New Mexico Forest Health Conditions Report, 2016


Ponderosa pine mortality, Piños Altos Range

Energy, Minerals, and Natural Resources Department
Forestry Division

1. Summary

The New Mexico State Forestry (NMSF) Division collaborates with the USDA Forest Service, Forest Health Protection (FHP), New Mexico Zone to conduct annual insect and pathogen surveys of the state's forests and woodlands. The following report describes what forest health specialists, entomologists, pathologists, and aerial surveyors observed and documented across New Mexico in 2016.

Most of the information in this report was collected by aerial detection surveys (ADS)[1]. The maps associated with ADS data (**Appendix 1**) were produced in partnership with FHP[2]. Additional materials were gathered through the observations of NMSF and FHP personnel, interactions with the private sector, ground checks, and cooperative monitoring projects. The NMSF Forest Health Program Manager provided observational commentary and insight.

A variety of defoliating and tree-killing forest insects and pathogens were identified and mapped by ADS during the 2016 flight season. The surveys encompassed ~10.7 million acres of forests and woodlands, including ~2.6 million acres of state and private lands. Across the entire state, ~286,000 of the acres surveyed were damaged by insects and pathogens[3]. This is a considerable decrease (-28%) from the ~399,000 acres of damage mapped in 2015 (**Table 1; Fig. 1a**). Of this damage, ~82,000 acres occurred on state and private land, which is a corresponding decrease (-29%) from the ~117,000 acres mapped in 2015 (**Table 2; Fig. 1a**). Statewide trends for defoliation and mortality have declined since 2012 and 2013, respectively (**Fig. 1b**), and overall damaged acres across New Mexico decreased by 60% since 2013.

Following over a decade of severe and persistent drought, favorable moisture conditions returned to New Mexico in late 2014. Drought conditions continued to subside during the uncharacteristically wet spring and moderate-to-strong summer monsoon of 2015. Similar moisture conditions prevailed through 2016, contributing to a third consecutive year of sharp reductions in statewide defoliator and bark beetle activity. Despite relief from long-term drought, serious damages were observed in some areas:

- i) Aspen and mixed conifer defoliation north of Interstate 40, including a striking Douglas-fir tussock moth outbreak on Shaggy Peak near Cañada de los Alamos;
- ii) Ponderosa pine mortality on the Piños Altos Range, Black Range, and Southern Sacramento Mountains;
- iii) Mixed conifer mortality on middle elevation slopes statewide;
- iv) Spruce mortality on portions of the San Juan, Jemez, Sangre de Cristo, and Northern Sacramento Mountains.

These issues emphasize the continued need for managers to develop and conduct silvicultural treatments to reduce tree density on much of the state's forests and woodlands. Insect infestations and forest disease complexes (many interacting factors) are nearly impossible to suppress or control once in place; therefore, prevention is the proper forest health strategy. Prevention is achieved by restoring the capacity of a forest ecosystem to resist disturbance, recover quickly, and retain vital structure and function. This is called *forest resiliency*. Without resilient forests, damage will continue until the responsible agents run out of hosts.

Spruce mortality, Brazos Ridge (photo credit: Dan Ryerson, FHP)

Mixed conifer invasion of wet ponderosa site due to fire exclusion, Nacimiento Mountains

[1] ADS datasets are collected under difficult conditions and are not intended to replace more specific forest health information. An accuracy assessment has not been done for this dataset; however, ground checks were completed in accordance with local and national guidelines. NMSF and FHP shall not be held responsible for missing or inaccurate data. Maps and data may be updated without notice.

[2] Geospatial data shown for only defoliation and mortality damage types with ≥1000 statewide acres.

