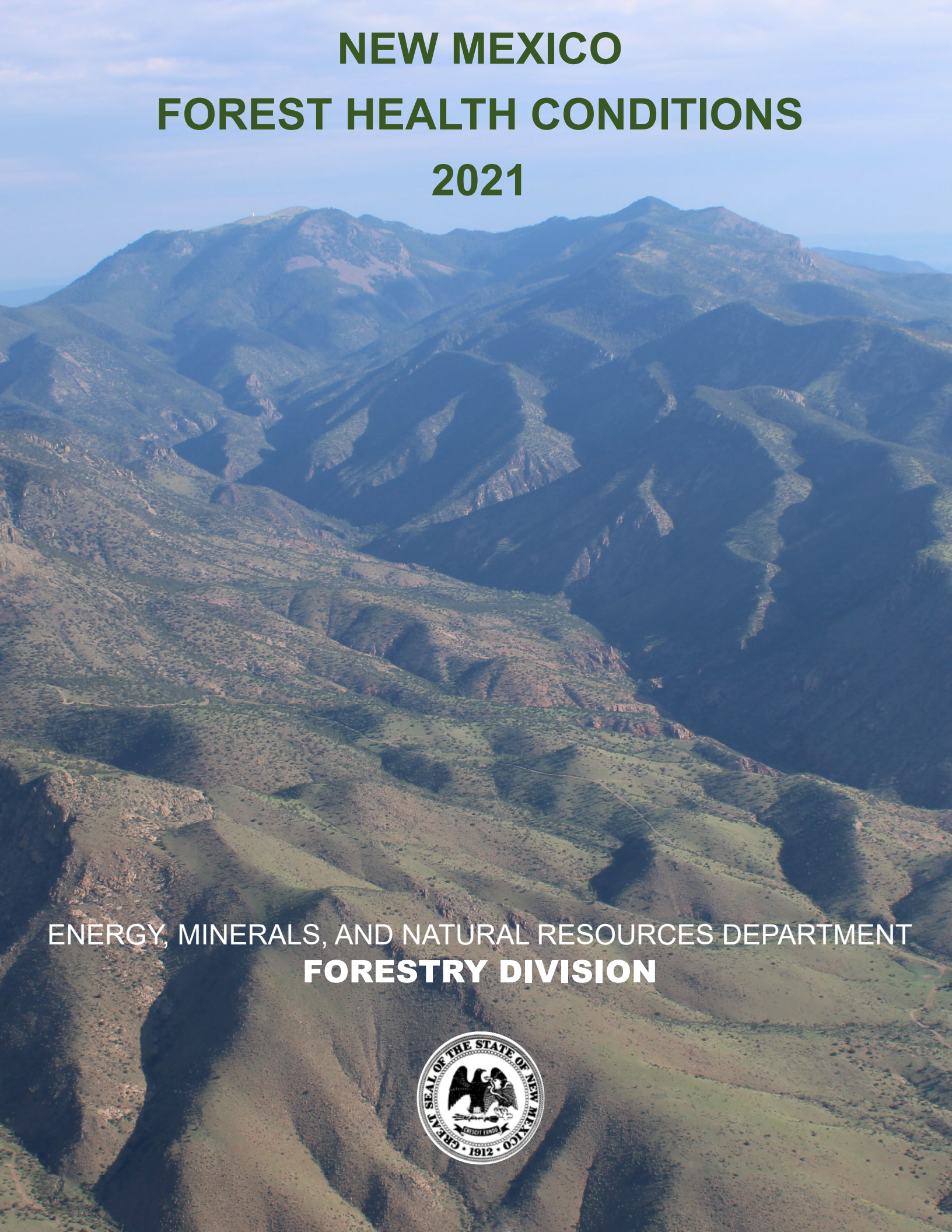
NEW MEXICO
FOREST HEALTH CONDITIONS
2021



ENERGY, MINERALS, AND NATURAL RESOURCES DEPARTMENT

FORESTRY DIVISION

CONTENTS

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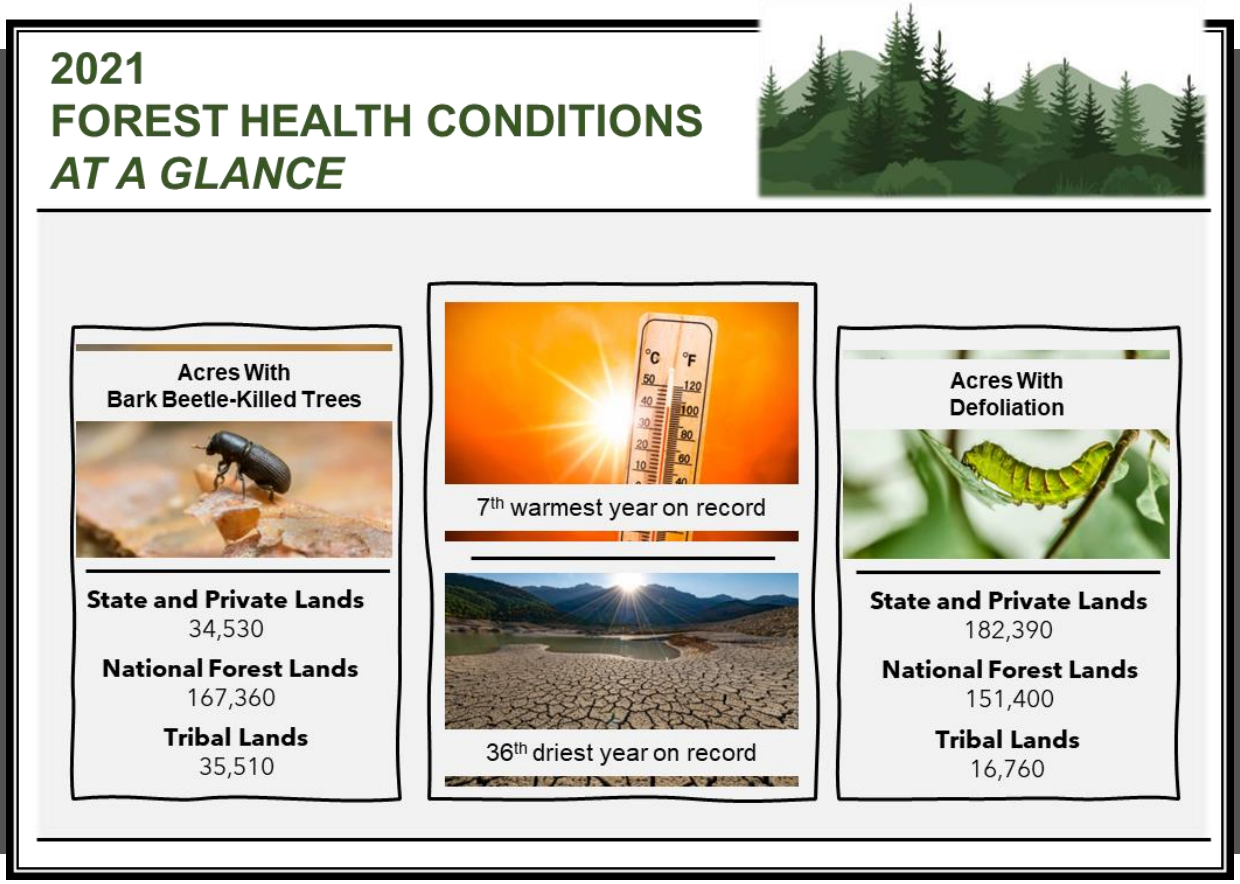
Caveat

ACRES WITH

mortality or defoliation stated throughout this report describes an amount of acreage with some percentage of damaged trees, i.e. not every tree in every reported acre is killed or defoliated.

