USDA United States Department of Agriculture

Forest Health Highlights in Oregon - 2019

Forest Service January 2020

Pacific Northwest Region
Forest Health Protection

Oregon Department of Forestry
Forest Health Program

FOREST HEALTH HIGHLIGHTS IN OREGON - 2019

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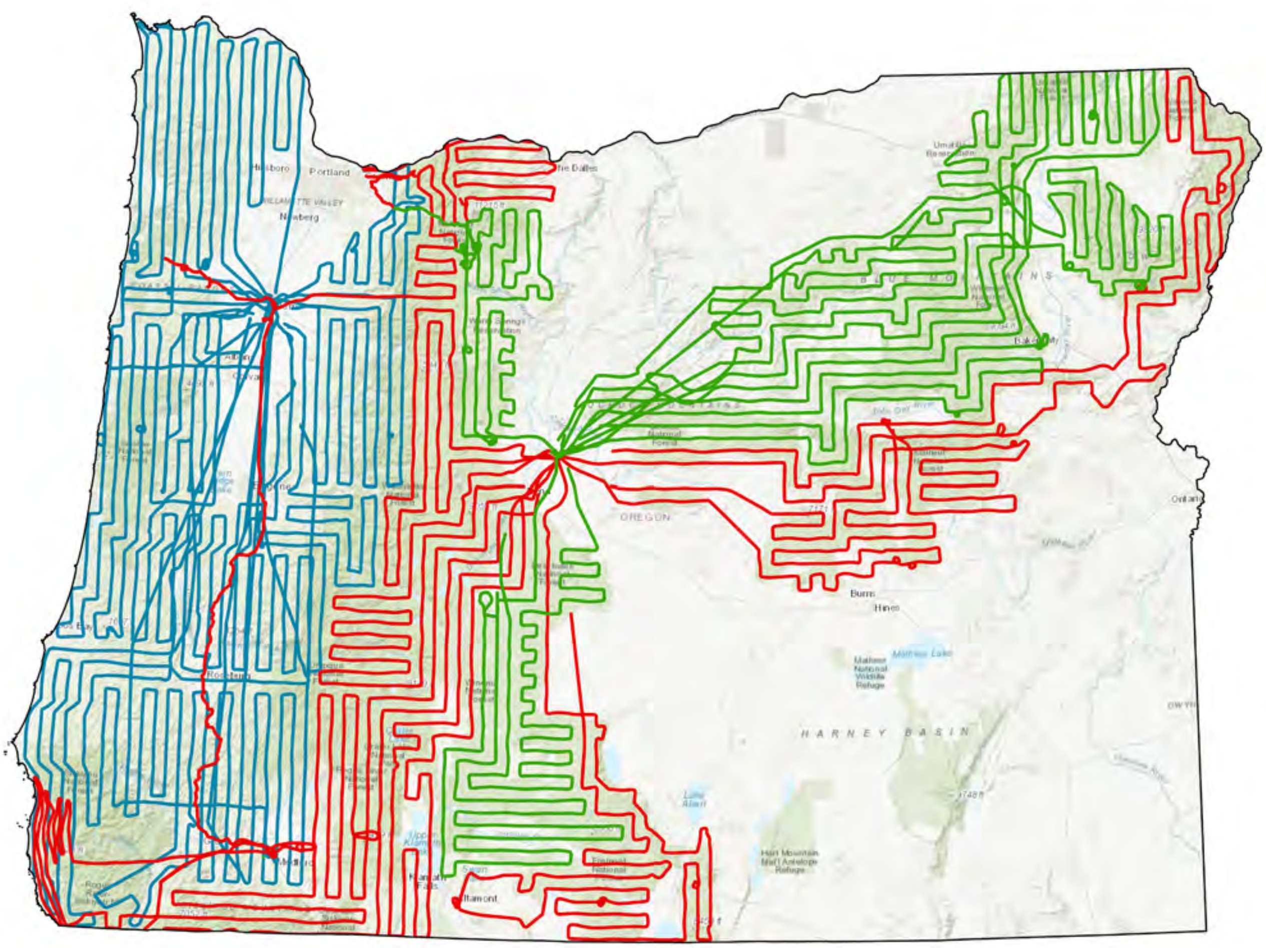
Cooperative Aerial Survey: 2019 flight lines



Front cover: *Sudden oak death in Oregon: aerial photo over Brookings, OR of dead and dying tanoaks and close-up of a tanoak stem with girdling canker caused by Phytophthora ramorum, the causal agent of sudden oak death.*

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LANDOWNER RESOURCES

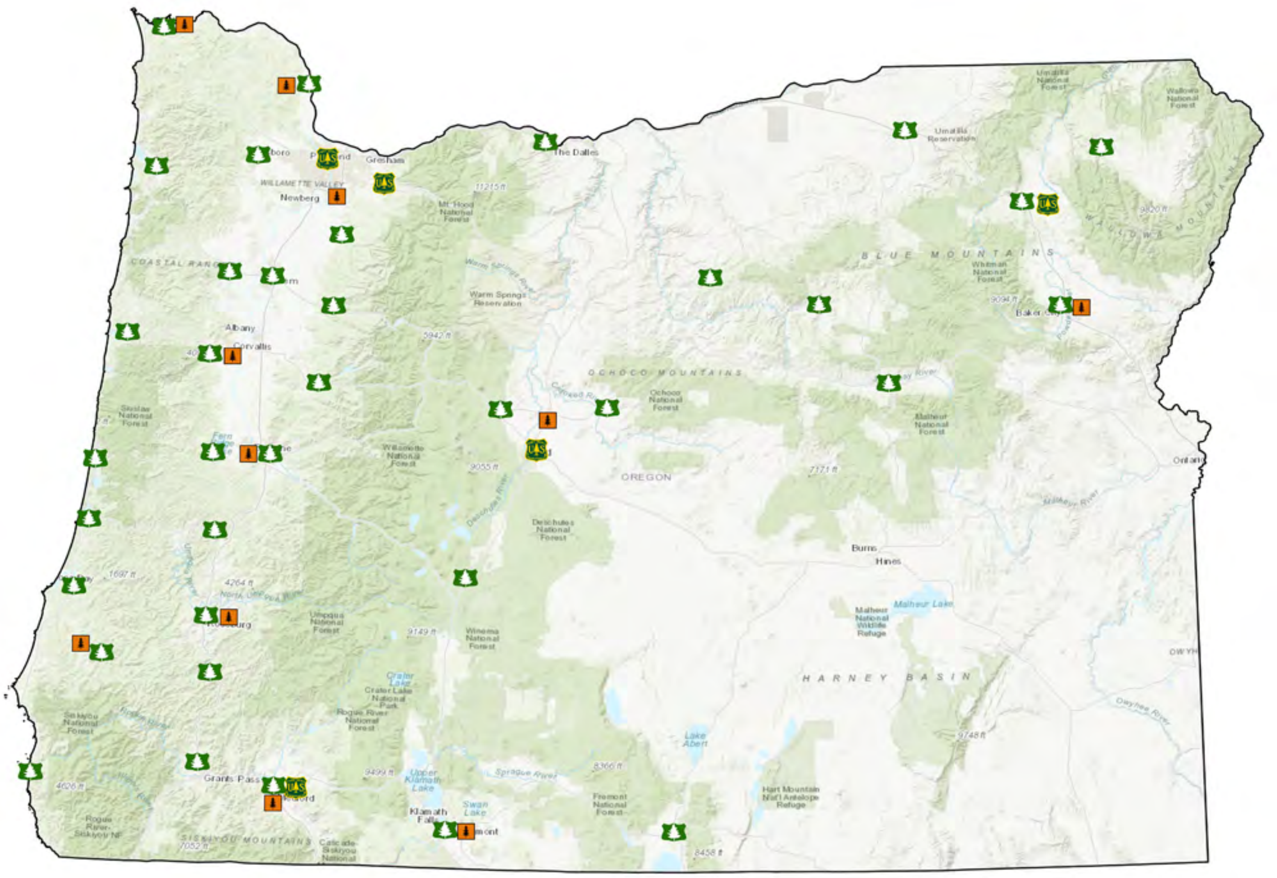


Figure 1. Map of ODF (green with white tree), USFS (green and yellow USFS badge) and OSU (orange tree) unit offices.

OREGON DEPARTMENT OF FORESTRY (ODF) RESOURCES:

Connect with your local ODF stewardship forester to get stand management guidance, diagnose and troubleshoot issues and learn about incentive programs: *https://tinyurl.com/ODF-forester*

Connect with the ODF Forest Health team to diagnose and manage abiotic stressors, insects, diseases, weeds and other invasive species. Visit the ODF Forest Health website for factsheets and training videos: *http://tinyurl.com/odf-foresthealth*

USDA FOREST SERVICE (USFS) RESOURCES:

(Federal agencies and Tribes only) Connect with USFS Forest Health Protection specialists to diagnose and manage abiotic stressors, insects, diseases, weeds and other invasive species: *https://www.fs.usda.gov/goto/r6/foresthealth*

OREGON STATE UNIVERSITY (OSU) FORESTRY EXTENSION SERVICE RESOURCES:

Connect with your local OSU Forestry Extension agent to get stand management guidance and to diagnose and troubleshoot forest health issues: *https://tinyurl.com/OSU-forester*

FORESTRY IN OREGON

Forestry has a long tradition in the Pacific Northwest, especially in Oregon which at 30 million acres is second only to Alaska in total acreage of forest lands. This number has remained unchanged since 1953.

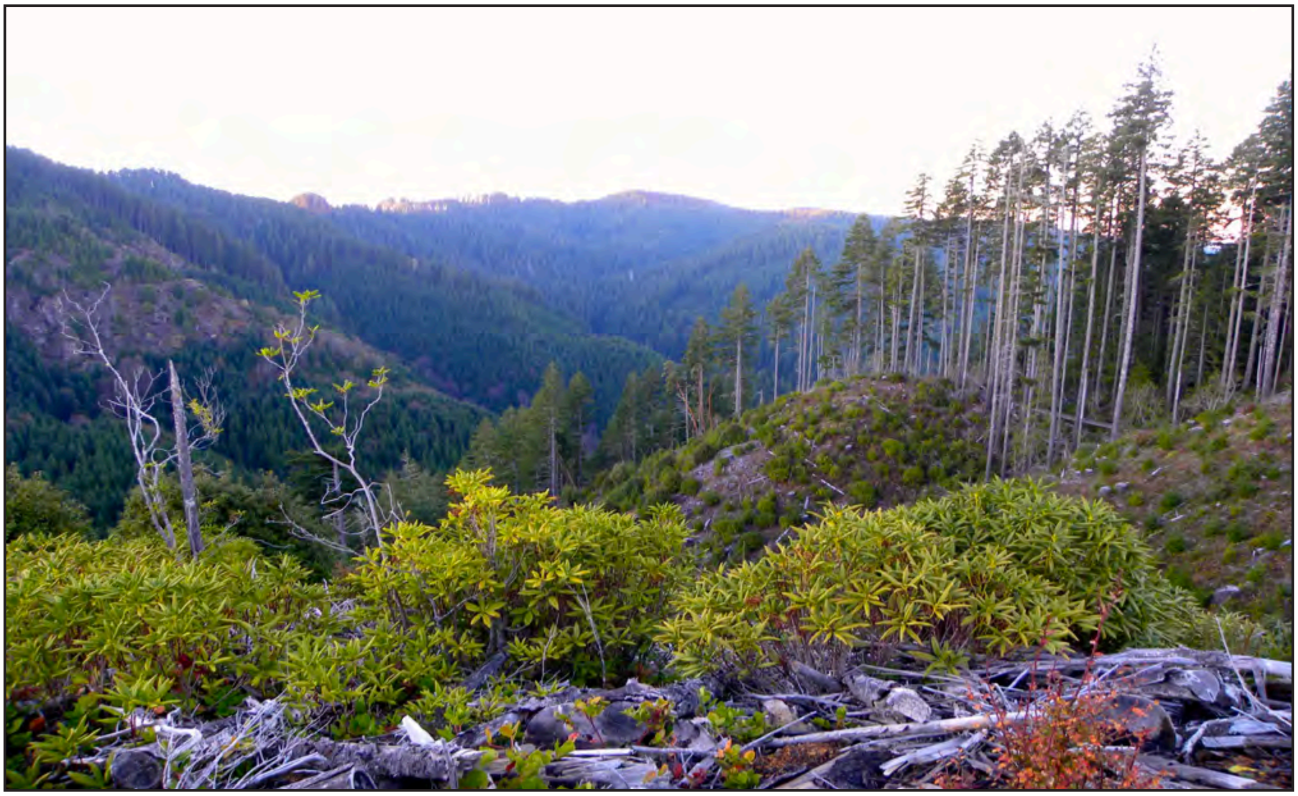


Figure 2. A recently harvested and replanted forest stand near Oakland, OR (Christine Buhl, ODF).