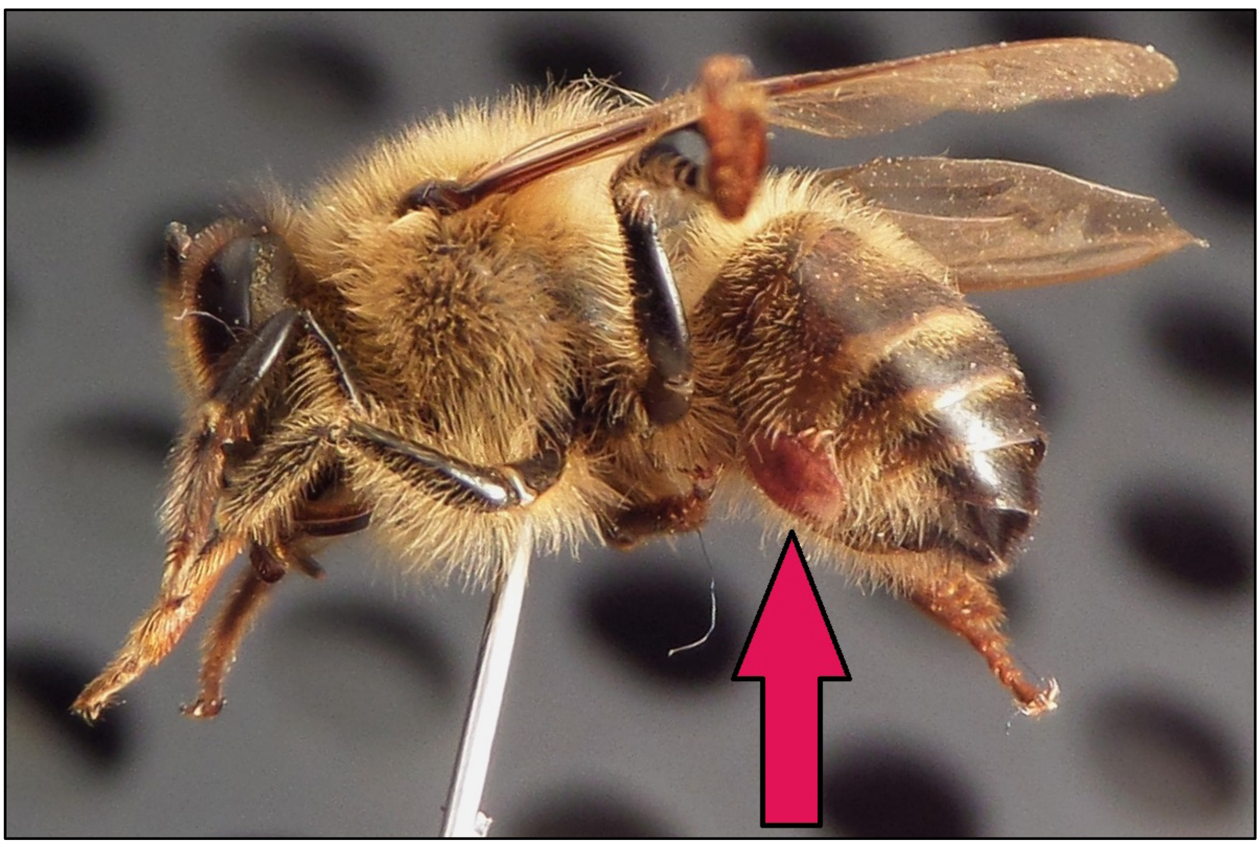
[3] Damaged areas may be mapped with more than one damage agent. The acres reported in this section represent the total "footprint" of damage, with no multiple counting of acres. Not all trees in a damaged footprint are defoliated or dead.

2. Observed Conditions

2.1. Technical assistance

The NMSF Forest Health Program Manager provided a variety of technical assistance to private landowners and state and federal agencies in 2016 (**Table 3**). There were 72 documented requests for support; 22% involved crown dieback or mortality of conifers and 29% were requests for insect or pathogen identification. Of these interactions, 13 required site visits. Assistance regarding tree damage is considerably more frequent when low-to-middle elevation tree mortality occurs near population centers. A high proportion of requests for identification or general information is casually suggestive of a year with adequate widespread moisture.

Requests for identification often serve as an opportunity to learn something new. One of the more stimulating requests I received in 2016 was not about tree but “bee” mortality. Although dead bees are not a straightforward forest health issue, pollinator declines are an indicator of ecosystem health at large, and honey bees are essential to global agriculture. These are just a few of the reasons why we should all “Bee Aware”[1]. The picture below illustrates the causal agent of varroosis disease, a possible contributing factor of colony collapse disorder.



Varroa mite on honey bee from a collapsed colony

[1] New Mexico Governor Susanna Martinez proclaimed June 15, 2016 as Bee Aware Day to promote education about the importance of bees to New Mexico’s economy and quality of life.

2.2. Defoliation agents

Defoliation agents cause dramatic visible damage but do not often kill mature trees during a single event. The immediate effects of defoliation are reduced vigor and photosynthetic capacity. Successive years of heavy defoliation can cause growth deformity, crown dieback, and eventually tree death. In general, defoliation weakens trees and predisposes them to the attack of deadlier damage agents. Statewide defoliation decreased by 30% from 2015 to 2016.

2.2.1. aspen

A broad set of insects and fungi defoliate aspen in New Mexico. Of these, the western tent caterpillar (*Malacosoma californicum*) was the most important species of the past few years. Impressive western tent caterpillar outbreaks were observed near the Santa Fe Ski Area and from Canjilon Mountain to the Colorado border. Despite these events, there was a 13% statewide decrease in aspen defoliation from 2015 to 2016. This corresponds with a steep decline (-84%) in defoliation since a spike in activity in 2012. The outbreak pictured below was adjacent to high-use recreation sites along Hyde Park/Santa Fe Ski Basin Road. Complete defoliation of affected host occurred by late June. However, aspen recovered and refoliated by early August and experienced little to no mortality.