2021 FOREST HEALTH SUMMARY

The number of acres of forest and woodlands mapped with insect, disease, and drought-stress damage increased by 240,000 acres across all land ownership types in New Mexico since 2020. Most of the increase was caused by a rise in bark beetle-caused piñon, ponderosa pine, and Douglas-fir mortality. Damage mapped on state- and privately-owned forest and woodlands increased by 51,000 acres or 31% from 2020 levels. Overall, most of the forest and woodland damage mapped in the state in 2021 occurred north of I-40. The Forestry Division's Forest Health Specialist continued to observe increased bark beetle-induced piñon mortality around Santa Fe, Cuba, and within the communities of the East Mountains (e.g. Edgewood). Examinations of the bark beetle-killed piñon trees in these areas found them to be unable to produce adequate pitch (i.e. sap) to repel bark beetle colonization. Consequently, it can be concluded that trees remain severely drought-stressed even though drought conditions improved in the state during 2021. Drought- and bark beetle-related tree mortality may continue to increase throughout the state in 2022 unless drought conditions continue to improve.



AERIAL DETECTION SURVEY

Most of the information and data within this report were collected via aerial detection surveys. Aerial detection surveys (ADS) have been the most efficient and cost-effective method for collecting annual forest health data in New Mexico. In fact, the cost of ADS has been about a penny per acre. 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. Approximately 13 million acres of forest and woodlands are surveyed in New Mexico each year. Ground surveys are conducted post-ADS to check unknown or anomalous conditions observed from the air. The information within 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 in the state is surveyed. However, the area surveyed each year is approximately the same and data among years can be analyzed for trends.

1920s

first reports of aerially mapping forest insect damage in the U.S.

DROUGHT AND WARMING

1992

is the last year it was cooler than normal in New Mexico

Drought conditions in New Mexico improved slightly during 2021. For example, 53% of the state was in the D4 or exceptional drought category in January, but by December 2021 most of the state had moved into the D2 or severe drought classification (Fig. 1). Summer temperatures in 2021 were, on average, slightly cooler than in 2020. As a result, 2021 was the 7th warmest and 36th driest year on record in New Mexico. Drought and warming temperatures have been linked to amplified tree death (Allen et al. 2010) and if weather conditions continue on a similar trend in 2022, then tree death may increase in direct response to drought and warming or indirectly by being more attractive and susceptible to bark beetle attack.

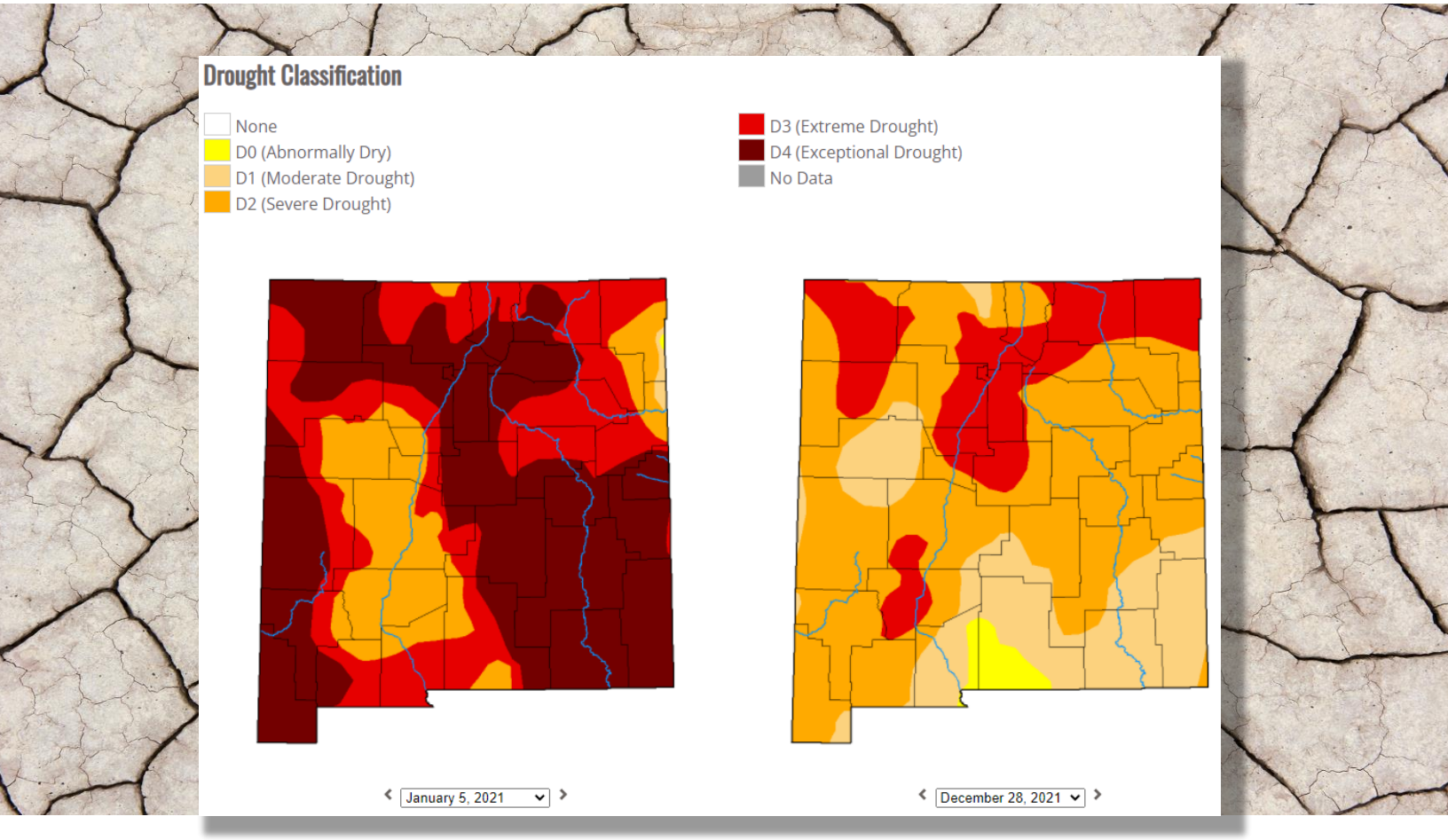
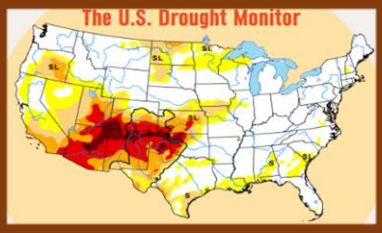


Figure 1. Comparison of drought at the beginning (L) and at the end of 2021 (R) in New Mexico.



