NEW MEXICO

FOREST HEALTH CONDITIONS

2020

Drought-stressed ponderosa pine with yellow foliage, Zuni Mountains

ENERGY, MINERALS, AND NATURAL RESOURCES DEPARTMENT

FORESTRY DIVISION

Contents

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Cover Photo: Dan Ryerson, USFS

2020 FOREST HEALTH SUMMARY

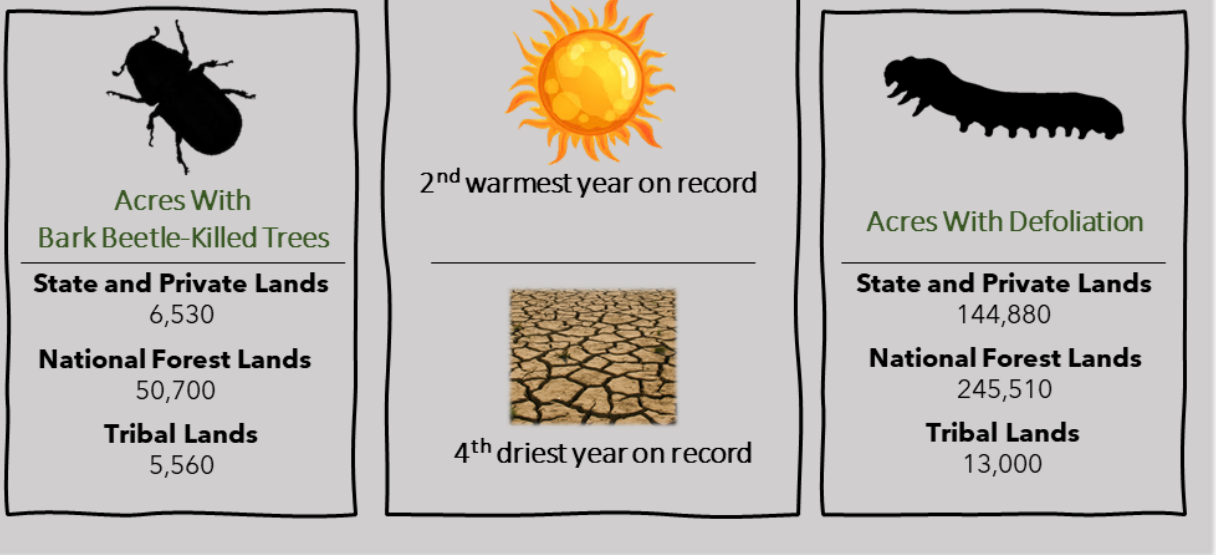
INTERACTIVE MAP

Quickly access and query the 2020 aerial survey data map by clicking here

In 2020, the number of acres of forest and woodlands with insect, disease, and drought-stress damage on state and private lands increased 9% since 2019. The majority of the increase was caused by a rise in aspen defoliation, western spruce budworm activity, and drought-stress symptoms in ponderosa pine. The overall number of acres of state and private land mapped with bark beetle-attacked trees decreased 30% since 2019. However, acres mapped with ponderosa and aspen mortality both increased more than 100%. The increase in ponderosa mortality was caused by bark beetle-related activity, whereas the rise in aspen mortality was caused by a combination of drought, root diseases, chronic defoliation, and other factors. Overall, most of the forest and woodland damage mapped in the state in 2020 occurred north of I-40.

The Forestry Division's Forest Health Specialist detected increased bark beetle-induced piñon mortality during the summer and fall of 2020 within communities of the East Mountains (e.g. Tijeras and Edgewood) and around Santa Fe. These observations were made at the same time as drought conditions worsened and temperatures exceeded norms across much of the state. Examinations of the bark beetle-attacked piñon trees found them to be severely drought-stressed and unable to produce pitch (i.e. sap) to repel bark beetle colonization. Drought- and bark beetle-related piñon and ponderosa morality may increase throughout the state in 2021/2022 unless drought conditions improve. Therefore, current forest thinning and slash management strategies may need to be reconsidered if environmental conditions remain poor and bark beetle activity increases.

2020 CONDITIONS AT A GLANCE



AERIAL DETECTION SURVEY

Aerial surveyor (R) mapping forest insect, disease, and drought-related issues in New Mexico

Most of the information and data within this report were collection via aerial detection surveys. Aerial detection surveys (ADS) are the primary method of collecting annual data on the health of forests in the United States. These surveys are the most efficient and cost-effective method for collecting annual forest health data. In fact, the cost of ADS is about a penny per acre. Approximately 373 million acres of forestland in the United States are surveyed for insect and disease issues each year. Of those, approximately 10 million acres of forest and woodlands are surveyed in New Mexico. Each region in the U.S. has specially trained aerial survey observers, fixed-wing aircraft, and procedures for collecting aerial survey data. In New Mexico, the Forestry Division's Forest Health Specialist works with U.S. Forest Service, Forest Health Protection, New Mexico Zone personnel to aerially survey the state's forests and woodlands. Ground surveys are conducted post-ADS to check unknown or anomalous conditions observed from the air. The data in this report is not a complete picture of forest health in New Mexico, especially on state and private lands, because not every acre of forest and woodland is surveyed. However, the area surveyed each year is approximately the same and data among years can be analyzed for trends.

Image of Truchas Peak and surrounding mountains taken during aerial detection surveys

DROUGHT AND WARMING

Drought conditions in New Mexico rapidly intensified during 2020. For example, 50% of the state was drought-free at the beginning of 2020 (Fig. 1A); but by the end of 2020, 100% of the state was in varying drought conditions with 53% of the state in the D4 or exceptional drought category (Fig. 1B). In addition to the rapid onset of drought conditions temperatures throughout much of the state were above average (Fig. 2). As a result, 2020 was the 2nd warmest and 4th driest year on record in New Mexico according to NOAA. Drought and warming temperatures have been linked to amplified tree death (Allen et al. 2010). Consequently, if these conditions remain similar in 2021 then tree death may increase in direct response to drought and warming or indirectly by being more attractive and susceptible to bark beetle attack.

