Forest Service
U.S. DEPARTMENT OF AGRICULTURE

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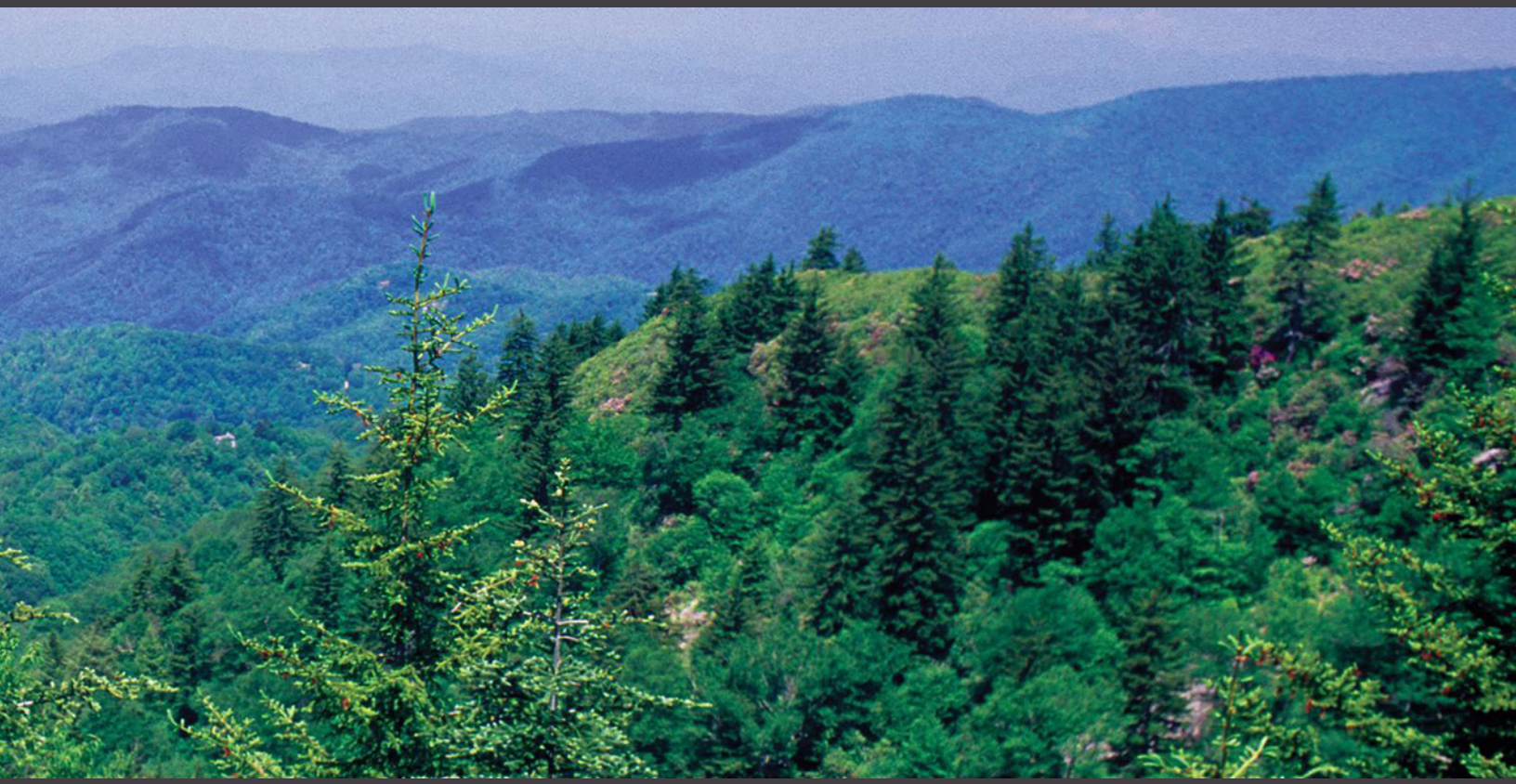
Major Forest Insect and Disease Conditions in the United States 2020



Major Forest Insect and Disease Conditions in the United States 2020

Acknowledgements

The annual forest conditions report provides information generated through the combined efforts of U.S. Department of Agriculture (USDA), Forest Service employees; State agencies; and other partners. Their dedication to the monitoring, detection, suppression, treatment, and management of our forested lands for insects and disease makes this report possible.

Report compiled by S. Sky Stephens, Sheryl A. Romero, and Frank J. Krist (USDA Forest Service, Forest Health Protection).

Photo credit

Cover photo: Mixed-species tree stands. Photo by USDA Forest Service.

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This report and other Forest Health Protection materials can be found online at:
https://www.fs.usda.gov/foresthealth

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406–329–3308

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Rocky Mountain Region (R2)
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Lakewood, CO 80401
303–275–5350

USDA Forest Service
Southwestern Region (R3)
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USDA Forest Service
Intermountain Region (R4)
324 25th Street
Ogden, UT 84401
801–625–5759

USDA Forest Service
Pacific Southwest Region (R5)
1323 Club Drive
Vallejo, CA 94592
707–562–8921

USDA Forest Service
Pacific Northwest Region (R6)
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Southern Region (R8)
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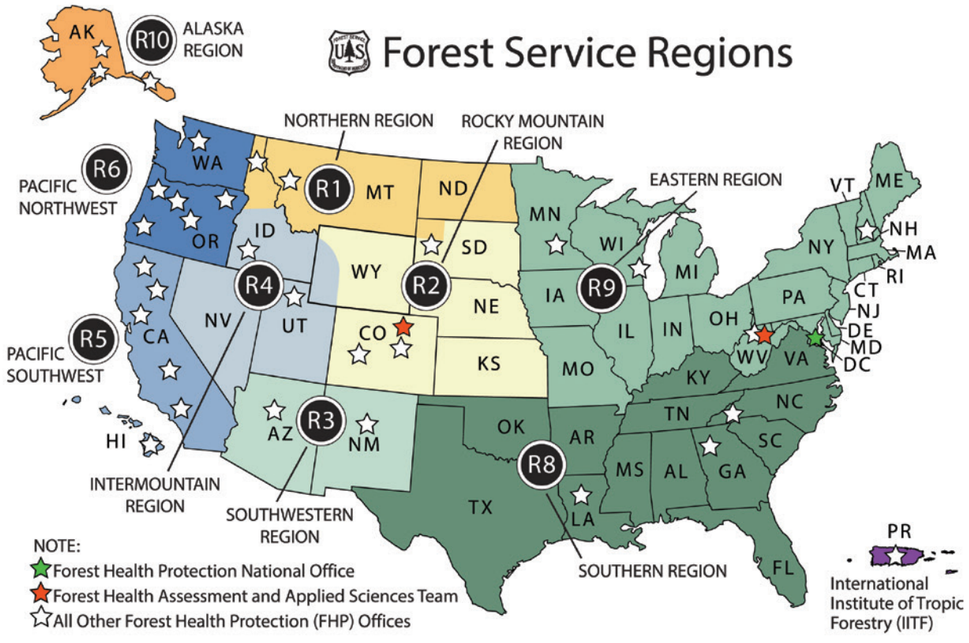


Preface

This report on the major insect and disease conditions of the Nation's forests represents the 70th annual report prepared by the U.S. Department of Agriculture (USDA), Forest Service. The report focuses on major insects and diseases that annually impact our Nation's forests. This 2020 update provides a national summary of the major changes and status of major forest pests with updated charts, tables, and maps. Additional information on these and other pests is available at: https://www.fs.usda.gov/foresthealth/.

The information in this report is provided by the Forest Health Protection program of the Forest Service and its State partners. This program serves all Federal lands, including National Forest System lands, lands administered by the U.S. Departments of Defense and the Interior, and Tribal lands. The program also provides assistance to private landowners through State foresters and other State agencies. Key elements of the program are administered by Forest Service and State program specialists to detect and report insect and disease epidemics through annual detection and monitoring surveys.

For additional information about forest health conditions, contact a Forest Service office (see map for office coverage) or your State Forester.

Contents

IMPORTANT: *When interpreting maps throughout this document, note that data are displayed at the county scale only. For example, if damage was reported at just one location in the county, the entire county is displayed as affected. This standard convention is used because data for most pests are collected only at the county level. If the damage were reported at finer scales, many areas would not be visible at the scale used in this publication. The maps represent only what is reported as mortality or defoliation and not the total infestation of a particular pest. In any given year, some areas are not surveyed due to physical limitations, such as forest fires, weather events, or limited resources. Data collected from ground and aerial surveys used in this report represent a single snapshot in time for a given year. More frequent surveys are conducted in specific areas on a case-by-case basis. By combining these surveys over time, this report captures general trends and conditions of selected insects and diseases across multiple years.*

Introduction

500 MILLION ACRES surveyed in 2019

50 PERCENT reduction in acres surveyed in 2020

215 MILLION ACRES surveyed in 2020

Insects and diseases play critical roles in maintaining healthy, resilient ecosystems. They also can be among the most serious economic and environmental threats to the forests and urban landscapes in the United States. Trees respond to environmental cues and may be positively or negatively impacted by these changes, altering ecosystem services derived from forested lands, including timber, recreation, tourism, clean water, energy, wildlife habitat, and jobs. To understand how conditions are changing and to protect species, forests are surveyed for insect and disease extent and intensity on an annual basis. Federal and State agencies and other stakeholders work together to use this survey information for management to ensure resilient forests are sustainable into the future. The overall mortality caused by insects and diseases varies by year and by pest, and cumulative effects can cause significant change.

COVID-19 IMPACTS

Insect and disease surveys for 2020 were impacted by the coronavirus COVID-19 pandemic, and some regions and States were unable to conduct their typical surveys. Additional remote sensing products including high-resolution imagery interpretation, ground surveys, and change detection programs were used to supplement data gathered by limited aerial surveys. Many areas of high priority for tracking insect and disease activity or observing at risk resources were prioritized by regions and States. However, many areas remained unsurveyed. Overall, there was **more than a 50-percent reduction in acres surveyed** in 2020 with only **215 million acres surveyed, down from 500 million acres surveyed in 2019**. The following summaries include all data sources available.

