USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

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Major Forest Insect and Disease Conditions in the United States: 2022

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Acknowledgments

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: Fall foliage from Foote Pond Overlook in the Huron-Manistee National Forests. Photo by Brendon O'Dell, USDA Forest Service.

Copies of this report are available from:

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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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1400 Independence Avenue, SW
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USDA Forest Service
Northern Region (R1)
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200 East Broadway
P.O. Box 7669
Missoula, MT 59807–7669
406–329–3308

USDA Forest Service
Rocky Mountain Region (R2)
1617 Cole Boulevard, Building 17
Lakewood, CO 80401
303–275–5350

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Southwestern Region (R3)
333 Broadway Boulevard, SE
Albuquerque, NM 87102
505–842–3247

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324 25th Street
Ogden, UT 84401
801–625–5759

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Vallejo, CA 94592
707–562–8921

USDA Forest Service
Pacific Northwest Region (R6)
1220 SW 3rd Ave.
Portland, OR 97204–3440
503–808–2913

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Southern Region (R8)
1720 Peachtree Road, NW
Atlanta, GA 30309
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626 East Wisconsin Avenue
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3301 C Street, Suite 202
Anchorage, AK 99503–3956
907–743–9455

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Jardín Botánico Sur,
1201 Calle Ceiba
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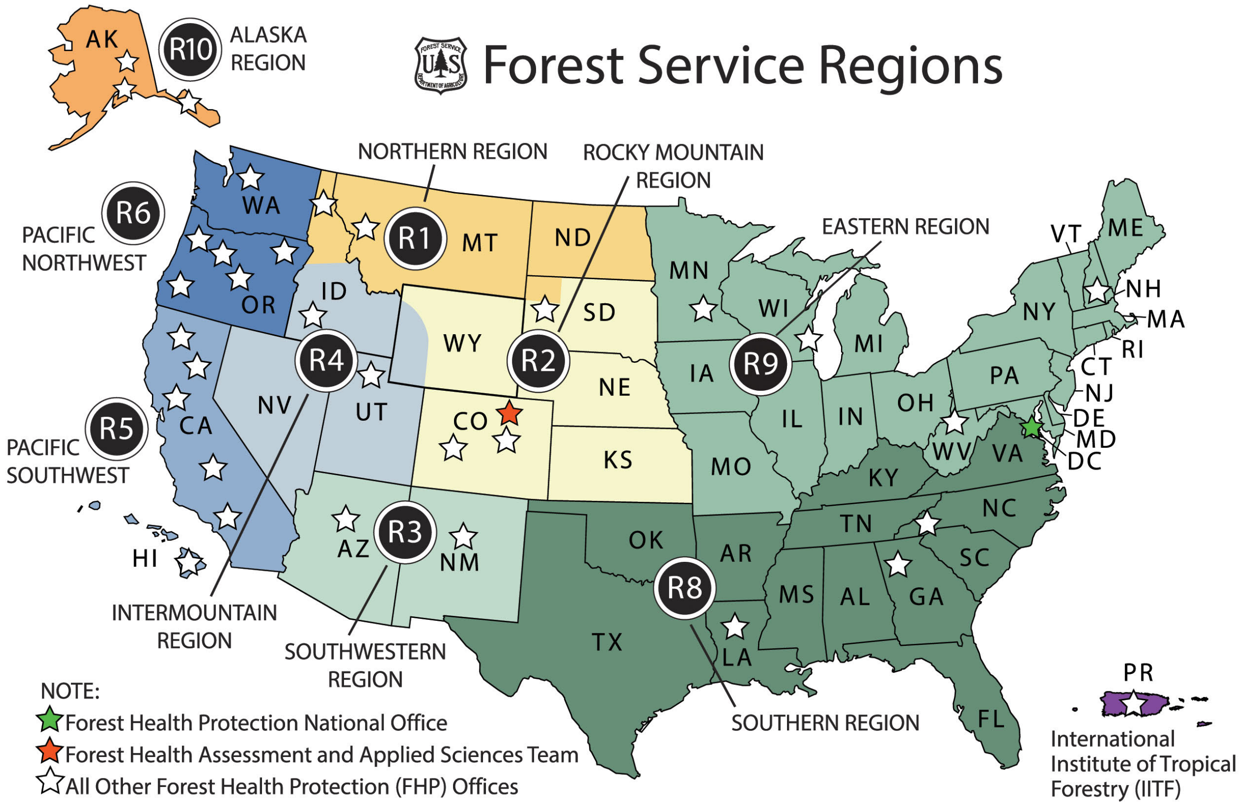
787–766–5335



Preface

This report on the major insect and disease conditions of the Nation's forests represents the 72nd annual report prepared by the U.S. Department of Agriculture, Forest Service. The report focuses on major insects and diseases that annually impact our Nation's forests. This 2022 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 and lands administered by the U.S. Departments of Defense and the Interior, as well as 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 was 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

462 MILLION ACRES surveyed in 2022

8.4 MILLION ACRES with dead trees in 2022

5.9 MILLION ACRES with tree damage in 2022

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 information for management to ensure resilient forests are sustainable into the future. The overall tree mortality caused by insects and diseases varies by year and by pest, and cumulative effects can cause significant change.

TREE MORTALITY

In 2022, more than 8.4 million acres with tree mortality caused by insects and diseases was observed in the United States. A total of 462 million acres of forests were surveyed in 2022. The total tree mortality reported in 2021 was 5.8 million acres with 423 million acres of forests surveyed. Total tree mortality is difficult to compare year to year based on survey coverage. In some areas, specific queries can be made to identify localized change where surveys were completed in both years.

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 2022, surveys identified 5.9 million acres of defoliation and other types of damage.

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/

FOREST HEALTH PROTECTION 2022 HIGHLIGHTS OF TREE MORTALITY AND DAMAGE FROM INSECTS AND DISEASES

462 million acres surveyed

8.4 MILLION ACRES WITH DEAD TREES

5.9 MILLION ACRES WITH TREE DAMAGE

BEECH LEAF DISEASE
BEECH

- Michigan **confirms first occurrence**
- **Foliar symptoms observed** in forests and landscape trees in the Northeast

WHITE PINE BLISTER RUST
FIVE-NEEDLE PINES

- Whitebark pine was **designated as threatened under the Endangered Species Act**
- **Whitebark pine mortality is extensive** in high-elevation forests in the Western United States

SOUTHERN PINE BEETLE
SOUTHERN PINES

- **Additional trap detections** in Maine after initial 2021 detection
- **Over 9,000 acres** with mortality **reported** in New York

SPONGY MOTH
HARDWOODS

- **Reduced defoliation reported** across States heavily impacted in 2021
- **1.7 million acres with defoliation reported** predominately in MI and PA

EMERALD ASH BORER
ASH

- **First new State detection** since 2018 occurred in Oregon
- **Ash mortality continues** in impacted States

RAPID ʻŌHIʻA DEATH
ʻŌHIʻA

- **Tree mortality continues to spread** on Hawaiʻi Island
- **Tree wounding** by invasive ungulates **increases ROD infections** in HI

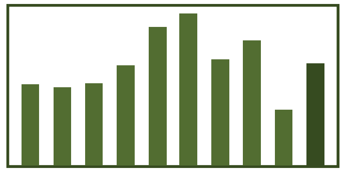
FIR ENGRAVER
WESTERN FIRS

- **Mortality attributed** to fir engraver on **nearly 3.4 million acres**
- **Drought conditions continue** to promote fir engraver activity in the West

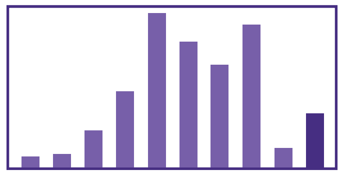
ACTIVITIES SUPPORTED BY FOREST HEALTH PROTECTION

BEECH LEAF DISEASE	SOUTHERN PINE BEETLE	EMERALD ASH BORER	RAPID ʻŌHIʻA DEATH	FIR ENGRAVER	SPONGY MOTH	WHITE PINE BLISTER RUST
Ongoing survey detection	Treatment of active infestations and thinning forests for prevention	Providing treatments, technical assistance, community response planning, and outreach	Detection survey, rapid response, sanitation, and resistance screening	Surveying, suppression, and developing management options	Eradication, suppression, and Slow the Spread Program	Surveying, resistance screening, and planting

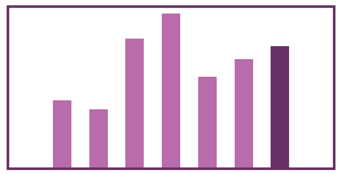
TREE MORTALITY SURVEY TRENDS 2013–2022



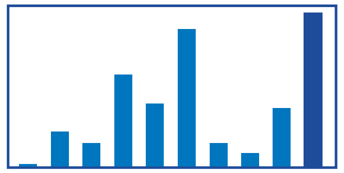
ALL TREE MORTALITY 8.4 MILLION ACRES IN 2022



FIR ENGRAVER 3.4 MILLION ACRES IN 2022

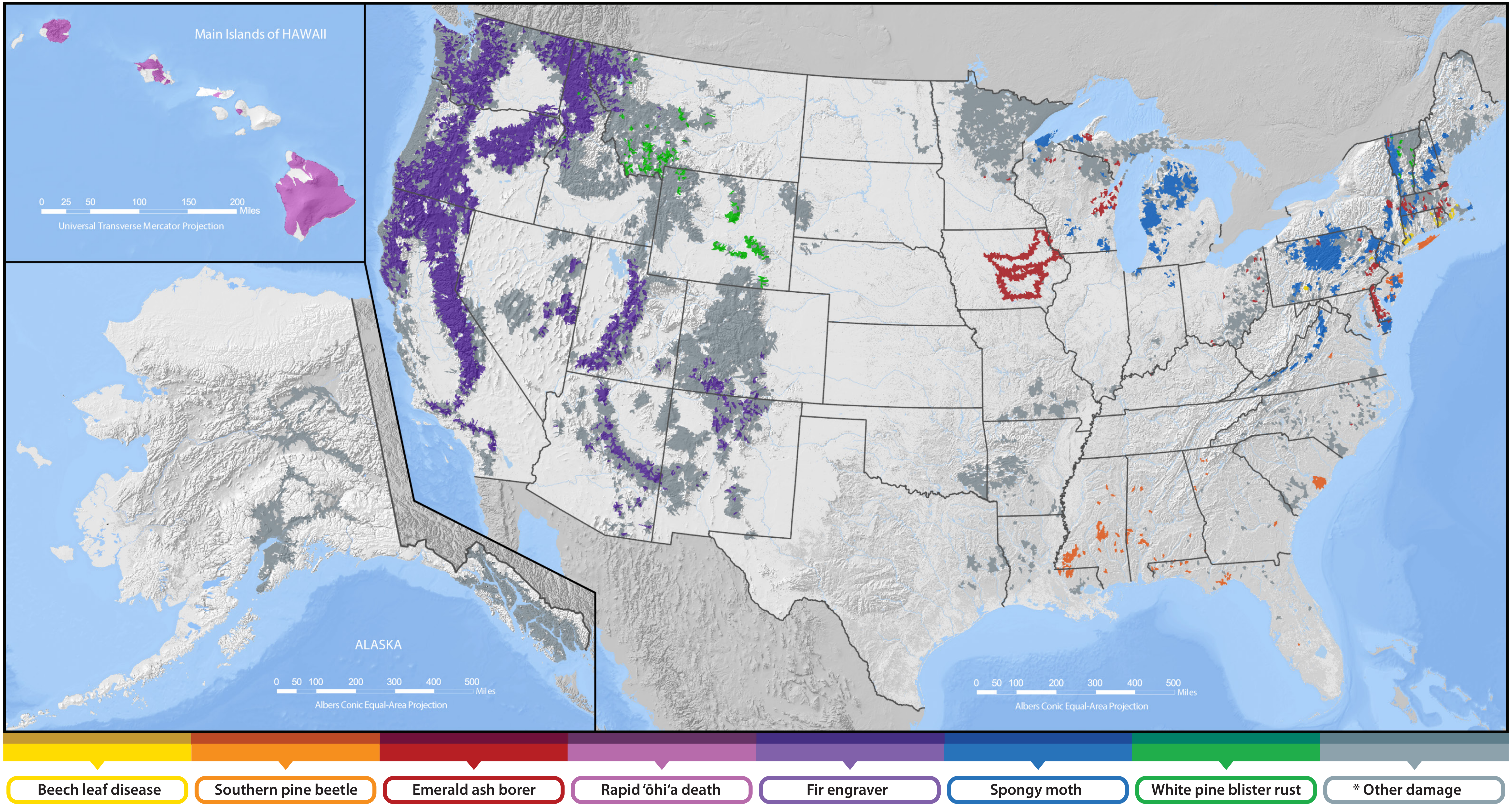


RAPID ʻŌHIʻA DEATH 93,000 ACRES IN 2022



SPONGY MOTH 1.7 M DEFOLIATION ACRES IN 2022

2022 INSECT AND DISEASE SURVEY—WATERSHEDS WITH TREE DAMAGE



*Includes damage from spruce budworm, western spruce budworm, western blackheaded budworm, spruce beetle and other western bark beetles, eastern larch beetle, browntail moth, forest tent caterpillar, and many other less significant pests.