View the current U.S. Drought Monitor map by clicking the graphic to the left

PEST HIGHLIGHTS

The following sections highlight the major pests that caused damage to New Mexico's forest and woodlands in 2021.

MORTALITY AGENTS

Insects have killed more trees in the United States than any other biotic or abiotic agent, including wildfire (Raffa et al. 2008). Approximately 90% of tree mortality in New Mexico each year has been due to native bark beetles. Bark beetle-caused tree mortality can have substantial negative impacts on ecological processes, such as altering the carbon uptake of forests. The negative effects 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. Bark beetle-killed trees are eventually replaced by juvenile trees that resist disturbance, recover more quickly, and maintain structure and function better than forest stands with old trees. Furthermore, canopy structure disturbance from bark beetle-caused tree mortality can increase the amount of sunlight reaching the forest floor and increase the number 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 increased substantially from 2020 to 2021 (Fig. 2), most likely due to continuing drought conditions and above average temperatures throughout the state.

1.9M

acres mapped with bark beetle-killed trees over the last decade

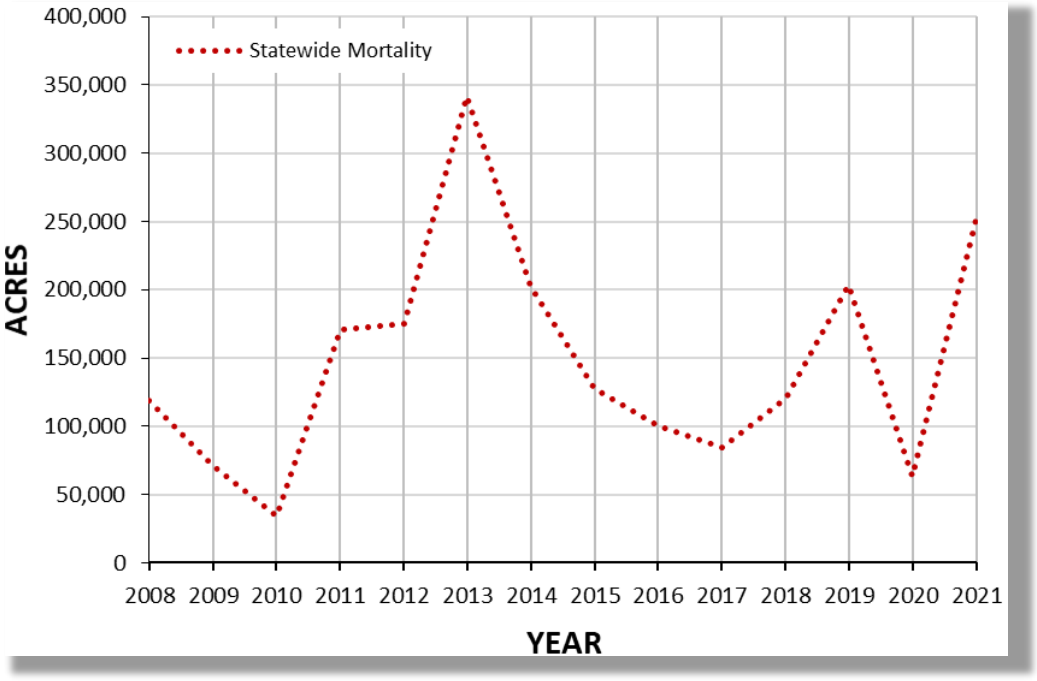


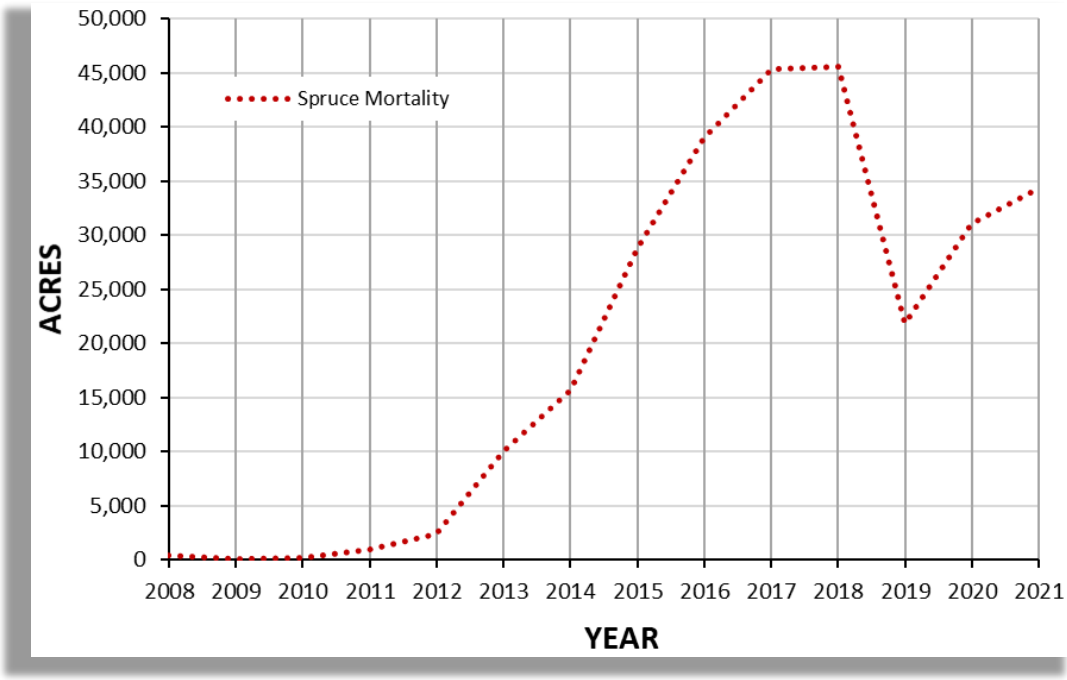
Figure 2. Trend of statewide forest mortality mapped on all land types in New Mexico from 2008 to 2021.