TREE MORTALITY

In 2020, surveyors observed more than **3.2 million acres** of tree mortality caused by insects and diseases in the United States. The total tree mortality reported in 2020 is incomparable to the tree mortality reported in 2019 due to the reduction in surveyed acres in 2020. In some areas, specific queries can be made to identify localized change where a survey was completed in both 2019 and 2020.

Every year, hundreds of native and nonnative insects and diseases damage our Nation's forests. This report provides descriptions of major insects and diseases that contribute to annual tree mortality and damage. Additionally, the "Feature" section describes pests that the Forest Service and its partners are closely monitoring. While each pest is reported separately, multiple pests may be active in the same area causing mortality to multiple host trees, magnifying the change in forest condition and creating complex forest management challenges.

For more information on all the mortality and damage agents please visit: https://www.fs.usda.gov/foresthealth/.

In addition to mortality, defoliating pests can damage trees by eating leaves or needles, causing significant losses of foliage and altering forest health. A single defoliation event does not usually cause tree mortality; taken together with repeated attacks or severe abiotic factors, such as weather and drought, trees can succumb to these defoliating insects or be predisposed to other insects and disease impacts. In 2020, surveys recorded **4.4 million acres** of defoliation and other types of damage agents.

FOREST HEALTH PROTECTION

2020 HIGHLIGHTS OF TREE MORTALITY AND OTHER DAMAGE FROM INSECTS AND DISEASES

*Insect and disease surveys for 2020 were impacted by the COVID-19 pandemic, and some regions and States were unable to conduct typical surveys. Therefore, other remote sensing products and additional ground surveys were used to supplement data gathered by aerial surveys. Overall, there was a 50-percent reduction in acres surveyed this year with only 215 M acres in 2020, down from 500 M acres surveyed in 2019.

*Approximately **215 million acres** surveyed

3.2 MILLION ACRES WITH **DEAD TREES**

4.4 MILLION ACRES WITH **OTHER TREE DAMAGE**

SPRUCE BEETLE
SPRUCE
- Attacks most spruce trees across its range
- Infestations continue to impact spruce forests in Alaska and Colorado

SUDDEN OAK DEATH
OAK AND TANOAK
- Kills several oak species and tanoak in California and Oregon
- Continues to spread northward in infected areas

SOUTHERN PINE BEETLE
SOUTHERN PINES
- Infestations remain very low across the Southeastern United States
- Populations are expanding in the Northeast due to warming winters

LAUREL WILT
LAUREL FAMILY
- Devastates red bay and sassafras
- Continues to move northward with new finds confirmed in KY, AR, and TN in 2020

EMERALD ASH BORER
ASH
- Devastates ash trees in urban and community forests and native hardwood forests
- Continues to spread to additional counties in infested States, but no new States in 2020

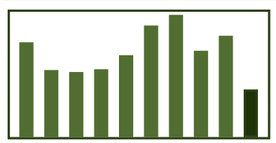
FIR ENGRAVER
WESTERN FIRS
- Impacts fir species in the Pacific Northwest and California
- Outbreaks are often driven by disease and drought stress

SPONGY MOTH
HARDWOODS
- Defoliation can result in reduced annual growth, canopy dieback, and mortality
- Infestations are down across most of the Northeast, except Michigan which reported 950,000 acres with defoliation in 2020

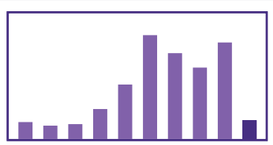
ACTIVITIES SUPPORTED BY FOREST HEALTH PROTECTION

SPRUCE BEETLE	SOUTHERN PINE BEETLE	EMERALD ASH BORER	FIR ENGRAVER	SPONGY MOTH	LAUREL WILT	SUDDEN OAK DEATH
Pest suppression, detection, management, and treatments	Suppression of active infestations and thinning forest for prevention	Provided technical assistance and outreach	Surveying, suppression, and developing management options	Eradication, suppression, and Slow the Spread Program	Expanded survey work with the focus on the northernmost occurrences	Stream detection and treatments in targeted areas

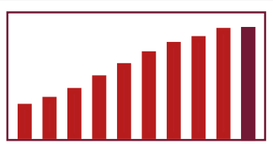
TREE MORTALITY SURVEY TRENDS 2011–2020*



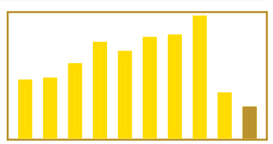
ALL TREE MORTALITY
3.2 MILLION ACRES
IN 2020



FIR ENGRAVER
370,000 ACRES
IN 2020



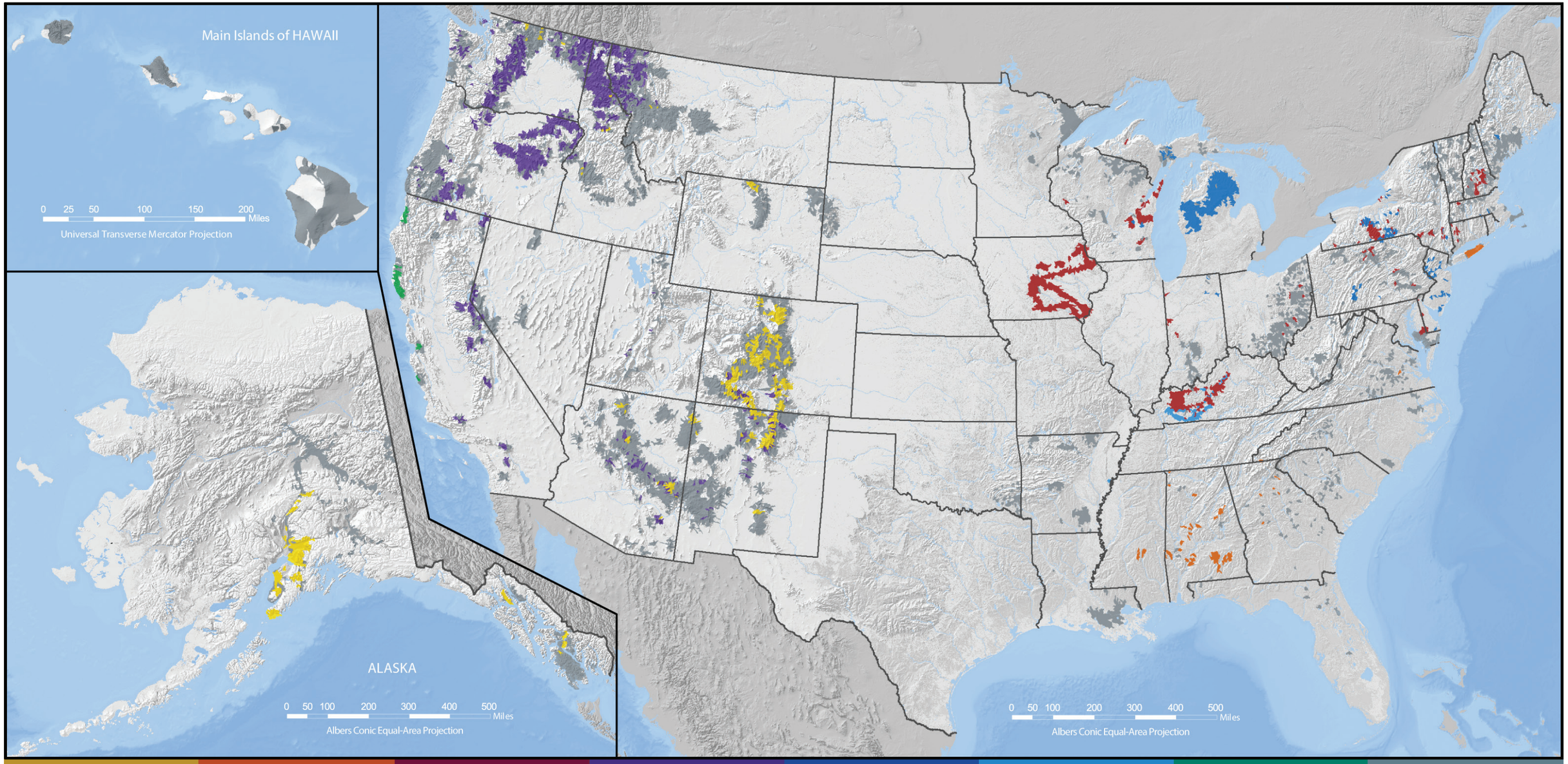
EMERALD ASH BORER
1,124 COUNTIES IMPACTED
IN 2020



SPRUCE BEETLE
209,000 ACRES
IN 2020

2020 INSECT AND DISEASE SURVEY—WATERSHEDS WITH TREE DAMAGE

⚠ *Insect and disease surveys for 2020 were impacted by COVID-19, and some regions and States were unable to conduct typical surveys. Remote sensing and additional ground survey supplemented data gathered by aerial survey. Overall there was a marked reduction in surveyed acres over known pest ranges such as laurel wilt.



Spruce beetle | Southern pine beetle | Emerald ash borer | Fir engraver | Spongy moth | Laurel wilt | Sudden oak death | ** Other damage

**Includes damage from spruce budworm, forest tent caterpillar, baldcypress leafroller, browntail moth, hemlock sawfly, Douglas-fir beetle, and many other less significant pests.

Mediterranean Oak Borer

Xyleborus monographus

A new threat to California white oaks.

Oak decline and mortality caused by Mediterranean oak borer damage. Photo by Sheri Smith, USDA Forest Service.

The Mediterranean oak borer (MOB) is an invasive ambrosia beetle native to the Mediterranean region. It is known to attack a range of trees in the oak and beech family including at least 12 species of oaks in its native range. The Mediterranean oak borer creates feeding tunnels or galleries in the trunks and branches of host trees. It initially attacks the crown of the tree killing individual limbs. Several fungi are associated with the MOB with some serving as larval food. Infestation can continue over several seasons before invading the main trunk and killing the entire tree. Infested trees can become a hazard, prone to premature failure, when widespread galleries weaken limbs and the upper trunk.