FEATURE

Cogongrass

Imperata cylindrica

Cogongrass impacts fire regimes in the South.

Cogongrass forest infestation. Photo by Chris Evans, University of Illinois, Bugwood.org.

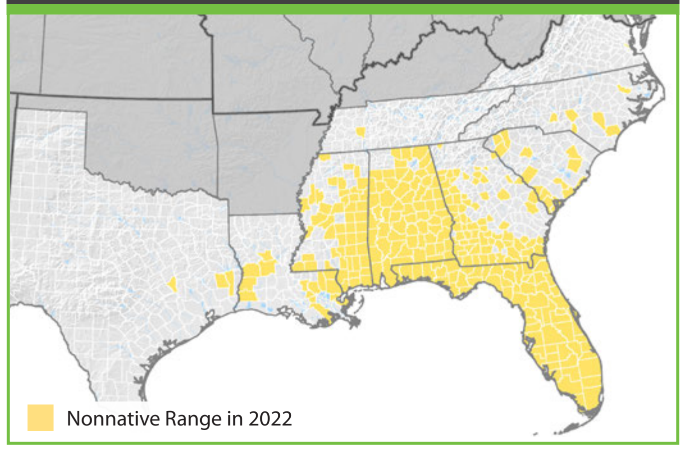
Invasive plants are a major threat to our Nation's forests and grasslands. Millions of acres across the United States are impacted by these invasive species, threatening the ecological integrity and biological diversity of our forests and causing significant negative economic impacts. The establishment and spread of invasive plants can displace native species and negatively impact soils, water, wildlife, recreation, forest productivity, and fire regimes.

Cogongrass is one of the world's worst invasive plants. First introduced in the early 1900s in Mobile, AL, cogongrass continues to spread. Cogongrass is native to southeast Asia and has become established throughout the Southeast in Texas, Louisiana, Mississippi, Alabama, Georgia, Florida, South Carolina, North Carolina, and Tennessee. Cogongrass suppresses other plants' growth, displaces native plants and animals, and can alter fire regimes causing more frequent and intense fires. Cogongrass thrives in disturbed areas, including pastures, fields, forests, and transportation and utility rights-of-way.

Mississippi, Alabama, and Florida are significantly impacted by cogongrass with over 1 million acres infested. In 2022, Georgia identified 152 new detections of cogongrass, bringing the total known infested area to nearly 500 acres across 73 counties. Additional reports of infestations were also made in South Carolina and North Carolina.

Acreages with extensive cogongrass infestations are economically and ecologically degraded. Where cogongrass is widespread, eradication efforts are continuous, arduous, and expensive. Preventing, detecting, monitoring, and managing invasive species and restoring ecosystems impacted by these organisms is an immense and continuous task that requires collective efforts from local, State, and Federal agencies in addition to community support.

INVASIVE PLANT RANGE



Cogongrass wildfire. Photo by Charles T. Bryson, USDA Agricultural Research Service, Bugwood.org.

EXOTIC

Rapid ʻŌhiʻa Death

Ceratocystis lukuohia and *Ceratocystis huliohia*

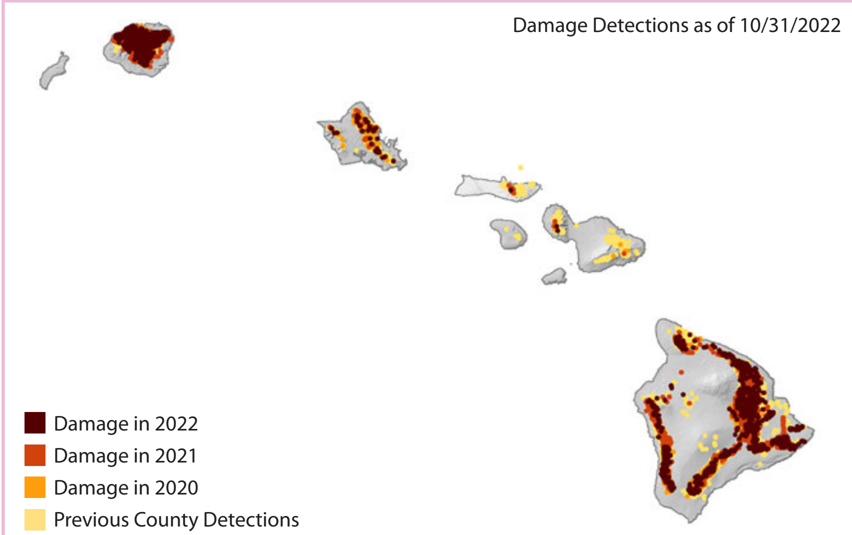
Tree mortality spreads on Hawaiʻi Island.

Defoliated ʻōhiʻa tree infected with *Ceratocystis huliohia*. Photo by J. B. Friday, University of Hawaiʻi.

ʻOhiʻa (*Metrosideros polymorpha*) is the most common tree species in Hawaii's native forests; it accounts for 50 percent of all forest trees in the State. Growing from sea-level to nearly 8,000 feet in elevation, ʻohiʻa' occurs in dry, mesic, and wet forests. ʻOhiʻa-dominated forests cover 865,000 acres statewide, with 618,000 acres occurring on Hawaiʻi Island.

In 2022, rapid ʻohiʻa death (ROD) continued to spread on Hawaiʻi Island, mostly filling in areas where only scattered mortality occurred. Surveys have determined that areas with invasive hoofed animals are experiencing higher incidence of ROD. On Kauai, both Ceratocystis species have been detected in multiple areas and managers on that island are responding with ROD containment strategies. Only *C. huliohia* has been detected on Oahu, while a single detection of *C. huliohia* on Maui was destroyed and no further detections have been made on the islands making up Maui Nui. Limited ROD detections on Oahu and Maui indicate that ROD response strategies are making a difference in protecting high-value forests.

FOREST DAMAGE AND RANGE*



*Annual insect and disease surveys are conducted by Forest Health Protection to detect forest pest damage and/or mortality when there are concerns about forest pest activity that can cause significant economic and environmental harm.

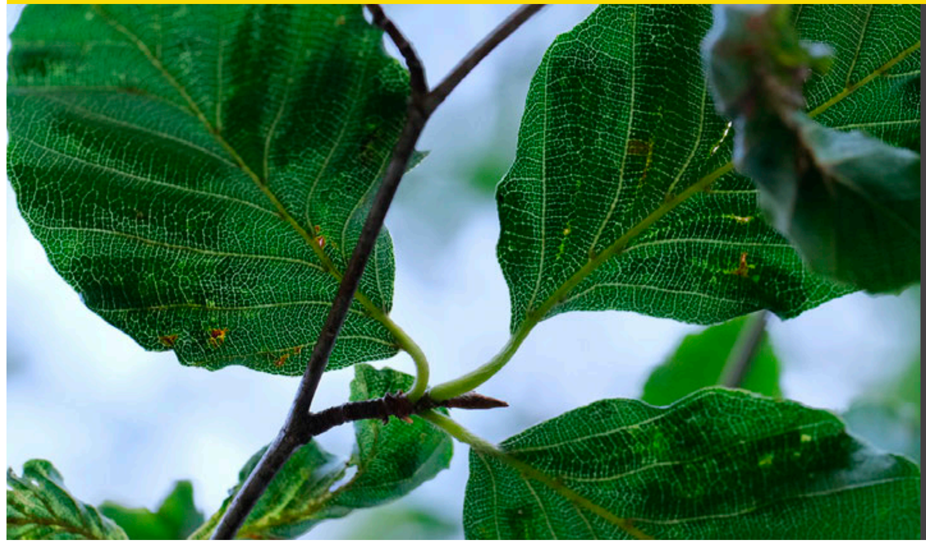
HOST: ʻŌHIʻA

- ★ **Tree mortality continues to spread** on Hawaiʻi Island
- ★ **Tree wounding** by invasive ungulates **increases ROD infections** in Hawaii

Typical staining caused by *Ceratocystis* sp. A in ʻōhiʻa. Photo by J. B. Friday, University of Hawaiʻi.

Beech Leaf Disease

Litylenchus crenatae mccannii



First detection in Michigan.

Dark interveinal bands indicating beech leaf disease infection. Photo by Matt Borden, Bartlett Tree Experts, Bugwood.org.

Beech leaf disease (BLD) continued to spread in the New England and mid-Atlantic States of Connecticut, Maine, Michigan, Massachusetts, Ohio, New Hampshire, New York, New Jersey, Pennsylvania, and Rhode Island.

Damage has been observed in both forest and landscape settings. The disease has also been confirmed to occur in nurseries.

Beech leaf disease has been documented since 2012 in areas of northern Ohio. In Connecticut and Massachusetts, BLD is confirmed in all counties. In Pennsylvania, 65 out of 67 counties had BLD positives in 2022. In New Jersey, two new counties reported the disease in 2022. The heaviest impacts of BLD occurred in the northeastern corner of the State. Beech leaf disease was first detected in St. Clair County, MI on private land in 2022 then subsequently in both Oakland and Wayne Counties. In Virginia, the disease has been identified in Fairfax County. Submitted samples to USDA's Animal and Plant Health Inspection Service (APHIS) confirmed *Litylenchus crenatae mccannii*, the nematode responsible for BLD.

Bands at various severity levels indicating beech leaf disease infection. Photo by Matt Borden, Bartlett Tree Experts, Bugwood.org.

Cupped, shriveled, and misshapen leaves associated with beech leaf disease infection. Photo by Matt Borden, Bartlett Tree Experts, Bugwood.org.