Heavy aspen defoliation, Sangre de Cristo Mountains

2.2.2. western spruce budworm (*Choristoneura freemani*)

Larvae of this moth feed on most mid-to-high elevation conifer species, but Douglas-fir and true firs (*Abies* spp.) are the preferred hosts in New Mexico. Severe infestations can spread across entire forested landscapes without following an apparent pattern. The overstocked mixed conifer forests of Northern New Mexico are currently experiencing a savage, multi-year spruce budworm outbreak. Although the southern half of the state does not generally suffer from the large-scale defoliation events common north of Interstate 40, several budworm outbreaks were observed on the Southern Sacramento Mountains near Cloudcroft. Budworm defoliation has declined every year since 2011, and has now dropped to 135,000 acres[1].

2.2.3. needle cast

Several different species of needle cast fungi attack conifers in New Mexico. These pathogens are uncommon in the American Southwest because the weather conditions required for infection and reproduction (e.g., high humidity and splashing rain) are not usually present when needle cast fungi require them. New Mexico experienced a wet spring for the second year in a row, and needle casts on piñon, ponderosa pine, and mixed conifer were reported and observed across the state. Of these hosts, ponderosa pine on the east slope of the Sangre de Cristo Mountains had the largest infection footprint. Needle cast caused ~15,000 acres of statewide defoliation in 2016, which is a >100% increase from last year.

2.2.4. Douglas-fir tussock moth (*Orgyia pseudotsugae*)

Douglas-fir and white fir are the preferred hosts of this moth larva in New Mexico. Defoliation is often complete in both overstory and understory trees, and, unlike other common defoliators, severe outbreaks can cause mortality in less than two years. Dispersal is somewhat limited because females are flightless and must reproduce near their place of origin. Therefore, tussock moth defoliation in New Mexico is rarely widespread, but outbreaks are highly visible and troublesome (due to tussockosis) when they occur near population centers. A ~10,000-acre tussock moth infestation occurred on and near Shaggy Peak in 2016. This single event caused a >100% increase in statewide tussock moth activity. Small outbreaks were also observed on the Sandia Mountains and near Cloudcroft. The Sandia population will likely erupt along the Sandia Crest Highway next year. This busy recreational thoroughfare will provide the public with an unobstructed view of potentially lethal defoliation.

Heavy Douglas-fir tussock moth defoliation, Shaggy Peak (photo credit: Tom Coleman, FHP)

The Shaggy Peak outbreak occurred in extremely dense (800-1000 trees per acre) two-storied stands of dominant ponderosa pine and codominant and intermediate Douglas-fir and white fir. Defoliation levels of preferred hosts were 90-99%, and some feeding was observed on non-host ponderosa pine. An egg mass survey conducted in October showed that the population is destined to crash in 2017 due to low egg mass numbers and the ubiquitous presence of a naturally-occurring nuclear polyhedrosis virus.

2.2.5. pine needle miner (*Coleotechnites* sp.)

Ponderosa pine is the preferred host of this moth larva. Development is completed in a single needle; thus, needle miner is rarely counted among the serious defoliators of New Mexico. Extensive needle death occurred across ~7,300 acres of mostly private land on Mount Taylor. Though tree injury was unsightly, needle miner defoliation impacted <20% of the living crowns, and tree mortality was not evident in the footprint of this outbreak. This was the first year that pine needle miner appeared anywhere in the state on a scale large enough to observe from the air.

2.2.6. pine sawfly (*Neodiprion* sp.)[2]

Ponderosa pine is the preferred host of this stingless wasp larva. When present in sufficient numbers, sawflies create extensive defoliation pressure for host pines. There were 640 acres of sawfly defoliation in 2016. The only reason that sawfly earned a spot in this report is because 100% of the activity occurred on state land on the Luera Mountains. New Mexico has experienced a decreasing trend in sawfly activity since 2012.

2.2.7. tamarisk (saltcedar) leaf beetles (*Diorhabda* spp.)[3]

Tamarisk leaf beetles are exotic biocontrol agents that entered New Mexico from legal introductions in neighboring states. Several species of leaf beetle currently defoliate tamarisk along waterways statewide. The northern half of the state has the northern tamarisk beetle (*D. carinulata*), an ecotype adapted to colder environments; the southern half has the subtropical tamarisk beetle (*D. sublineata*), an ecotype adapted to warmer environments. Leaf beetles offer land managers an exciting opportunity to intensify control efforts for non-native, invasive tamarisk where it has replaced cottonwood, willow, and other native riparian tree species.

Until recently, leaf beetle was absent from Albuquerque to the southern border. The situation changed drastically in 2015 when the northern and southern populations rapidly advanced along the Rio Grande Corridor to San Antonio and Elephant Butte Reservoir, respectively. By the end of 2016, only a small gap remained near Bosque del Apache National Wildlife Refuge. Full coverage of the Rio Grande will occur next spring when these converging populations meet for the first time ever in nature. The southern population also advanced west of the Rio Grande Corridor towards Silver City in 2016. Though movements are difficult to predict across deserts, the Upper Gila River might experience an infestation next year. From there, leaf beetle could rapidly colonize the Gila, Salt, Verde, and Agua Fria Rivers in Arizona, where biocontrol of tamarisk is currently absent.