The first MOB infestations in North America were in valley oaks in Napa County, CA, identified in 2019, followed by Lake, Sonoma, and Sacramento Counties in 2020. Complete distribution of the MOB within these counties is currently undetermined. While the MOB is not believed to be widespread in California there is considerable potential for the beetle's range to expand. In California, the MOB has been found infesting two species of white oak, predominately valley oak but also blue oak. One limited observation was made on a severely distressed black oak. The Mediterranean oak borer appears to preferentially infest trees that are already suffering from drought or other insects or disease. California forests are under considerable stress from drought, fire, and disease, so they may be especially vulnerable to the MOB.

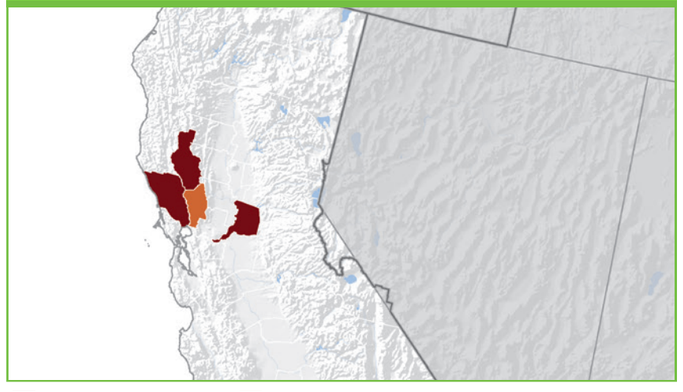
Work is ongoing to develop management tools including semiochemicals, chipping, steam treatment, and solarization of infested material. Several of the known infested trees are very large diameter making removal challenging and costly.

HOST: **OAK AND BEECH**

- **First North American infestations** of MOB detected in Napa County, CA
- California forests are **under considerable stress** from drought, fire, and disease

Mediterranean oak borer adults. Photo by Curtis Ewing, California Department of Forestry and Fire Protection.

FOREST DAMAGE AND RANGE



New Damage in 2020 | New Damage in 2019 | Affected State | Pest Not Yet Established | Forest Service Region

Laurel Wilt

Raffaelea lauricola

A risk to sensitive native trees and the avocado industry.

Staining in redbay caused by laurel wilt. Photo by Albert Mayfield, USDA Forest Service.

Laurel wilt continues to spread across 11 Southern States including: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Texas. Laurel wilt, *Raffaelea lauricola,* is vectored by the redbay ambrosia beetle and impacts trees in the laurel family including laurels, redbay, sassafras, swamp bay, camphor, and avocado.

Laurel wilt was first detected in Florida in 2005 and has spread rapidly across the State devastating populations of native trees. In 2020, laurel wilt caused heavy losses of swamp bay in sensitive tree islands in the Everglades and impacted commercial avocado groves in Miami-Dade County. New counties impacted by laurel wilt were identified in Arkansas, Georgia, Kentucky, Tennessee, Louisiana, North Carolina, and Texas in 2020. New county detections were determined by surveys, beetle detections, and molecular analysis.

Laurel wilt continues to expand.

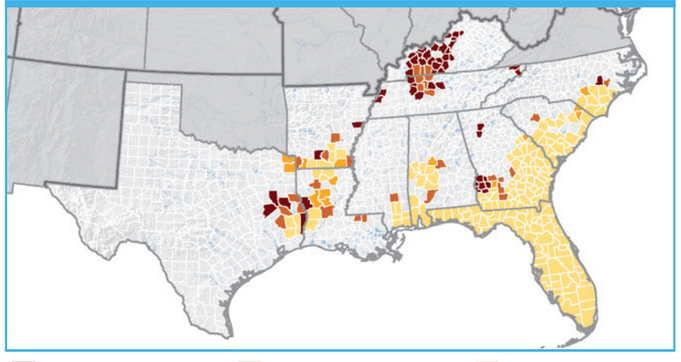
In Mississippi, mortality of redbay, swamp bay, camphor, and sassafras were severe, especially in and around the Pascagoula River basin. Laurel wilt continues to expand and is entering the northern boundary of the Coastal Plain. In Tennessee, laurel wilt appears to be rapidly spreading throughout the State and neighboring Kentucky counties, Trigg and Simpson, have also confirmed laurel wilt. In 2020, the Texas A&M Forest Service implemented a distribution study for the detection of redbay ambrosia beetle that identified five new counties infected with laurel wilt. Currently laurel wilt in Texas has only impacted a small area, but there is concern the disease could spread along the Texas coast into Mexico affecting the avocado industry.

HOST: **LAUREL FAMILY**

- **Devastating wilt disease** of red bay and sassafras
- **Continues to spread northward** with new finds confirmed in KY, AR, and TN in 2020

Foliar damage and discoloration in redbay caused by laurel wilt. Photo by Albert Mayfield, USDA Forest Service.

FOREST DAMAGE AND RANGE



New Damage in 2020 | New Damage in 2019 | New Damage in 2018 | Biological Range & Previous Damage | Affected State | Pest Not Yet Established | Forest Service Region

Spruce Beetle

Dendroctonus rufipennis

Ongoing activity increases large diameter tree loss.

Mortality in Engelmann spruce caused by the spruce beetle. Photo by William M. Ciesla, Forest Health Management International, Bugwood.org.

The spruce beetle caused mortality across western forests from Alaska to New Mexico. Reductions in aerial survey efforts due to COVID-19 restrictions were supplemented with ground assessments, roadside surveys, and aerial imagery interpretation in 2020.

South-central Alaska is estimated to be in the fifth year of a spruce beetle outbreak. Of the recent damage mapped, 96 percent is within the outbreak area in south-central Alaska. Approximately 145,000 acres of spruce beetle activity was recorded in 2020, bringing the cumulative acreage affected by the spruce beetle to at least 1.2 million acres. Notable areas of ongoing spruce beetle mortality were documented in the Cooper Landing area, the Anchorage Municipality, and along the Parks Highway. Scattered spruce beetle activity was documented extending north into the Denali Borough.

In the Intermountain Region, the spruce beetle remains at a low level with all activity detected in Idaho, almost entirely within the Nez Perce-Clearwater National Forests on the Moose Creek, Red River, and Salmon River Ranger Districts.

In the Central Rocky Mountains, spruce beetle epidemics are expanding where larger diameter spruce remains available. In Wyoming, the Shoshone National Forest has spruce beetle activity on the Wind River District. The Bighorn National Forest also has some light spruce beetle activity that appears to be expanding.

In Colorado, there is activity in and around Rocky Mountain National Park, and spruce beetles continue to become more detectable near areas of blowdown throughout the State.

The largest areas of activity continue to be in southern Colorado with notable expansion and increased intensity in the Wet Mountains.

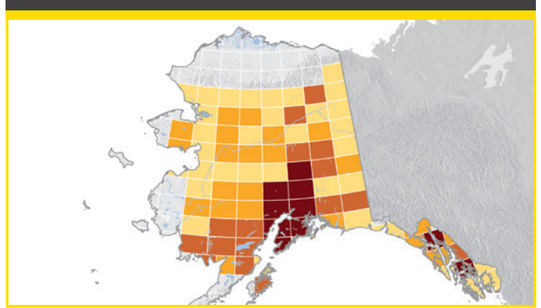
Spruce beetle activity and associated tree mortality increased in Arizona in 2020, particularly on Apache and Navajo Tribal lands and on the Apache-Sitgreaves National Forest. A small but notable increase in spruce mortality was also observed in Grand Canyon National Park, north of the rim on the Kaibab Plateau. In New Mexico, acres with mortality caused by the spruce beetle increased in 2020, primarily on the Carson and Santa Fe National Forests and adjacent lands. Some of the stands that have experienced several years of bark beetle activity have recorded greater than 90 percent spruce mortality and little new activity was observed in these areas. Low levels of spruce beetle activity continued on Sierra Blanca peak in the Sacramento Mountains in the southern part of the State. The spruce beetle was also observed on the Ski Apache ski area and nearby Mescalero Apache Tribal lands.

Spruce beetle adult. Photo by Edward H. Holsten, USDA Forest Service.

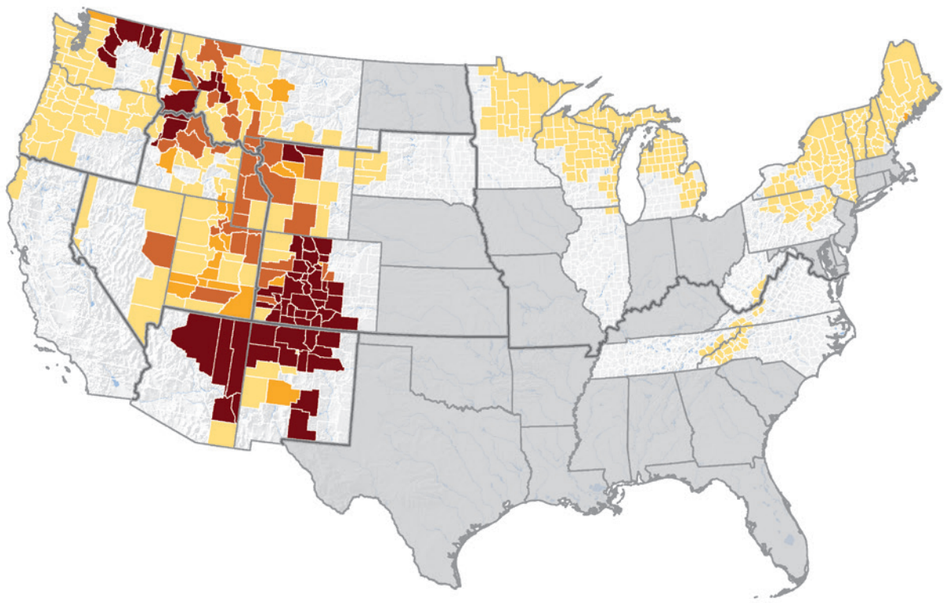
HOST: **SPRUCE**

- **Attacks most spruce trees** across its range
- Infestations **continue to impact** spruce forests in Alaska and Colorado

FOREST DAMAGE AND RANGE



FOREST DAMAGE AND RANGE



Southern Pine Beetle

Dendroctonus frontalis

Aerial view of southern pine beetle spot infestation. Photo by USDA Forest Service.