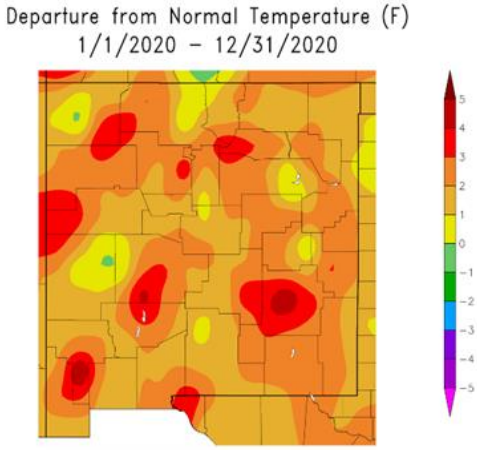


Figure 2. Departure from normal temperature during 2020. Each color interval represents one-degree Fahrenheit (source: HPRCC and NOAA Regional Climate Centers).

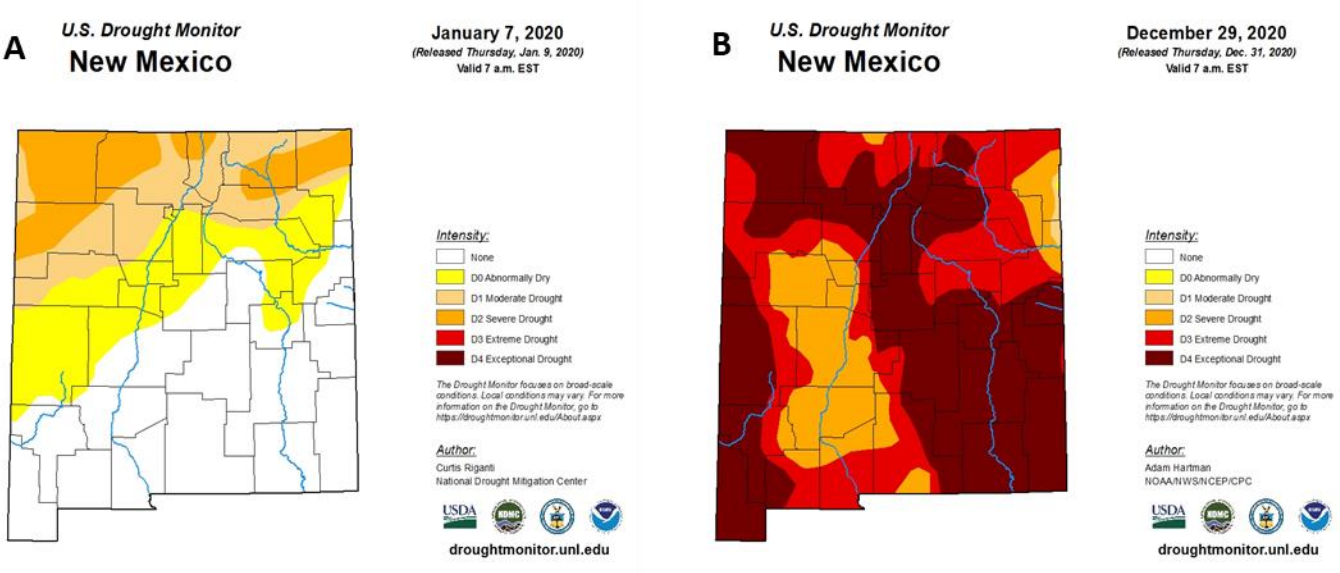


Figure 1. Comparison of drought at A) the beginning of 2020 and at B) the end of 2020 in New Mexico

PEST HIGHLIGHTS

The following sections highlight the major pests that caused damage to New Mexico's forest and woodlands in 2020.

MORTALITY AGENTS

Insects kill more trees in the United States than any other biotic or abiotic agent, including wildfire (Raffa et al. 2008). The principle cause of tree mortality in New Mexico is native bark beetles and approximately 90% of tree mortality in the state each year is due to these tree-dwelling pests. The mortality events caused by bark beetle can have substantial negative impacts on ecological processes, such as reducing the carbon uptake of forests. This negative effect can be especially profound when bark beetles kill large areas of forest or woodlands (Kurz et al. 2008). However, bark beetles do play a beneficial role in ecosystem function by killing stressed, over-mature, overstocked, or otherwise unhealthy trees. The bark beetle-killed trees are eventually replaced by young trees that resist disturbance, recover quicker, and maintain structure and function better than forest stands with older trees. Furthermore, canopy structure disturbance from bark beetle-caused tree mortality can increase the amount of sunlight reaching the forest floor and increase the amount of snags and woody debris. This, in turn, can increase the species richness of flora and fauna in an area. Overall statewide mortality from bark beetles decreased 69% from 2019 to 2020, most likely due to the special survey in 2019 that mapped piñon mortality in areas outside the usual survey area. This special survey was not repeated in 2020. Over the last decade and primarily driven by drought conditions and above average temperatures, 1.62 million acres of forest and woodlands in New Mexico have been mapped with bark beetle-killed trees or other mortality agents.