[1] Though much of the reduction in western spruce budworm defoliation is a true ecological effect, some is because of a change in survey protocol. New Mexico's aerial surveyors no longer map light budworm activity.

[2] Sawfly geospatial data not shown on maps because <1000 statewide acres were observed.

[3] Tamarisk data not shown anywhere in this report because ADS does not provide an accurate estimate of statewide acres. Special surveys of river and stream corridors are required to capture this data.

2.3. Mortality agents

The principal cause of tree mortality in New Mexico is the activity of native bark beetles. Endemic (non-outbreak) beetle populations always have, and always will, kill New Mexican trees as part of a normal predator–prey relationship. Problematic tree mortality occurs when endemic populations switch to an epidemic phase, leading to widespread and severe outbreaks that have sizeable impacts on the ecology of entire forested regions. These outbreaks have strong relationships with environmental factors that reduce tree defenses, especially prolonged drought. Statewide mortality decreased by 23% from 2015 to 2016, primarily because abundant moisture allowed healthy conifers to resist bark beetle attacks with defensive resins. Trends in bark beetle activity since 2008 are provided in **Fig. 2**.

Resin mass (pitch tube) from a red turpentine beetle attack, ponderosa pine

2.3.1. spruce–fir bark beetles

Spruce beetle (*Dendroctonus rufipennis*) and western balsam bark beetle (*Dryocoetes confusus*) attack New Mexico's spruce and subalpine fir, respectively. There were ~41,000 acres of statewide spruce–fir mortality in 2016, which is a 24% increase from last year. Nearly all spruce–fir mortality occurred in spruce; bark beetle activity in neighboring subalpine fir was extremely low (~2,000 acres). Statewide spruce mortality has increased 290% since 2013.

This alarming spruce beetle epidemic continues to spread across New Mexico while all other bark beetle populations decline in the face of several years of favorable moisture conditions. This is because spruce beetle populations do not correspond with drought as much as other bark beetles. Other factors besides drought that influence spruce beetle include availability of susceptible host, local disturbances (especially blowdown events), and temperature. Of these, I suspect that temperature is the most relevant variable. Warm summers and lack of extreme and sustained freezing wintertime temperatures in the New Mexican high country are probable contributors of the current population explosion. Warm summers can accelerate beetle life cycle from semivoltine (one generation per two years) to univoltine (one generation per year). Mild winters allow overwintering adults to survive until the next season. A series of harsh winter freezes (below -15°F) are needed to kill spruce beetle. Until then, the threat of imminent landscape-level spruce mortality is high.

2.3.2. mixed conifer bark beetles

Douglas-fir beetle (*Dendroctonus pseudotsugae*) and fir engraver (*Scolytus ventralis*) attack New Mexico's Douglas-fir and white fir, respectively. They caused a combined total of ~33,000 acres of statewide mixed conifer mortality, which is a 44% decrease from 2015. Despite this dramatic decrease, mixed conifer forests continue to be one of the most assailed forested habitats in New Mexico. Historically imbalanced tree species distributions and overly dense forest conditions beget the constant threat of bark beetle outbreaks and catastrophic wildfire.

2.3.3. ponderosa pine bark beetles

Dendroctonus and *Ips* bark beetles attack New Mexico's ponderosa pine. The important species in these two genera are: pine engraver (*I. pini*); western pine beetle (*D. brevicomis*); roundheaded pine beetle (*D. adjunctus*); and red turpentine beetle (*D. valens*). These beetles caused a combined total of ~21,000 acres of statewide ponderosa pine mortality, which is a 34% decrease from 2015. This decline in activity is apparent everywhere except the forests of Southern New Mexico, where ponderosa pine continues to suffer from the severe impacts of long-term bark beetle infestations.

2.3.4. aspen

Aspen stands are damaged by a set of mortality agents that cannot be distinguished during ADS. Outrageous regional losses to aspen following the mega-droughts of the 2000's appear to be over. New aspen mortality across New Mexico has been low for the past 5 years. There were ~3,000 acres of statewide aspen mortality in 2016. Much of this damage was limited to Peñasco Amarillo near Brazos Cliffs.

2.3.5. piñon ips (*I. confusus)*

Piñon occupy low elevation sites that are particularly prone to drought in New Mexico. Predictable piñon ips outbreaks occur during or following any hot and dry year. Recent outbreaks on the Manzano and Sandia Mountains subsided when moisture conditions improved last year. Ips caused ~3,000 acres of statewide piñon mortality, mostly on El Malpais National Conservation Area near Cebollita Mesa and the Southern Black Range near Log Cabin Peak.