For over a decade, Oregon has been the #1 timber producer in the U.S., accounting for 18% of the nation's total softwood production at about 5.2 billion board feet annually. Oregon supplies 30% of the nation's plywood with 2.5 billion board feet annually and hosts 25% of the engineered wood (glulam, I-joist, laminated veneer, cross-laminated timber) facilities in the U.S. In 2019, forest timber products brought in over $10 billion in revenue and supplied about 3% of total statewide employment. Additionally, 25% of U.S. Forest Service (USFS) and 50% of Bureau of Land Management (BLM) timber revenues help fund education, road construction, libraries, fi police protection across the state.

Oregon's forests cover approximately 30 million acres and consist of federal (60%), private (35%), state (3%), tribal (1%), and other public (1%) ownerships. Timber production is not the primary objective across the state. The Forest Practices A (OAR 629) guides private landowners on how best to manage their forestlands to promote ecosystem functioning and sustainability while utilizing this renewable resource. There are certification processes (Sustainability Forestry Initiative, American Tree Farm System, Forest Stewardship Council) in place to help consumers identify products grown and harvested under specific standards.

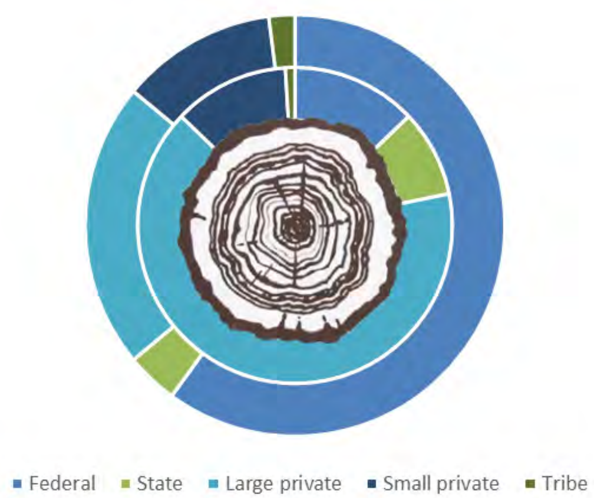


Figure 3. Proportion of acres owned (outer ring) and acres harvested in 2019 (inner ring) by landowner type.

FOREST HEALTH SUMMARY

Insects, diseases and abiotic disturbance agents cause significant tree mortality, growth loss, and damage in Oregon forests each year. Large outbreaks and invasive exotic species can affect the function and resilience of forest ecosystems and may contribute to hazardous forest fire conditions. However, these agents also play a critical role in maintaining healthy, functioning forests by contributing to decomposition, nutrient cycling, and creating openings that enhance forest diversity and wildlife habitat.

A healthy forest is never totally free of insects, diseases, and other disturbances.

Western Oregon is characterized by high rainfall and dense coniferous forests along the Pacific coastline, the Coast Range, and western slopes of the Cascade Range. Eastern Oregon largely consists of lower density, semi-arid forests and higher elevation desert. Oregon forests are primarily dominated by conifers such as Douglas-fir, true firs, western redcedar, western hemlock, lodgepole and ponderosa pine, among others. The most abundant hardwoods are bigleaf maple, red alder, Oregon white oak, and black cottonwood.

This report highlights major agents of damage or mortality in Oregon forests over the past year and provides updates on chronic issues. Much of this information is obtained from aerial surveys, which provide a snapshot in time of damage visible from the air. Symptoms of some forest stressors may not be diagnosed from the air due to timing of surveys or a lack of externally visible signatures. Information for some of these agents is also obtained from ground surveys and monitoring programs. Complexes of multiple stressors are common and determining the initial or primary cause of tree mortality is sometimes difficult. Totals reflect acres with not of damage or mortality, meaning that not every tree in an identified pocket of poor health is damaged or dead. *Disclaimer: Volume of damage, causal agents and geolocations reported here and in the raw data are estimates and should not be used exclusively to guide management.*

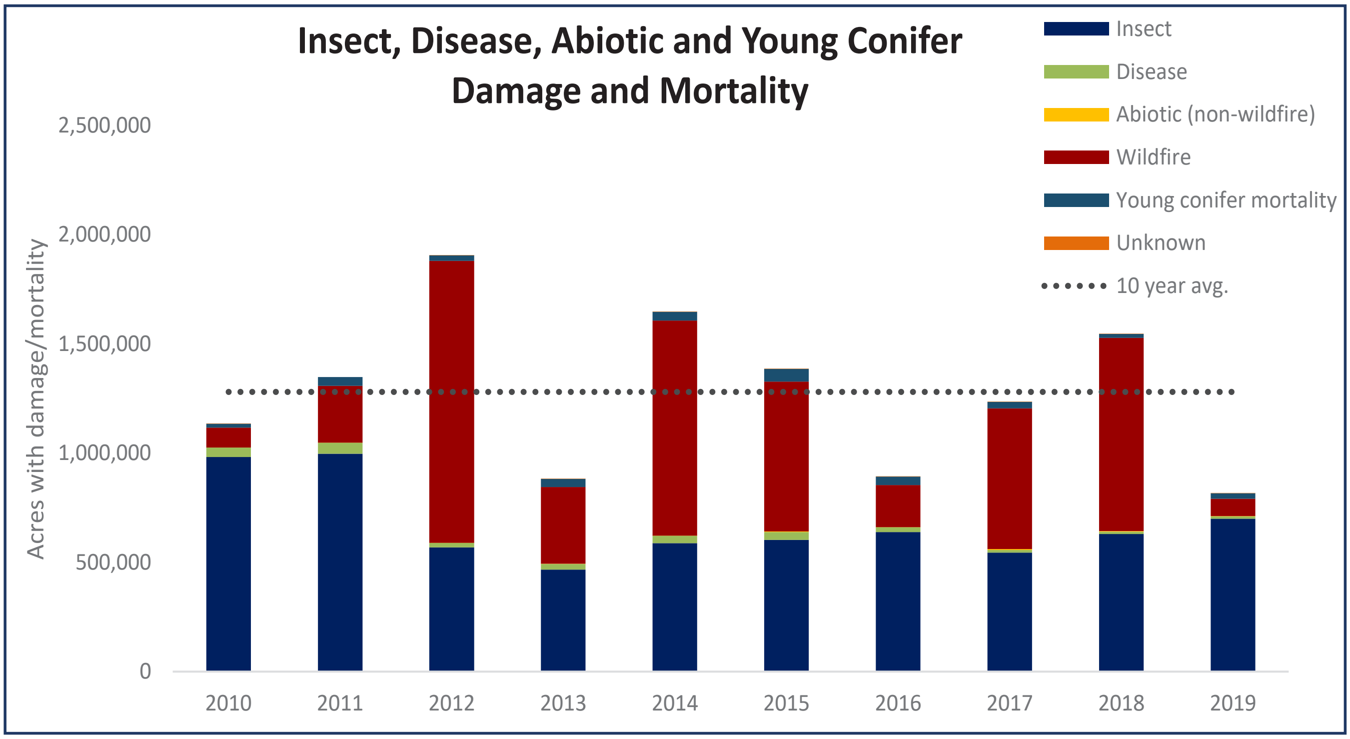


Figure 4. Of the approximately 30 million total forested acres in Oregon about 738,500 acres contained damage or mortality from insects, disease and abiotic stressors that could be observed in aerial surveys, and about another 79,000 acres were damaged by wildfire in 2019 .

SURVEYS, MONITORING AND OTHER PROJECTS

Aerial survey

Each year ODF cooperatively surveys the forestland base with the USFS Forest Health Protection as part of a national effort to monitor trends in damage from forest insects, diseases and other stressors. In Oregon, annual surveys began in 1947. Each year observers from each agency climb into small aircraft like ODF's twin engine Partenavia Observer or a Quest Kodiak and conduct a process called sketch-mapping. With an observer on each side of the plane, damage to the forest is drawn on a map and the cause is attributed based on experience and educated assumption. Beginning in the early 2000's the mapping process was moved from paper maps to a digital system with a moving map screen, aerial photos, and a plethora of other information. More recent advances in technology have led to nationwide implementation of streamlined tablets, databases, and editing tools. Despite the advances over the years, sketch-mapping is more scientific art than pure quantification. Technical experts ground-check unidentified damage and undergo regular ground and classroom quality control training to better tune their assessments.

In Oregon, the annual "general overview" survey covers roughly 28 million acres to assess most insect, disease and biotic agents that can be identified from the air. Additional "special surveys" are flown for damage agents like Swiss needle cast, sudden oak death, pandora moth, and occasionally oak looper or gorse. In total, the agencies cover from 35 million to 41 million acres in a given year. Damage observed in these surveys can be cyclical with peaks and valleys as one agent or another ramps up and then declines. Historically we have seen this cycle time and again from agents such as mountain pine beetle causing landscape-level mortality in lodgepole landscapes to drought-induced mortality in Douglas-fir and true fir extending from the Willamette Valley to the Siskiyous.

The 2019 aerial survey year started off in June with a warm spring producing distinct damage signatures on much of the west side of the state, and survey of this region was completed by the end of the month. The remainder of the summer stayed cooler and cloudy which slowed completion of the central and eastern parts of the state. Fortunately, low fire activity in the region allowed skies to remain clear of smoky haze through most of the survey season.

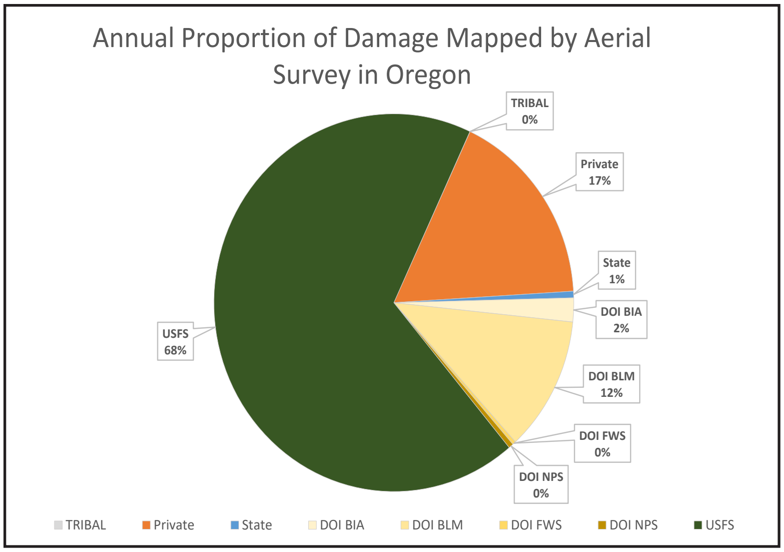


Figure 5. Proportion of acres mapped during aerial survey by ownership.

Overall damage (not including wildfire) recorded during the 2019 aerial survey was slightly higher than the 10-year average by about 20,000 acres. Most of this damage was due to bark beetles in the eastern two thirds and southwest corner of the state, which increased from the previous year. Other areas of note include the damage from an impactful 2018-2019 winter storm that toppled trees and blocked roads from Veneta to Roseburg. As is typical with winter storm damage, not all of the impacted areas were visible from the air as the remaining canopy masked the true extent of damage. When looking at areas of mapped damage, it is important to note that the metric is acres *with* damage and that not all the trees in the indicated areas experience mortality or defoliation. Much like a fire, there are patches of uninjured trees within damage areas resulting in a mosaic of damage. As is normally observed, the majority of the area with damage is on federal lands, followed by industrial, small non-industrial, state, and tribal ownerships (Fig. 5).

As part of the national aerial survey program, current year and future survey efforts will be conducted utilizing recently developed data collection software called Digital Mobile Sketch Mapping and a relatively new metric of observation, "percent forested area affected" for the Pacific Northwest. This new system provides the end user with reliable data that can more easily be compared across ecotypes and converted into *acres of* damage. While this is a change from the previous two decades of data, shifts in the metric of aerial surveys have happened in the past. It is important to remember that this form of survey work is highly subjective to the individual surveyor and is best applied at the landscape level, and thus, should not be utilized for fine scale management decisions such as silvicultural prescriptions or single stand management. If you would like to discuss this new system, its use, the metrics involved, or the process as a whole, contact ODF or USFS aerial survey staff.