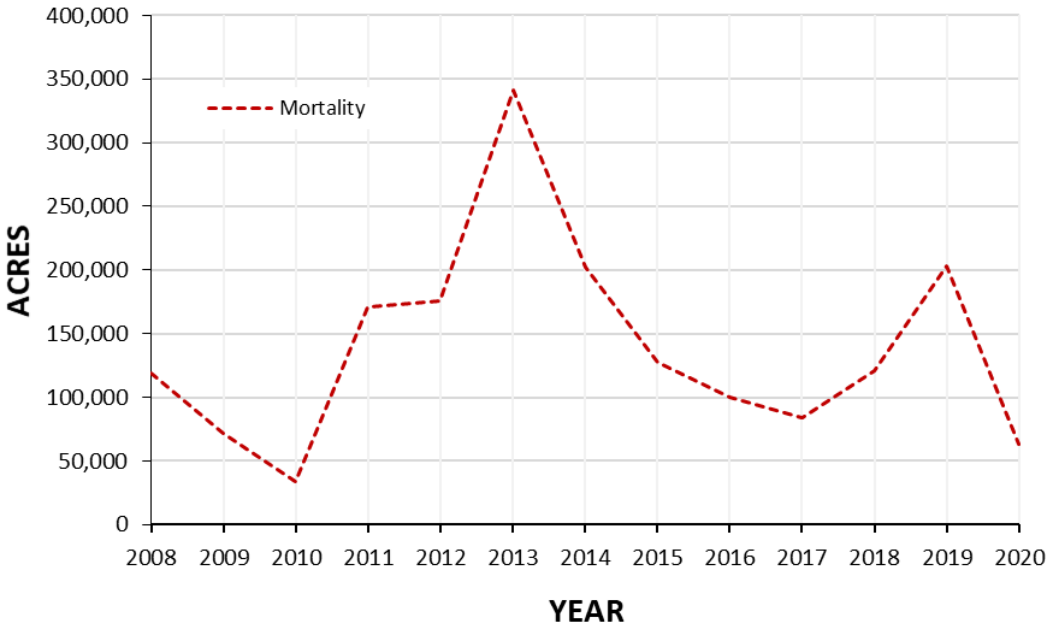


Figure 3. Trend of statewide forest mortality mapped on all land types in New Mexico from 2008 to 2020

Spruce Beetle

(*Dendroctonus rufipennis*)

ACRES MAPPED WITH SPRUCE MORTALITY	
(note: not every tree in each acre is killed)	
National Forest Lands	**28,560**
State and Private Lands	**2,134**
Tribal Lands	**537**

Spruce beetle was the most destructive forest insect in New Mexico in 2020. Approximately 31,000 acres of high-elevation Engelmann spruce forests in the state were mapped with spruce beetle activity this year. This was a 42% increase in acres mapped with activity since 2019 (Fig. 4). Most of the spruce mortality occurred on the Santa Fe and Carson National Forests (20,600 and 7,900 acres, respectively). Spruce mortality on state and private lands decreased 7% since 2019 with most of the morality detected on private land north and east of Chama, NM. A few hundred acres of spruce mortality was mapped on private land in both Mora and Taos Counties. Spruce mortality on tribal lands totaled 540 acres with 82% of the total acres recorded on the Navajo Nation. The spruce beetle activity on Mescalero Apache and Lincoln National Forest lands decreased 67% since 2019 and it is possible this activity will decrease even more over the next few years. Spruce beetle infestations have progressed annually since 2013 (Fig. 5) and a cumulative total of 240,600 acres of spruce forest have been mapped with spruce beetle activity between 2010 and 2020.

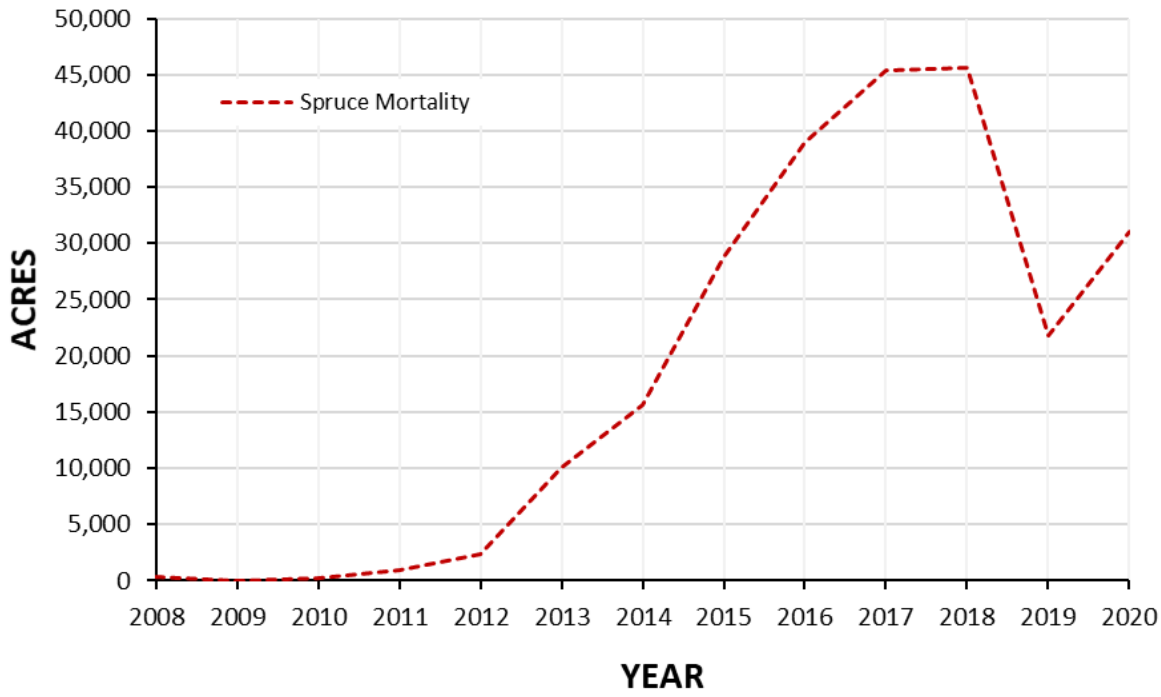


Figure 4. Trend of statewide spruce beetle-induced spruce mortality mapped on all land types in New Mexico from 2008-2020