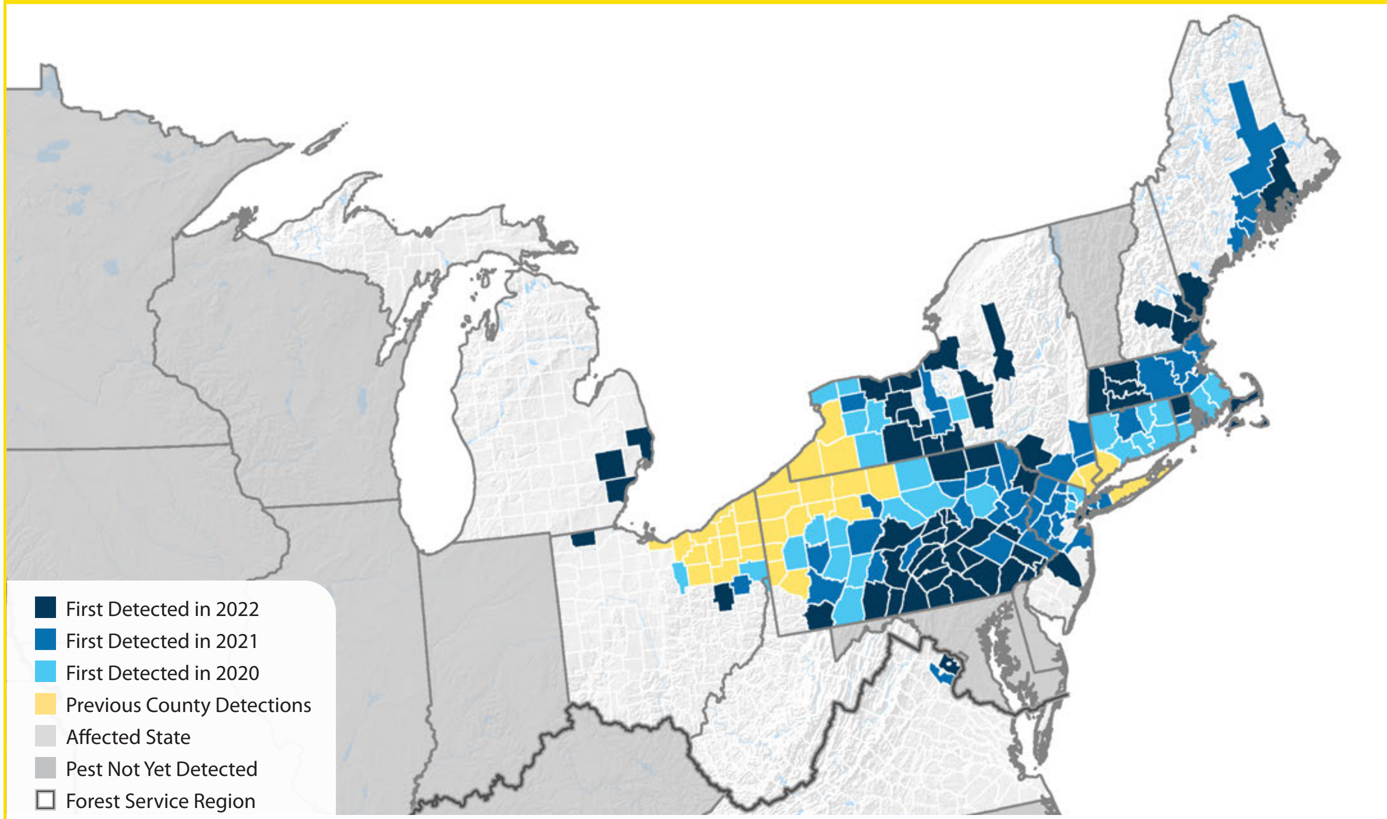
HOST: **BEECH**

- Michigan **confirms first occurrence**
- **Foliar symptoms observed** in forests and landscape trees in the Northeast

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

FOREST PEST DETECTIONS*

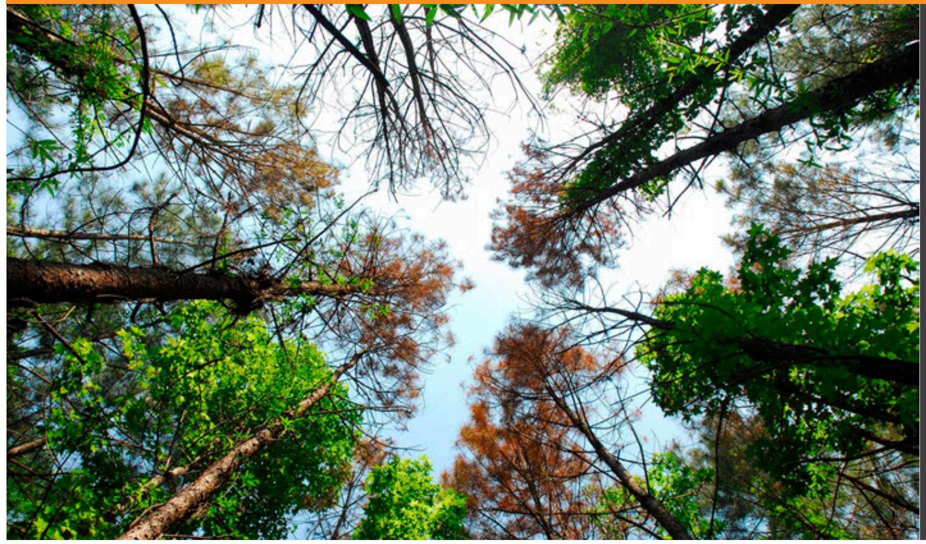
County Detections as of 10/31/2022



*Forest pest detections are recorded at the county level when pest presence is determined and may not be reflective of damage severity.

Southern Pine Beetle

Dendroctonus frontalis



Monitoring traps detect additional southern pine beetles in Maine.

Loblolly pine mortality caused by the southern pine beetle. Photo by Erich G. Vallery, USDA Forest Service, Bugwood.org.

In 2022, southern pine beetle (SPB) activity was observed on less than 14,000 acres. The SPB caused light mortality across Mississippi, Alabama, Georgia, South Carolina, and Florida with outbreak levels recorded on national forests in Mississippi and South Carolina.

Scattered infestations of the SPB occurred across the Southern States, including Mississippi and South Carolina and to a much lesser extent in Georgia, Alabama, North Carolina, and Virginia, on approximately 3,400 acres. Southern pine beetle activity was reported in "spots"—areas of beetle activity typically less than 1 acre—in Alabama, Florida, Georgia, Mississippi, North Carolina, and Virginia. The Homochitto National Forest and Bienville National Forest in Mississippi and the Francis Marion National Forest in South Carolina saw the heaviest tree mortality caused by the SPB.

In the New England and the mid-Atlantic States of Maryland, Pennsylvania, Delaware, Rhode Island, and New Hampshire, the only detections of SPB remained in traps, with a few exceptions. In Massachusetts, infested trees, two pitch pines, were detected for the first time. The SPB was reported in traps in Pennsylvania, New Hampshire, Rhode Island, and Maine. Pennsylvania State cooperators detected the SPB in a new county—Cumberland County—in 2022. Tree mortality or infestation was reported in New Jersey and New York.

In the mid-Atlantic, tree mortality caused by the SPB was generally low. Tree mortality was only observed within limited portions of the New Jersey Pine Barrens.

Aerial view of southern pine beetle infestation. Photo by Andrew J. Boone, South Carolina Forestry Commission, Bugwood.org.

Adult southern pine beetle on a pitch tube is evidence of an attack on the host. Photo by Erich G. Vallery, USDA Forest Service, Bugwood.org.

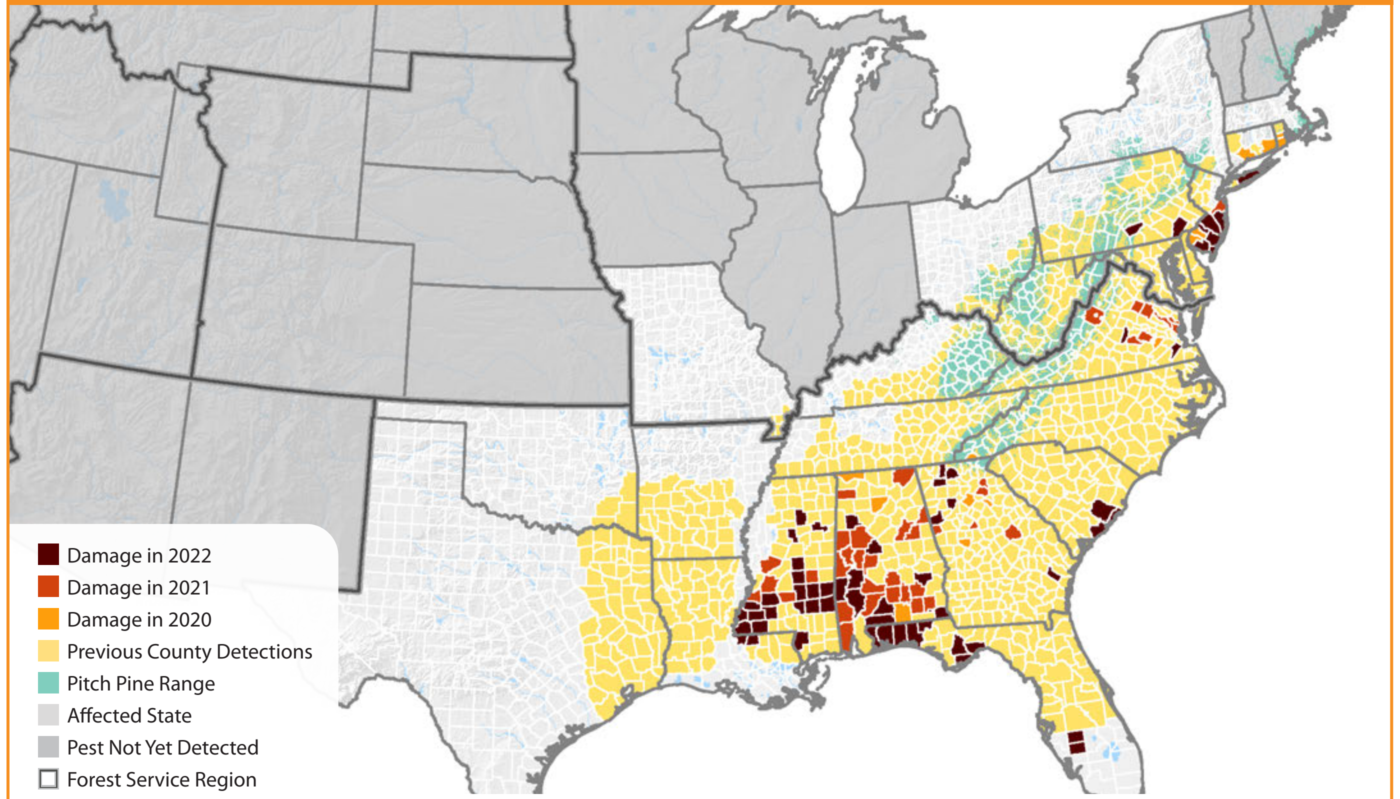
HOST: SOUTHERN PINES

- **Additional trap detections** in Maine after initial 2021 detection
- **Over 9,000 acres** with mortality **reported** in New York

Blue staining in a cut log is a symptom of southern pine beetle damage. Photo by Erich G. Vallery, USDA Forest Service, Bugwood.org.

FOREST DAMAGE AND RANGE*

County Detections as of 10/31/2022



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Emerald Ash Borer

Agrilus planipennis

Oregon identified emerald ash borer in June 2022.

Emerald ash borer adult. Photo by Dan West, Colorado State Forest Service.

The emerald ash borer (EAB) was detected in Oregon in 2022. The Oregon find represents the first detection in the Pacific Northwest and the first new State since 2018.

The EAB continued to spread to new counties within the 35 previously confirmed infested States with impact to urban and natural forests. Ongoing tree mortality and decline continues to have increased impacts on forests and their products and services. Throughout New England and the Eastern, mid-Atlantic, Central, and Southern States, tree decline and mortality caused by the EAB continued to impact urban and suburban communities and natural forest. Most States continued to identify additional impacted counties and communities. Mississippi, Florida, and Oklahoma remain uninfested. In the Great Plains and intermountain west the EAB continues to be active in Colorado, Kansas, Nebraska, and South Dakota.

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. Tree loss is a significant concern in newly impacted areas where ash resources are often concentrated in river corridors and in urban landscapes.

OREGON IN FOCUS

On June 30, 2022, the emerald ash borer was detected in 16 small ornamental ash trees at an elementary school in Forest Grove, Washington County, OR. Additional infested trees were identified in nearby parks, street plantings, and private properties. Some of the infested trees were adjacent to native riparian forests and conservation plantings of Oregon ash, *Fraxinus latifolia*, an ash species native to the Western United States. Oregon ash occupies an important riparian niche providing shade, leaf and mast inputs, and bank stabilization to riparian habitats occupied by endangered fish and plants.