Spruce Beetle

(*Dendroctonus rufipennis*)

275,000
acres mapped with spruce beetle-killed trees over the last decade

Approximately 35,000 acres of high-elevation Engelmann spruce forests in the state were mapped with spruce beetle-related tree mortality in 2021 (Fig. 3). This was a 11% increase in acres mapped with spruce beetle activity since 2020. Most of the spruce mortality occurred on the Santa Fe and Carson National Forests (18,000 and 15,000 acres, respectively). Spruce mortality on state and private lands increased since 2020 with most of the morality detected on private land in Rio Arriba, Taos, and Mora counties. Spruce mortality on tribal lands totaled 130 acres with 99% of the total acres mapped on Jicarilla Apache tribal lands. The spruce beetle outbreak on the Mescalero Apache and Lincoln National Forest lands have declined over the last several years and crashed altogether in 2021.



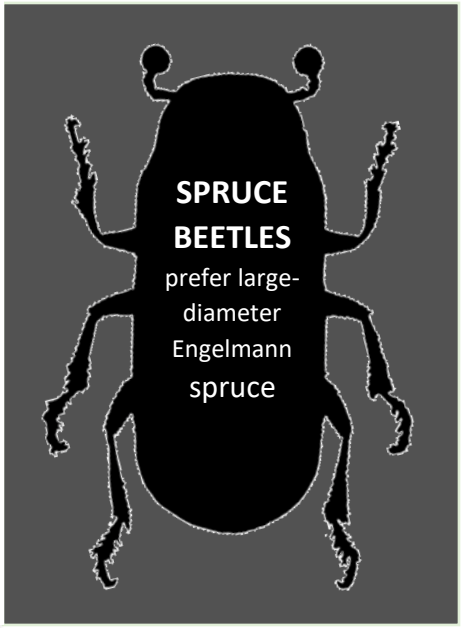
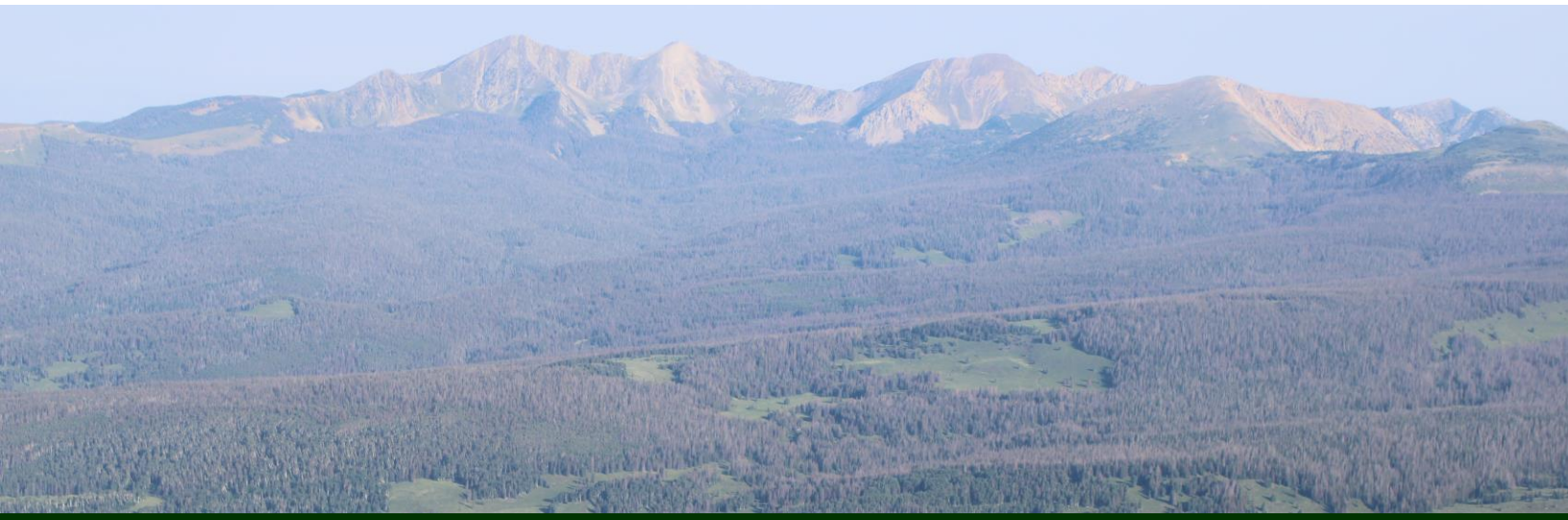


Figure 3. Trend of statewide spruce mortality mapped on all land types in New Mexico from 2008-2021.

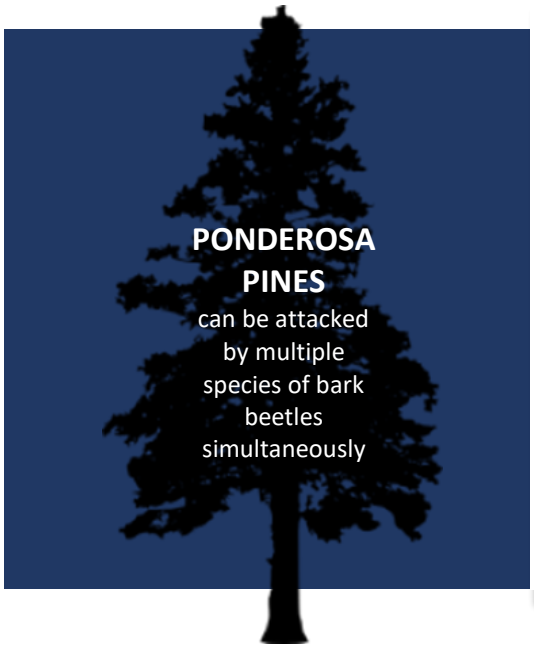


Ponderosa Pine Bark Beetles

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

913,000
acres mapped with bark beetle-killed ponderosa over the last decade

Approximately 116,000 acres of forests in the state were mapped with ponderosa mortality caused by this complex of bark beetle species, which was a substantial increase from 2020 levels (Fig. 4). Most of the acres mapped with mortality occurred on the Gila National Forest (77,000 acres), which remained consistent with previous aerial survey findings. The Cibola National Forest contained the second highest amount of mapped ponderosa mortality with 7,000 acres. The other National Forests in the state (i.e., Santa Fe, Carson, Lincoln) had similar mapped acreage that ranged from 3,000 to 6,000 acres. Mapped acres with ponderosa mortality on state and private lands increased more than 100% since 2020, with most of the mortality occurring in Mora, Colfax, and Cibola counties. Ponderosa mortality on tribal lands increased substantially since 2020 with most of the acres mapped on the Mescalero (2,200 acres) and Jicarilla (1,000 acres) Apache tribal lands. Bark beetle-induced ponderosa mortality throughout the state may continue to increase in 2022 due to on-going drought conditions and above average temperatures.