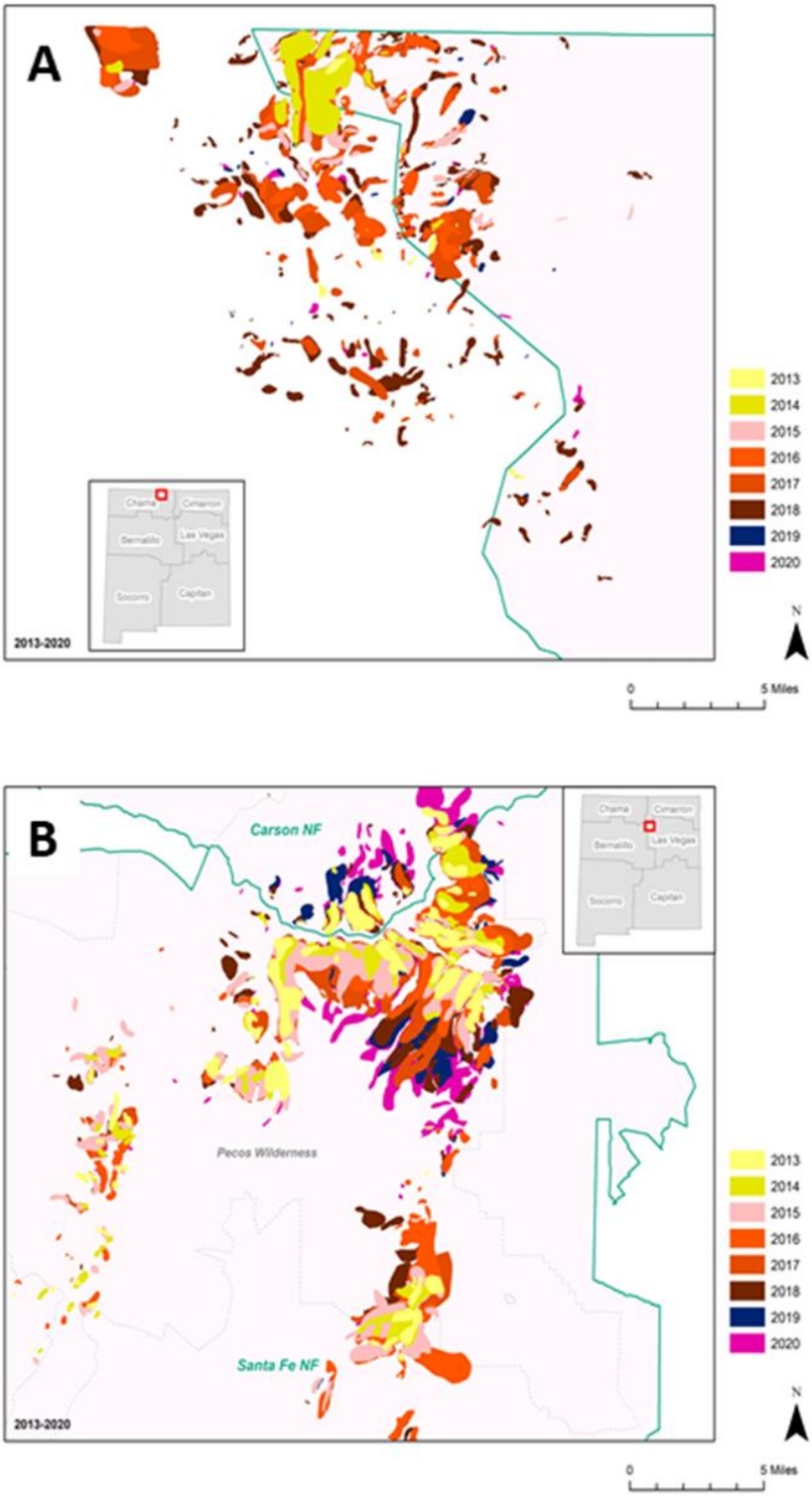


Figure 5. Progression of spruce beetle-induced Engelmann spruce mortality mapped from 2013-2020 during aerial detection surveys A) on or adjacent to the northwest corner of the Tres Piedras Ranger District (Carson National Forest) and B) in and around the Pecos Wilderness (Santa Fe National Forest)

Ponderosa Pine Bark Beetles

(western pine beetle; *Dendroctonus brevicomis*)
(roundheaded pine beetle; *D. adjunctus*)
(red turpentine beetle; *D. valens*)
(pine engraver; *Ips pini*)

ACRES MAPPED WITH PONDEROSA MORTALITY	
(note: not every tree in each acre is killed)	
National Forest Lands	10,394
State and Private Lands	1,710
Tribal Lands	667

This complex of bark beetle species was mapped on approximately 13,000 acres of ponderosa forests across the state, an 89% decrease in acres since the 2019 aerial survey. Most of the acres with mortality occurred on the Gila National Forest, which is consistent with previous aerial survey findings. The Cibola National Forest contained the second highest amount of mapped ponderosa mortality. Only a small amount of bark beetle-killed ponderosa pine was detected on the other National Forests in the state (i.e. Lincoln, Carson, Santa Fe). Interestingly, mapped acres on state and private lands increased more than 100% since 2019, perhaps because lower elevation ponderosa forests are experiencing warmer and drier conditions than those at higher elevations in the National Forests. Ponderosa mortality on tribal lands decreased substantially since 2019, but once again, most of the acres mapped were on the Navajo Nation. A cumulative total of 852,000 acres of ponderosa forest have been mapped with bark beetle-killed ponderosa pine between 2010 and 2020. Bark beetle-induced ponderosa mortality may increase in 2021 due to the severe drought conditions and above average temperatures throughout the state.