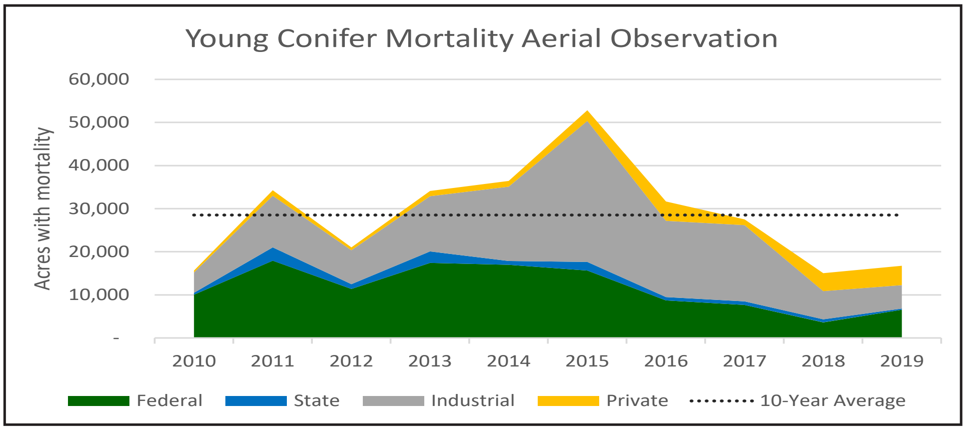


Figure 6. Acres with mortality mapped during aerial survey of young conifer.

Young conifer mortality aerial survey

Compounding impacts of early stand mortality can be significant. When the target rotation of a crop of trees is measured in decades, the loss of trees when they are young reduces growing stock, decreases the wood fiber accumulated, and reduces carbon stores (an area of increasing interest), and ultimately causes significant economic losses.

ODF and the USFS started conducting aerial surveys to target damage to young stands in 1988. Originally the survey on the west-side of the state focused on issues related to bark peeling by black bears. In more recent years the impact of drought stress and root disease, among others, is quantified at the same time. Recent research has shown that up to 70% of mortality in young stands is attributable to root diseases and abiotic injury; much higher than previous ODF surveys which indicated that roughly 30% of damage in young conifer stands was caused by these factors.

In the 2019 aerial survey, observers mapped about 16,700 acres of damage in young conifers. While damage observed was about 29,000 acres less than the 10-year average, it increased on federal and small private lands and decreased on state and industrial lands (Fig. 6). Damage to young conifers that is visible from the air tends to follow a cyclical trend with a peak roughly every 10 years. Although only speculative, young conifer damage is higher following drought years and then subsequently declines. Peaks were observed in 2003, 2007 and 2015; all years following drought periods.

Recent stand surveys suggest that the occurrence of black stain root disease may be increasing in several parts of the Oregon Coast Range, particularly in young stands. Additional field work and studies are ongoing through OSU and may shed light on this interaction and provide guidance on management strategies to reduce mortality in young stands.

SURVEYS, MONITORING AND OTHER PROJECTS

Drought online survey

The National Drought Mitigation Center has developed an online drought reporting survey in which landowners can report drought impacts on their forestlands to help us track spread and intensity:
https://go.unl.edu/cmor_drought

Western redcedar decline monitoring

From Oregon to Vancouver B.C. pockets of declining western redcedar (*Thuja plicata*) have been observed. The sites of decline are typically in pockets and often located in areas where redcedar typically thrives such as along streams and within closed canopies. *State and federal forestry agencies have been attempting to determine the cause, but so far no insect or disease agent has been identified* – beyond the agents that typically attack only dead or dying trees. It is possible that these trees are being impacted by a changing climate that includes drought stress, even along streams. Forest health experts in Oregon and Washington are working together to establish monitoring sites to identify the distribution of the problem, patterns and progression of mortality, and any potential causes. See ODF Why is my Tree Dying? Western redcedar fact sheet:
http://tinyurl.com/odf-foresthealth

Figure 7. Western redcedar showing a symptom (thin canopy) of decline (Christine Buhl, ODF).

Hazard Tree program

Pathologists with ODF and the USFS evaluate tree hazards and provide trainings on an annual basis to ensure that trees at risk of failure, due to root or stem rots, are removed to protect those working and recreating in the woods. ODF assists the Oregon Parks and Recreation Department with hazard tree training to ensure that state parks have trained staff available to identify hazard trees.

Bark beetle landowner incentives program

As part of the USFS Western Bark Beetle Strategy, treatments such as thinning, pine slash management, and anti-aggregation pheromone applications are used to improve tree resilience to bark beetles, which is especially important during times of drought. Each year money is allocated from the USFS to ODF to provide non-federal landowners partial funding (50/50) for doing this work to prevent or mitigate large-scale bark beetle outbreaks. In 2019, 170 private acres and 1,770 federal acres were treated for preventative management of bark beetles.

Figure 8. Expert tree climbers assessing structure of an old growth Sitka spruce in a coastal campground (Sarah Navarro, ODF).

Douglas-fir tussock moth surveillance trapping

This annual trapping effort to detect increases in moth populations and predict outbreak potentials in eastern Oregon entered its 40th year. The decrease in numbers in 2019 indicates that the current outbreak may be on the decline.
Monitor progress here: *https://tinyurl.com/dougfirtussockmoth*

Exotic woodborer monitoring

During 2016-2018, a special survey for exotic, invasive woodborers across 12 sites along the Columbia River corridor was conducted cooperatively by the Oregon Departments of Forestry and Agriculture (ODF and ODA). To date, over 100,000 bark beetles and ambrosia beetles (Curculionidae: Scolytinae), wood-boring beetles (Buprestidae; Cerambycidae) and wood wasps (Siricidae) have been collected and identified across all sites. There have been over 25 exotic species recorded in the survey, most of which are long-term residents of Oregon. However, four new exotic species have been detected in project traps: (1) an eastern U.S. flatheaded borer (*Chrysobothris rugosiceps*), (2) an Asian ambrosia beetle (*Cyclorhipidion pelliculosum*), (3) a European hardwood weevil (*Trypodendron domesticum*), and (4) a European ambrosia beetle (*Xyleborus monographus*).

In 2019, ODF Forest Health staff assisted ODA in delimiting trapping for *Xyleborus monographus* in the vicinity of Chinook Landing Marine Park near the city of Troutdale. This ambrosia beetle is known to cause damage to white oak trees in Europe and Asia. At the time of its discovery in Oregon in 2018, it had never been recorded in North America. However, since 2018 forest health professionals from California have reported *X. monographus* attacking and killing valley oaks (*Quercus lobata*) in Napa, Lake and Sonoma counties. The 2019 trapping effort at Chinook Landing Marine Park did not yield any *X. monographus*.

Figure 9. European ambrosia beetle (X. monographus) (ODA).

Oregon Forest Pest Detector program

For the sixth consecutive year, ODF Forest Health staff served on the interagency Oregon Forest Pest Detector (OFPD) program. The USDA-funded OFPD, coordinated and led by OSU Forestry Extension, aims to train arborists, landscapers, park workers and other professionals on the early signs and symptoms of priority invasive forest insects. Using a combination of online presentations, face-to-face seminars and field training courses, over 500 professionals have been trained as "First Detectors" of emerald ash borer, Asian long-horned beetles and other exotic forest insects. The OFPD works with the Oregon Invasive Species Council to utilize the Oregon Invasives Online Hotline reporting system so that First Detectors can take a picture and log a report of possible invasive species while in the field. The overall goal is to detect key forest invaders early in their invasion when eradication is still feasible. *http://pestdetector.forestry.oregonstate.edu*

In the summer of 2019, two graduates of the OFPD independently submitted reports to the state's invasive species hotline of suspicious exotic insect damage to native twinberry plants (*Lonicera involucrata*) in the Portland metro region. ODF Forest Health staff, alongside partners with the ODA, responded to the reports and identified an exotic woodborer, *Agrilus cyanescens*, previously unknown to the Pacific Northwest. This Eurasian insect has occurred in the northeastern U.S. since at least 1921, where it feeds on native honeysuckles (*Lonicera* spp.). ODF is assisting ODA and other partners in monitoring and outreach of this discovery. The discovery and reporting of previously undocumented exotic woodborer demonstrates the effectiveness of targeted education of Oregon's forest professionals through the OFPD program reporting through the Oregon Invasive Species Online Hotline: *https://oregoninvasiveshotline.org*

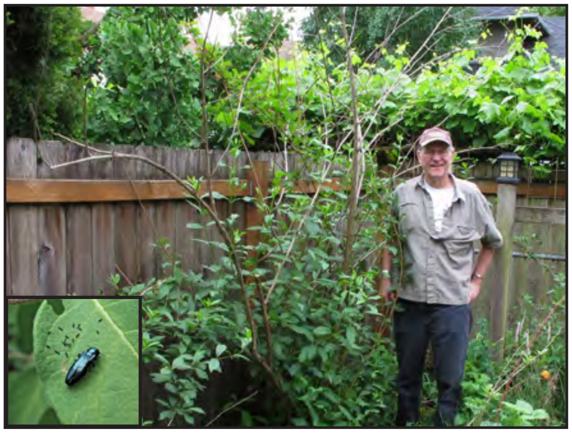


Figure 10. Twinberry (main) damaged by A. cyanescens (inset) (Ansel Oommen, Bugwood.org and Rick Westcott, ODA).

SURVEYS, MONITORING AND OTHER PROJECTS

ODF Tillamook Forest Center

The ODF Forest Health unit often collaborates with the Tillamook Forest Center (TFC) on education and training projects. In 2019, Forest Health staff installed a new field course at the TFC for Oregon Forest Pest Detector (see previous page). The TFC also hosts Fresh Brewed Forestry, an education event that enabled several Forest Health staff to speak to the public about various forest health-related topics: *https://www.facebook.com/pg/tillamookforestcenteroregon/videos*

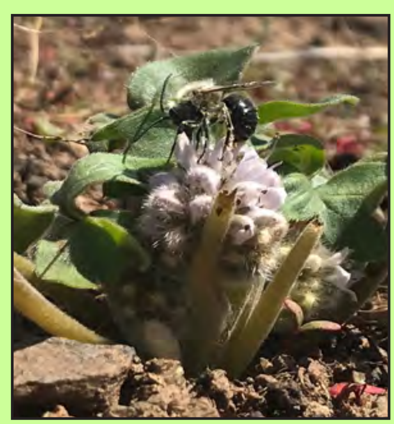
Forest Bee Projects

The Oregon Bee Project (OBP) and affiliated partners (shown observing pollinators, below right) have made great strides in 2019 in assessing forest bee populations. Most notable are efforts by OSU Forestry Extension, Hampton Lumber and many Oregon Bee Atlas citizen science volunteers:

- OSU established forbs and hedgerow shrubs in forest plots and began assessing bee populations and plant visitation as part of a multi-year study: *http://blogs.oregonstate.edu/treetopics/2019/09/19/forests-and-native-bees-the-season-1-recap*
- Hampton continued their work establishing pollinator plots alongside harvest replants and continued research into post-harvest management techniques to increase pollinator habitat: *https://www.hamptonlumber.com/sustainability/sustainable-forests/pollinator-project*
- Oregon Bee Atlas volunteers have been greatly increasing their participation from 2018 to 2019 by doubling collection locations (560 to 1,300) and individual specimens (12,000 to 27,500)!

Did you know?

Oregon has over 500 species of bees, most of which are ground and cavity nesting. Recent research from OSU has shown high abundance and diversity of bees in forests with high levels of disturbance by fire or harvest operations. This disturbance both exposes bare soil that bees use for nesting and increases light which warms nests and promotes the germination of flowering plants. Native bees in forests has become a hot topic and Oregon is leading the way, via the Oregon Bee Project (led by OSU, ODF and ODA), in enhancing bee health and habitat and engaging the public.



ABIOTIC AGENTS

Climate and weather are often primary contributors to tree health and forest conditions. Events that stress trees reduce growth and decrease their ability to defend themselves or rebound from insects, diseases and additional stressors. Healthy trees are able to defend themselves from insects and disease with pitch and compartmentalization, which are forms of mechanical and chemical defenses. Attacking insects get stuck in or drowned by pitch, or are repelled by the chemical compounds it produces. Similarly, pitch is a defense against some fungi by sealing wounds that can be entry points for spores, compartmentalizing diseases to prevent their spread among tissues, or reducing virulence by containing antimicrobial chemicals.