The Oregon Emerald Ash Borer Readiness and Response Plan, prepared in 2018, was quickly implemented. The Oregon Department of Agriculture was declared the lead agency. An EAB Task Force, with approximately 40 members and subcommittees on communication, training, surveys and monitoring, integrated pest management, wood waste and wood utilization, research, and funding, was established and meets monthly.

The public was encouraged to report suspected infested ash trees through the Oregon Invasive Species Council's "Report an Invader" application and phone number. Trained agency staff documented their visual surveys through a standardized electronic data sheet and dashboard. By the end of 2022 approximately 58 infested trees had been confirmed with approximately 120 suspected trees nearby. The infested trees all occupy approximately a 6-mile-diameter area from the initial detection. Washington County was quarantined in December 2022.

In addition to the use of biocontrol agents, a treatment strategy known as "Slow Ash Mortality" (or SLAM) is being implemented in the Forest Grove area. Slowing ash mortality builds time to support survey efforts and make management decisions for ash in private, community, and forest landscapes. A priority for research is to investigate potential replacement species for Oregon ash. Seeds from Oregon ash have also been collected for safe storage, resistance testing, and future restoration efforts.

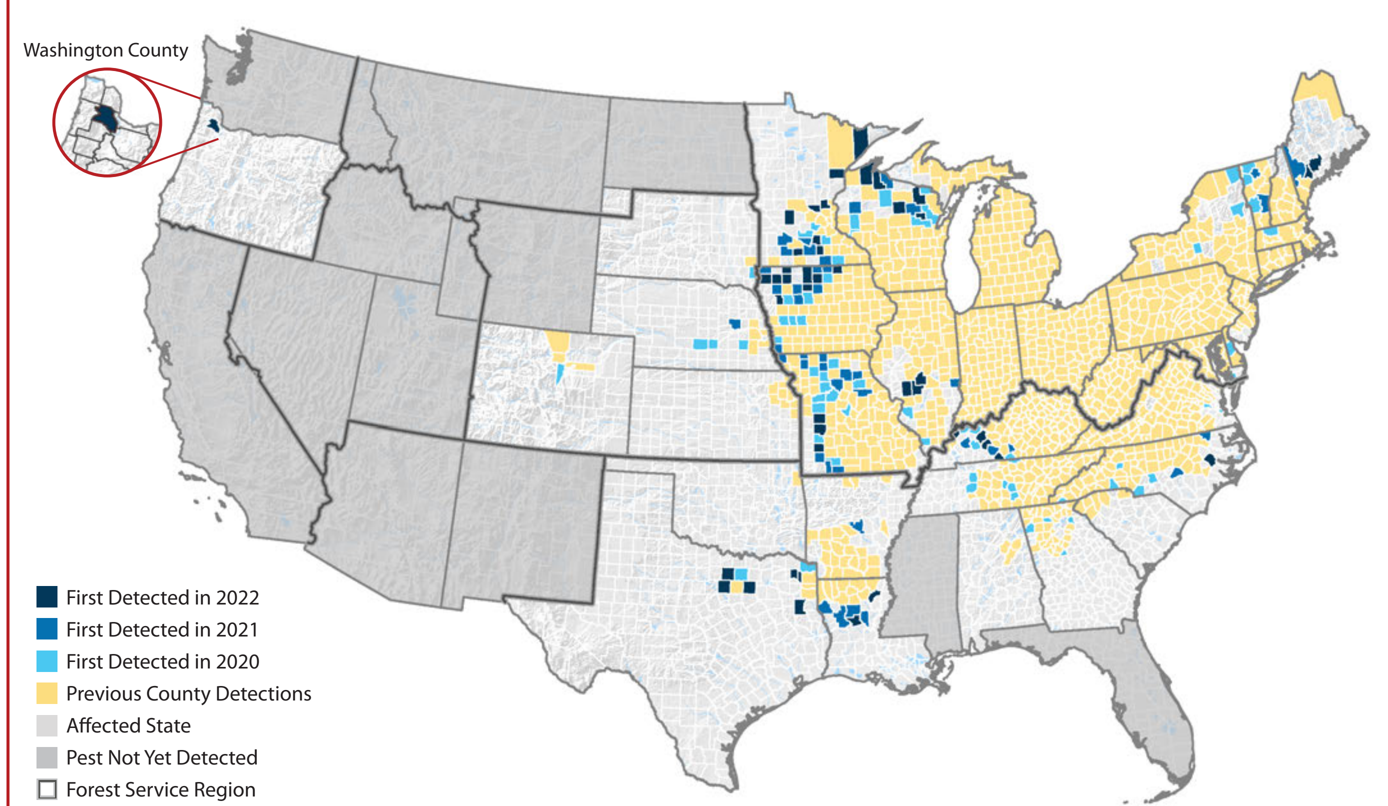
HOST: **ASH**

- ★ **First new State detection** since 2018 occurred in Oregon
- ★ **Ash mortality continues** in impacted States

Emerald ash borer galleries. Photo by David Cappaert, Bugwood.org.

FOREST PEST DETECTIONS*

County Detections as of 10/31/2022



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Fir Engraver

Scolytus ventralis

Significant tree mortality in all species of true fir.

Aerial view of white fir tree mortality caused by the fir engraver. Photo by William M. Ciesla, Forest Health Management International, Bugwood.org.

Ongoing drought and extreme summer temperatures continued to impact western fir forests. Tree mortality caused by the fir engraver continued throughout the Western United States in 2022.

Mortality in fir forests caused by the fir engraver was reported on nearly 3.4 million acres.

In the Southwest, fir mortality was attributed to the fir engraver in Arizona and New Mexico. Arizona observed mortality on 43,000 acres of fir predominately on the Kaibab National Forest with additional mortality on the Coconino National Forest, Coronado National Forest, Grand Canyon National Park, and White Mountain Apache Tribal lands. New Mexico reported almost 7,000 acres, double that observed in 2021, of fir mortality on the Cibola National Forest and Santa Fe National Forest.

In the Pacific Northwest, tree mortality caused by the fir engraver continued, particularly in overstocked stands of fir on drought-prone sites and in trees infected with root disease. In Oregon, over a million acres with damage was reported by aerial detection surveys. This level of tree injury has not been recorded in over 75 years of aerial detection in Oregon. Many forests impacted by the fir engraver are also being impacted by chronic hot droughts, root disease, and balsam woolly adelgid. Mortality caused by the fir engraver is widespread in Washington throughout the Cascades.

In California, fir mortality attributed to the fir engraver beetle comprised over 77 percent of the total tree mortality observed in 2022. The State recorded approximately 28.1 million dead firs across almost 2 million acres. Red fir mortality was most intense and widespread throughout the central Sierra Nevada Range. Mortality from fir engraver was most severe where red fir occurs in mature, fir-dominated stands at high elevations. White fir mortality was widespread but less severe in mixed conifer stands. Grand fir mortality was light to moderate throughout its range in northwestern California.

Surveyors continued to detect the fir engraver across Idaho, Montana, Nevada, and Utah. In Utah, 30,000 acres of fir mortality were attributed to the fir engraver. Significant fir mortality was observed around Lake Tahoe. The fir engraver beetle continues to impact white fir in southern Colorado. Aerial surveys detected 4,600 acres of fir mortality, most notably around the town of Ouray and north of Durango where the 416 Fire burned in 2018.

Grand fir mortality caused by the fir engraver. Photo by Dave Powell, USDA Forest Service, Bugwood.org.

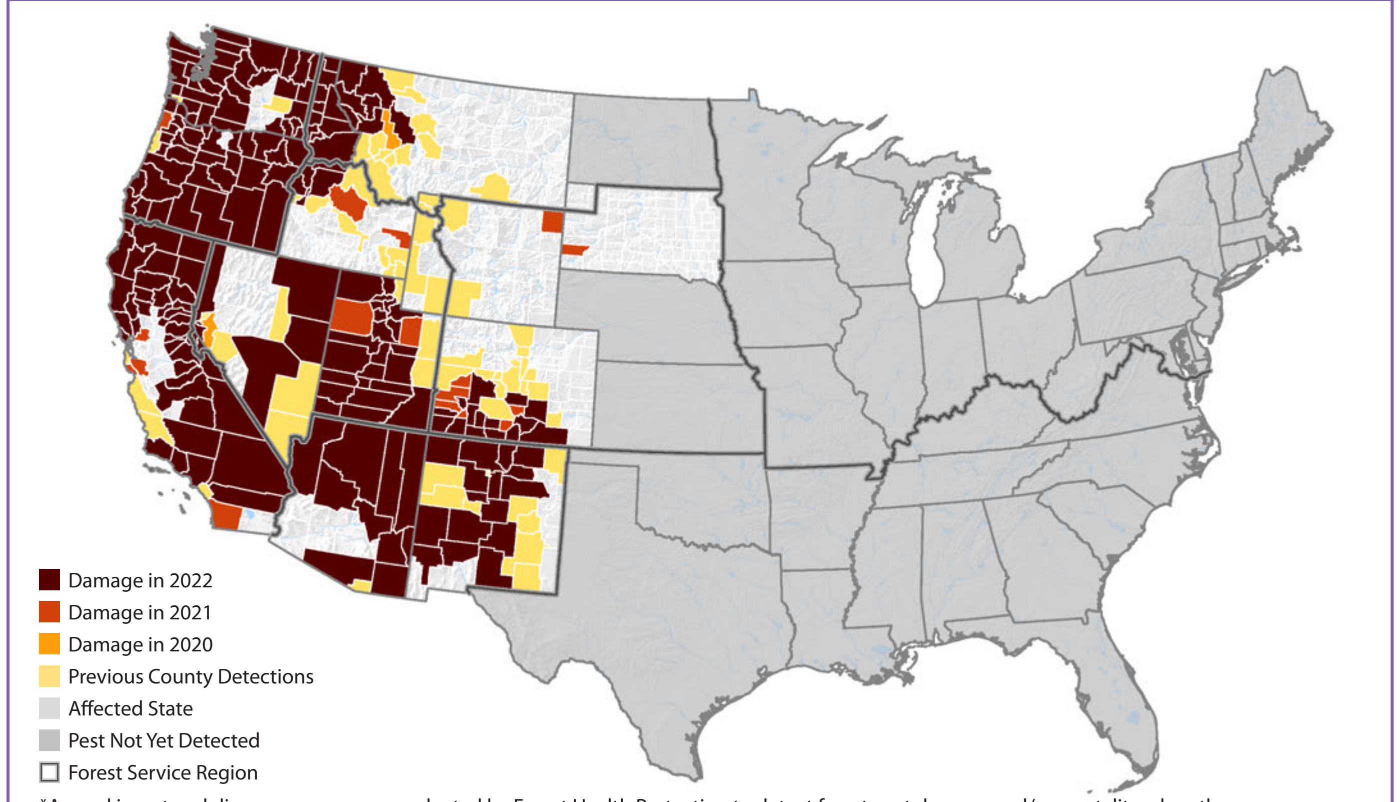
HOST: WESTERN FIRS

- **Mortality attributed** to fir engraver on **nearly 3.4 million acres**
- **Drought conditions continue** to promote fir engraver activity in the West

Fir engraver beetle adult. Photo by Dan West, Colorado State Forest Service.

FOREST DAMAGE AND RANGE*

County Detections as of 10/31/2022



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Spongy Moth

Lymantria dispar dispar

Significant reduction of defoliation in 2021.

Spongy moth larva(e). Photo by Karla Salp, Washington State Department of Agriculture, Bugwood.org.

Defoliation caused by the spongy moth decreased to 1.8 million acres nationally from 2.5 million acres in 2021. Spongy moth activity declined significantly in Michigan to approximately 370,000 acres compared to nearly 1.3 million acres in 2021.

Defoliation by the spongy moth increased dramatically in Pennsylvania.