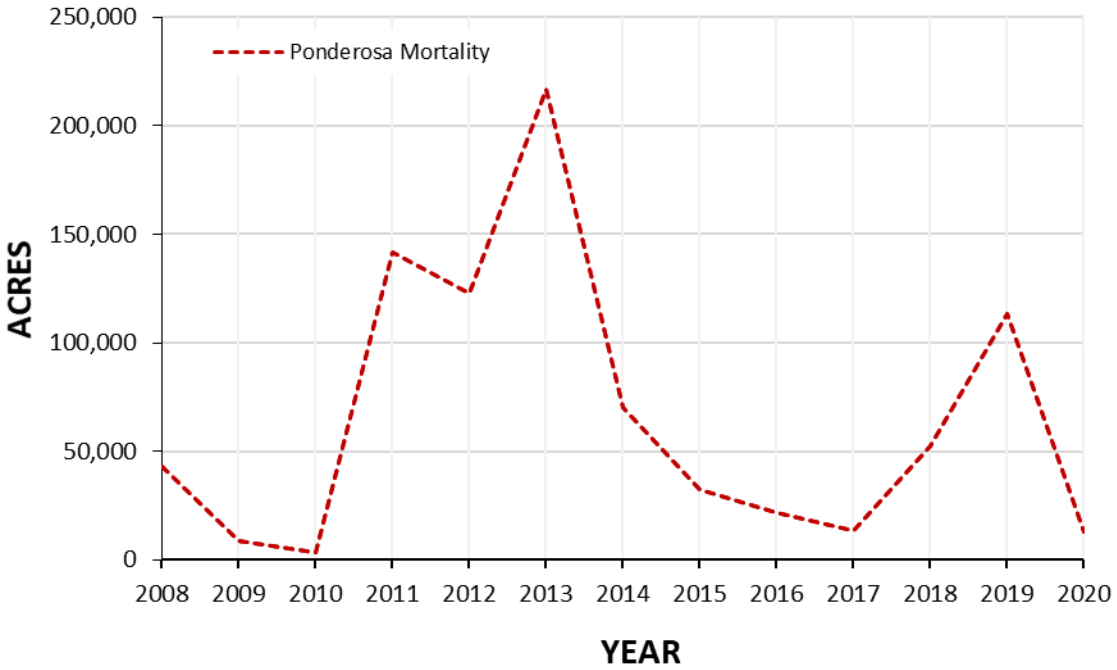


Figure 6. Trend of statewide bark beetle-induced ponderosa mortality on all land types in New Mexico from 2008-2020

Mixed Conifer Bark Beetles

(Douglas-fir beetle; *Dendroctonus pseudotsugae*)
(fir engraver; *Scolytus ventralis*)

ACRES MAPPED WITH MIXED CONIFER MORTALITY	
(note: not every tree in each acre is killed)	
National Forest Lands	**11,393**
State and Private Lands	**896**
Tribal Lands	**1,383**

Douglas-fir beetle and fir engraver attack New Mexico's mid-elevation tree species, Douglas-fir and white fir, respectively. These two species of bark beetles caused a total of 13,450 acres of mixed conifer mortality statewide, which is a 30% reduction in acres since the 2019 aerial survey. Mixed conifer mortality on state and private and tribal lands decreased 6% and 50%, respectively, in 2020 compared to 2019 aerial survey results. The fir engraver beetle again was relatively inactive in 2020 with only 5% of the acres of mortality in mixed conifer forests caused by this species. The number of acres killed by these bark beetles has decreased annually since 2014 (Fig. 7). Large-scale outbreaks of these bark beetles are rare in the southwest; however, increased Douglas-fir beetle activity can be observed in drought-stressed forests or those immediately surrounding recent fire scars.

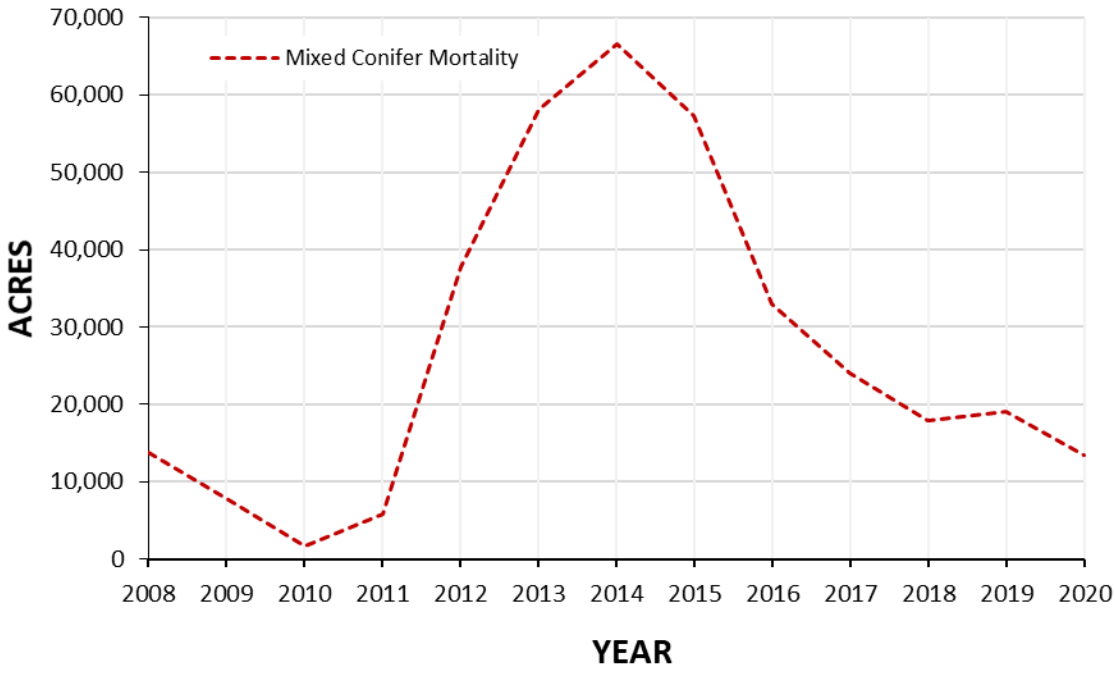


Figure 7. Trend of statewide bark beetle-induced mixed conifer mortality on all land types in New Mexico from 2008-2020

Piñon Ips

(*Ips confusus*)

ACRES MAPPED WITH PIÑON MORTALITY	
(note: not every tree in each acre is killed)	
National Forest Lands	**439**
State and Private Lands	**377**
Tribal Lands	**2,900**

Piñon ips is the most significant mortality agent of piñon in New Mexico and outbreaks of this species can be driven by prolonged drought conditions. For example, piñon ips killed millions of drought-stressed piñon across the southwest from 2002 to 2004. In 2020, 3,650 acres of piñon ips-induced mortality were mapped in the state and ~80% of the total piñon mortality occurred on the Navajo Nation. The total acres mapped on all land types in the state decreased more than a 92% since 2019 when 45,600 acres were mapped statewide. Most of the 2019 acreage was recorded north of Grants and Gallup during a special late-season aerial survey to capture reports of wide-spread piñon mortality. This area has been rarely, if ever, mapped during annual aerial surveys, and due to the COVID pandemic, the special survey was not repeated in 2020. Not being able to resurvey the area again could explain why acres with piñon ips-induced mortality decreased so substantially in 2020. It was likely that piñon morality was still elevated in the area. Most of the remaining mortality was mapped on National Forest and state and private lands south of I-40. If drought conditions don't improve piñon mortality may increase substantially over the next few years.