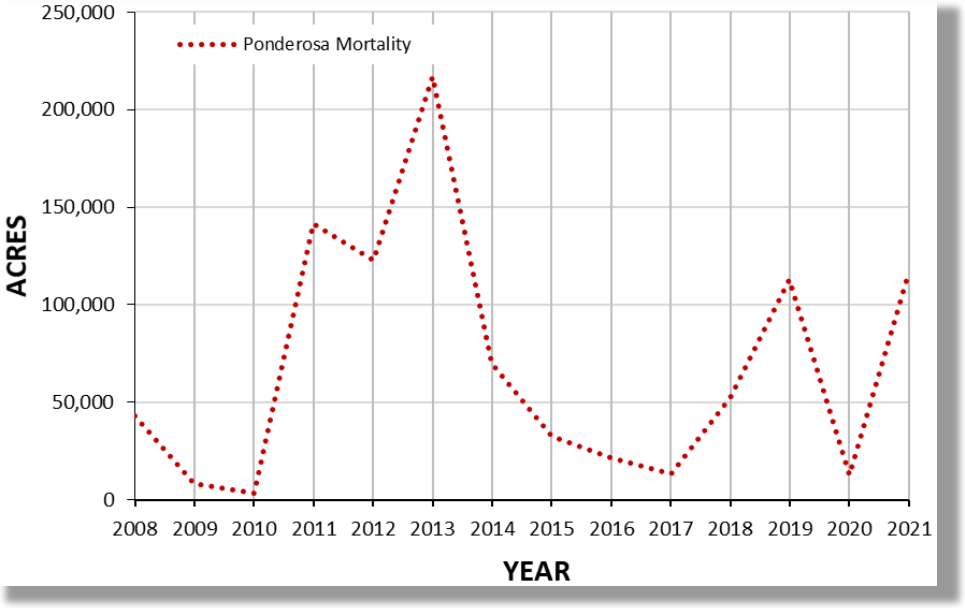
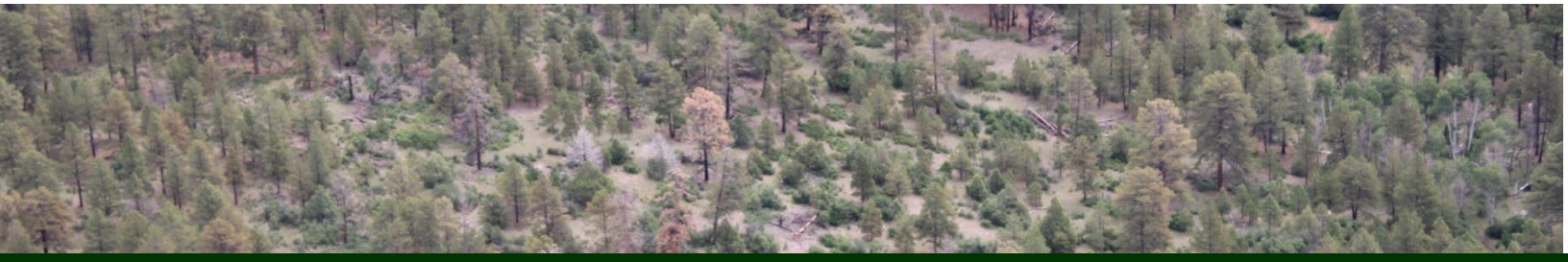


Figure 4. Trend of statewide bark beetle-induced ponderosa mortality on all land types in New Mexico from 2008-2021.



Mixed Conifer Bark Beetles

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

364,000
acres mapped with bark beetle-killed mixed conifer trees over the last decade

Douglas-fir beetle and fir engraver attack New Mexico's mid-elevation conifer species, Douglas-fir and white fir, respectively. Approximately, 31,000 acres of mixed conifer forests throughout the state were mapped with mortality caused by these two species of bark beetles, which is a substantial increase in acres from 2020 levels. Mixed conifer mortality on state and private and tribal lands increased substantially (158% and 98%, respectively) in 2021 compared to 2020 levels. The fir engraver beetle again was relatively inactive in 2021 with only 9% of the acres mapped with mortality in mixed conifer forests caused by this species. The number of acres killed by these bark beetles has decreased annually since 2014, but acres mapped with mortality substantially increased during 2021 (Fig. 5). Large-scale outbreaks of these bark beetles have been rare in the southwest; however, increased Douglas-fir beetle activity can be observed in drought-stressed forests or those immediately surrounding recent fire scars.

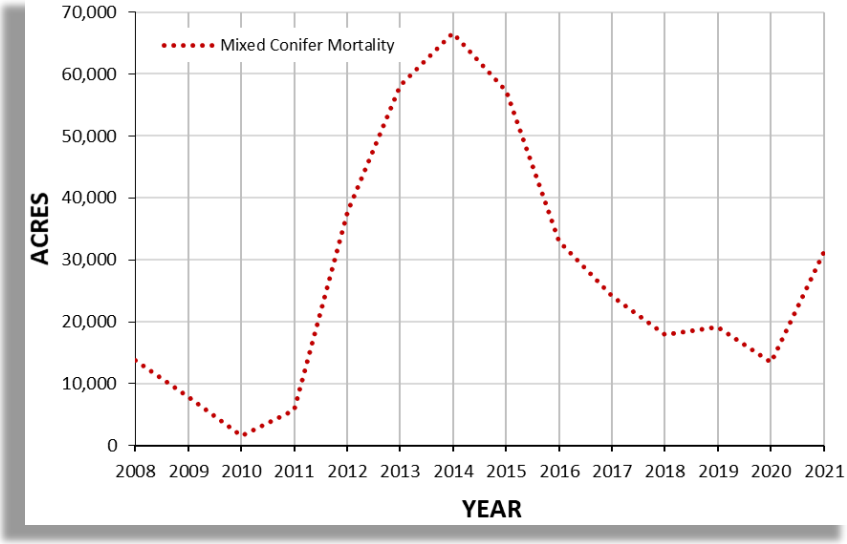


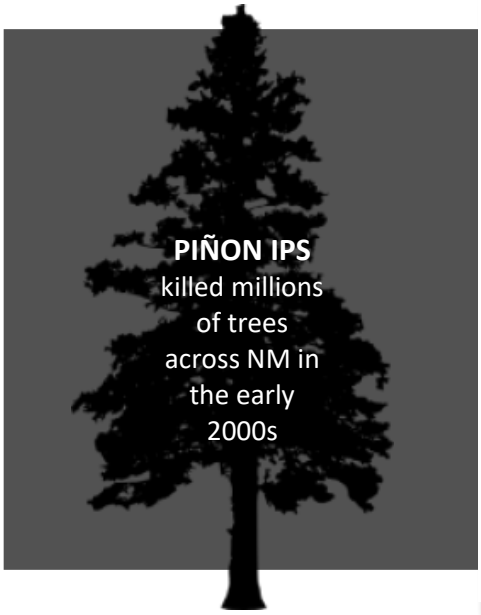
Figure 5. Trend of statewide bark beetle-induced mixed conifer mortality on all land types in New Mexico from 2008-2021.