HEALTHY TREES = RESILIENT TREES

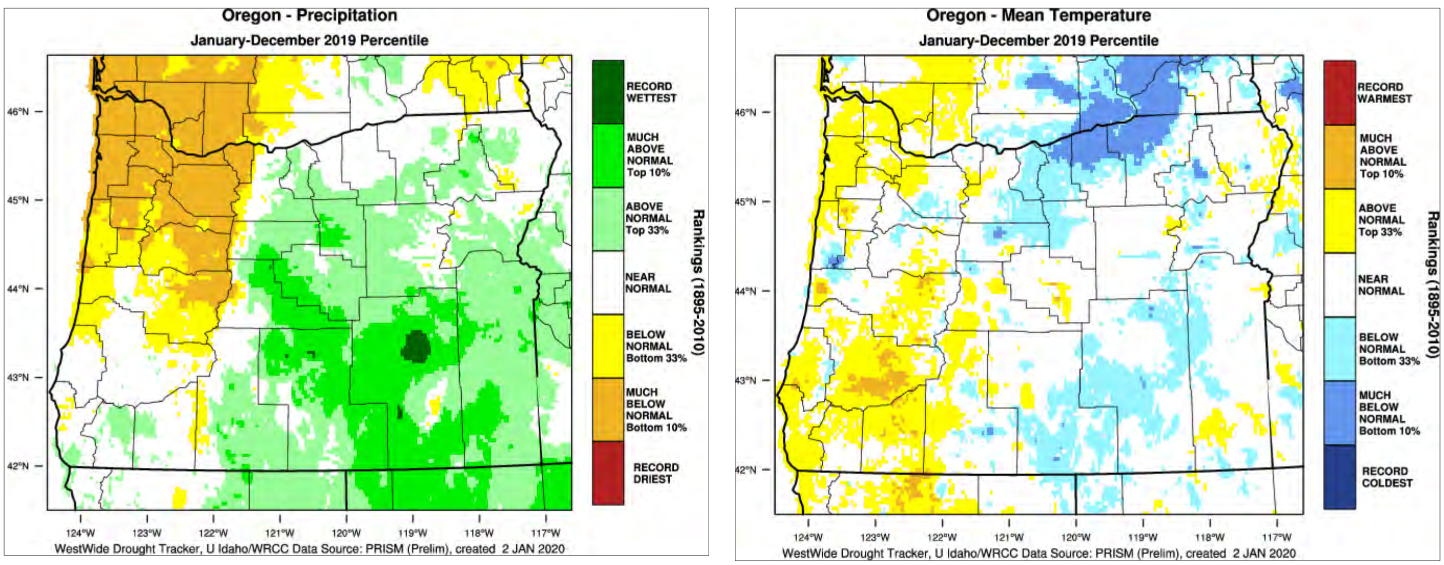


Figure 11. Average precipitation and temperature levels from January-November 2019, relative to the average normal based on 115 years spanning from 1895 to 2010 (Western Regional Climate Center).

Climate change

One of the major reoccurring stressors in Oregon forests has been ongoing drought as a result of climate change. Oregon has a diversity of forest ecosystems due to variations in latitude, elevation, topography, and proximity to the ocean and mountains (rain shadow effects). All these factors play a role in determining the impacts of altered temperatures and precipitation (rain and snow) levels. Additionally, soil and ground cover type, local water use and watershed dynamics can place different pressures on water storage capacities. Tree stocking levels influence the competition among trees for the availability of water resources. Some tree species have strategies to tolerate drought better than others.

There many climate change models for the Pacific Northwest but most echo the same prediction: warmer average temperatures resulting in warmer winters and longer summers; more erratic precipitation events; and winter precipitation in the form of rain rather than snow. The fact that we are experiencing a change is not unprecedented. Earth experiences naturally alternating periods of cooling and warming and we are currently in a warmer phase. However, the rate that change has been occurring is extreme. Temperatures have already risen 1.0 – 2.0°C along the west coast over the last 60 years and are predicted to increase by 1.0 - 3.5°C by the 2050's. In relation to forestry, many of these climate change projections predict change well within the span of a stand rotation or two. Therefore management decisions such as species mix and densities must be made in anticipation of these projections.

ABIOTIC AGENTS

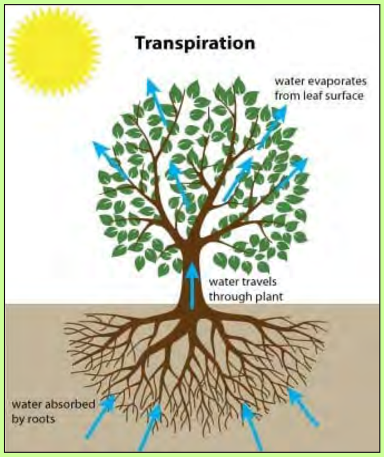
Drought

Droughts should not be simply defined by high temperature or low precipitation records. Timing and duration of these events must be taken into account to properly evaluate their impacts on trees. Warmer temperatures or drier conditions in the fall reduce moisture levels that hold trees over during dormancy, and similar conditions in the spring, when trees break dormancy, add further stress during a crucial time in growth. Trees also need long, slow "drinks" of water and can't get their needs met by infrequent "dumps" of rain, or rain in place of snow (which slowly melts in the spring, watering higher elevation trees and recharging waterways). At times it may appear that we are getting a lot of rain or returning to the pre-drought conditions of 2012 either because of short storm/flood events or simply because we have become accustomed to current drought conditions. Keep up to date by subscribing to Oregon Water Resources Department's monthly drought summary email: *https://tinyurl.com/drought-report*

Although Oregon experienced a bit of a reprieve from enduring high temperatures and low moisture levels in 2019, many parts of the state returned to pre-drought conditions for most of the year (Fig. 11). However, it takes more than one year of improved moisture conditions for trees to rebound from years of drought damage. Although average temperatures did decrease and hot days did not persist, the type and timing of precipitation has still not been ideal for trees. At periods we have experienced some increased precipitation from previous years but often in the form of storm events resulting in flooding (rather than the slow watering that trees require) or winter precipitation as rain when snow should be expected.

How do trees respond to drought?

To understand how drought affects trees and how they respond, one must understand some basic biological processes. Trees are actively pulling in water through roots and transporting it through a bundled network of straws (vascular tissues) to leaves that release moisture into the air via small holes (stomata). A common misconception is that roots are pushing moisture up throughout the tree. In reality this process is driven by the pull of moisture from leaves into the atmosphere. Dry or windy conditions result in lower atmospheric moisture which results in a greater pull of moisture from leaves to maintain water balance between leaves and the air. When stomata open they let in CO_2 which, when combined with sunlight and water, allows trees to make food during photosynthesis. When stomata close, as a mechanism of drought-tolerance to reduce water loss, starvation occurs due to the halt of photosynthesis.



During periods of low water availability, roots may die back, or grow closer to the surface in search for moisture, exposing them to compaction near the surface. Replacement of root tissues takes time, so even if moisture levels increase, there may not be enough root tissue biomass present to absorb enough of it. When soil moisture levels are low or roots are not present to obtain it, moisture continues to be lost through leaves. The upward pull through vascular tissues can create so much pressure that air pockets form and tubes within the tissues break. It takes time for these tissues to be rebuilt as the tree grows, so trees are left with reduced ability to translocate available moisture. Trees can withstand mild or infrequent droughts through a variety of moisture conserving techniques (premature leaf drop, stomatal closure, etc.), but prolonged or repeated droughts often result in mortality, sometimes years later.

Figure 12. Symptoms of drought: thin canopy, topkill, asymmetrical crown (Christine Buhl, ODF).

How to manage for future drought stress:

- Plant: native species, seed sources local to your region, and species adapted to the various conditions and microclimates (soils, aspect, sun or wind exposure, etc.) at your site. Do not continue to replant with species that are struggling to survive or don't naturally regenerate. Pay attention to which species are doing well.
- Maintain: thin trees early and leave enough space between trees to handle future droughts. Reduce competition from other competing plants especially grasses and invasive species. Do not fertilize during droughts (increased growth increases moisture requirements).
- Prevent and control: be aware of the major insects and diseases that occur in your tree species and in your region (see page 28). Follow management guidance. Remove weak, injured or extremely stressed trees.

Storms

Winter storm events in the Willamette Valley caused tree blowdown and flooding. Damage was particularly evident in Douglas, Coos and Lane counties. Work was done to clear roadways but many interior areas still contain debris that attracts insects that preferentially attack downed material, promoting population buildups that may spread into adjacent standing trees.

The primary species of concern is Douglas-fir beetle which attacks large diameter (>10 inches diameter at breast height) Douglas-fir. ODF consulted with small private, industrial and public landowners in affected areas to inform of possible mitigation options. More on management of this insect on page 16 and in ODF Forest Health fact sheets (Douglas-fir beetle, Storm damage, MCH).

Figure 13. Blowdown near Roseburg from 2019 winter storm (Christine Buhl, ODF).

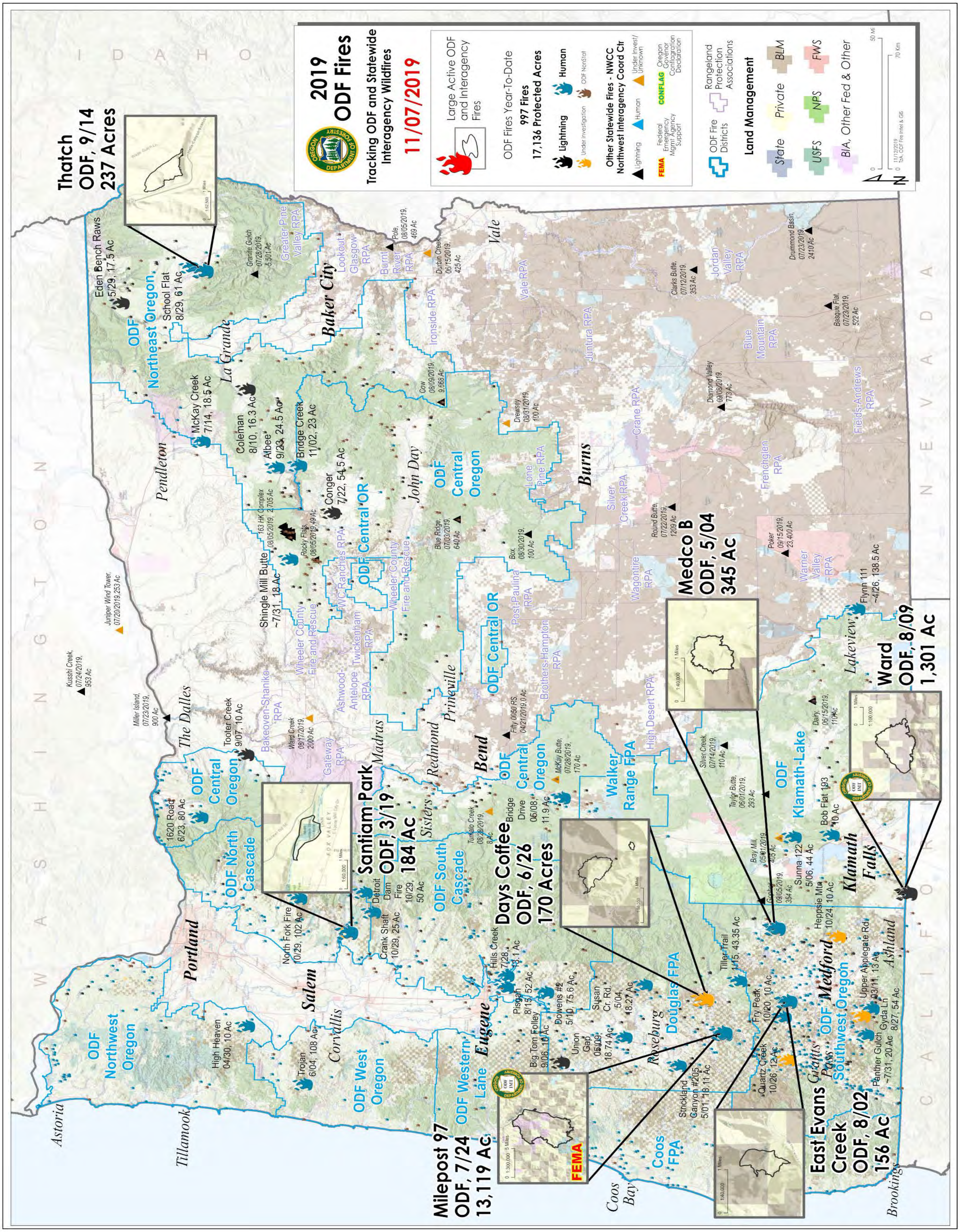
Wildfire

Figure 14. Milepost 97 wildfire in Douglas County (Kyle Reed, ODF).

2019 provided a break in a sequence of high severity fire seasons in Oregon, resulting in fewer acres of damage from wildfire than experienced in over 15 years. Across all ownerships, nearly 2,300 fires damaged approximately 80,000 acres, nearly 7 times less than the 10-year average of 546,000 acres. Lighting was the cause of approximately 50% of wildland fires in 2019, and accounted for 75% of the acres. Debris burning and escaped camp fires continue to be the primary causes of human-caused fires. On ODF protected lands, aggressive initial attack kept 97% of the fires at less than 10 acres. The largest fire on ODF protected lands in 2019 was the Milepost 97 fire in Douglas County (Fig. 14) near Roseburg at 13,119 acres, costing $21.8M to suppress. With a reduced fire season in Oregon, many wildland firefighters were readily able to assist with fires in other states and Canada. See wildfire map on next page.