3. Conclusions

Forest health in the state of New Mexico is tied to climatic trends and large-scale weather cycles. These include the El Niño Southern Oscillation, the Pacific Decadal Oscillation, and others. These cycles impact New Mexico's weather by controlling the location of high and low pressure centers, which, in turn, dictate precipitation across the state. New Mexico's long-term climate follows a bimodal distribution of precipitation, with spikes in winter and the summer monsoon. Trees suffer during the warm and dry spring because the timing of seasonal drought coincides with insect emergence and attack. The unusually wet springs of 2015 and 2016 provided our forests with much-needed relief from years of deep, multi-year drought and associated insect outbreaks.

We should be encouraged by recent weather patterns and subsequent improvements to the health of our forests. But several years of adequate moisture cannot defeat a 15-year drought. Current reservoir levels tell a story that is consistent with the region's long-term moisture deficit (**Table 4**). Of the ten largest reservoirs in New Mexico, only one is above 30% capacity, and only two are above their respective 30-year average. Averaged together, these large reservoirs are 20% below average capacity.

The National Weather Service recently ended the La Niña Advisory that was in place for much of winter 2016/17. El Niño Southern Oscillation neutral conditions currently exist over the Pacific Ocean and are expected to persist into summer 2017. However, the National Oceanic and Atmospheric Administration's Climate Prediction Center forecasts the increased likelihood of warmer and drier conditions for New Mexico through late spring.

Strong monsoon and looming spruce mortality, Elk Mountain


Juniper twig pruner and expansive New Mexican sky, Santa Fe County

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NEW MEXICO STATE FORESTRY

Table 1. Statewide aerial detection survey results for forest insect and pathogen activity in New Mexico

Damage type[1]	2016 acres	2015 acres	% Δ[2]
Defoliation			
By host[3]			
aspen	22,140	25,360	-13
By agent			
western spruce budworm	134,670	242,170	-44
needle cast (multiple hosts)	14,640	5,010	>100
Douglas-fir tussock moth	10,870	1,570	>100
pine needle miner	7,270	0	–
piñon needle scale	890	0	–
pine sawfly	640	140	>100
unknown (multiple hosts)	410	590	-31
defoliation summary	191,530	274,840	-30
Mortality			
By forest type[4]			
spruce–fir	40,670	32,900	24
mixed conifer	32,990	58,420	-44
By host[3]			
ponderosa pine	21,480	32,470	-34
aspen	3,240	7,340	-56
southwestern white pine	*	100	-99
By agent			
piñon ips	2,670	210	>100
mortality summary	101,050	131,440	-23
Other			
branch flagging (multiple hosts)	2,680	40	>100
discoloration (multiple hosts)	510	250	>100
dieback (multiple hosts)	150	2,630	-94
other summary	3,340	2,920	14
grand summary	295,920	412,120	-28
total area mapped[5]	286,170	398,810	-28

[1] Data not shown for damage types with <100 acres in both current and preceding year
[2] (2016 acres - 2015 acres) / 2015 acres * 100
[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 more than one damage agent. The total area mapped represents the “footprint” of damage, with no multiple counting of acres; summary values reflect multiple counting
[*] Activity detected, but on less than 5 acres

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

Damage type	2016 acres	2015 acres	% Δ[1]	% all lands[2]
Defoliation				
By host[3]				
aspen	9,350	8,060	16	42
By agent				
western spruce budworm	36,320	82,670	-56	27
needle cast (multiple hosts)	13,300	2,060	>100	91
Douglas-fir tussock moth	290	490	-41	3
pine needle miner	6,210	0	–	85
piñon needle scale	0	0	–	0
pine sawfly	640	50	>100	100
unknown (multiple hosts)	110	40	>100	27
defoliation summary	66,220	93,370	-29	35
Mortality				
By forest type[4]				
spruce–fir	5,540	3,100	79	14
mixed conifer	9,590	16,790	-43	29
By host[3]				
ponderosa pine	1,050	2,120	-50	5
aspen	1,530	2,410	-37	47
southwestern white pine	0	0	–	0
By agent				
piñon ips	40	70	-43	1
mortality summary	17,750	24,490	-28	18
Other				
branch flagging (multiple hosts)	1,540	30	>100	57
discoloration (multiple hosts)	110	210	-48	22
dieback (multiple hosts)	40	140	-71	27
other summary	1,690	380	>100	51
grand summary	85,660	118,240	-28	29
total area mapped[5]	82,380	116,650	-29	29

1 (2016 acres - 2015 acres) / 2015 acres * 100
2 State and private acres as a percentage of statewide acres (**Table 1)**
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 more than one damage agent. The total area mapped represents the "footprint" of damage, with no multiple counting of acres; summary values reflect multiple counting