In New York, the population of the spongy moth largely collapsed in 2022 and considerably less damage was observed. Localized pockets of severe defoliation occurred mainly in Schenectady, Saratoga, and Warren Counties. The presence of Nucleopolyhedrosis virus (NPV) and *Entomophaga maimaiga* was high resulting in high caterpillar mortality, effectively ending the outbreak that began in 2020.

The spongy moth caused areas of severe defoliation in western Massachusetts where more than 30,000 acres with defoliation were detected. Vermont reported the second year of a spongy moth outbreak affecting 43,000 acres, predominately in oak forests in western Vermont. Connecticut reported more than 76,000 acres with defoliation in the western part of the State. No defoliation was observed in Rhode Island.

In Maine, the second year of the spongy moth outbreak resulted in approximately 55,000 acres with defoliation statewide. Surveyors reported extensive damage in southern Oxford County accounting for almost all the spongy moth activity in Maine. Damage was also reported in smaller pockets across the State. An additional 52,000 acres with defoliation was reported across the border in New Hampshire.

The mid-Atlantic States of Delaware, West Virginia, and Ohio reported limited to no defoliation by the spongy moth. Pennsylvania and New Jersey reported high levels of the spongy moth activity with many large areas of severe defoliation. The nearly 900,000 acres of spongy moth defoliation reported in Pennsylvania is almost three times more than reporting in 2021. In New Jersey, the spongy moth defoliated more than 15,000 acres, mostly in the southern part of the State. Maryland reported 20,000 acres with defoliation in the southeastern part of the State.

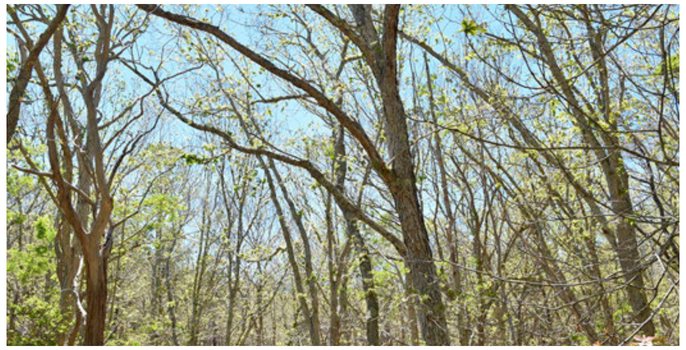
The Central States of Iowa, Illinois, Missouri, and Minnesota did not report any tree damage from the spongy moth. Less than 2,000 acres with defoliation were reported from Indiana. In Wisconsin, the spongy moth impacted over 117,000 acres—an increase over 2021. Spongy moth populations collapsed in the northern Lower Peninsula of Michigan following a record defoliation event in 2021.

In the South, about 25,000 acres with defoliation by the spongy moth was reported in Virginia along the spine of the Appalachians, the Blue Ridge Mountains, and Shenandoah National Park. The spongy moth continued to be collected in traps in other Southern States.

Across the Western United States, the Forest Service conducted pheromone-based male spongy moth trapping surveys in coordinated efforts with USDA's Animal and Plant Health Inspection Service (APHIS) and State and Tribal agriculture departments. Annual monitoring and detection traps were negative in the Western States with three exceptions—Washington, Oregon, and Montana. Delimiting trappings in response to detections in Western States conducted in response to positive catches in previous years were negative in 2022.

HOST: **HARDWOODS**

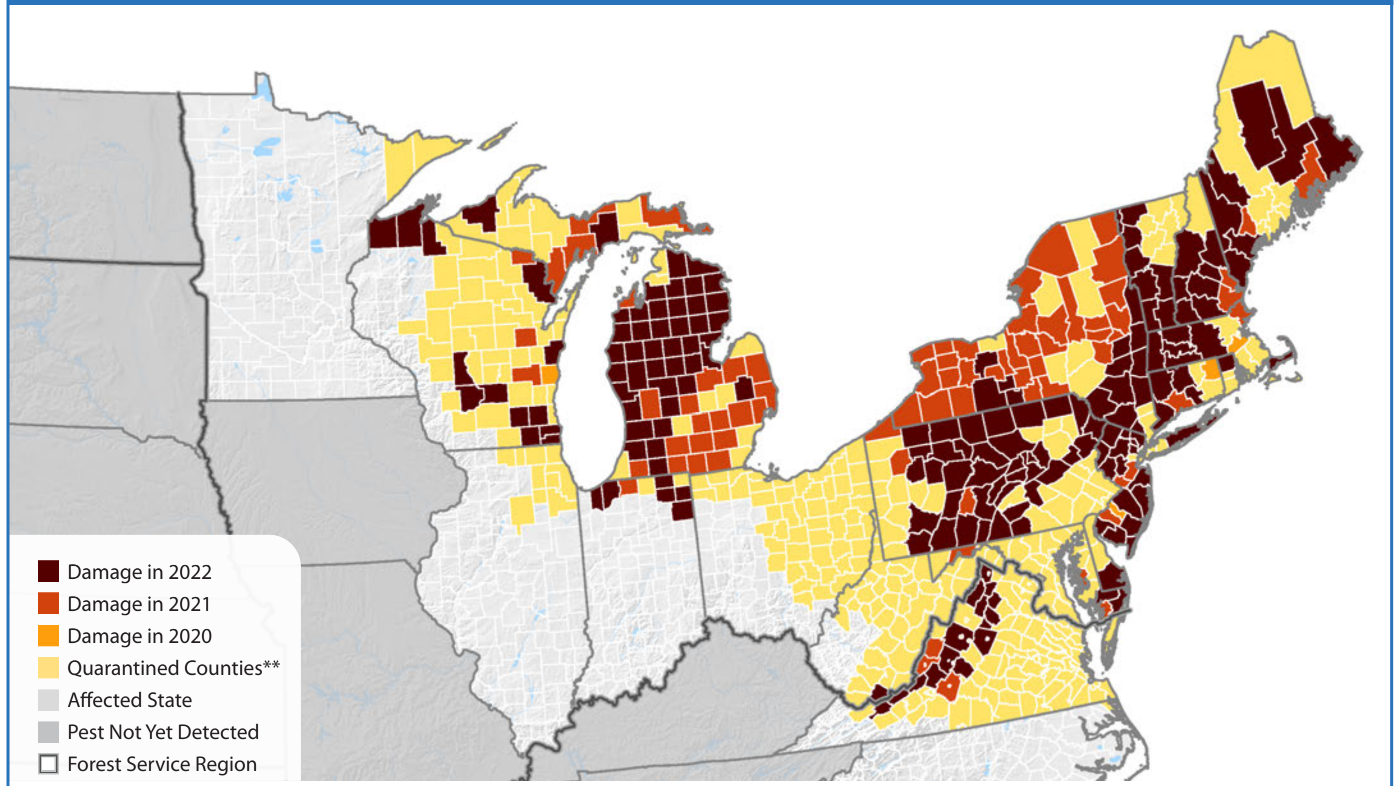
- **Reduced defoliation reported** across States heavily impacted in 2021
- **1.7 million acres with defoliation reported** predominately in MI and PA



Oak and white pine damage from the spongy moth. Photo by Karla Salp, Washington State Department of Agriculture, Bugwood.org.

FOREST DAMAGE AND RANGE*

County Detections as of 10/31/2022



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**Federal Quarantine Area – Animal and Plant Health Inspection Service.

White Pine Blister Rust

Cronartium ribicola

Whitebark pine, a host species, is listed as a threatened species.

Extensive whitebark pine mortality caused by white pine blister rust. Photo by Christy Cleaver, USDA Forest Service.

In December, the U.S. Department of the Interior's Fish and Wildlife Service listed whitebark pine, which occurs in high-elevation areas across the West, as threatened under the Endangered Species Act. The Species Status Assessment Report concluded that the primary damage agent affecting the conservation status of whitebark pine is the nonnative fungal disease white pine blister rust (WPBR). Additional threats to whitebark pine, including mountain pine beetle, wildfire, and climate change, have resulted in more than 50 percent mortality of whitebark pine across its range.

White pine blister rust, caused by *Cronartium ribicola*, causes cankers on stems, limbs, and branches of all North American white pines, including limber, whitebark, bristlecone, southwestern white, western white, and eastern white. It can be observed on all ages of host trees from seedlings and saplings to mature trees. Even at low infection rates, branch cankers tend to kill cone-bearing branches, reducing the seed source for regeneration.

Disease occurrence in whitebark pine includes approximately 500,000 acres above 5,000 feet on the high mountain tops in Idaho and Montana, from the Canadian border south to Glacier and Yellowstone National Parks. In the West, WPBR is most frequently found on whitebark and limber pines. Infected western white pine and sugar pine were found only along the California-Nevada border.

In Wyoming, field observations in 2021 and 2022 indicated evidence that a localized "wave-year" event had occurred. A "wave-year" is a marked by multiple periods of high relative humidity in the summer and fall leading to increased WPBR infections detected as stem and branch cankers.

Bright red, recently killed (flagged) branches on limber pine. Photo by Christy Cleaver, USDA Forest Service.

In Washington and Oregon, WBPR is found throughout the historic range of western white pine in the Olympic, Gifford Pinchot, Mt. Hood, and Willamette National Forests. Whitebark pine forests in the same national forests are also affected. Sugar pine is impacted in southwest Oregon.

In New Mexico, WPBR infections were found around Hillsboro Peak on the Black Range of Gila National Forest in Sierra County. This 2022 detection is the first detection of WPBR in this mountain range and county. The infestation in the Sacramento and White Mountains of southern New Mexico is advanced and causing widespread crown dieback and mortality.

In the East, WPBR remains a significant threat to eastern white pine regeneration and sapling-sized trees and stands throughout the State of Maine wherever white pine and its alternate hosts coexist. In Vermont, mortality of eastern white pine caused by WPBR was mapped by aerial survey throughout the State.

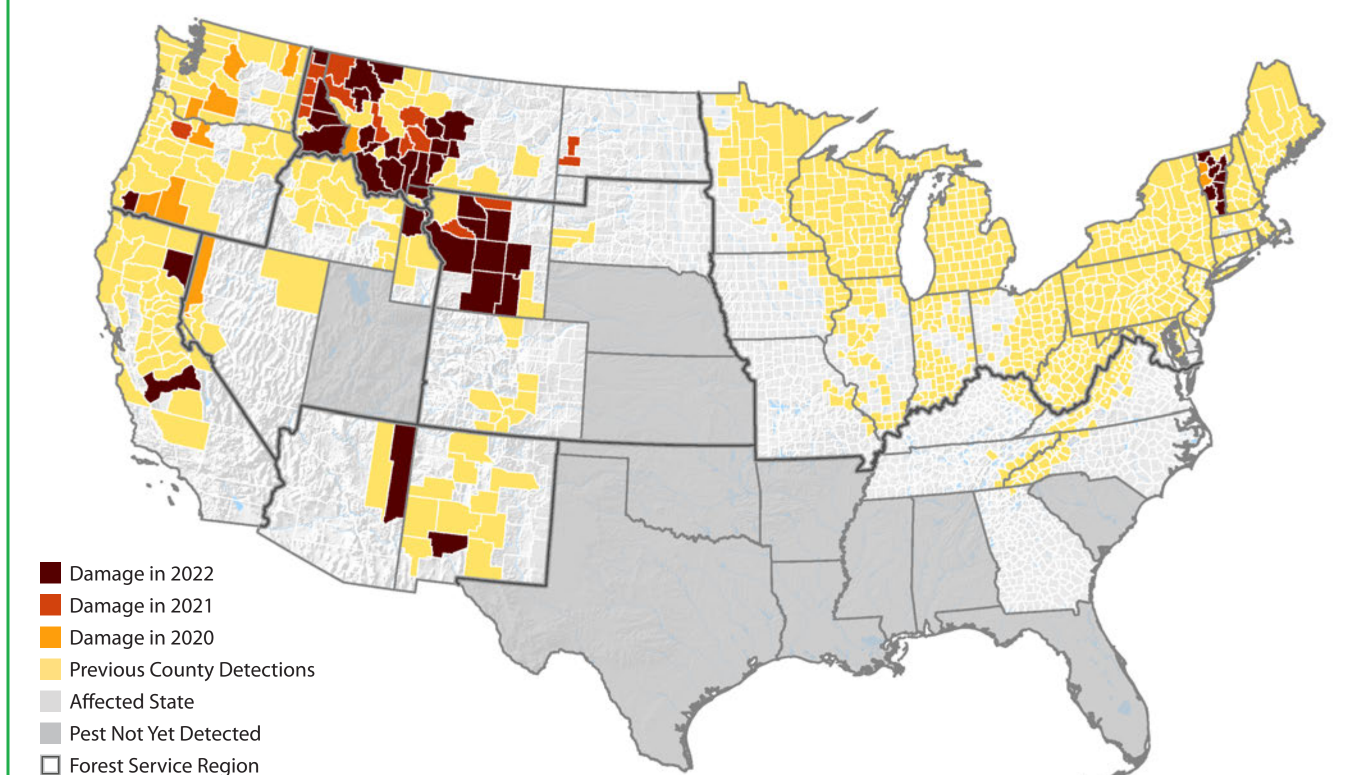
HOST: **FIVE-NEEDLE PINES**

- Whitebark pine was **designated as threatened under the Endangered Species Act**
- **Whitebark pine mortality is extensive** in high-elevation forests in the Western United States

Orange spores are produced within canker blisters on white pine branch. Photo by USDA Forest Service.