Fires are a natural part of an ecosystem and there is a natural fire cycle for each type of forest found in Oregon (Fig. 15). For example, coastal spruce-hemlock forests may only burn naturally around every 400 years or so, but when they do burn it is often at a high intensity because of the amount of fuel that has accumulated over time and the steep terrain. At the other end of the spectrum, ponderosa pine dominated stands can withstand higher regularity of burning (about 5-25 years) due to their thick bark. Because these fires are more frequent, the fuels don't tend to build, resulting in fires with lower intensity. Each of these systems has evolved to withstand wildfire or generate a new seral complement of species that shifts as the stand ages. When natural wildfire cycles are suppressed, these systems become less resilient and more predisposed to catastrophic wildfires that create an economic burden on local communities and remove the ecological benefits of fire (nutrient cycling, reduced competition for resources, loss of less resilient trees, creation of wildlife snags, etc.).

Figure 15. Coastal forest adapted to infrequent fires (left) and ponderosa forest adapted to more frequent fires (right) (Christine Buhl, ODF).


2019 ODF Fires
Tracking ODF and Statewide Interagency Wildfires
11/07/2019
Large Active ODF and Interagency Fires
ODF Fires Year-To-Date
997 Fires
17,136 Protected Acres
Lightning
Human
Under investigation
ODF Nonstat
Other Statewide Fires - NWCC Northwest Interagency Coord Ctr
Lightning
Human
Under invest/Unknown
FEMA
Federal Emergency Mgmt Agency Support
CONFLAG
Oregon Governor Conflagration Declaration
ODF Fire Districts
Rangeland Protection Associations
Land Management
State
Private
BLM
USFS
NPS
FWS
BIA, Other Fed & Other
Thatch
ODF, 9/14
237 Acres
Santiam Park
ODF, 3/19
184 Ac
Days Coffee
ODF, 6/26
170 Acres
Medco B
ODF, 5/04
345 Ac
Ward
ODF, 8/09
1,301 Ac
Milepost 97
ODF, 7/24
13,119 Ac.
East Evans Creek
ODF, 8/02
156 Ac
ODF Northwest Oregon
ODF West Oregon
ODF North Cascade
ODF South Cascade
ODF Western Lane
ODF Central Oregon
ODF Northeast Oregon
ODF Central OR
ODF Klamath-Lake
ODF Southwest Oregon
Douglas FPA
Coos FPA
Walker Range FPA
Eden Bench Raws
5/29, 17.5 Ac
School Flat
8/29, 61 Ac
McKay Creek
7/14, 18.5 Ac
Coleman
8/10, 16.3 Ac
Albee
9/23, 24.5 Ac
Bridge Creek
11/02, 23 Ac
Conger
7/22, 54.5 Ac
Shingle Mill Butte
~7/31, 18 Ac
Tooter Creek
9/07, 10 Ac
1620 Road
6/23, 80 Ac
North Fork Fire
10/29, 102 Ac
Detroit Dam Fire
10/29, 50 Ac
Crank Shaft
10/29, 25 Ac
Bridge Drive
06/08, 11.9 Ac
Hills Creek
7/28, 18.1 Ac
High Heaven
04/30, 10 Ac
Trojan
6/04, 108 Ac
Pisgah
8/15, 52 Ac
Big Tom Folley
9/06, 10 Ac
Dowens #2
5/10, 75.6 Ac
Sysan Cr. Rd.
5/04, 18.27 Ac
Union Gap
05/09, 18.74 Ac
Strickland Canyon #205
5/01, 18.11 Ac
Tiller Trail
1/15, 43.35 Ac
Fry Peak
10/20, 10 Ac
Quartz Creek
10/26, 12 Ac
Heppsie Mtn
10/24, 10 Ac
Upper Applegate Rd
03/11, 13 Ac
Panther Gulch
~7/31, 20 Ac
Gyda Ln
8/27, 54 Ac
Sunna 122
5/06, 44 Ac
Bob Flat 193
10 Ac
Flynn 111
~4/26, 138.5 Ac
Astoria
Tillamook
Portland
Salem
Corvallis
Eugene
Roseburg
Coos Bay
Grants Pass
Medford
Ashland
Brookings
Klamath Falls
Lakeview
The Dalles
Madras
Redmond
Sisters
Bend
Prineville
John Day
Pendleton
La Grande
Baker City
Burns
Vale
WASHINGTON
IDAHO
NEVADA
CALIFORNIA

FOREST INSECT AND DISEASE MAP

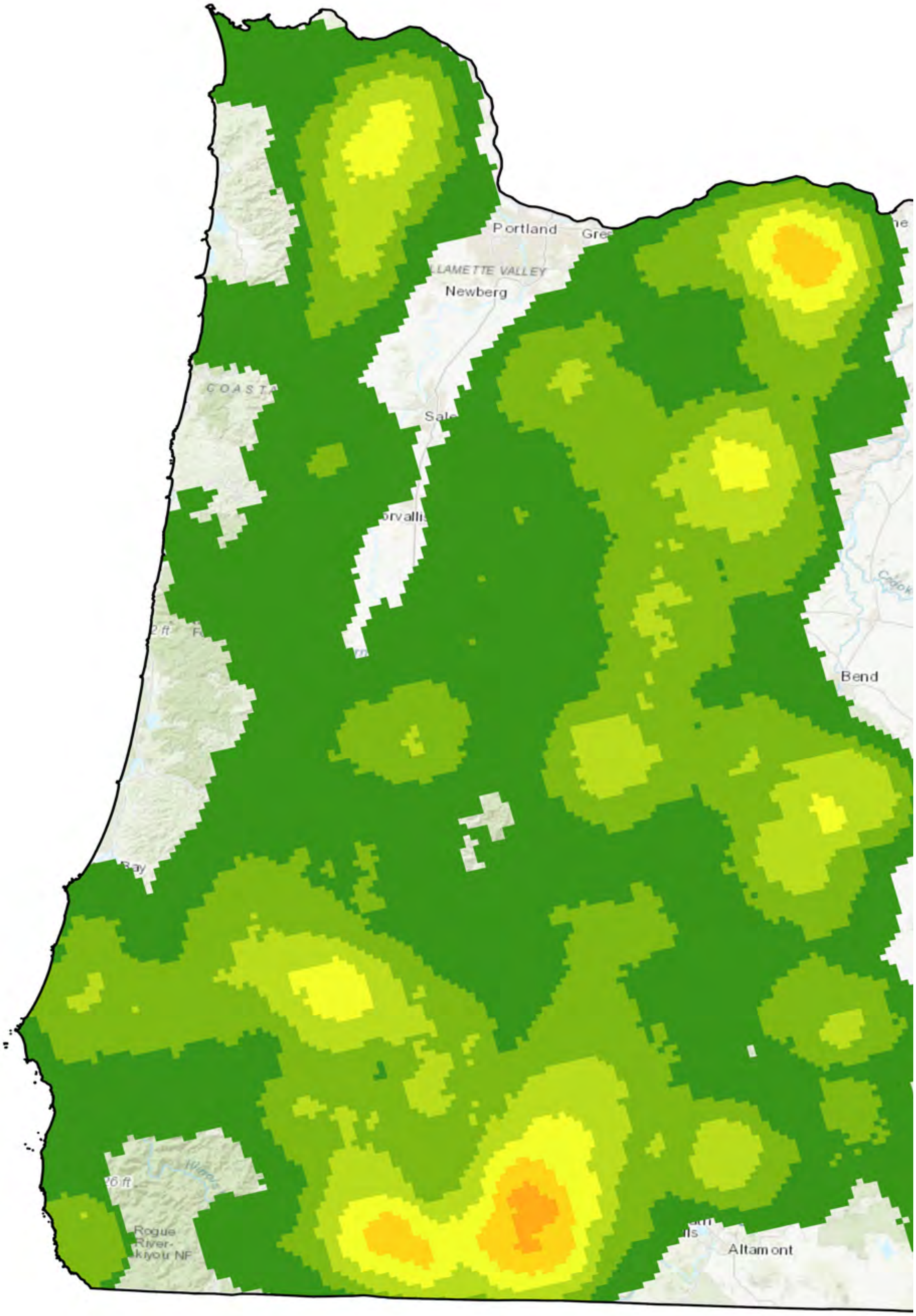
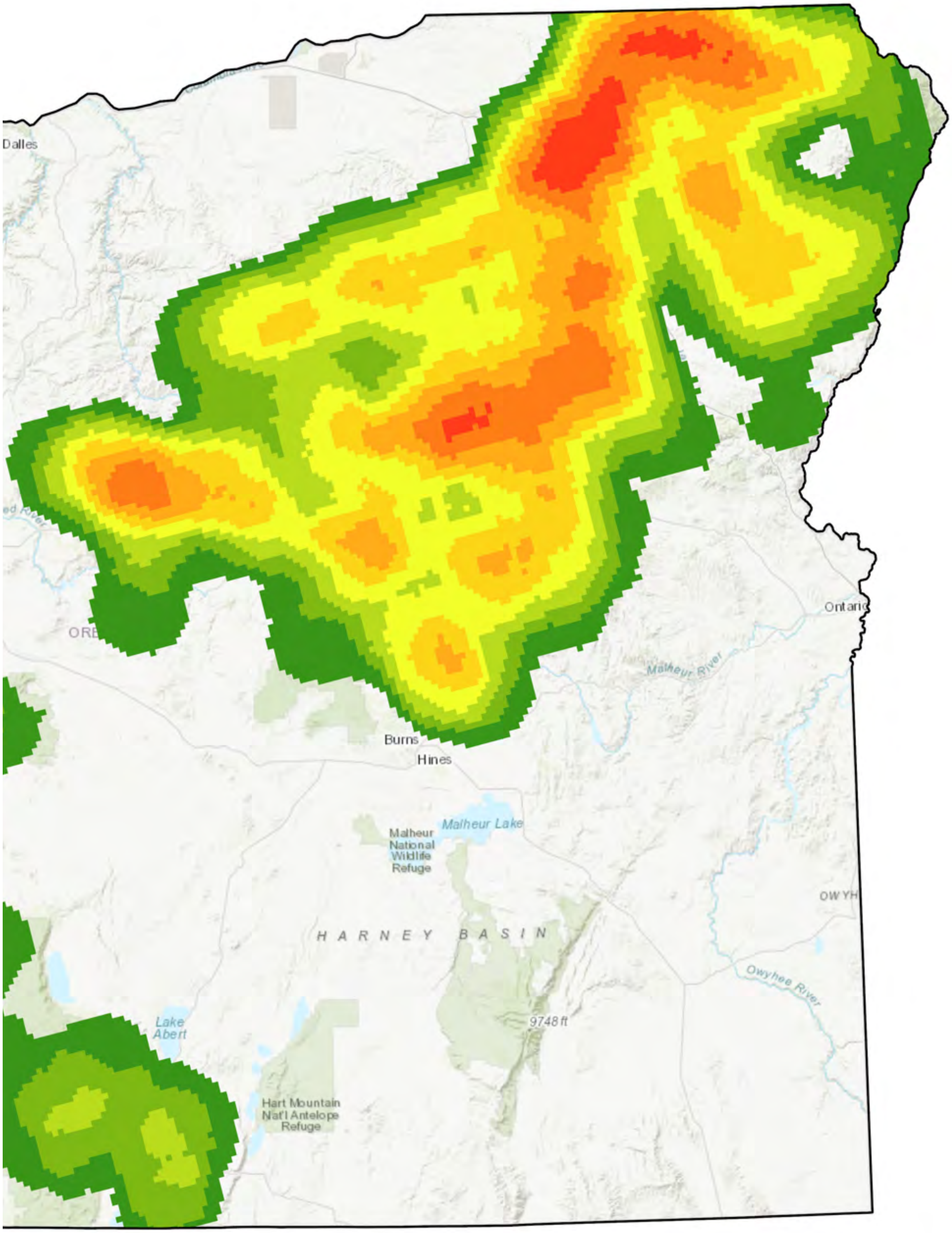


Figure 16. Map of tree damage/mortality intensity as detected by aerial surveyors in 2019. Damage shown on the map is not comprehensive as some agents cannot be detected by aerial survey. Intensity increases from green to red.



The highest intensity of damage can be seen in the northeast and is attributed mainly to bark beetle attacks in true fir. High damage areas in southern Oregon are attributed to bark beetle attacks in pine and drought-stressed Douglas-fir. In the Columbia River Gorge it's bark beetles attacking pine at lower elevations and true fir at higher elevations. In the Willamette Valley much of the mortality is attributed to drought stress in Douglas-fir and true fir, followed by bark beetles.