Table 3. Summary of forest health technical assistance given in 2016

Assistance type	#	%	Site visit	Confirmed damage agents[1]
Private landowner				
request (identification)	14	32	1	black-horned juniper borer, varroa bee mite, inky cap
mortality (conifer)	7	16	0	piñon ips, cedar bark beetle, cypress tip moth
request (info)	7	16	0	–
defoliation (conifer)	4	9	1	Douglas-fir tussock moth, piñon needle scale, tiger moth
dieback (conifer)	4	9	2	juniper twig pruner, bark moth
defoliation (hardwood)	3	7	1	western tent caterpillar, fall webworm, bagworm
mortality (hardwood)	3	7	3	Cytospora canker, drought stress
dieback (hardwood)	2	4	1	Drummond's blue buprestid
landowner total	44		9	
State government				
request (identification)	6	24	0	Oslar's oakworm moth, pleasing fungus beetle, fir broom rust
request (info)	5	20	0	–
defoliation (hardwood)	4	16	2	elm leaf beetle, bagworm, tamarisk leaf beetle
dieback (conifer)	3	12	1	pine engraver, juniper tip blight, sunscald
mortality (hardwood)	3	12	0	European elm scale, black canker
defoliation (conifer)	2	8	0	pine & piñon sawfly
dieback (hardwood)	1	4	0	bacterial leaf scorch
mortality (conifer)	1	4	0	piñon ips
state total	25		3	
Federal government				
dieback (conifer)	1	33	1	mechanical damage
defoliation (conifer)	1	33	0	piñon needle scale
request (identification)	1	33	0	dog vomit slime mold
federal total	3		1	
grand total[2]	72		13	

1 Identity determined by site visits, samples, or picture analysis
2 2015: # = 79; site visit = 15

Table 4. Water storage of the ten largest reservoirs by volume in New Mexico (data provided by the USDA Natural Resources Conservation Service)

Name	Current % capacity[1]	Average % capacity[2]
El Vado	28	53
Conchas	29	79
Caballo	9	30
Heron	17	74
Santa Rosa	12	12
Cochiti	9	12
Brantley	4	2
Abiquiu	10	13
Navajo	79	76
Elephant Butte	13	59
average	21	41