FOREST DAMAGE AND RANGE*

County Detections as of 10/31/2022



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Hemlock Woolly Adelgid

Adelges tsugae

An invasive threat to eastern and Carolina hemlocks.

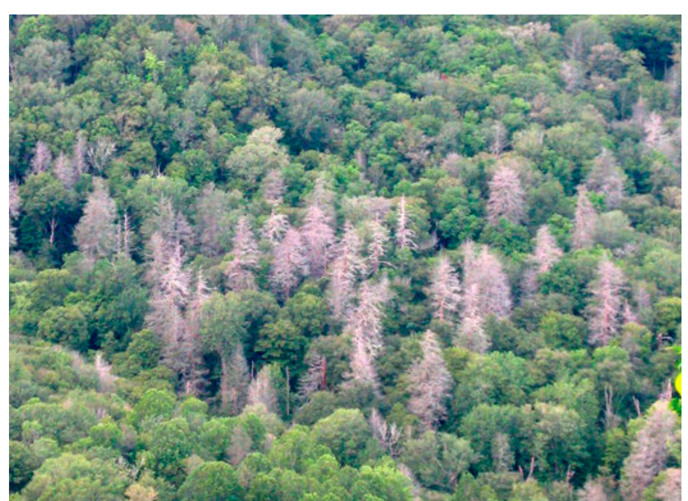
Immature hemlock woolly adelgid crawler emerging from egg mass. Photo by Lorraine Graney, Bartlett Tree Experts, Bugwood.org.

The hemlock woolly adelgid (HWA) is a cryptic species with at least 10 distinct genetic lineages, 2 of which are considered established in the continental United States. In western North America, the linage is considered native and does not cause significant damage to western hemlocks. In the Eastern United States, a different linage established from Japan is considered invasive and causes high levels of mortality to eastern hemlocks. Introduced in 1951, the HWA can now be found throughout the range of hemlock in North America. In 2022, the HWA was observed causing damage on hemlock across nearly 6,000 acres in the East.

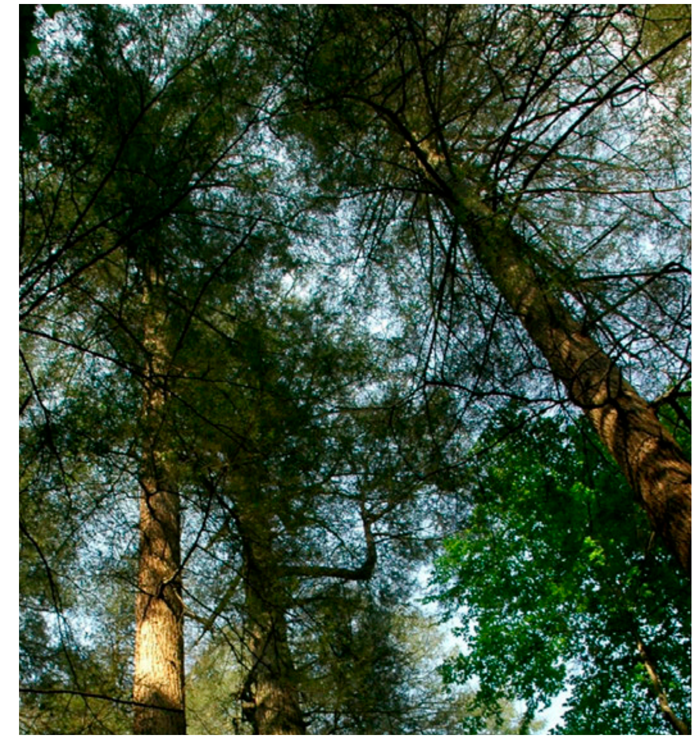
In the mid-Atlantic, HWA is found wherever hemlock occurs in Ohio, Pennsylvania, West Virginia, Maryland, and New Jersey. Several States reported additional counties with the HWA. In Maryland, 85 percent of the hemlock is located in the westernmost two counties and those stands have persistent HWA. In New Jersey, almost all the native hemlock in forests, isolated in the northwest, has been infested with the HWA. Hemlock woolly adelgid is also observed throughout the State on ornamental hemlock. Michigan and Indiana have observed areas of the HWA.

In the Northeast, the HWA is found in Connecticut, Massachusetts, New York, New Hampshire, Rhode Island, and Maine. Throughout this area the HWA is persistent and caused varying levels of decline and mortality on eastern and ornamental hemlocks. Maine identified HWA in several new areas including near Acadia National Park in 2022.

In the South, HWA is found in Alabama, Georgia, Kentucky, North Carolina, South Carolina, Tennessee, and Virginia. In Georgia and Kentucky, the HWA is found across the entire range of hemlock. In South Carolina, the HWA threatens eastern and Carolina hemlock, a small but important long-lived mountain tree species.



Hemlock tree mortality caused by the hemlock woolly adelgid. Photo by USDA Forest Service.



Tree decline and mortality caused by the hemlock woolly adelgid. Photo by William M. Ciesla, Forest Health Management International, Bugwood.org.

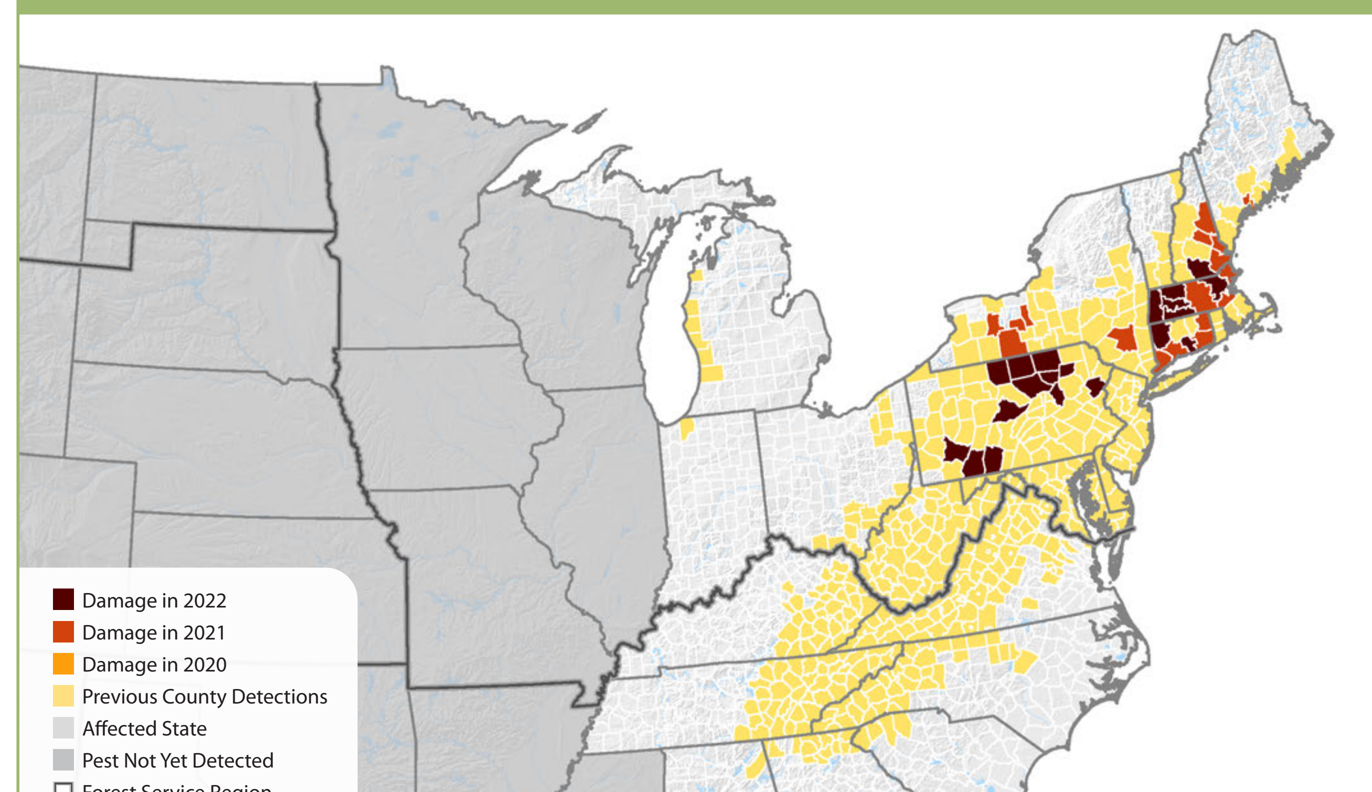
HOST: **HEMLOCKS**

- ★ **Mortality occurs** on eastern and ornamental hemlocks
- ★ **Reported throughout the range** of hemlock

Immobile, white woolly masses at the base of needles on the underside of hemlock twig. Photo by Bruce Watt, University of Maine, Bugwood.org.

FOREST DAMAGE AND RANGE*

County Detections as of 10/31/2022



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Oak Wilt

Bretziella fagacearum

An aggressive wilt disease of oaks.

View of actively wilting oak tree branches caused by the oak wilt disease. Photo by Steven Katovich, Bugwood.org.

Oak wilt is an aggressive tree disease that impacts oaks. Oak wilt affects both red and white oak species killing oaks in forests, woodlots, and community landscapes throughout New England and the 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 was widely distributed over Pennsylvania, Ohio, Maryland, and West Virginia in 2022. In New York, two new sites were detected in Ontario and Yates Counties. In West Virginia, 52 of 55 counties have reported active oak wilt. In Pennsylvania, 34 out of 67 counties have confirmed oak wilt. In Ohio, oak wilt infections were identified in several areas with many confirmed pockets of infection in northwestern and east-central Ohio. In Indiana, 66 of 92 counties have confirmed occurrence of oak wilt. Most counties without oak wilt are in the east-central part of the State, which is predominately agriculture fields with limited woodlots and forest areas.

In Michigan, oak wilt continued to increase within the oak resource in the Upper and Lower Peninsulas. In Minnesota, no new counties were identified. In Missouri, one positive result for oak wilt was reported in Henry County. In Wisconsin, oak wilt continues to cause pockets of mortality. Oak wilt was also found co-infecting bur oak with bur oak blight.

Red oak mortality caused by oak wilt. Photo by Joseph O'Brien, USDA Forest Service, Bugwood.org.

Leaf discoloration and wilting is a symptom of the oak wilt disease. Photo by Ryan Armbrust, Kansas Forest Service, Bugwood.org.