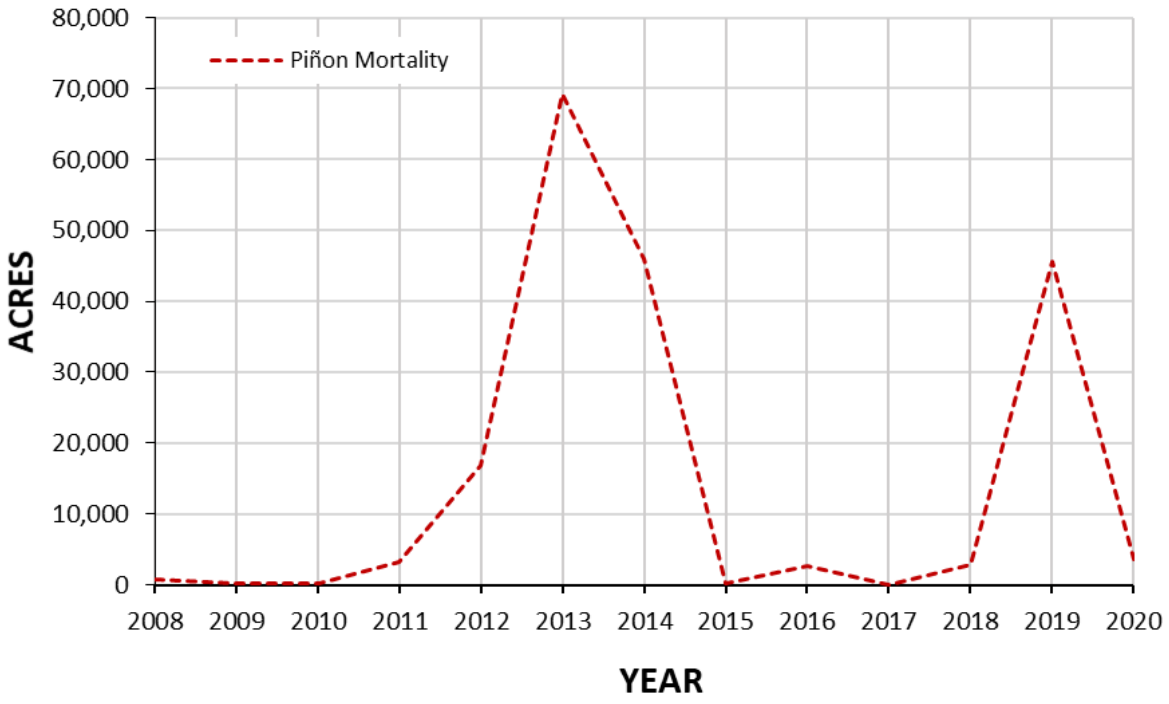


Figure 8. Trend of statewide piñon-ips induced piñon mortality on all land types in New Mexico from 2008-2020

DEFOLIATION AGENTS

Defoliation agents, such as caterpillars and piñon needle scale, have impacted 3.8 million acres of forest and woodlands in New Mexico over the last decade. Defoliating agents rarely kill trees in a single season, but prolonged multi-year defoliation activity can result in growth loss, crown dieback, and in some instances, tree death. Defoliation also weakens trees and can predispose them to attack by bark beetles or pathogens. In general, deciduous trees (e.g. aspen) can withstand defoliation activity better than evergreen species (e.g. pine, fir), although some exceptions do occur. Statewide defoliation increased by 33% from 2019 to 2020, which was due to an increase in western spruce budworm, western tent caterpillar, large aspen tortrix, and ponderosa needleminer activity. Defoliation on state and private lands increased 36% in 2020, which was due to increased western spruce budworm, western tent caterpillar, large aspen tortrix, and pine sawfly activity.