Piñon Ips

(*Ips confusus*)

257,000
acres mapped with bark beetle-killed piñon trees over the last decade

Piñon ips has been the most significant mortality agent of piñon in New Mexico and outbreaks of this species have been driven by prolonged drought conditions. In 2021, approximately 67,000 acres with bark beetle-killed piñon were mapped in the state, which was a substantial increase in acres since 2020 and the most mapped since 2013 (Fig. 6). This increase was most likely influenced by the on-going severe drought conditions. Most of the 2021 acreage was mapped on private land in Sandoval and Cibola counties and in the northern part of the state on Navajo Nation and Bureau of Land Management lands. Most of the remaining mortality was mapped on National Forest and state and private lands south of 1-40. If drought conditions don't improve piñon mortality may continue to increase over the next few years.



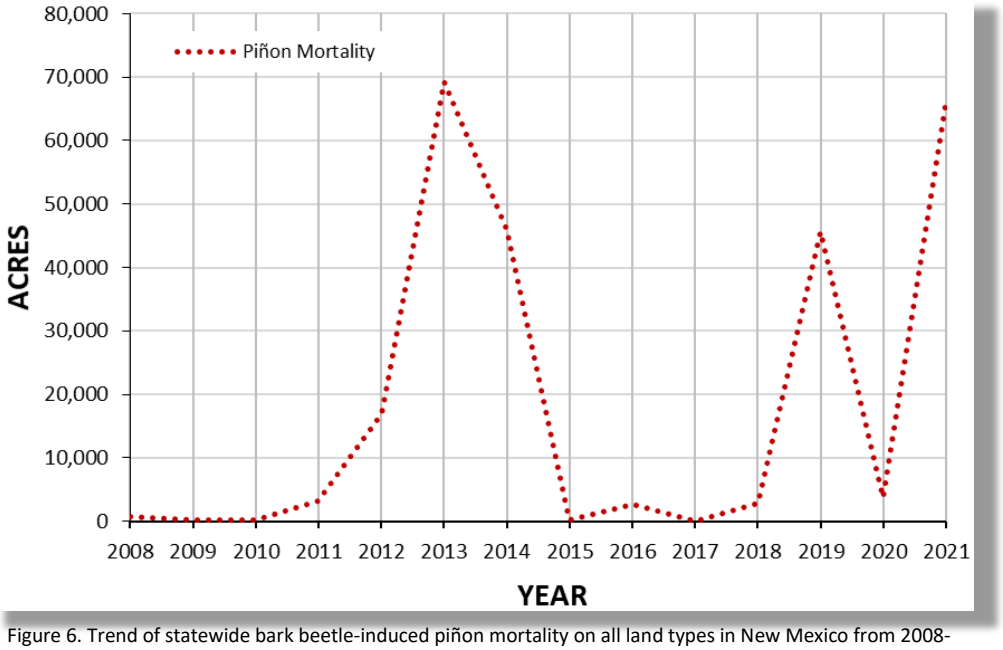
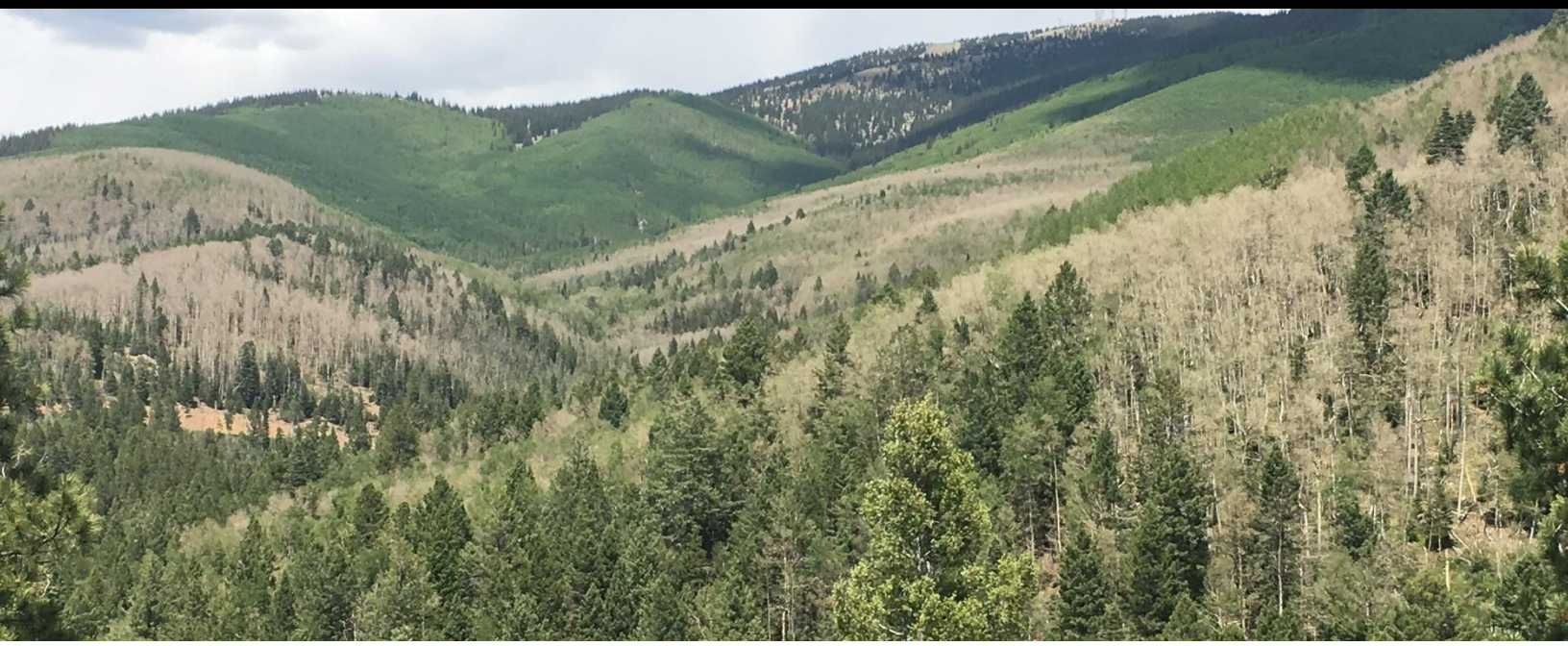


Figure 6. Trend of statewide bark beetle-induced piñon mortality on all land types in New Mexico from 2008-2021.