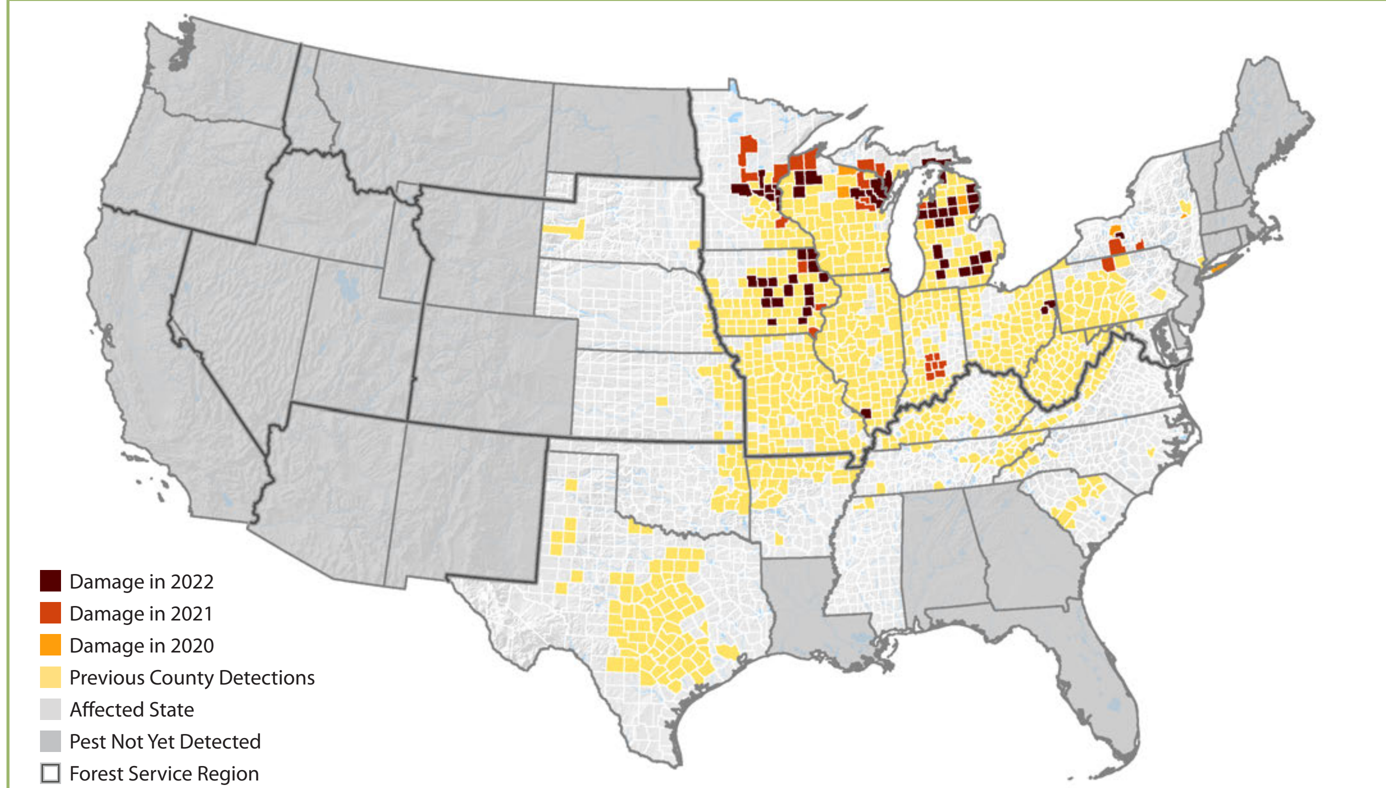
HOST: **OAK**

- An **aggressive tree disease** of red oak species
- **Actively spreading among oaks** damaged or trimmed during April, May, or June each year

Oak leaves with veinal necrosis. Photo by Ronald F. Billings, Texas A&M Forest Service, Bugwood.org.

FOREST DAMAGE AND RANGE*

County Detections as of 10/31/2022



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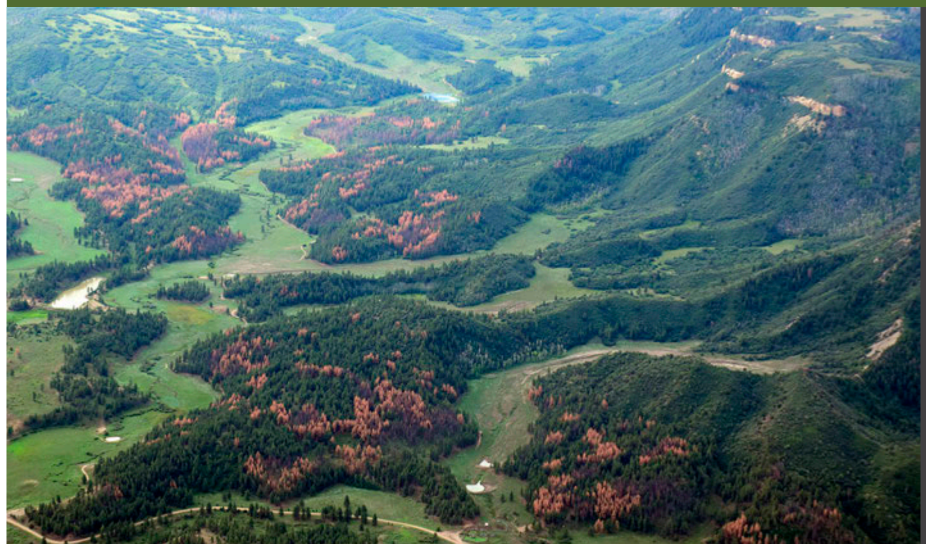
Roundheaded Pine Beetle

Dendroctonus adjunctus



Aerial view of tree mortality caused by the roundheaded pine beetle. Photo by Justin Backsen, USDA Forest Service.

Bark beetle complexes contribute to mortality in southwestern Colorado.

When multiple insects, diseases, and abiotic factors combine within a forest ecosystem, the resulting changes and tree mortality can be dramatic.

In 2022, the roundheaded pine beetle (RHPB), in conjunction with other bark beetles, caused approximately 4,500 acres with mortality across the area locally known as "the glade." Beetle expansion has moved north towards the edge of the ponderosa forest on the Dolores Plateau. Fall ground surveys conducted indicate that the RHPB population continues to expand, usually in small pockets that grow significantly every year. Additional detections of the RHPB were also confirmed on the Uncompahgre National Forest.

The RHPB is a native insect that attacks ponderosa pine. An epidemic, or outbreak, of primarily RHPB began on the San Juan National Forest, CO, in 2014. The RHPB is often observed in conjunction with other native species of bark beetles, creating a bark beetle "complex" that kills trees and can complicate forest management. The RHPB was co-occurring in ponderosa pine stands with western pine beetle, mountain pine beetle, and engraver beetles. Compared to other beetles in the complex, RHPB attacks trees later in the year, resulting in trees being under attack by beetles for much of their growing season. Warmer than average temperatures combined with extreme to severe drought conditions in southwest Colorado over the last several years likely contributed to increased tree mortality caused by this bark beetle complex.

Tree mortality caused by the roundheaded pine beetle. Photo by Suzanne Marchetti, USDA Forest Service.

Tree mortality caused by the roundheaded pine beetle. Photo by John Nelson, USDA Forest Service.

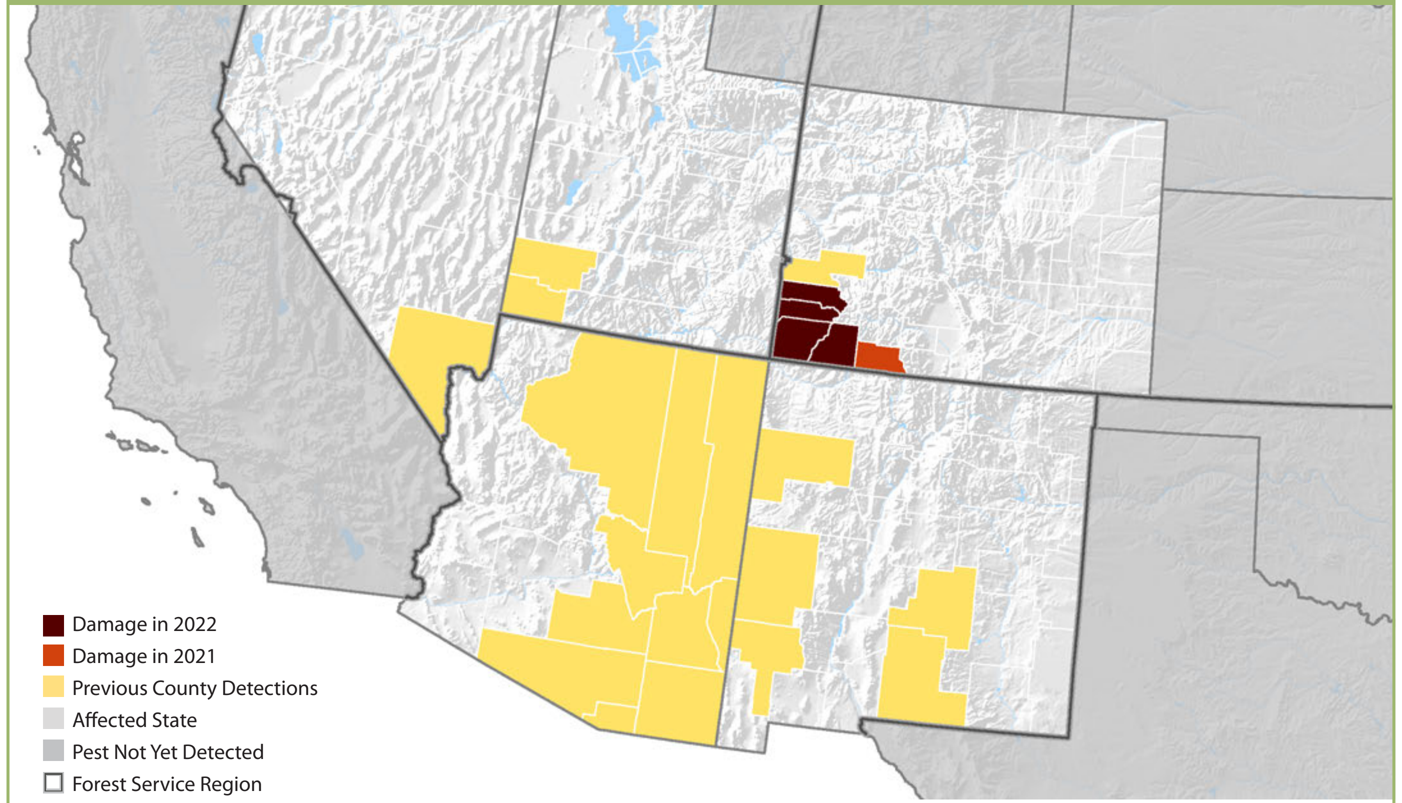
HOST: PONDEROSA PINE

- ★ **Beetles attack host trees** in the fall
- ★ Over **4,500 acres of mortality** in southwest Colorado

An adult roundheaded pine beetle on a pitch tube is evidence of an attack on the host. Photo by Suzanne Marchetti, USDA Forest Service.