Reduced tree mortality and trap detections across the South and East.

In 2020, all States in the Southern and Eastern Regions reported little to no tree mortality caused by the southern pine beetle (SPB). Aerial survey efforts were reduced by COVID-19 restrictions to approximately one-third of 2019 coverage with some States having no aerial survey flights. States that typically conduct SPB trapping, like Pennsylvania, halted efforts during the pandemic, while others experienced reduced field-based activities. Ground verifications, landowner visits, trap catches, and State partner efforts help inform 2020 SPB impacts.

In the Southern Region, SPB activity was observed in Alabama, Georgia, North Carolina, and Virginia. Most of these States reported small spots of SPB activity, mostly on national forest land and seldom exceeding one acre in size. Trapping efforts detected the SPB in Louisiana but no infestations were observed. Texas continues to deploy SPB survey traps and results indicate that SPB populations are very low or absent.

In the Eastern Region, the SPB continues to cause pine mortality in the Pine Barrens of New York and New Jersey. While the SPB outbreak continues in the towns of South Hampton and East Hampton on the South Fork of Long Island, NY, sustained suppression efforts have reduced SPB populations below outbreak status in the Central Pine Barrens. In New Jersey the SPB impacted approximately 1,500 acres, mainly in the southern half of the State in the Pine Barrens region. Maryland, Delaware, Connecticut, Massachusetts, and Rhode Island continue to detect the SPB in traps but reported no tree mortality. Pennsylvania, Ohio, West Virginia, South Carolina, and Mississippi did not report any new tree mortality caused by SPB in 2020.

Tree mortality caused by the southern pine beetle. Photo by Ronald F. Billings, Texas A&M Forest Service, Bugwood.org.

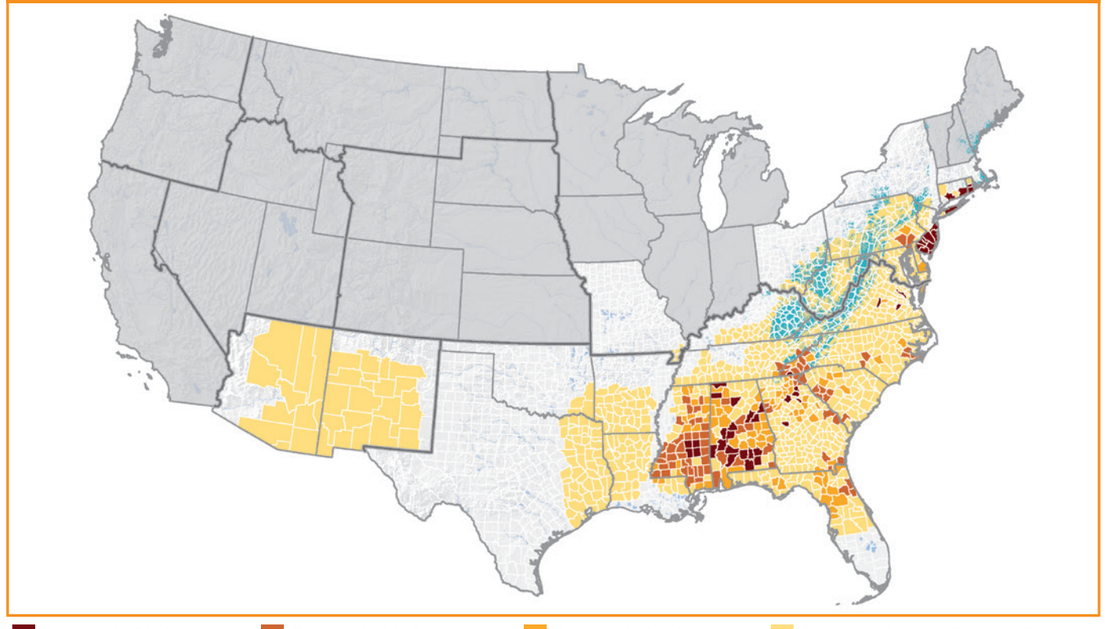
Pitch tubes are evidence of southern pine beetle attacks on host. Photo by Erich G. Vallery, USDA Forest Service.

HOST: **SOUTHERN PINES**

- **Infestations remain very low** across the Southeastern United States
- **Populations are expanding** in the Northeast due to warming winters

Southern pine beetle adult. Photo by Erich G. Vallery, USDA Forest Service.

FOREST DAMAGE AND RANGE



Emerald Ash Borer

Agrilus planipennis

Federal regulation ends December 2020.

Emerging emerald ash borer adults. Photo by Debbie Miller, USDA Forest Service.

The emerald ash borer (EAB) was not detected in any new States in 2020. It continued to spread to new counties within the 35 confirmed infested States. Dead and declining trees in infested areas continued to be an issue in both urban and natural forests. Surveying, trapping, biosurveillance, and monitoring and detection programs, combined with observations from citizens, and green industry professionals, identify and quantify areas impacted by the EAB.

The emerald ash borer was federally deregulated in December 2020, which formally removes the domestic quarantine regulations, managed by USDA's Animal and Plant Health Inspection Service (APHIS), for EAB effective January 2021. This action discontinues the domestic regulatory component of the EAB program. Funding previously allocated to the implementation and enforcement of these domestic quarantine regulations will instead be directed to nonregulatory options to mitigate and control the pest. Additionally, States are free to establish their own regulations governing the movement of EAB host material.

In the Eastern Region, the EAB occurs in all 20 States and the District of Columbia. All counties in Connecticut, Pennsylvania, West Virginia, Ohio, and Indiana are impacted. In the mid-Atlantic States, the EAB is found in all counties with the exception of six counties along the Atlantic seaboard, two in Maryland and four in New Jersey, where the ash resource is very sparse. The emerald ash borer is also present throughout the Southern and Central States. The emerald ash borer is also present in Colorado and remains a concern for the Western States.

States in the Eastern Region report significant ash mortality with some areas suffering from considerable loss in urban and suburban areas as well as native forests. Maine, New York, Vermont, Massachusetts, Maryland, Delaware, Rhode Island, Iowa, Minnesota, Missouri, and Wisconsin report additional county level detections. Rhode Island has observed EAB infestation expanding to approximately one-half of the State since initial detection in 2018. Illinois, the Upper Peninsula of Michigan, and Wisconsin report significant mortality reaching upward of 90 percent of the mature ash component. Ohio reports some declining EAB populations in counties where most ash trees are dead or have been treated.

In the Southern Region, EAB remains undetected in only two States: Mississippi and Florida. Emerald ash borer is only known in Oklahoma through a single positive trap catch in 2016. Emerald ash borer continued to spread across most infested States with 20 new county level detections in Arkansas, Georgia, Kentucky, North Carolina, Tennessee, Texas, and Virginia. Tree mortality is easily observed along impacted waterways, within forests, along roadways, in parks, and wherever ash has been planted in communities. Tree removals are occurring around homes and high-value locations.

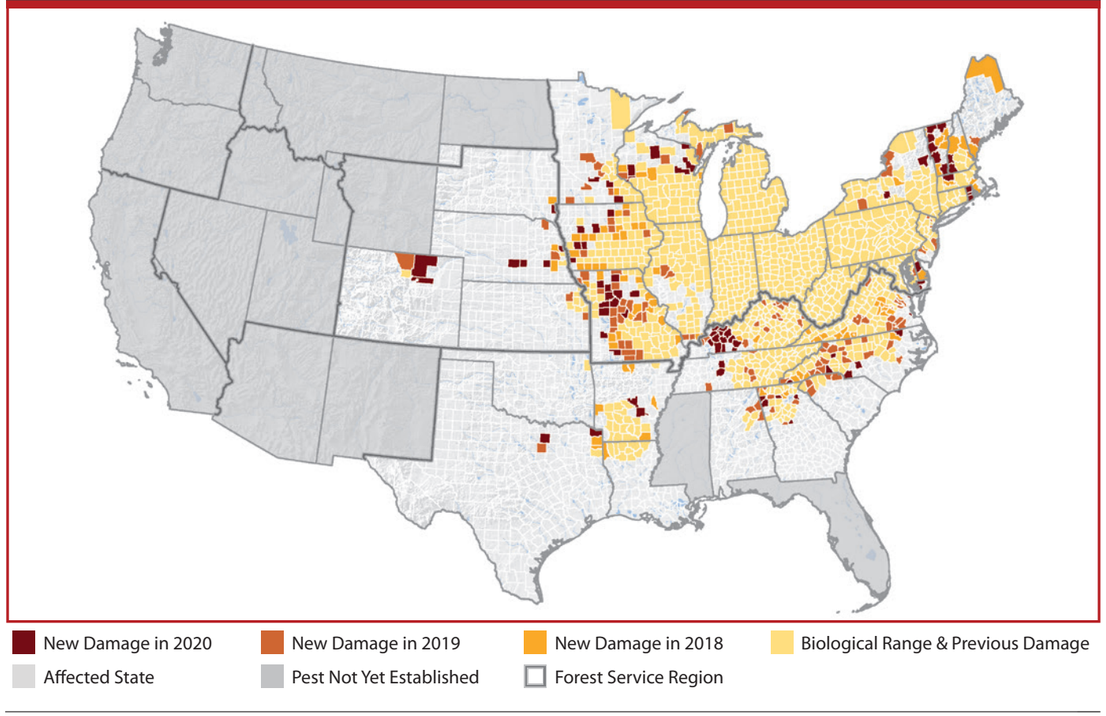
In the western regions EAB occurs only in Colorado, Kansas, Nebraska, and South Dakota. The emerald ash borer was identified in five new counties: Jefferson County, CO, and Buffalo, Hall, Seward and Washington Counties in Nebraska. The emerald ash borer remains a concern for Western States where ash tends to dominate the urban tree landscape.