FOREST INSECTS

In 2019, Oregon statewide aerial surveys detected approximately 700,000 acres with damage or mortality from forest insects, which represents over 90% of the total acres of forest damage detected in aerial surveys. However aerial survey does not detect many tree diseases such as root diseases that are also extensive on the forested landscape. In most cases these insects are opportunistic, preying on already stressed or dying trees and are not the primary reason for tree decline or death. Most of these attacking insects are native or, if introduced, have been established on our landscape for quite some time. Many of the following insects only become "pests" when stressors such as drought, fire, mechanical damage and disease weaken trees to the point where they can be killed by insects.

BARK BEETLES

Douglas-fir beetle (*Dendroctonus pseudotsugae*) continues to kill drought-stressed Douglas-fir across the state. The heaviest hit areas are in the southern Willamette Valley starting around Lane and Douglas counties. This insect also preferentially attacks freshly fallen, large-diameter Douglas-fir - which are often created in winter storm blowdown events as we saw in winter 2018-2019. The typical cycle is for the beetle to lay eggs in downed material the April following the blowdown event. Eggs hatch and eventually develop into adults of the next generation that attack standing trees the next April to repeat the cycle. Reddish-brown piles of boring dust (frass) in bark crevices indicate attack (Fig. 17). Trees downed for over a year and already attacked trees do not become re-infested and are therefore not reservoirs. To prevent local population buildups of this pest it is advised to remove downed Douglas-fir logs before April 2020 to prevent beetles from emerging and attacking standing trees. An anti-aggregation pheromone, MCH (Fig. 17), can also be stapled to trees in blowdown areas in a grid pattern at 30 foot spacing to effectively disperse beetles across the landscape as they search for areas that do not emit MCH. In their search many may beetles die, thereby also reducing the population. MCH is an inexpensive, general use pesticide that does not require a license and may be purchased online. Notification of planned MCH application on private land must be submitted to ODF via the FERNS notification system two weeks prior. More on MCH application strategies in USDA MCH Handbook: https://tinyurl.com/USFS-MCH

Figure 17. Brown piles of frass indicates bark betle attack (left) and MCH pouch (right) (C. Buhl, ODF and Darrell Ross, OSU).

Ips bark beetles (*Ips pini* and *I. paraconfusus*) also continue to be a problem in pockets around central Oregon up to the Gorge and in the Willamette Valley wherever pine slash has not been managed properly. See more on management of this insect in ODF FH fact sheets (Ips Beetles, Slash Management). Some areas in eastern Oregon are still experiencing pockets of **western pine beetle** (*D. brevicomis*) outbreaks in ponderosa pine (Fig. 18), and **fir engraver** (*Scolytus ventralis*) continues to kill true fir that are struggling from drought stress or root disease across the state.

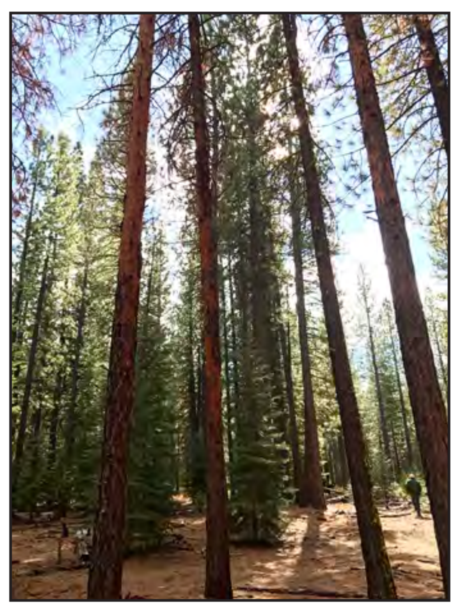


Figure 18. Western pine beetle outbreak in eastern Oregon (Christine Buhl, ODF).

WOODBORERS

Emerald ash borer (EAB, *Agrilus planipennis*) is an exotic, invasive beetle that has been confirmed as far west as Colorado, and much preparation is underway for its potential arrival in Oregon. A cooperative statewide EAB survey was conducted in 2019. EAB traps and lures were provided by USDA-APHIS with ODF coordinating the survey with local cooperators. Local government officials in Portland, Hillsboro, St. Helens, Corvallis, and Ashland participated alongside ODF and USDA-APHIS in placing EAB traps in Oregon. Since Oregon began surveying for EAB in 2008, the exotic woodborer has never been detected in the state, including in the 2019 cooperative survey.

Figure 19. Oregon ash forest (top), and their seeds (bottom) (Wyatt Williams, ODF).

Following the completion of the Oregon Emerald Ash Borer Readiness and Response Plan in 2018, ODF Forest Health received funding from the USFS to collect and store seeds of Oregon ash (*Fraxinus latifolia*) before the arrival of EAB in Oregon. The seeds will be stored in freezers for genetic conservation (USDA Seed Lab, Fort Collins) and research (USFS Dorena Genetic Resource Center). In 2019, approximately 350,000 seeds were collected from over 100 mother trees across 12 populations in western Oregon. In 2020, ODF plans to collect another 600,000 seeds from an additional 200 mother trees to be collected and stored. This is a unique opportunity to be proactive and prevent the loss of an ecologically important native species before EAB is detected in the state and Oregon ash is already threatened. For more on the risk and mitigation of EAB, visit Oregon's EAB Readiness and Response Plan: *www.OregonEAB.info*

Did you know?

Firefighters are not strangers to many insects that fly in during and after wildfires, but what are they doing? Beetles commonly called "firebugs" (*Melanophila* spp.) often appear after (and sometimes during!) wildfires to lay eggs in damaged, and thus weakly defended, trees. They have heat-detecting organs and can detect volatiles released from burning trees. There are also a myriad of other bark beetles and woodboring beetles and wasps that can detect the smell of these injured trees. Some of these insects are large, have menacing-looking jaws or stingers and may "taste" a nearby human to determine if they are trees. Large woodboring wasps may make stinging reflexes if handled but, have no fear, they are all bark and no bite! Even though their "stinger" is meant to drill into wood, it cannot penetrate human skin. Even long after the fire has been put out the larvae of large woodborers can often be heard chomping through dead and dying trees. Their mandibles are so effective at chewing through wood that the first pattern for chainsaw teeth was developed from the jaws of these so-called "timber worms". Often white boring dust in bark crevices indicates infestation from one of these woodborers.

DEFOLIATORS

Central Oregon saw an increase in defoliating insects in 2019 with the continuation of an active Pandora moth outbreak and the addition of isolated activity of pine-attacking sawflies and needleminers. **Pandora moth** (*Coloradia pandora*) is estimated to be in year six of an outbreak cycle that tends to collapse naturally after 6-8 years. Defoliation observed in 2019 was reduced to isolated pockets. Since these insects have a two year life cycle, with only one year of feeding by the caterpillar larvae (adults do not feed), pine trees can grow needles every other year, which assists in toleration of damage. However prolonged drought has added a baseline of underlying stress. The added stress of defoliation increases chances of tree mortality or reduced resistance or tolerance to future stress such as attacks from bark beetles. Treatment for Pandora moth is not advised as it may have impacts on beneficial, non-target insects. Instead strategies to improve tree resilience such as reducing competition for water by thinning tree stands or removing weeds, and by preventing buildup of Ips bark beetles in pine slash (see ODF Slash Management fact sheet) are recommended. In Oregon, moths are present in odd-numbered years and caterpillars during even-numbered years and may be seen feeding on needles this March - April (Fig. 20).

Figure 20. Pandora moth caterpillars (Donald Owen, California Department of Forestry and Fire Protection).

Figure 21. Defoliation damage (left) from pine sawfly larvae (right) (Robbie Flowers, USFS).

About 4,000 acres of **pine sawfly** (*Neodiprion nanulus contortae*) damage was observed along Highway 97 near Chemult (Fig. 21). Sawfly larvae feed, initially as a group, on older foliage leaving branches with a lion's tail appearance. This preference for older needles allows trees to retain their current year needles each year and, therefore, defoliation usually results in reduced growth rather than tree mortality. The last sawfly outbreak close to this area was in 1978. Outbreaks from sawflies often decline on their own within 2-4 years.

Damage from the larvae of **ponderosa needleminer moths** (suspected to be *Coleotechnites ponderosae*) was observed across about 750 acres in the Warner Mountains (Fig. 22). Damage from these insects can be spotty on the landscape due to variable resistance among trees but most trees usually recover from this defoliation without serious injury.

Figure 22. Ponderosa needle miner damage (Robbie Flowers, USFS).

In northeast Oregon an active **Douglas-fir tussock moth** (*Orgyia pseudotsugata,* Fig. 23) outbreak may be peaking in most areas. Annual surveillance trap monitoring, aerial and ground surveys recorded the start of this outbreak in 2018. Outbreaks from this insect typically collapse on their own within three years due to natural controls such as pathogens and natural enemies. Surveys indicated 9,400 acres of damage in 2018 and 14,200 acres in 2019. Mortality has been highest in pockets of Douglas-fir and true fir-dominated stands of trees growing in zones more suited for pine.

Figure 23. Douglas-fir tussock moth larva (Christine Buhl, ODF).

Gypsy moth (*Lymantria dispar dispar*) is an exotic defoliating insect that feeds on several hundred species of trees and shrubs, including conifers. If it were to establish in western states, it has the potential to dramatically change forest management and ecology, leading to increased aerial pesticide use and increased costs of timber harvest. While European gypsy moth is established in the eastern U.S. and is regularly detected in Oregon, gypsy moth eradications in Oregon have been successful since monitoring began in the 1970s. Today, there are no established populations of gypsy moth in Oregon due to an excellent early detection and rapid response system.

European gypsy moth was detected in 2018 by the Oregon Department of Agriculture in NW Corvallis. Traps captured 27 adult gypsy moths around two apartment complexes. ODF Forest Health staff assisted ODA in a ground-based treatment of 46 acres in May 2019 using *Bacillus thuringinesis kurstaki,* a bioinsecticide. ODF provided technical expertise as well as on-the-ground education and outreach. ODA reports that the treatment was largely successful with only three adult gypsy moths captured in the area after the ground-based treatments were completed. Monitoring of the site will continue in 2020.

SAP-SUCKING INSECTS

Balsam woolly adelgid (BWA, *Adelges piceae*) is an exotic insect that has been established in Oregon since 1930 and continues to spread in true fir at higher elevations of the Cascade crest and peaks in northeast Oregon. In 2019 near the Anthony Lakes area, where we would expect to see BWA, another insect was also present. **Fir mealybugs** were observed covering subalpine fir needles and twigs. Many stems were also covered with the insects or sooty mold. Similar to BWA, mealybug excrement allows growth of sooty mold and feeding damage causes gouting. Mealybugs were also found infesting adjacent whitebark pine.

Figure 24. Mealybug crawlers (Kristen Chadwick, USFS).

Noticeable damage of Sitka spruce from **spruce aphid** (*Elatobium abietinum*) took place from Astoria to Newport and inland within the fog belt. Although we have not seen an outbreak from this pest for quite some time, it has attacked more acres along the coast historically (Fig. 26) and trees have recovered. Spruce aphid is originally from Europe but has been established in the Pacific Northwest since the early 1900's. Since then attacks have been infrequent in Oregon although occasional outbreaks have been observed in Washington and Alaska. This insect is largely controlled by generalist predators such as ladybeetles and spiders, low temperatures in the winter, and early spring frosts. The mild winter experienced along the NW coast in 2018-19 may be responsible for this latest outbreak.

Spruce aphid only damages older foliage, therefore spruce are able to retain their current-year needles (Fig. 25). Although tree growth may be reduced, tree mortality is uncommon. Populations of this insect are largely controlled by low winter temperatures which are predicted to become less common, thus it is possible that multiple, sequential years of outbreaks may occur in coming years and some trees may die before natural predator populations can respond and reduce aphid numbers. ODF and OSU Forestry Extension are actively monitoring spruce tree plots to assess how much damage the trees can withstand. Chemical treatment may be warranted in some cases but is too expensive and laborious to apply for most landowners, and may have non-target impacts on natural enemies which will prolong the outbreak.

Figure 25. Sitka spruce on NW Oregon coast heavily defoliated by spuce aphid (above) but a closer look at the same tree shows that the current year needles are not damaged (right).

Historically, Oregon has experienced far more extensive damage from this insect but trees were able to recover (below) (Christine Buhl, ODF).