FOREST DAMAGE AND RANGE*

County Detections as of 10/31/2022



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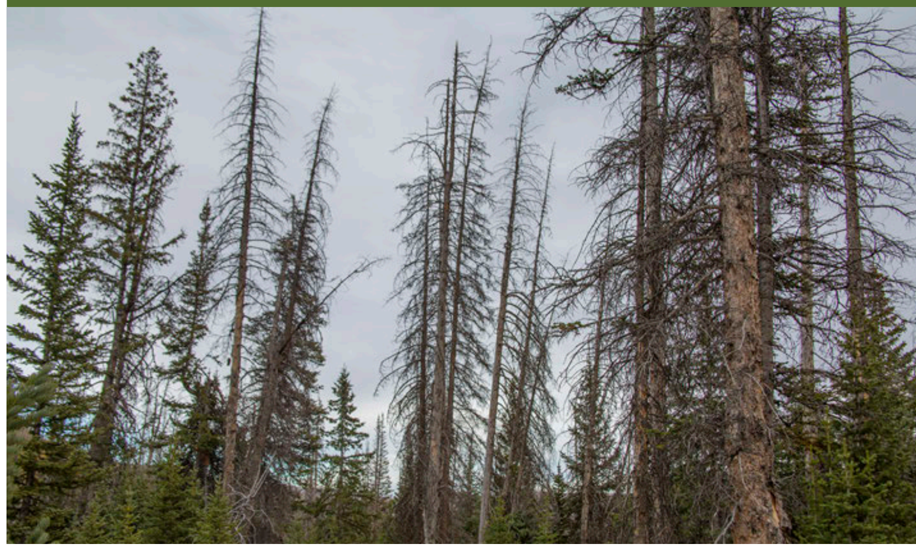
Spruce Beetle

Dendroctonus rufipennis



Cumulative tree mortality impacts high-elevation forests across range of spruce.

Engelmann spruce mortality caused by the spruce beetle. Photo by USDA Forest Service.

The spruce beetle continued to cause tree mortality across the range of spruce in the Western United States from Mew Mexico to Alaska. Several areas reported reduced tree mortality in 2022 where mature spruce have been depleted from the landscape.

In Alaska, spruce beetle activity was observed on roughly 48,800 acres. This is the least spruce beetle activity mapped annually since 2015. Nearly all spruce beetle activity mapped was in south-central Alaska, where the ongoing spruce beetle outbreak is now estimated to be in its seventh year. The outbreak has affected nearly 1.9 million cumulative acres since 2016. Activity has declined greatly in areas that were impacted most severely early in the outbreak. Tree mortality caused by the spruce beetle was observed in all or portions of the Denali, Matanuska-Susitna, and Kenai Boroughs, as well as the Municipality of Anchorage. Ground observations have also confirmed mortality of black spruce caused by the spruce beetle.

Almost 1,900 acres of black spruce mortality were attributed to spruce beetles in 2022.

In the interior west, surveys indicated that tree mortality caused by spruce beetles remained present but was decreasing, with approximately 29,000 acres reported. In Wyoming, about 14,000 acres of mapped spruce beetle area occurred on the Bridger-Teton National Forest. The Shoshone National Forest continued to experience high levels of spruce mortality, and activity in Utah continued on the Ashley National Forest and Uinta-Wasatch-Cache National Forest. Tree mortality caused by the spruce beetle is expected to decrease as suitable host material is exhausted in the Uinta Mountains. In Montana and northern Idaho, tree mortality from spruce beetles was very low at less than 250 acres reported.

In Colorado, tree mortality caused by spruce beetles continued to expand where there are suitable hosts, particularly in the San Juan National Forest, Gunnison National Forest, San Isabel National Forest, Arapahoe and Roosevelt National Forests, and Rocky Mountain National Park. Overall acres reported declined in 2022 to less than 30,000 acres. There are now many large areas with ongoing spruce beetle activity that have little mature spruce remaining.

Bark removal reveals an adult spruce beetle among packed frass. Photo by Steve Swenson, USDA Forest Service.

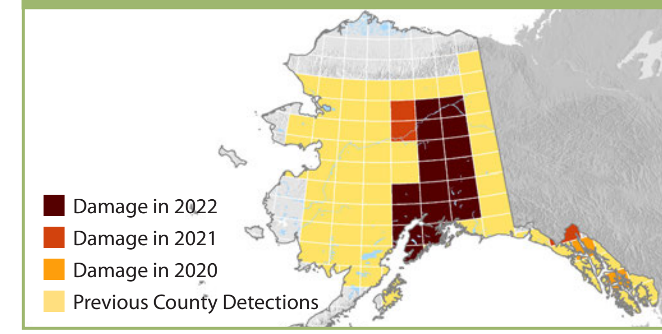
In South Dakota, small groups of the spruce beetle are scattered in the northern Bighorns in the Burgess Junction area. The Crater Ridge Fire that burned in the summer of 2021 in the northwest Bighorn National Forest resulted in standing, partially scorched Engelmann spruce that were attacked by the spruce beetle.

In Arizona, spruce beetle activity was limited and predominately observed on the Kaibab National Forest. In New Mexico, the spruce beetle outbreak continued to kill Engelmann spruce in spruce-fir forests primarily on the Carson National Forest and the Santa Fe National Forest and adjacent lands. Some stands that have experienced several years of tree mortality from spruce beetles have less than 10 percent live spruce remaining.

HOST: **SPRUCE**

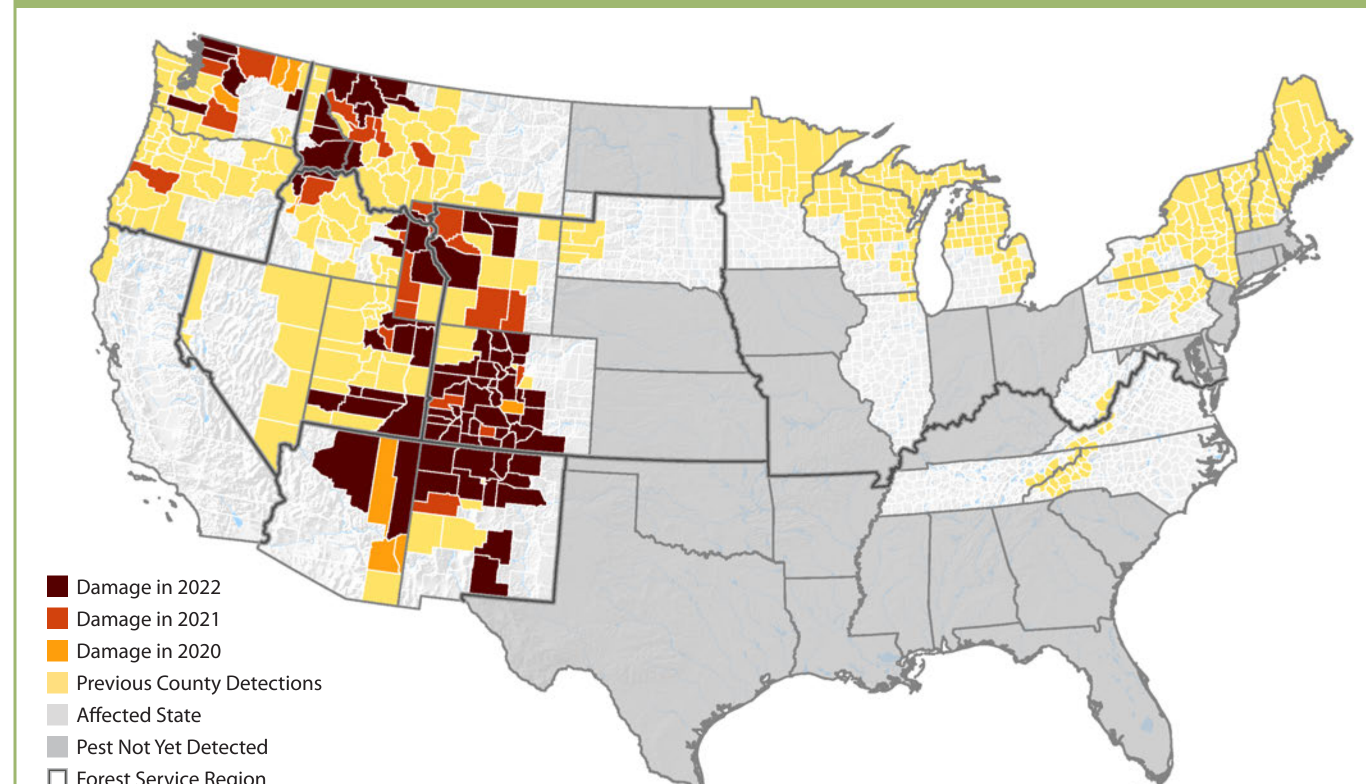
- ★ **Attacks spruce trees across its range** in North America
- ★ **Mortality continues** across the Western United States

FOREST DAMAGE AND RANGE*



FOREST DAMAGE AND RANGE*

County Detections as of 10/31/2022



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Sudden Oak Death

Phytophthora ramorum

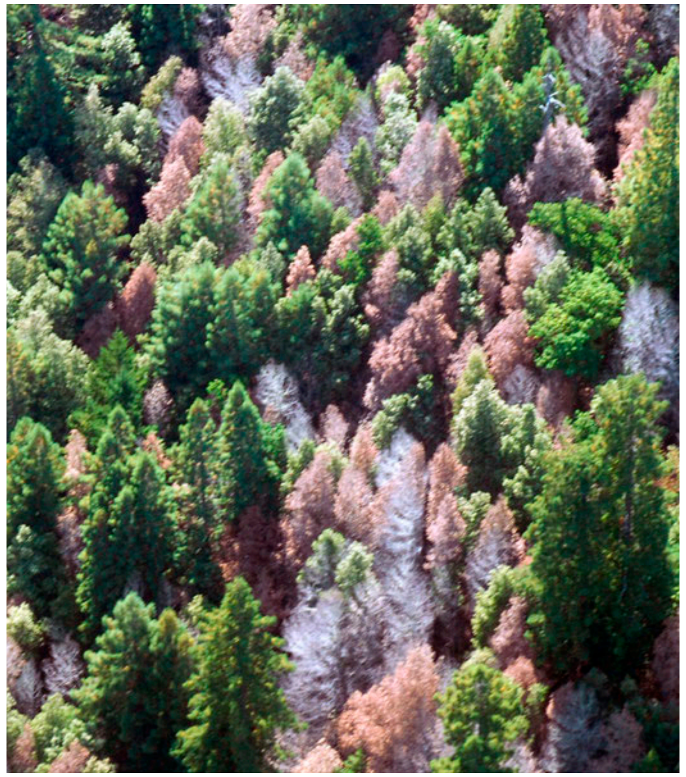
Tree mortality caused by sudden oak death. Photo by Joseph O'Brien, USDA Forest Service, Bugwood.org.

Survey and monitoring help determine where to slow the spread.

Sudden oak death (SOD), caused by *Phytophthora ramorum*, is known to occur in natural forested areas in Oregon and California. It is a federally regulated pest with established quarantines in Curry County, OR, and the State of California.

In 2022, no new infestations were detected outside of the SOD quarantine area. In California, one new satellite infestation was found near the European strain (EU1) detection from 2021. In Oregon, the current slow-the-spread program uses early detection, monitoring, and eradication treatments in areas outside the generally infested area to reduce the rate of disease spread and slow disease intensification.

Surveying, detection, and monitoring efforts for SOD include ground, aerial, and stream bait surveys. Ground-based detection and delimitation surveys are conducted year-round near infested sites. Aerial surveys, conducted from fixed-winged aircraft and helicopter, take place four times per year, and are supplemented with high-resolution digital imagery. The primary aerial survey occurs when current-year tanoak mortality is most visible in July and October. Within the SOD quarantine area and in high-risk areas outside the quarantine area, a detection method called "stream baiting" is used. Stream baiting tests for the presence of *P. ramorum* in waterways, which can aid in detection of infested oaks upstream and supports early detection and mitigation.



Tanoak mortality caused by sudden oak death. Photo by USDA Forest Service.

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

HOST: **OAK AND TANOAK**

- ★ **County-level quarantines in place** in California and Oregon
- ★ Detection **methods include stream baiting**

Discolored tissue and black zone lines beneath the bark of oak is a symptom of sudden oak death. Photo by Bruce Moltzan, USDA Forest Service, Bugwood.org.

FOREST DAMAGE AND RANGE*

County Detections as of 10/31/2022

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**Federal Quarantine Area – Animal Plant and Health Inspection Service. Only a portion of Curry County, OR, is included in the quarantined area.