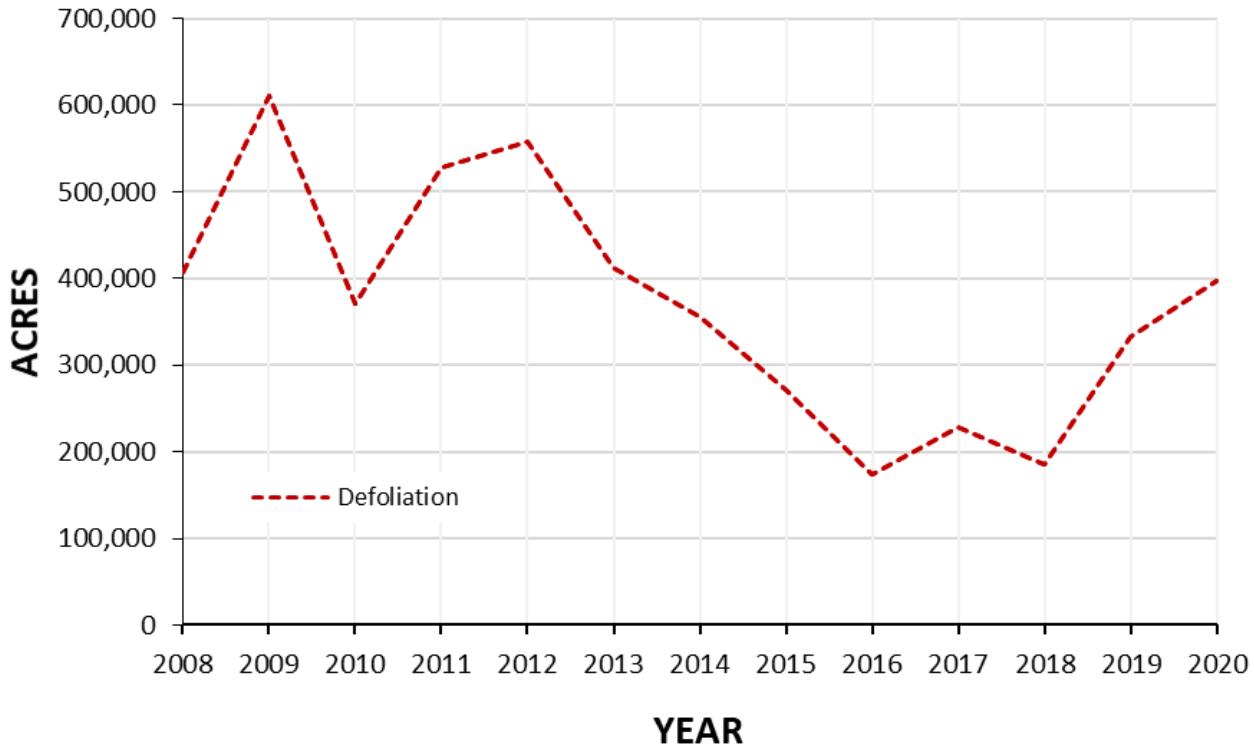


Figure 9. Trend of statewide forest defoliation mapped on all land types in New Mexico from 2008 to 2020

Western Spruce Budworm

(*Choristoneura freemani*)

ACRES MAPPED WITH WESTERN SPRUCE BUDWORM FEEDING DAMAGE	
(note: not every tree in each acre is damaged)	
National Forest Lands	**201,300**
State and Private Lands	**84,700**
Tribal Lands	**9,000**

Caterpillars of this moth feed on Douglas-fir, true firs (e.g. white fir, subalpine fir), and spruce. In 2020, western spruce budworm (WSBW) feeding was detected on 296,800 acres statewide and was the most damaging defoliation agent in New Mexico. The number of acres on all land types with WSBW activity increased 58% between the 2019 and 2020 aerial survey, possibly due to declining forest stands conditions and/or an increase in defoliation severity. Similarly, WSBW feeding activity on state and private and tribal lands increased 43% and 40%, respectively, between 2019 and 2020. Most (92%) of WSBW feeding activity mapped on tribal forests occurred on the Jicarilla Apache and Taos Pueblo lands. The majority of WSBW defoliation in the state occurred on the Carson and Santa Fe National Forests and on state and private lands near these National Forests. Collectively, these areas accounted for 92% of the total acres impacted by WSBW. Western spruce budworm usually is the most destructive defoliator in the western U.S. and New Mexico is no exception. The overstocked mixed conifer forests of New Mexico have led to and sustained high populations of WSBW for several decades. However, the southern portion of the state generally does not have large-scale WSBW events that is common north of Interstate 40. For example, this year, there was no WSBW feeding activity mapped on the Gila National Forest and very little mapped on the Lincoln National Forest. The chronic feeding of this species can severely stress mature trees or cause mortality of small understory trees. Furthermore, mature trees that have been stressed by this insect generally are more susceptible to bark beetle attack.

Western spruce budworm feeding damage (orange foliage) in New Mexico

Ponderosa Needleminer

(*Coleotechnites ponderosae*)

ACRES MAPPED WITH NEEDLEMINER FEEDING DAMAGE	
(note: not every tree in each acre is damaged)	
National Forest Lands	**5,100**
State and Private Lands	**44,200**
Tribal Lands	**0**

The tiny caterpillar of this species feeds within needles of ponderosa pine and can cause dramatic visual change over large areas. Feeding damage caused by this insect doesn't normally lead to tree death, but the damage can stress trees and make them more susceptible to bark beetle attack. This was the third year of a large-scale outbreak of this moth species on and around the Vermejo Ranch near Raton. Acres affected by this insect slightly increased between 2019 and 2020, but overall acres have decline since 2018 or the first year of the outbreak. Additionally, this year, the species spread westward from the Vermejo Ranch and 5,100 acres of needleminer damage was newly mapped on the Carson National Forest near Tres Piedras. Large-scale outbreaks are uncommon in New Mexico; however, there were reports of large outbreaks occurring in the northeastern part of the state in the 1980s and 1990s. For example, about 52,000 acres were mapped in 1989 in San Miguel County.

Ponderosa needleminer feeding damage (yellowish-orange foliage) on the Vermejo Ranch in northern New Mexico (photo: Dan Ryerson, USFS)

Aspen Defoliators

(western tent caterpillar; *Malacosoma californicum*)
(large aspen tortrix; *Choristoneura conflictana*)

ACRES MAPPED WITH ASPEN DEFOLIATION	
(note: not every tree in each acre is defoliated)	
National Forest Lands	39,050
State and Private Lands	15,100
Tribal Lands	3,500

The western tent caterpillar and large aspen tortrix are the main defoliating agents of aspen in New Mexico and large-scale, chronic outbreaks of these species are common. Large-scale aspen foliar disease (e.g. black ink spot) outbreaks were recorded in 1980's and 1990's; however, because of below average annual precipitation rates, these disease events are currently rare in New Mexico. In 2020, approximately 57,000 acres of aspen were defoliated across the state, the majority (66%) of which occurred on the Carson and Santa Fe National Forests. Overall acres affected by these defoliators increased 218% between 2019 and 2020. Aspen defoliation on state and private lands increased 26% with most activity mapped in Colfax, Taos, and Rio Arriba Counties. WSBW activity on tribal lands increased substantially from 2019 to 2020 with 72% of the damage mapped on the Taos Pueblo. The large-scale outbreak of western tent caterpillar around the Aspen Vista area of the Santa Fe National Forest is still on-going. This outbreak has been present since 2015 and, as a result, has negatively impacted the vibrant fall color of aspen in the area. Despite the prolonged defoliation activity, little to no aspen mortality has been observed in the infested area and these epidemic western tent caterpillar populations may crash over the next few years.