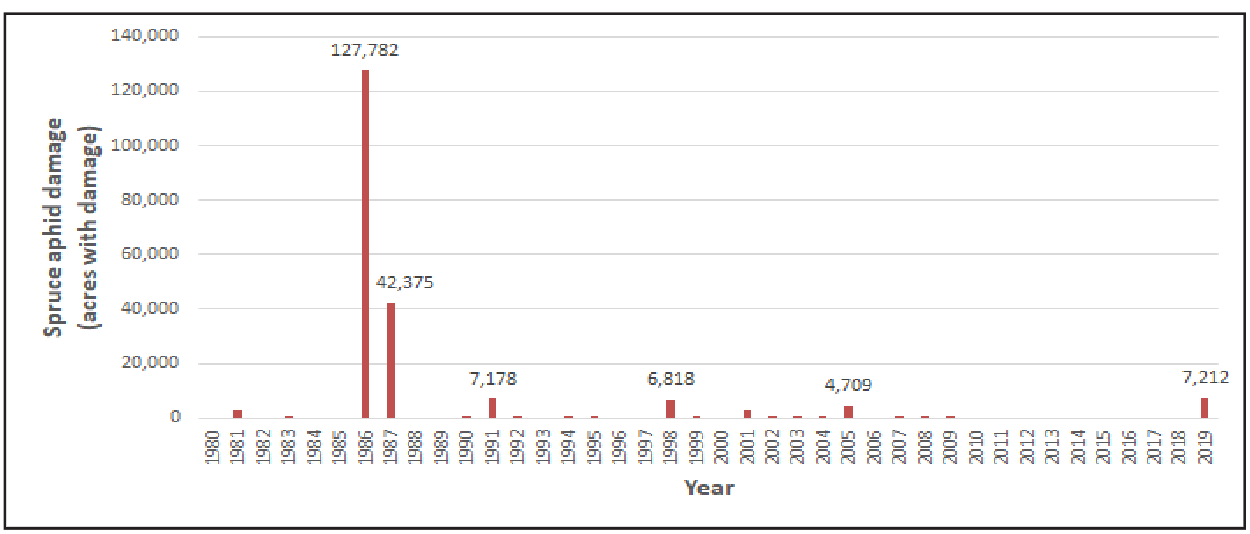


Figure 26. Historic spruce aphid damage.

FOREST DISEASES

Phytophthora ramorum is an exotic invasive non-native pathogen that causes the **sudden oak death** (SOD) disease in tanoak. SOD was first discovered in northern coastal California in the 1990s and the disease has since spread to 15 counties. *P. ramorum* was discovered in 2001 in Curry County, Oregon. Immediately, an interagency program formed with the goal of complete eradication. Spread of *P. ramorum* is managed through the designation of a SOD Generally Infested Area (GIA) and SOD quarantine area under the authorities of the Oregon Department of Agriculture (ORS 603-052-1230) and the U.S. Department of Agriculture Animal Plant Health Inspection Service (7 CFR 301-92). These state and federal quarantines regulate the intrastate and interstate movement of host plant material outside of the quarantine area. Oregon regulations require infested sites on state and private lands to undergo eradication treatment. Since 2001, approximately 7,320 acres have been treated to eradicate *P. ramorum* and slow its spread. Treatments include cutting and burning infected and potentially exposed host material (Fig. 27).

Figure 27. Piles of tanoak ready to burn as part of a local eradication treatment to slow the spread of SOD (Casara Nichols, ODF).

Recent developments for the SOD Program include the continued detection of EU1 infestations, a new citizen science program, an updated economic impact assessment, and resistance testing. Since 2015, ODF has been aggressively treating all known EU1 infestations with large buffers of 300 - 600 feet. Eradication treatments for EU1 infestations totaled 270 acres in 2017 and 203 acres for 2018. In 2019, ODF completed treatments on 117 acres with more scheduled treatments for 2020.

Starting in September 2018, ODF and Oregon State University Extension collaborated to develop a SOD citizen science pilot project and outreach education program. We launched our outreach with a well-attended community workshop in Pistol River followed by citizen science trainings in Gold Beach and a science talk by Dr. Everett Hansen (Fig. 28). The citizen scientist volunteers learned standard sampling protocol to set monitoring bait stations, collect, record and send samples to the OSU LeBoldus forest pathology lab for disease screening every two weeks for a three-month period. Citizen scientists deployed 20 bucket baits on 5 sites at the leading edge of the disease and baited 4 stream reaches in the first year of the project and found no new detections of *P. ramorum*. The second year of the project is currently underway. Workshop success was measured with pre- and post- workshop evaluations. Before the workshop 34% of participants indicated that they understood disease concepts "very much", this increased to 72% after the workshop. First year citizen science project results indicate that citizen scientist volunteers are motivated to help with early detection strategies by following sampling protocols and spreading awareness in the community.

Figure 28. Citizen scientists learning about SOD symptoms in tanoak leaves and bark (Norma Kline, OSU).

SOD continued...

On behalf of the Oregon SOD Task Force, ODF contracted with Highland Economics and Mason, Bruce and Girard to complete an assessment of the economic impacts of SOD on Oregon's forests and associated industries. Until now the disease has not had a significant impact on the economy of Curry County, according to the assessment. It states there has been no decline in timber harvest, export and log prices, or recreation and tourism revenue. However, it appears certain private properties where tanoaks have died may have lost real estate value. The assessment concluded that current efforts are keeping the infestation's spread to between 0.5 - 4.5 mile(s) a year. According to the assessment, with continued treatment, SOD's spread north of the Rogue River could be delayed until about 2028. Without any treatment, the disease would most likely appear north of the Rogue just four years from now and enter Coos County by 2028. Other impacts from discontinuing treatment that could happen as early as 2028 include:

- Sanctions on southwest Oregon timber exports by China, Japan, and/or Korea
- Loss of 1,200 jobs related to timber export, translating to $57.9 million in lost annual wages
- Reduction of timber harvest by 15%, with proportional loss of forest products harvest tax revenue, forest sector jobs and wages
- Collapse of rural residential property value; loss of real estate transaction revenues
- Decline in recreation and tourism income out of proportion to the extent of SOD infestation if an unfavorable public perception of the region takes hold
- The report also highlighted that the disappearance of tanoak from southwest Oregon forests impacts the local ecology and Native American culture in ways not reflected in purely economic terms.

Figure 29. ODF staff collected tanoak acrons in 2016-2018 from tanoak trees both exposed to the disease, within the SOD GIA, and from areas free of disease, such as along the Rogue River. Several thousand seedlings produced from these acorns were out-planted on industrial land in the GIA where they will be exposed to P. ramorum and monitored for genetic resistance to the disease (Wyatt Williams, ODF).

Sudden oak death information:
http://www.oregon.gov/oda/cid/plant_health/sod_index.shtml
https://catalog.extension.oregonstate.edu/em9216
http://www.aphis.usda.gov/plant_health/plant_pest_info/pram/
http://www.suddenoakdeath.org

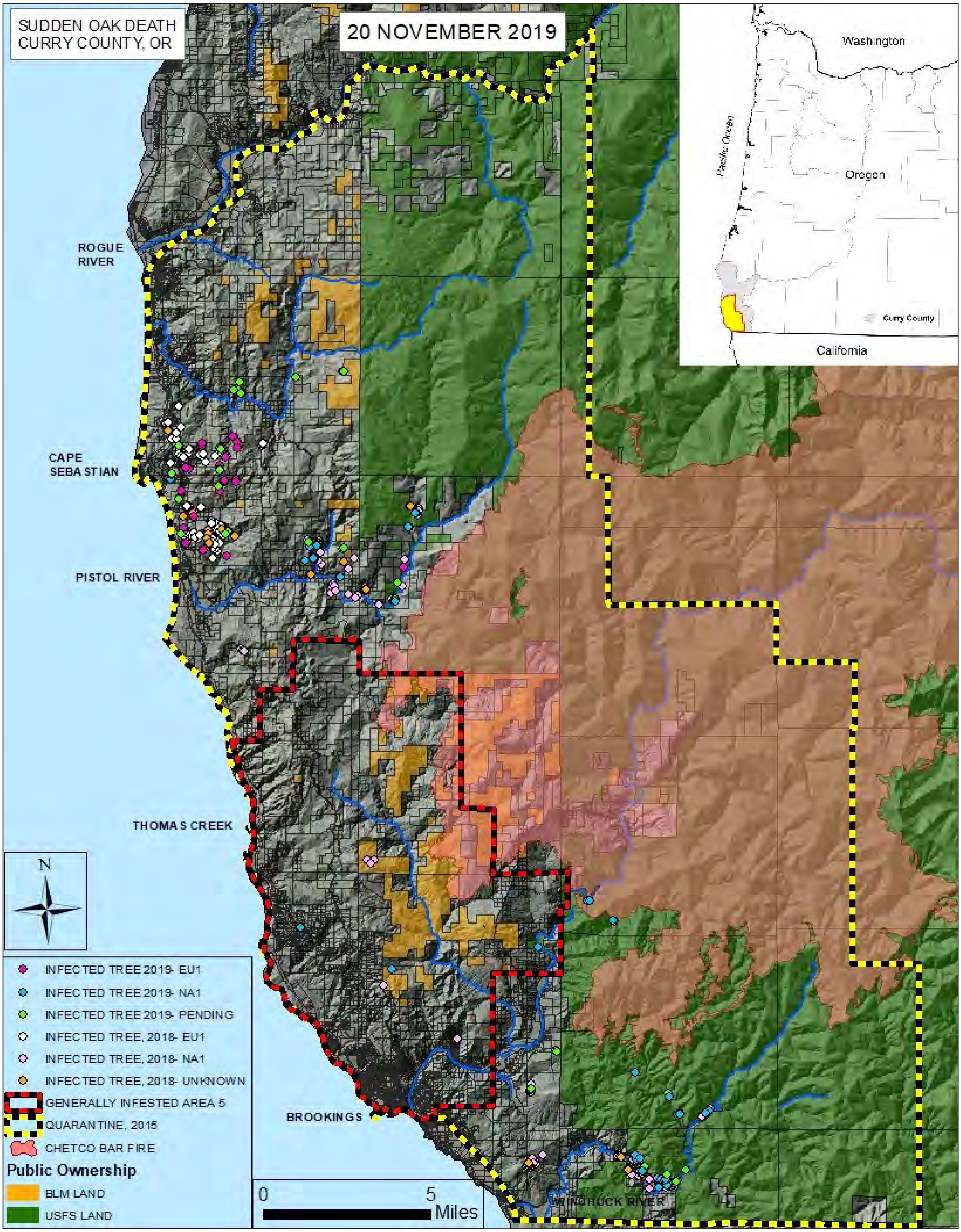


Figure 30. Map of SOD infection area (red) and quarantine area (yellow). EU1 and NA1 are two different lineages of P. ramorum. In Europe, the EU1 lineage kills or damages conifer tree species and is considered more aggressive than the NA1 lineage.

FOREST DISEASES

Swiss needle cast (SNC), a foliar disease affecting Douglas-fir in the Pacific Northwest, is caused by the native fungus *Nothophaeocryptopus gaeumannii*. The fungus is common where its only host, Douglas-fir, is grown. It has become particularly damaging to Douglas-fir forests on the western slopes of the Oregon Coast Range. The host – pathogen interaction is unique, because both the fungus and the host tree are native in the Pacific Northwest (PNW), where the disease originated.

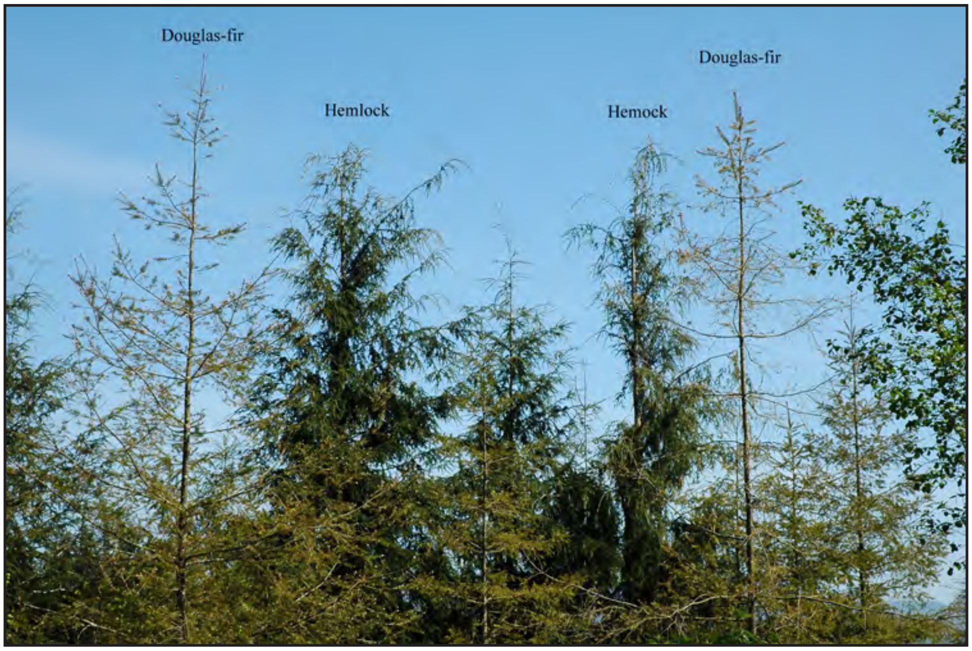


Figure 31. SNC causes foliage loss and sparse yellow crowns in Douglas-fir in Oregon's Coast Range. Low foliage retention can reduce tree volume growth by more than 50%. Western hemlock is unaffected (Alan Kanaskie, ODF).