DEFOLIATION AGENTS

Defoliation agents, such as western spruce budworm or western tent caterpillar, have damaged approximately 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 decreased by 13% from 2020 to 2021 (Fig. 7), which was due to a decrease in western spruce budworm and western tent caterpillar defoliation activity. Defoliation on state and private lands in 2021 increased 26% from 2020 levels, which was due to increased ponderosa pine needleminer and piñon needle scale defoliation activity.

3.8M

acres of trees mapped with defoliation over the last decade

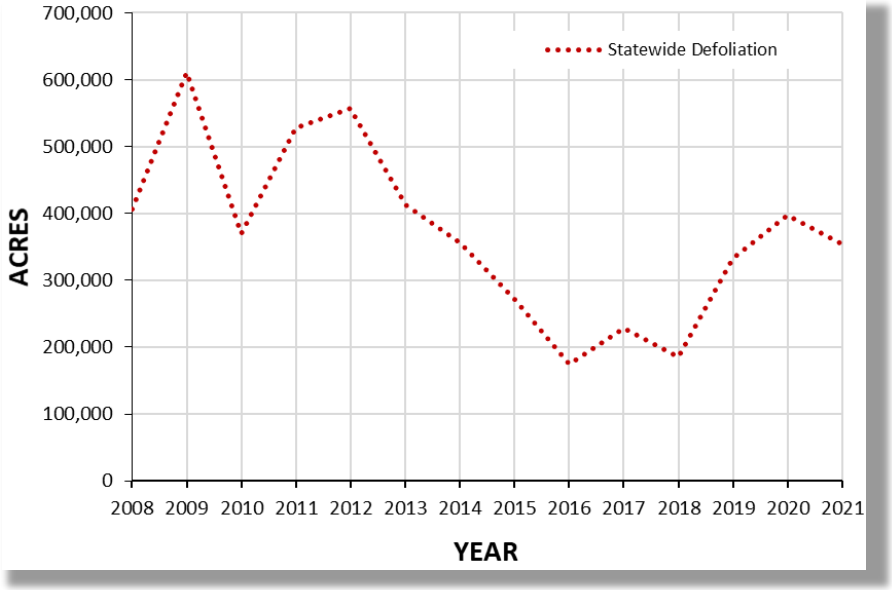


Figure 7. Trend of statewide defoliation activity on all land types in New Mexico from 2008-2021.

Western Spruce Budworm

(*Choristoneura freemani*)

Caterpillars of this moth feed on Douglas-fir, true firs (e.g. white fir), and spruce. In 2021, western spruce budworm (WSBW) feeding was detected on 223,000 acres of forests statewide and was, once again, the most damaging defoliation agent in New Mexico. The number of acres on all land types with WSBW activity decreased 23% between 2020 and 2021 (Fig. 8), possibly due to decreased defoliation severity. Similarly, WSBW feeding activity on state and private lands decreased 5% between 2020 and 2021. Most of the WSBW feeding activity mapped on tribal forests occurred on the Jicarilla Apache (6,800 acres) and Taos Pueblo (5,600 acres) lands, which was comparable to 2020 levels. 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 93% 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. 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's defoliation activity generally are more susceptible to bark beetle attack.

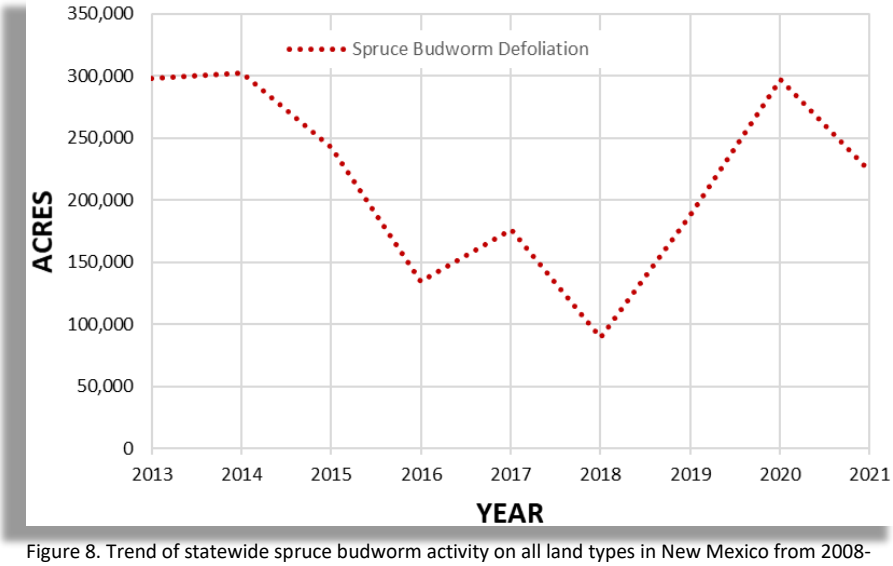


Figure 8. Trend of statewide spruce budworm activity on all land types in New Mexico from 2008-2021.

Ponderosa Needleminer

(*Coleotechnites ponderosae*)

1989

52,000 acres were mapped in San Miguel County with needleminer defoliation damage

The tiny caterpillar of this species feeds within needles of ponderosa pine and has caused dramatic visual change over large areas (bottom image below). Feeding damage caused by this insect does not normally lead to tree death, but the damage can stress trees and make them more susceptible to bark beetle attack. This was the fourth year of a large-scale outbreak of this moth species on and around the Vermejo Park Ranch near Raton and acres affected by the species in this area increased to 100,000 acres or over 100% between 2020 and 2021. Additionally, this year, the species continued spreading around 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.

Above: Ponderosa needleminer caterpillar extracted from its feeding location with a needle sheath. Below: Large-scale defoliation damage (yellow crowns) on Vermejo Park Ranch caused by the ponderosa needleminer.

Aspen Defoliators

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

6 years
of a western tent caterpillar outbreak in the Aspen Vista area of the Santa Fe National Forest