Twig Beetles

(*Pityophthorus* spp.)
(*Pityogenes* spp.)
(*Pityoborus secundus*)

ACRES MAPPED WITH TWIG BEETLE DAMAGE	
(note: not every tree in each acre has damaged)	
National Forest Lands	430
State and Private Lands	4,350
Tribal Lands	0

Twig beetles are a type of bark beetle, but are much smaller than species of *Ips* or *Dendroctonus*. In a typical year, they can be found in low levels colonizing twigs or branches throughout the forest. However, in times of drought, they can cause widespread twig and branch die-back of mature trees and/or attack and kill young, small trees. In 2020, widespread branch and twig die-back on ponderosa pine was mapped on ~4,400 acres of state and private land in San Miguel and Mora Counties. Post-aerial ground checks of these areas confirmed the presence of twig beetle. Many of the trees exhibiting crown discoloration (see 'Abiotic Disturbances' below) were also attacked by twig beetle, which is a strong indicator that the outbreak is most likely related to drought-stress. Twig beetle activity may stay high in the affected areas if drought conditions persist; however, direct mortality of mature ponderosa trees from twig beetle attack is unlikely. It is possible that mortality of small piñons from twig beetle attack may increase if drought conditions persist.

ABIOTIC DISTURBANCE

Ponderosa Pine

(*Pinus ponderosa*)

ACRES MAPPED WITH PONDEROSA DISCOLOR	
(note: not every tree in each acre has discoloration)	
National Forest Lands	22,950
State and Private Lands	14,700
Tribal Lands	290

Approximately 36,000 acres of ponderosa forests were mapped statewide this year with discoloration from an unknown agent. Post-aerial survey ground checks were conducted to determine the cause of the discoloration. Ground checks revealed that the old needles within the canopy had turned yellow. Ponderosa pine naturally senesces and sheds old needles every year; however, these needles were turning yellow months before they do normally. This symptom was a strong indicator of severe drought-stress. Most discoloration was mapped on the Gila National Forest (~16,000 acres) and state and private lands (~15,000 acres). The discoloration on state and private lands was concentrated to Mora, Colfax, Cibola, and San Miguel Counties. Unfortunately, these visually drought-stressed ponderosa forests may experience increased twig beetle activity or bark beetle-induced mortality over the next few years.

Ponderosa pine discolored due to drought-stress near Gurman Canyon in the Zuni Mountains (photo: Dan Ryerson, USFS)

CONCLUSIONS

The health of forests and woodlands in New Mexico is strongly influenced by temperature and precipitation. For example, warmer temperatures can increase insect activity and drier conditions can reduce the ability of trees to fight off pests, as exemplified by the large-scale piñon mortality event during the early 2000's. According to the National Weather Service, 2020 was the 2nd warmest year on record in New Mexico and statewide precipitation average 8.03 inches below normal (i.e. the 4th driest year on record). Despite this, acres of forest mortality declined between the 2019 and 2020 aerial surveys. However, defoliation increased 33% from 2019 to 2020. The National Weather Service predicts the severe drought conditions in New Mexico will persist well into 2021. As a result, continued drought stress on trees coupled with increased defoliation-caused stress may set the stage for increased bark beetle-related tree mortality in 2021 and/or 2022.

Autumn view from Mt. Taylor

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APPENDIX

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TABLES

Table 1. Aerial detection survey results for forest insect and disease activity on all land types in New Mexico in 2019 and 2020

Damage Type		2020 acres	2019 acres	% change[1]
DEFOLIATION				
by host [2]				
	aspen	57,020	17,940	218
by agent				
	western spruce budworm	296,750	187,710	58
	Janet's looper	2,620	5,650	-54
	piñon needle scale	840	45,510	-98
	pine sawfly	1,000	1,470	-32
	needleminer	48,990	47,040	4
Defoliation Total		**407,220**	**305,320**	**33**
MORTALITY				
by forest type [3]				
	spruce-fir	31,090	26,820	16
	mixed conifer	13,450	19,140	-30
by host [2]				
	ponderosa pine	12,590	113,130	-89
	aspen	2,610	740	253
by agent				
	piñon ips	3,650	45,590	-92
Mortality Total		**63,390**	**205,420**	**-69**
OTHER				
	twig beetle (ponderosa)	4,781	100	4,681
	drought discoloration (ponderosa)	36,014	27,520	31
	frost damage (oak)	5,545	1,150	382
Other Total		**46,340**	**28,770**	61
	Grand Total	**516,950**	**539,510**	**-4**
	Total Area Mapped[4]	**508,970**	**557,360**	**-9**

1 (2020 acres – 2019 acres) / 2019 acres * 100
2 Damage to a single tree species caused by multiple known agents that cannot be distinguished from the air
4 Damage to multiple commingled tree species caused by known agents
5 Areas may be mapped with >1 damage agent. The total area mapped represents the "footprint" of damage, with no multiple counting of acres; total values can reflect multiple counting

Table 2. Aerial detection survey results for forest insect and disease activity on state and private lands in New Mexico in 2019 and 2020

Damage Type		2020 acres	2019 acres	% change[1]	% of all lands[2]
DEFOLIATION					
by host[3]					
	aspen	15,070	3,700	>100	26
by agent					
	western spruce budworm	84,660	59,290	43	29
	Janet's looper	40	40	0	2
	piñon needle scale	160	24,530	-99	19
	pine sawfly	770	520	48	77
	needleminer	44,180	47,040	-6	90
Defoliation Total		**144,880**	**135,120**	**7**	**36**
MORTALITY					
by forest type[4]					
	spruce-fir	2,140	2,300	-7	7
	mixed conifer	900	960	-6	7
by host[3]					
	ponderosa pine	1,710	570	>100	14
	aspen	1,400	380	>100	54
by agent					
	piñon ips	380	5,110	-93	10
Mortality Total		**6,530**	**9,320**	**-30**	10
OTHER					
	twig beetle (ponderosa)	4,350	-	>100	91
	drought discoloration (ponderosa)	14,680	-	>100	41
	frost damage (oak)	1,330	-	>100	24
Other Total		**20,360**	**-**	**>100**	44
	Grand Total	**171,770**	**157,600**	**9**	**33**
	Total Area Mapped[5]	**165,450**	**124,660**	**33**	**33**

1 (2020 acres – 2019 acres) / 2019 acres * 100
2 State and private acres as a percentage of statewide acres
3 Damage to a single tree species caused by multiple known agents that cannot be distinguished from the air
4 Damage to multiple commingled tree species caused by known agents
5 Areas may be mapped with >1 damage agent. The total area mapped represents the "footprint" of damage, with no multiple counting of acres; total values can reflect multiple counting