HOST: **ASH**

- **Devastates ash trees** in urban and community forests and native hardwood forests
- **Continues to spread** to additional counties in infested States, but no new States in 2020

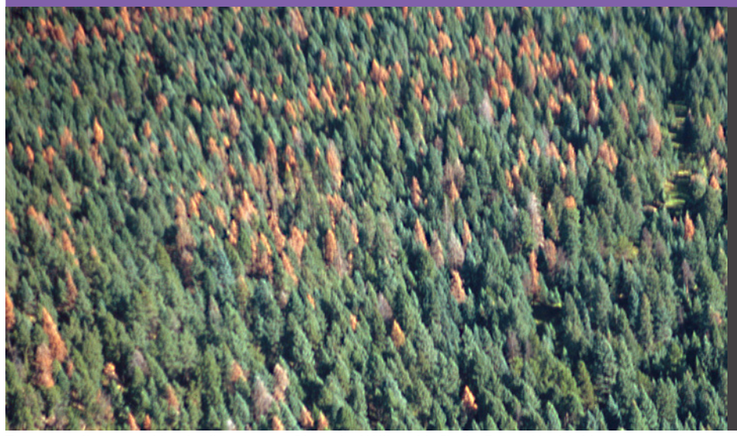
Tree mortality caused by the emerald ash borer. Photo by Ryan Armbrust, Kansas Forest Service, Bugwood.org.

FOREST DAMAGE AND RANGE



Fir Engraver

Scolytus ventralis



Drought conditions increase losses to fir engraver in the West.

Tree mortality caused by the fir engraver. Photo by William M. Ciesla, Forest Health Management International, Bugwood.org.

The fir engraver remained active throughout the Western United States. Most of the observed mortality caused by the fir engraver was in association with extreme drought conditions or injury from defoliators or tree pathogens. In 2020, the COVID-19 pandemic severely impacted aerial and ground survey efforts in California, Washington, and Oregon. In these States, satellite and high-resolution imagery interpretation focused on areas of significant interest and supplemented fir engraver observations for 2020. Nevada, Utah, Idaho, and Montana also had reduced aerial surveys in 2020.

In Washington and Oregon, the fir engraver continued to cause tree mortality and top-kill. Most of the mortality across the region is associated with recent drought conditions or root disease. In the Central Cascade Mountains, defoliation by the western spruce budworm predisposed trees to mortality caused by the fir engraver.

California assessed imagery for 10 areas of interest. Based on those assessments it appears that mortality caused by the fir engraver may have been down relative to 2019 in nine areas but may have increased in northeastern Sequoia National Forest. Ground assessments identified the fir engraver in northwestern Mendocino County and on the west side of the Klamath National Forest and on the Shasta-Trinity National Forest.

Mortality from the fir engraver was reported in Nevada, Utah, Idaho, and Montana. Trees in northern Idaho and western Montana weakened by age and root diseases continue to be predisposed to mortality by the fir engraver. A notable area of mortality caused by the fir engraver occurs on the east side of Flathead Lake on the Flathead National Forest and adjacent private lands.

Top-kill in white fir from the fir engraver. Photo by William M. Ciesla, Forest Health Management International, Bugwood.org.

Acres affected by the fir engraver on white fir continue to decrease in southern Colorado from a high of approximately 19,000 acres affected in 2015 to 530 acres in 2020. However, localized fir engraver activity has been killing large diameter white fir near the community of Ouray.

Impacts from the fir engraver, root disease, and defoliation have caused significant tree loss.

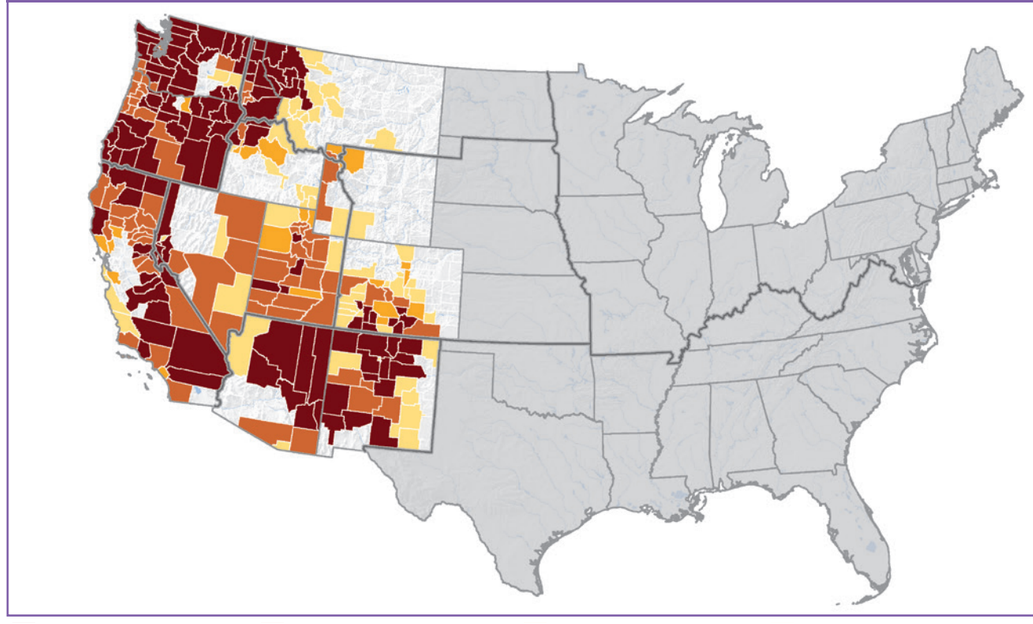
Mortality caused by the fir engraver continued to decline in Arizona and New Mexico. The white fir mortality that was observed in 2020 was on the Sangre de Cristo Mountains and the Sandia Mountains in New Mexico and the Coconino National Forest and Coronado National Forest in Arizona. The highest rates of tree mortality from the fir engraver were observed in dense stands on warm sites and frequently associated with Douglas-fir tussock moth defoliation and root disease.

HOST: **WESTERN FIRS**

- **Impacts fir species** in the Pacific Northwest and California
- **Outbreaks** are often **driven by** disease and drought stress

Fir engraver beetle galleries. Photo by Fred Honing, USDA Forest Service.

FOREST DAMAGE AND RANGE



Spongy Moth

Lymantria dispar dispar

Environmental conditions favor defoliation.

Male (brown) and female (white) adult spongy moths. Photo by John Ghent, Bugwood.org.

Defoliation caused by the spongy moth was highly variable in 2020. There were 959,950 acres of defoliation reported in 2020, a significant increase from the 230,190 acres reported in 2019. Some States had their aerial programs impacted by COVID-19 restrictions which reduced acres reported and, in some cases, acres treated. Data for defoliation was supported by change detection programs and ground surveys. Several States reported an increase in spongy moth observations from the public likely associated with more people being home during the COVID-19 pandemic.

In New York, 45,000 acres of moderate to severe defoliation was reported predominately around the western Finger Lakes. Connecticut, Massachusetts, Maine, and Vermont reported very little defoliation caused in 2020. However, Connecticut reported considerable tree mortality due to the combined effects of defoliation and drought. No defoliation was reported from Rhode Island or New Hampshire in 2020.

In Maine, climatic conditions favored larval development and feeding. Numerous areas were impacted by the browntail moth caterpillar cohabiting the same stands as the spongy moth caterpillar, making the defoliation impacts difficult to assign by species. Maine plans to complete winter spongy moth egg survey work in new areas to help determine if populations of the spongy moth are increasing overall.

The mid-Atlantic States of New Jersey, Maryland, Delaware, West Virginia, and Ohio reported limited to no defoliation by the spongy moth in 2020. Pennsylvania reported a significant increase compared to 2019. In absence of aerial surveys, ground surveys and change detection programs reported approximately 5,000 acres of defoliation in Pennsylvania, and egg masses were up substantially. These assessments will inform spongy moth spray program efforts in 2021.

The Central States of Iowa, Illinois, Minnesota, and Missouri did not report any tree damage from the spongy moth in 2020. Iowa's trapping program determined that two areas will be treated with mating disruption in 2021 and additional trapping to reduce likelihood of spongy moth establishment. Indiana and Wisconsin reported increased spongy moth populations in 2020 over 2019, with both an increase in trap detections and in community reports.

Michigan reported a significant spongy moth population increase in the northern Lower Peninsula. Almost 1 million acres of oak and aspen forests were moderately to severely defoliated in 2020, accounting for nearly all reported acres in 2020. This defoliation event was the most extensive spongy moth damage since the early 1990s. Egg mass surveys indicate a declining population across areas that were severely defoliated.

In the South, the spongy moth is trapped annually in North Carolina, Tennessee, and Kentucky, but no measurable defoliation has been caused in those States. Virginia has reported declining defoliation by the spongy moth in western and southwestern Virginia the last few years. No aerial surveys were conducted in Virginia in 2020 due to lack of defoliation and COVID-19 restrictions.

Across the West, trapping for adult male spongy moths continues as a coordinated effort with APHIS, the Forest Service, and State and Tribal agriculture departments. Annual monitoring and detection traps were negative in the Western States with three exceptions—Washington, Oregon, and California. Delimitation surveys conducted in Montana and North Dakota following positive moth catches in 2018 and 2019 did not result in additional detections in 2020. These States will continue delimitation surveys in 2021.

California detected both the European spongy moth and the Asian subspecies, *Lymantria dispar astiatica*, in 2020. Delimitation trapping was conducted through the fall of 2020 and will resume in 2021. Delimitation trapping around 2018 and 2019 trap positives did not result in additional moth catches.

