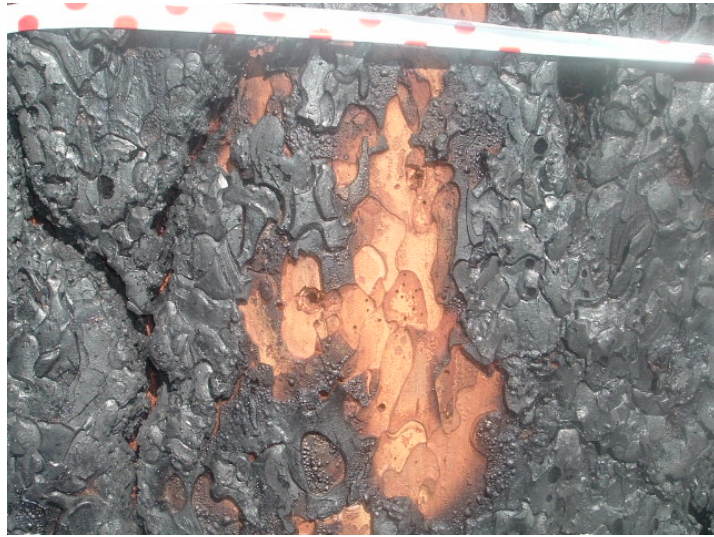
ALTERNATIVE SPECIES FOR ROOT DISEASES

Laminated root rot

Hardwoods, western white pine, western redcedar

Heterobasidion Root and Butt Rot

Western redcedar



Prescribed fire effects – near Bend, OR
Oops – too hot - bark beetles!



Conclusions

1. Forest health problems in the Pacific Northwest will continue and perhaps get worse with climate change, especially fires
2. Need to proactively manage forests to reduce stress in the east (including federal forests)
3. Employ ecosystem management in the west – mix species
4. Carbon sequestration and biofuels could play an important role in forest health management