1 As of March 1, 2017
2 Based on 1981-2010 reference period

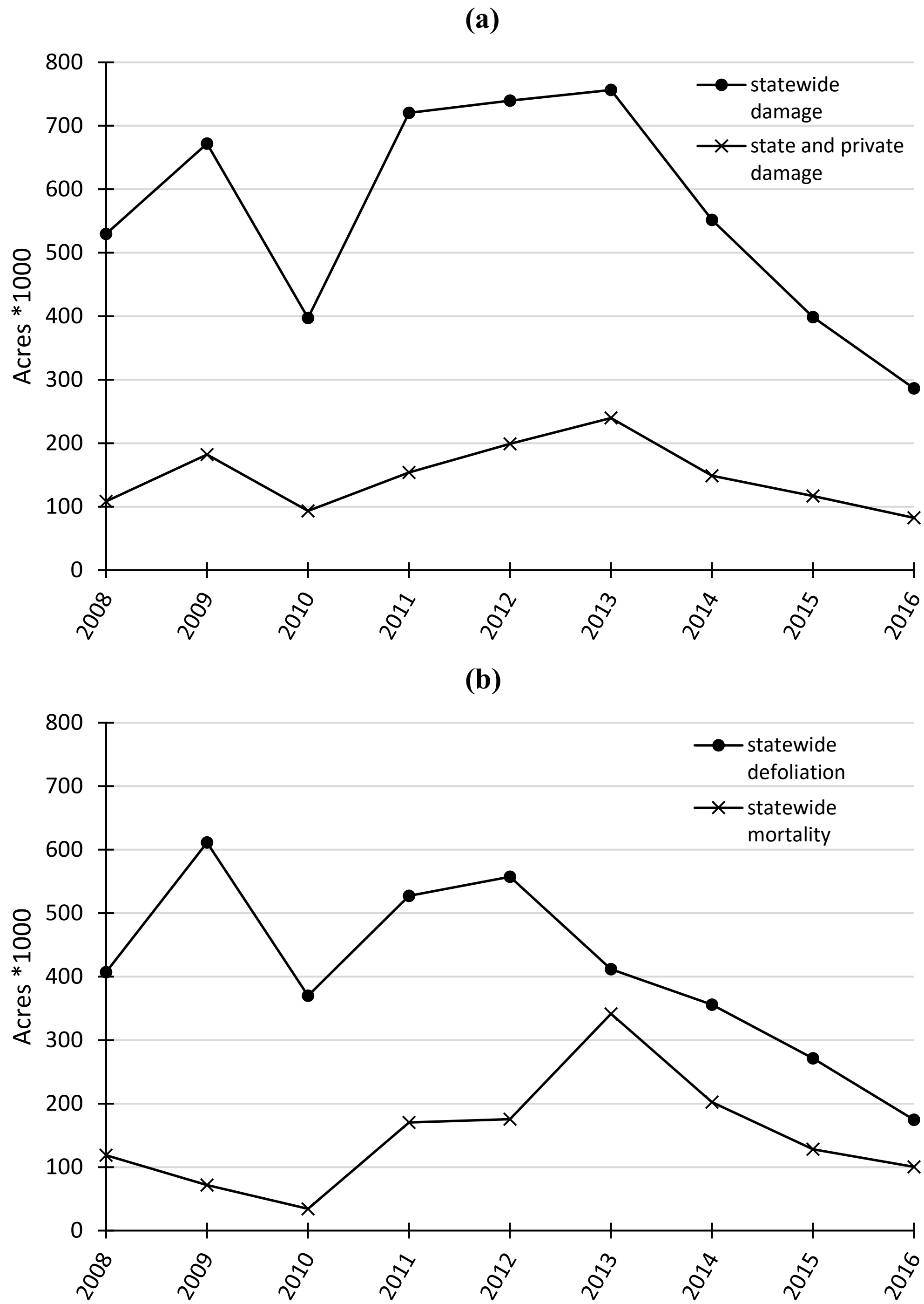
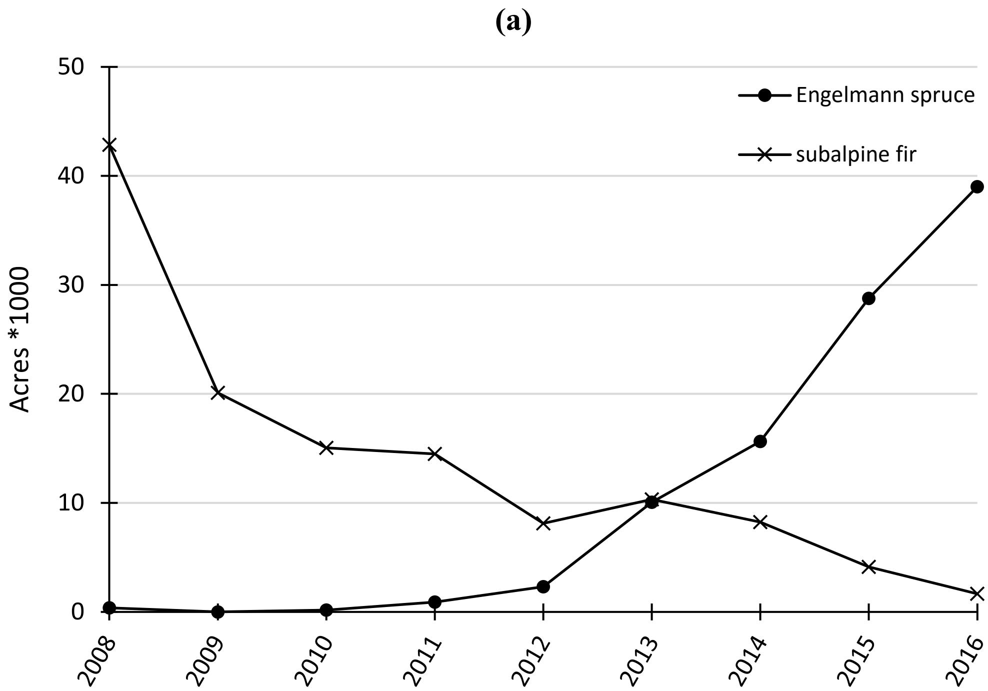


Figure 1. Trends for **(a)** statewide and state and private forest damage and **(b)** statewide forest defoliation and mortality in New Mexico; data before 2008 is not directly comparable to current data