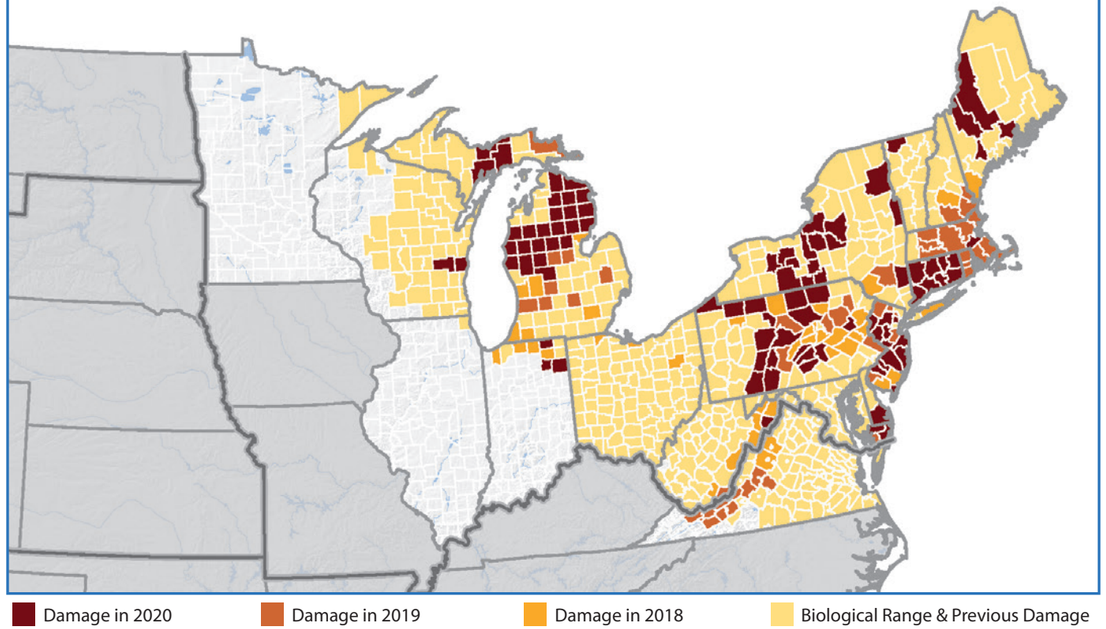
In Washington, spongy moth trapping was reduced due to COVID-19 impacts. Nine moths were collected at four sites, including one *Lymantria* species of Asian origin. An eradication treatment is planned for 2021. Eradication projects covered about 1,300 acres in Washington in 2020. No additional detections were made in the eradication area. Additional trapping will occur prior to determining if eradication efforts were successful. In Oregon, two detections were made, one European in Columbia County and one Asian in Multnomah County.

HOST: **HARDWOODS**

- Spongy moth defoliation can **result in reduced annual growth, canopy dieback, and mortality**
- **Infestations down** across most of the Northeast, except Michigan which reported 950,000 acres with defoliation

Defoliation in hardwoods caused by the spongy moth. Photo by Karla Salp, Washington State Department of Agriculture, Bugwood.org.

FOREST DAMAGE AND RANGE



Sudden Oak Death

Phytophthora ramorum

Outbreaks of SOD continue to cause mortality in California and Oregon.

Leaf discoloration symptoms from sudden oak death. Photo by Joseph O'Brien, USDA Forest Service.

Sudden oak death (SOD), caused by *Phytophthora ramorum*, has been identified in Washington, Oregon, and California. Federal quarantine regulations for SOD are in effect for 16 coastal California counties and in Curry County, Oregon. COVID-19 restrictions resulted in canceled regional aerial surveys and reduced field visits in 2020. Data for SOD in 2020 is supported by high-resolution aerial imagery interpretation, targeted ground surveys, and the SOD Blitz volunteer program.

In Oregon, over 600 tanoak spots were identified from aerial imagery and are being ground checked and sampled for SOD. In 2020, a multiple agency joint effort in Oregon completed treatments of 30 acres infested with the more aggressive European (EU1) linage of SOD.

Since 2002, eradication treatments have been completed on more than 7,400 acres at an estimated cost of over $31 million.

In California, limited ground surveys saw SOD activity increase in known infection centers, but activity was more inland relative to coastal sites. Based on remote sensing, tree mortality from SOD was down over most of the sites except for the two in northern Humboldt and Del Norte Counties. The first official regulatory confirmation of the EU1 lineage was found in Del Norte County in 2020. Surveys identified infected trees and positive stream samples in southern Monterey County. Sudden Oak Death Blitz volunteers reported SOD infection increases in Carmel, Santa Cruz, and the northern and eastern parts of the San Francisco Peninsula. In Sonoma County, mortality increased in plots inland near Healdsburg, CA. Surveyors recovered the *P. ramorum* pathogen in previously negative plots in Mendocino County. In southern Humboldt County tree symptoms are observed following a time lag after pathogen detection in streams. In northern Humboldt County, SOD continues to expand within Redwood National Park.

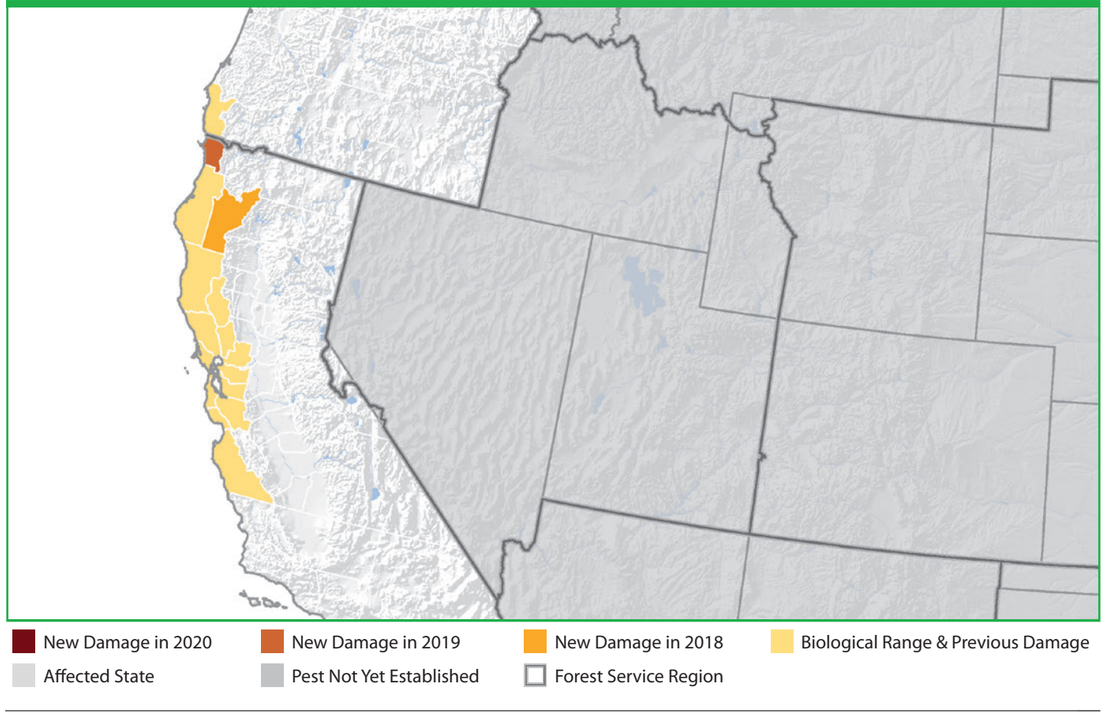
Tree mortality caused by sudden oak death. Photo by Bruce Moltzan, USDA Forest Service.

HOST: **OAK AND TANOAK**

- **Kills several oak species and tanoak** in California and Oregon
- **Continues to spread northward** in infected areas

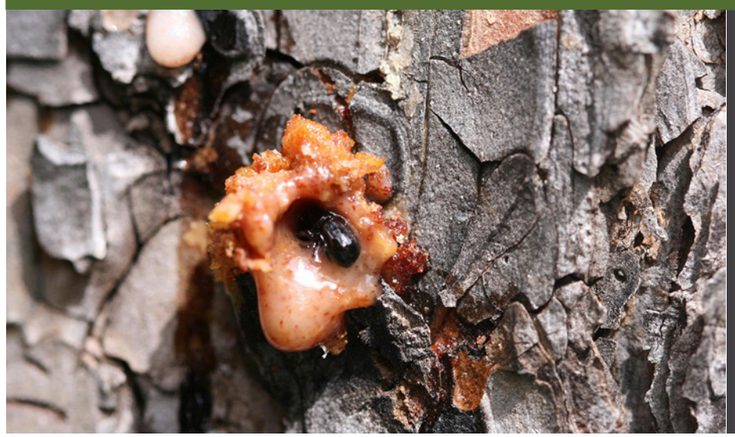
Sudden oak death impacts on coastal live oak. Photo by Joseph O'Brien, USDA Forest Service.

FOREST DAMAGE AND RANGE



Mountain Pine Beetle

Dendroctonus ponderosae



Endemic populations cause localized mortality.

Mountain pine beetles attack a ponderosa pine. Photo by Whitney Cranshaw, Colorado State University, Bugwood.org.

Across the Western States, aerial detection surveys were reduced in 2020 with some States reporting no aerial detection flights conducted due to COVID-19 restrictions. Ground surveys and aerial imagery interpretation supplemented the assessment of mortality caused by the mountain pine beetle (MPB). Mountain pine beetle populations were largely reported as endemic, causing only scattered pockets of mortality, through much of the West. California, Montana, and Colorado reported larger areas of tree mortality.

The mountain pine beetle continues to be active in the Pacific Northwest where it attacks mostly dense stands of lodgepole. In California, mortality caused by the MPB occurs in white pines, whitebark pine, and lodgepole pine. Mortality observed in 2020 was similar to 2019 in white pines in the northern Warner Mountains but increased in whitebark pine in Siskiyou County and in lodgepole pine around Mammoth and Medicine Lake Mountains. An estimated 2,000 acres have been affected since 2017, with up to 90 percent mortality in heavily infested lodgepole pine stands.