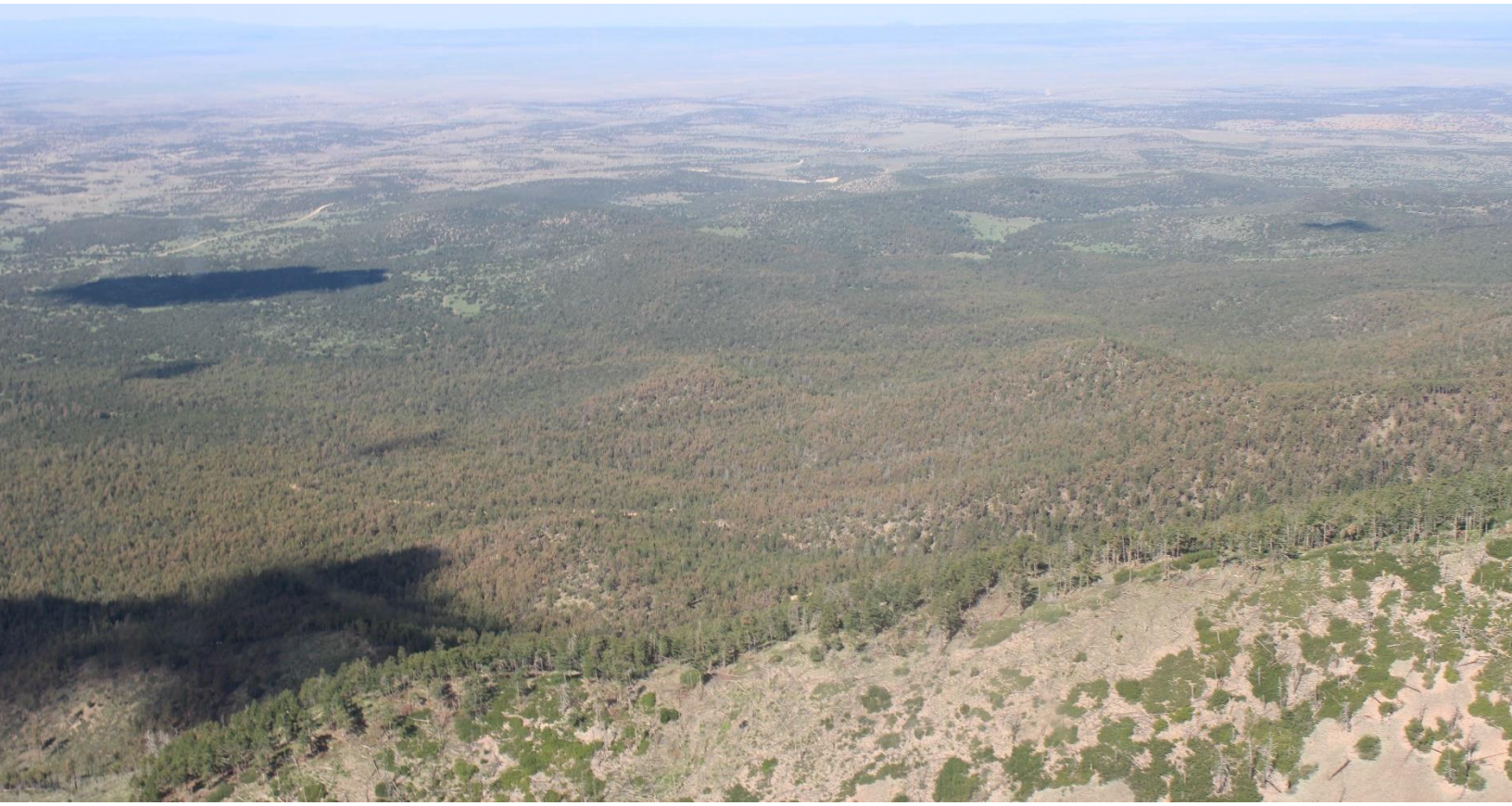
The western tent caterpillar and large aspen tortrix have been the main defoliating agents of aspen in New Mexico and large-scale, chronic outbreaks of these species have been common. Large-scale aspen foliar disease (e.g. black ink spot) outbreaks were recorded in 1980's and 1990's; however, because of below average annual precipitation rates and above average temperatures, these disease events recently have been rare in New Mexico. In 2021, approximately 13,000 acres of aspen were defoliated across the state, the majority of which occurred on the Santa Fe National Forests. Overall acres impacted by these defoliators decreased 78% between 2020 and 2021. Aspen defoliation on state and private lands decreased 83% with most activity mapped in Rio Arriba, San Miguel, Colfax, and Taos counties. Aspen defoliation activity on tribal lands decreased substantially from 2020 to 2021 with 40% and 26% of the total damage mapped on the Taos and Laguna Pueblo, respectively. The large-scale outbreak of western tent caterpillar around the Aspen Vista area of the Santa Fe National Forest remained 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 eventually over the next few years.

Aspen defoliation caused by the western tent caterpillar around the Aspen Vista area of the Santa Fe National Forest.

ABIOTIC DISTURBANCE

Drought and Heat

Approximately 121,000 acres of ponderosa forests were mapped statewide this year with discoloration caused by drought- and heat-related stress. Ponderosa pine naturally sheds old needles every year; however, needles on affected trees are turning yellow months before they do normally. This symptom was a strong indicator of continued drought- and heat-related stress. Most discoloration was mapped on state and private land (35,000 acres), the Carson (26,000 acres) and Gila National Forests (23,000 acres). The discoloration on state and private lands was concentrated to Mora and Colfax counties. Unfortunately, these visually drought-stressed ponderosa forests may experience increased twig beetle activity or bark beetle-induced mortality over the next few years.



Drought- and heat- stressed (yellow-orange crowns) ponderosa pines near Gallinas Peak on the Cibola National Forest.

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, 2021 was the 7th warmest year on record in New Mexico and statewide precipitation average 1.55 inches below normal (i.e. the 36th driest year on record). Despite slightly improved drought conditions throughout the state, acres of forest mortality increased between the 2020 and 2021. The National Weather Service predicts drought conditions in New Mexico will persist well into 2022. As a result, continued drought and heat stress on trees coupled with increased defoliation may set the stage for increased bark beetle-related tree mortality in the next 1-3 years.

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APPENDIX

REFERENCES

Allen, C. D., Macalady, A. K., Chenchouni, H., Bachelet, D., Mcdowell, N., Vennetier, M., Kitzberger, T., Rigling, A., Breshears, D.D., Hogg, E.H., et al. 2010. A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests. Forest Ecology and Management 259: 660-684.

Bale, J. S., Masters, G. J., Hodkinson, I. D., Awmack, C., Bezemer, T. M., Brown, V. K., Butterfield, J., Buse, A., Coulson, J. C., Farrar, J., Good, J. E. G., Harrington, R., Hartley, S., Jones, T. H., Lindroth, R. L., Press, M. C., Symrnioudis, I., Watt, A. D., Whittaker, J. B. 2002. Herbivory in global climate change research: direct effects of rising temperature on insect herbivores. Global Change Biology 8: 1-16.

Kurz, W. A., Dymond, C. C., Stinson, G., Rampley, G. J., Neilson, E. T., Carroll, A. L., Ebata, T., Safranyik, L. 2008. Mountain pine beetle and forest carbon feedback to climate change. Nature 452: 987-990.

Raffa, K. F., Aukema, B. H., Bentz, B. J., Carroll, A. L., Hicke, J. A., Turner, M. G., Romme, W. H. 2008. Cross-scale drivers of natural disturbances prone to anthropogenic amplification: the dynamics of bark beetle eruptions. AIBS Bulletin 58: 501-517