Trees affected by SNC exhibit chlorotic foliage in the late spring and cast needles prematurely, resulting in sparse crowns. Disease severity and growth impacts are assessed using the number of years of retained foliage. While healthy tree generally have a minimum of 3 years of retained foliage, severely distressed trees can have very low foliage retention of below 2 years (Fig. 31). SNC rarely kills trees but reduces diameter and height growth. Growth declines occur following foliage loss. Previous analyses (1998-2008) have shown growth losses exceeding 50% when only 1 year of foliage remains on the tree. Growth loss due to SNC in 10-70 year old Douglas-fir in the Oregon Coast Range is estimated at more than 190 million board feet per year. SNC also alters wood properties, which can lower the value of certain lumber products, hinder the development of stand structure and wildlife habitat, and limit stand management options.

Over a 3-year period, starting in 2013, the SNC Cooperative (SNCC) at OSU established a 106-plot research network in 10-25 year old Douglas-fir stands (Fig. 32). The plots are distributed from the Oregon-California border to southwest Washington and 35 miles inland. The SNCC will collect data from these plots for at least 10 years. The first five-year period of plot re-measurement is currently taking place and has provided information about disease severity, growth loss and its geographic distribution on 66 plots throughout the Coast Range. Analysis of these new data showed that the maximum cubic volume growth losses during the 2013-2019 period was ~36%. The lower maximum growth losses (relative to the 1998-2008 period) are thought due to fewer under-performing stands in the dataset/population because merchantable stands have been salvaged and pre-merchantable stands have been removed in coastal zones.

Swiss needle cast information, GIS data and interactive map:
http://tinyurl.com/odf-foresthealth
http://sncc.forestry.oregonstate.edu
https://www.arcgis.com/apps/MapJournal/index.html?appid=da5cda5003d24544b9231dbb8edf82fb

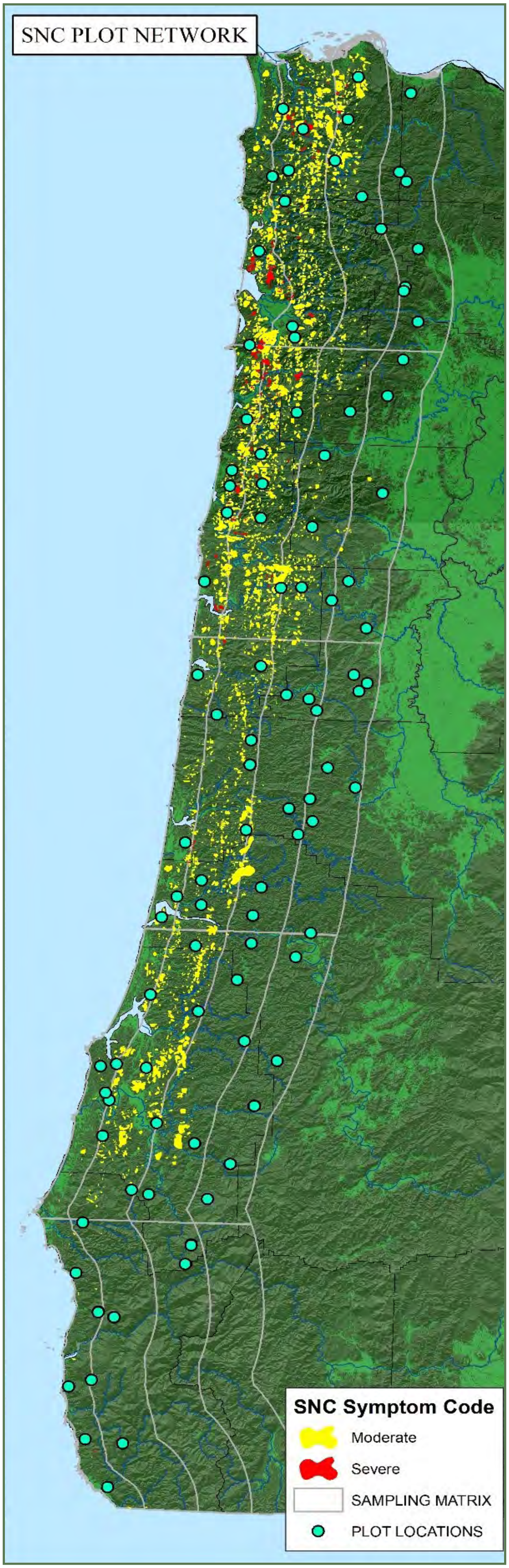


Figure 32. Map of SNC plot locations and SNC damage observed in Douglas-fir during the 2018 SNC aerial survey (left). The next aerial survey will take place in late spring of 2020.

During recent SNC aerial surveys, observers have noted that SNC infected Douglas-fir stands appear more dingy brown with thin crowns (above top) compared to previous years where symptomatic stands appeared more yellow in color (above bottom) (ODF).

EXOTIC INVASIVE PLANTS

Several hundred species of exotic plants have been accidentally or intentionally introduced over centuries to Oregon's forests from activities of European explorers, settlers and their American descendants. Today, new exotic plant species are still arriving and establishing in Oregon. While the effect of most of these introduced species is not well understood, several exotic plants have become serious economic and environmental pests in Oregon's forests. Himalayan blackberry, an escaped agricultural crop, and Scotch broom, an intentionally-introduced landscape plant, are the state's costliest noxious weeds. According to the Oregon Department of Agriculture (ODA), nearly $80 million in control costs and lost revenue are attributed annually to these two plants, more than all of the other noxious weeds combined.

Figure 33. Foxglove (Digitalis purpurea, top) is an attractive flowering plant from Europe that quickly establishes in replant areas and crowds out tree seedlings (bottom). It is not listed on Oregon's noxious weed list and, thus, is not regulated (Wyatt Williams, ODF).

The ODA Noxious Weed Program enforces the state's noxious weed laws and administrative rules set by the State's Noxious Weed Board. There are over 130 species of exotic plants on the Oregon Noxious Weed List (see Oregon Administrative Rule 603-052-1200). Class A noxious weeds require mandatory reporting to the ODA and eradication. All plant parts of List B noxious weeds, including seeds, are prohibited for purchase or sale in Oregon. Many troublesome exotic plants that affect Oregon's forests and timber production are not on the state's regulated noxious weed list. These include foxglove (Fig. 33), woodland groundsel, wall-lettuce, oxeye daisy, English hawthorn, English holly, reed canary grass and several species of clover, vetch and perennial grasses, all of which compete with tree seedlings. For more information on noxious weed laws visit: https://tinyurl.com/oregonweeds

Gorse (List B noxious weed)
Gorse (*Ulex europaeus*) was introduced intentionally from the United Kingdom to Bandon, OR in the 1870s. Like Scotch broom, seeds of gorse survive decades in the soil and are easily transported via heavy equipment. Unlike Scotch broom, gorse has thick, sharp spines (Fig. 34) and is very prone to fire due to high natural oil content. The Bandon fire of 1936, which burned nearly every structure in the town, was fueled primarily by this noxious weed. As it is a prolific seed producer, once gorse establishes a new population, it is extremely hard to eradicate and can become a major forest pest (Fig. 35).

Figure 34. Close-up of gorse plant in flower (Wyatt Williams, ODF).

In March 2019, ODF Forest Health staff conducted a special aerial survey over 370,000 acres in Curry County for gorse. Mid-March is the ideal time for surveying because peak gorse bloom usually occurs at this time, and Scotch broom, which has similar yellow flowers, typically blooms much later in the season (April-May). In 2019 we mapped 141 acres of gorse across 10 polygons, which is lower than in previous surveys. There are two plausible reasons why the detection was low: (a) we were surveying along the "front edge" of the invasion for our partners (Curry County and the Gorse Action Group), and (b) poor signature of yellow flowers. Despite the fact that gorse was in its peak flowering stage, unusually warm winter weather in late December 2018 caused some populations to flower early. This warm weather event was followed by a snowstorm in February, which may have led to petals falling off the shrubs, providing less-than-ideal conditions for aerial survey.


Figure 35.Gorse invading a timber plantation near the Elkhorn River in Port Orford (Wyatt Williams, ODF).

ODF Forest Health staff participated in steering group meetings for the Gorse Action Group in 2019. The group's objective is to control and reduce the spread of gorse in the south coast region of Oregon, to minimize its impacts on the economy and environment. More information can be found here: *www.gorseactiongroup.org*.

Orange hawkweed (List A noxious weed)

Orange hawkweed (*Hieracium aurantiacum*, Fig. 36) is a perennial plant in the sunflower family (Asteraceae) and proliferates in full sun, especially after a disturbance event, making it an opportunistic invader following timber harvest and road building activities. Orange hawkweed is a Class A noxious weed in Oregon. Because of its legal status as public menace, private and government landowners and land managers are required by law to report and manage this plant (ORS 569, OAR 603-052-1200).


Figure 36. Orange hawkweed in bloom (Wyatt Williams, ODF).

In 2017, ODF staff documented orange hawkweed for the first time in Clatsop County in northwest Oregon. In 2018, staff from ODF Forest Health and the Clatsop State Forest conducted a delimitation survey for the noxious weed. During the spring months in 2018, the population was monitored on a regular basis until flowers began to appear in early July. The population appeared to be limited to less than 50 plants within two clumps, both less than 21 ft^2. All flowers were clipped from plants, bagged and disposed of before seed could be set. The plants were then spot-sprayed with herbicide. At the time of peak flowering (July 2018), a survey of dozens of miles of forest roads in the area yielded no additional populations of orange hawkweed. In July 2019, the orange hawkweed treatment site was again surveyed and the road survey was also repeated. No orange hawkweed was detected at the site nor in the vicinity, and was declared eradicated from the area.

IMPORTANT INSECT AND DISEASE PESTS

	DOUGLAS-FIR	TRUE FIR	PINE
INSECTS	 • Douglas-fir beetle • Douglas-fir tussock moth • Western spruce budworm • Flatheaded fir borer • Cooley spruce gall adelgid* • Douglas-fir pole & engraver beetles*	 • Douglas-fir tussock moth • Western spruce budworm • Fir engraver • **Balsam woolly adelgid**	 • Ips beetles (pine engraver & California five-spined) • Mountain pine beetle • Western pine beetle (ponderosa only) • Pine butterfly • Black pineleaf scale • Sequoia pitch moth*
DISEASES	• Laminated root rot • Blackstain root disease • Armillaria root disease • Swiss needle cast • Rhabdocline needle cast • Douglas-fir dwarf mistletoe • Heart and stem decays	• Annosus root disease • Interior needle blight • Fir needle rust • Fir broom rust • Heart and stem decays	• **White pine blister rust** (5-needle pines) • Diplodia tip blight • Dothistroma needle blight • Western gall rust • Blackstain root disease • Armillaria root disease • Pine dwarf mistletoe

	TANOAK	WHITE OAK	MAPLE
INSECTS	• **Gypsy moth** 	• **Gypsy moth** • Oak looper* • Gall-making wasps & flies* • Leaf miners* 	• **Gypsy moth** • Various defoliators* 
DISEASES	• **Sudden oak death** (*Phytophthora ramorum*) • Armillaria root disease	• Armillaria root disease • Inonotus trunk rot	• Tar spot • Ganoderma trunk rot • Armillaria root disease

*Secondary or aesthetic pests that are not typically tree-killers
BOLD: non-native, exotic insects and diseases

IN NATIVE OREGON TREES

HEMLOCK	SPRUCE	‘CEDARS’	LARCH
 • Western hemlock looper	 • Spruce beetle • **Spruce aphid** • Cooley spruce gall adelgid*	 • Cedar bark beetles* • Amethyst borer* • Western cedar borer*	 • **Larch casebearer**
• Annosus root disease • Hemlock dwarf mistletoe • Hemlock needle rust • Heart and stem decays	• Spruce broom rust • Heart and stem decays	• **Port-Orford-cedar root disease** (POC only) • Cedar leaf blight (western redcedar only)	• Larch needle cast • Larch needle blight • Larch dwarf mistletoe

ALDER	ASH	POPLAR	MADRONE
• **Gypsy moth** • Western tent caterpillar* • Alder flea beetle* 	• **Emerald ash borer** • **Gypsy moth** 	• **Gypsy moth** • **Satin moth*** • Webworm* 	• **Gypsy moth** 
• Armillaria root disease • Nectria canker • Alder collar rot • Heart and stem decays		• Heart and stem decays	• Madrone leaf blight • Madrone branch dieback • Madrone stem cankers

Don’t know your tree? ID here:

Oregon tree ID: *http://oregonstate.edu/trees/name_common.html*

FOREST HEALTH CONTACTS

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