In Idaho and Montana, MPB caused more than 4,000 acres of tree mortality was caused by MPB, primarily in Montana on lodgepole pine. The greatest increases were noted on the Helena-Lewis and Clark National Forest, Lolo National Forest, and Glacier National Park, with continued significant activity on the Kootenai National Forest.

Across the Intermountain Region, approximately 5,500 acres with mortality caused by the MPB were reported, most of which occurred in California and Nevada on the Humboldt-Toiyabe National Forest in limber and whitebark pines on drought impacted landscapes. Whitebark pine mortality due to the mountain pine beetle and white pine blister rust is still occurring and was observed in the Sawtooth National Forest and Boise National Forest. Other areas with scattered lodgepole pine mortality caused by the MPB include the Payette National Forest and the Uinta-Wasatch-Cache National Forest.

Mountain pine beetle activity has returned to endemic levels in much of the Rocky Mountain Region.

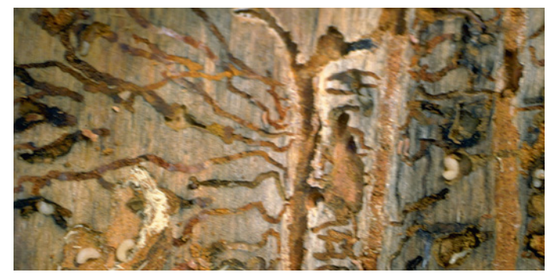
Mortality of lodgepole pine caused by the mountain pine beetle. Photo by Dave Powell, USDA Forest Service.

A notable exception is an outbreak that is expanding in the Wilder-Gunnison Highland communities and surrounding Gunnison National Forest located in the Taylor Canyon in Colorado. Ground surveys indicate a growing MPB population. This outbreak threatens one of the largest remaining mature lodgepole pine forests in Colorado unaffected by the mountain pine beetle epidemic in the 2000s. Drought stress is reducing tree defenses and contributing to conditions favorable to increasing beetle populations. Ground surveys on the Dolores Ranger District on the San Juan National Forest also show that the mountain pine beetle is part of a bark beetle complex in ponderosa pine including the roundheaded pine beetle and the western pine beetle.

In Arizona, mortality caused by tthe MPB was documented on very few acres in 2020. Observed tree mortality was limited to a few scattered single trees in high elevation stands on south and southwestern facing slopes in northern Arizona on the Kaibab National Forest and Coconino National Forest. Ground surveys did note some southwestern white pines being attacked and killed by beetles identified as MPB and *Ips bonanseai*.

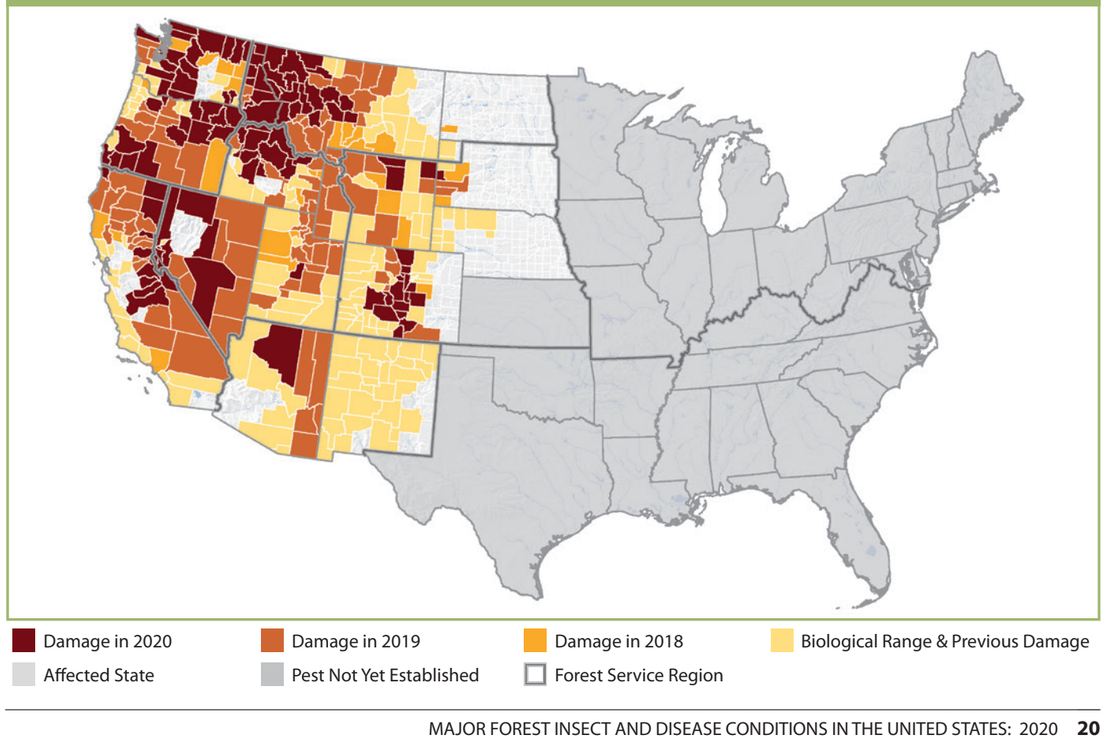
HOST: **WESTERN PINES**

- **Tree mortality caused by the mountain pine beetle** increased in California
- **Drought and warming temperatures increase** host susceptibility



Mountain pine beetle galleries. Photo by William M. Ciesla, Forest Health Management International, Bugwood.org.

FOREST DAMAGE AND RANGE



Oak Wilt

Bretziella fagacearum

Oak wilt in northern pin oak. Photo by Joseph OBrien, USDA Forest Service.

Mortality agent of oaks of all sizes.

Oak wilt is currently found in the New England, mid-Atlantic, Central, and Southern States of Ohio, Pennsylvania, Maryland, West Virginia, New York, Iowa, Indiana, Michigan, Missouri, Wisconsin, Minnesota, South Carolina, and Texas. Oak wilt has not been identified in New Jersey, Delaware, or the District of Columbia.

Oak wilt is widely distributed in Ohio, Pennsylvania, New York, Maryland, and West Virginia. Ohio was the most active State for reporting and management of the disease, including a "hot spot" of oak wilt infection in east-central Ohio within and around Yellow Creek State Forest. New York maintains six active quarantine districts and one infection center was treated in 2020 by removing infected and potentially root grafted trees in Yates County.

Due to COVID-19 restrictions, the Iowa Department of Natural Resources did not take any oak wilt samples.

The majority of the aerial surveys flown were in response to powerful straight-line wind events and subsequent oak wilt symptoms occurring on northern red oak. These sites will be monitored in 2021. In Indiana, oak wilt is common in woodlots with mortality occurring on red and black oaks from sapling to saw timber size.

Further south, oak wilt is most commonly found in the sand belt of South Carolina where soil type promotes root grafts between oaks. Oak wilt occurs throughout central Texas and is scattered in west Texas. In 2020, mitigation of oak wilt consisted of 65 trenches to sever below ground root graft connections as part of the Texas Cooperative Oak Wilt Suppression Project. Since the inception of the program, more than 250 miles of oak wilt trenches have been installed to control the spread of this disease.

Foliar decline in red oak caused by oak wilt. Photo by Joseph O'Brien, USDA Forest Service.

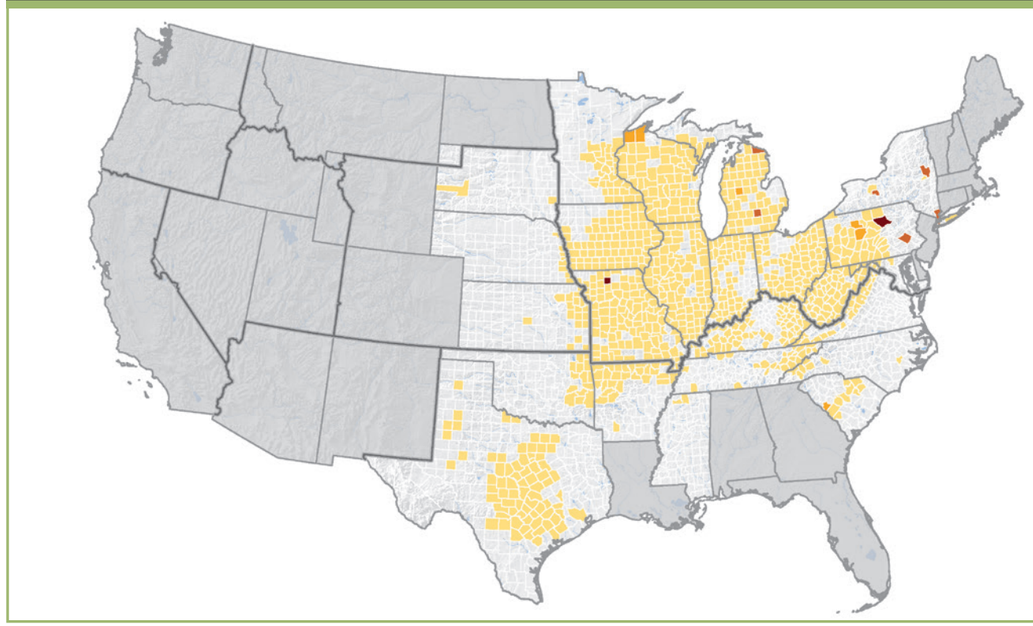
Northern pin oak mortality caused by oak wilt. Photo by Steven Katovich, Bugwood.org.

HOST: **OAK**

- **Infection can spread** through root contacts and by insect vectors
- Upstate New York **infections are of concern** to eastern Canada

Foliar decline caused by oak wilt. Photo by Joseph O'Brien, USDA Forest Service.

FOREST DAMAGE AND RANGE



Western Spruce Budworm

Choristoneura freemani

Repeat defoliation predisposes trees to other mortality agents.

Western spruce budworm defoliation of Douglas-fir and white fir. Photo by William M. Ciesla, Forest Health Management International, Bugwood.org.

The western spruce budworm (WSBW) is a native defoliator of western conifers including Douglas-fir, true fir, and spruce found throughout the West. This defoliator damages new year growth on hosts. Once cyclic in occurrence, the WSBW is frequently observed chronically impacting hosts throughout much of its range. Repeated defoliation can lead to top-kill, reduced growth, and predisposition to other biotic and abiotic stressors. In stands affected by WSBW and other stressors, particularly bark beetles and drought, tree mortality can occur.

In Montana and northern Idaho, aerial survey was greatly reduced in 2020 due to COVID-19 restrictions. WSBW defoliation of Douglas-fir was widespread. In 2020, most defoliation occurred on the Helena-Lewis and Clark National Forest and Lolo National Forest.

In the Intermountain Region, WSBW remains chronic, with defoliation recurring in stands year after year, increasing susceptibility to other mortality agents such as bark beetles. Idaho and Utah reported approximately 25,000 acres of WSBW defoliation, predominately in Idaho. Of those, 19,000 acres were considered severe. In Utah, WSBW defoliation was present at moderate to heavy levels on the Caribou-Targhee National Forest and Ashley National Forest.

In Colorado and Wyoming, WSBW activity intensified and expanded into areas where it has not been seen in many years. Limited aerial surveys detected 128,000 acres with defoliation. Ground observation in higher elevation spruce and subalpine forest types also documented defoliation in the northern Shoshone National Forest and Medicine Bow-Routt National Forest. Activity continued at high levels on the Shoshone; Bighorn; Pike and San Isabel; San Juan; Rio Grande; Medicine Bow-Routt; and Grand Mesa, Uncompahgre, and Gunnison National Forests and adjoining lands. In Wyoming, the WSBW is active throughout the range of Douglas-fir. Many areas have experienced defoliation at epidemic levels for multiple years causing mortality and predisposing trees to Douglas-fir beetle attack.

Western spruce budworm larva. Photo by Scott Tunnock, USDA Forest Service.

Defoliation by the WSBW has often caused the largest area of forest damage observed by aerial detection surveys in the Southwest.

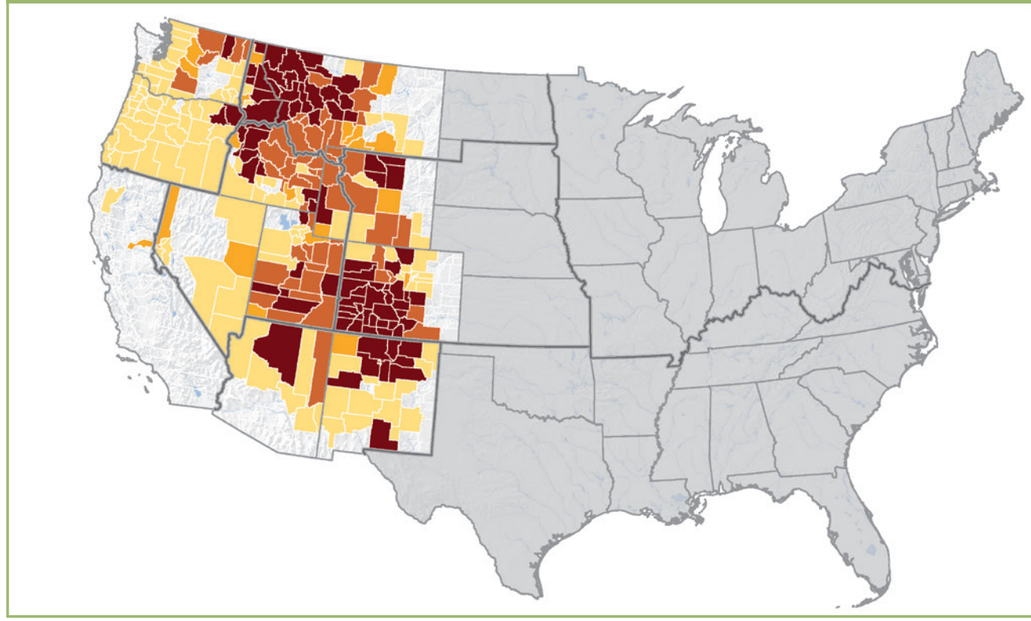
In New Mexico, defoliation by the WSBW continued to be the most widespread forest damage observed during aerial detection surveys. Acres mapped with defoliation from WSBW increased substantially in 2020, continuing an upward trend particularly on the Carson National Forest, Santa Fe National Forest, and adjacent State and private lands. Elevated levels of defoliation have been observed in this area for four decades in mixed conifer and spruce-fir forest stands. Twig dieback, top-kill, and tree mortality have resulted from the continuous defoliation, and understory regeneration has been significantly affected in some stands. In Arizona, defoliation by the WSBW continued to be observed north of the Grand Canyon on the Kaibab Plateau around Pleasant Valley and De Motte Park. The amount of damage observed fluctuates with weather and other environmental conditions. A small area with suspected WSBW activity was also mapped on the south side of the San Francisco Peaks.

HOST: **SPRUCE, FIRS, DOUGLAS-FIR**

- A **native defoliator** in western forests
- **Reduces tree growth and vigor,** increasing susceptibility to other insects and diseases

Grand fir defoliation by the western spruce budworm. Photo by William M. Ciesla, Forest Health Management International, Bugwood.org.

FOREST DAMAGE AND RANGE



Beech Leaf Disease

Litylenchus crenatae mccannii

Impacting natural forests and urban trees.

Dark, thickened stripes between leaf veins are early beech leaf disease symptoms. Photo by Matt Borden, Bartlett Tree Experts.

In 2020, beach leaf disease (BLD) was confirmed in New Jersey and Massachusetts on American and European beech trees. Surveys and laboratory diagnosis for the disease and the nematode *Litylenchus crenatae mccannii* have now identified BLD in seven New England and mid-Atlantic States including Ohio, Connecticut, Massachusetts, New Jersey, New York, Pennsylvania, and Rhode Island.

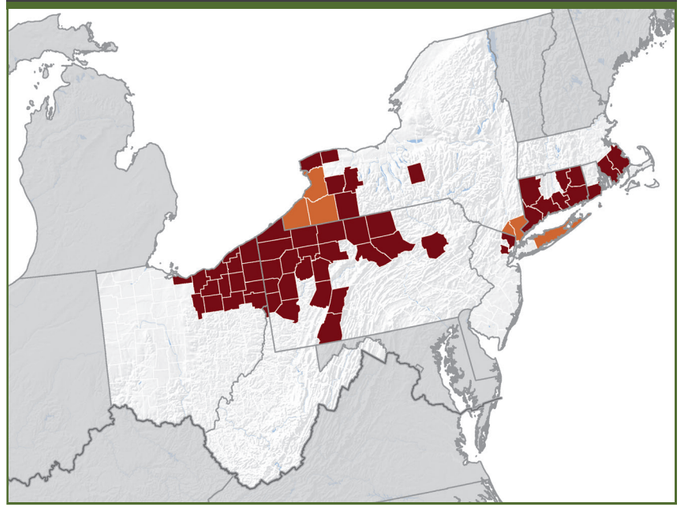
Mortality caused by BLD has been confirmed on trees, including saplings, in natural forest settings and in urban and community forests. Disease symptoms have been observed by ground survey efforts, landowner calls, and public reports. Beach leaf disease continued to spread across New York including a large expansion of known infested counties in western New York and a jump to central New York. Rhode Island established a delimitation survey area with the University of Rhode Island around a known BLD site for further observation. Connecticut, Pennsylvania, and Ohio reported additional counties with BLD in 2020.

HOST: **BEECH**

- A **newly identified** beech disease
- **Reported for the first time** in New Jersey and Massachusetts in 2020

Banding and discoloration caused by several years of beech leaf disease infection. Photo by Matt Borden, Bartlett Tree Experts.

FOREST DAMAGE AND RANGE



Rapid ʻŌhiʻa Death

Ceratocystis huliohia and *Ceratocystis lukuohia*

Management efforts shift from detection to mitigating spread.

ʻŌhiʻa forest showing scattered mortality resulting from rapid ʻōhiʻa death. Photo by Paul Berkowitz, Pacific Island Ecosystems Research Center.

ʻŌhiʻa is the most common tree species in Hawai'i's native forests accounting for 50 percent of all forest trees in the State and 80 percent of all native trees. Rapid ʻōhiʻa death (ROD) is a disease caused by the *Ceratocystis* fungi. Two related species, *Ceratocystis huliohia*, a slow spreading canker disease, and *Ceratocystis lukuohia*, an aggressive wilt disease, have killed over 1 million ʻōhiʻa trees. Estimates derived from aerial and ground surveys are that the disease kills about 200,000 trees annually.

Rapid ʻōhiʻa death is now found in all districts of Hawai'i Island where management has shifted from large-scale early detection and rapid response to reducing rate of spread. Spread of ROD can be mitigated through hygienic management and recreation practices which are a focus of outreach. On Kauai, ROD is limited to fragmented, invaded forests in lowland areas, and managers are working to prevent spread into the island's interior ʻōhiʻa forests. Early detection surveys continue on the islands of Oahu, Maui, Molokai, and Lanai. Only *C. huliohia* has been detected to date.

Limited ROD detections on Oahu and Maui indicate that the combination of strategies deployed by the ROD working groups are making a difference in protecting forests. Community outreach is an integral part of ROD management. An ʻōhiʻa disease resistance program is screening cuttings from genotypes across the State to test for resistance. The screening process should lead to finding some resistant genotypes for restoration purposes.

HOST: **ʻŌHIʻA**

- ʻŌhiʻa trees **account for 50 percent of all forest trees** in Hawai'i
- The aggressive *Ceratocystis lukuohia* **has caused most of the mortality** seen on Hawai'i island
- Managers in Kaua'i are **working to prevent spread** into the island's core ʻōhiʻa forests

FOREST DAMAGE AND RANGE