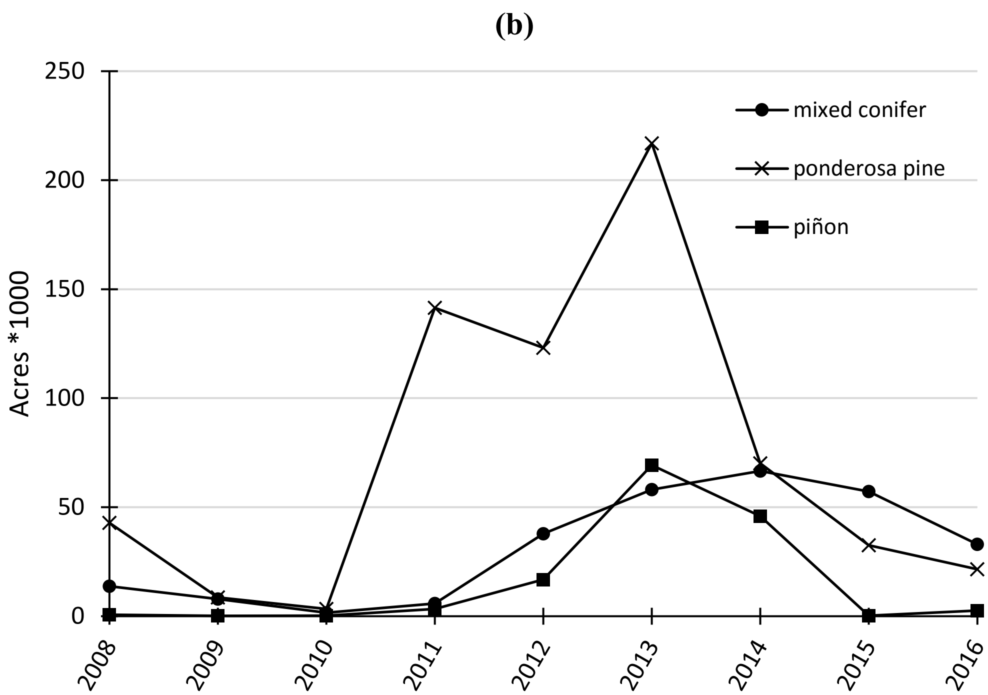
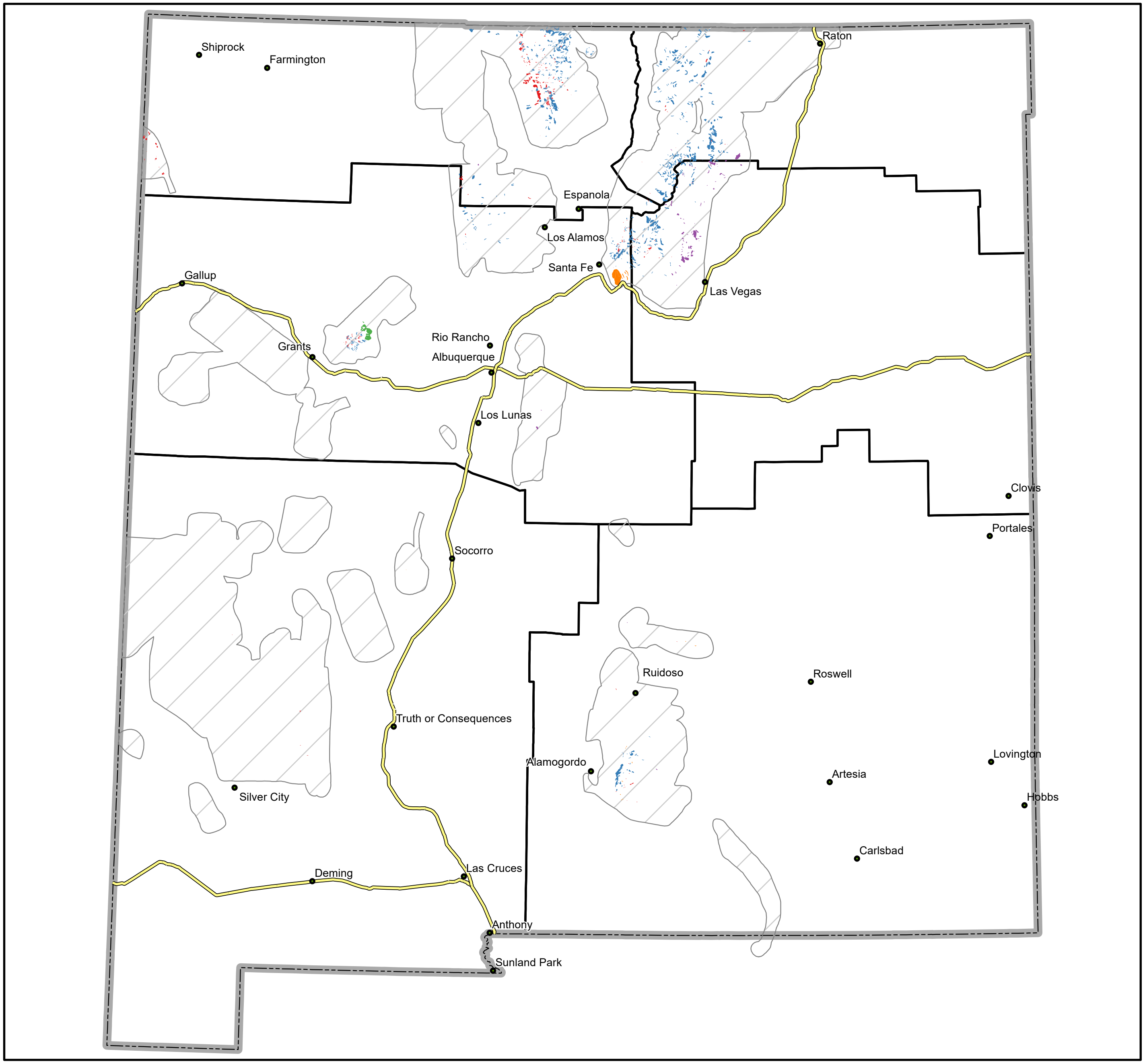


Figure 2. Statewide mortality trends for **(a)** high elevation and **(b)** middle and low elevation conifers in New Mexico due to bark beetles

2016 Forest Insect and Pathogen Activity

Defoliation

- Aspen
- Western spruce budworm
- Douglas-fir tussock moth
- Pine needle miner
- Needle cast
- Survey Extent
- NM Boundary
- NMSF Districts



Miles
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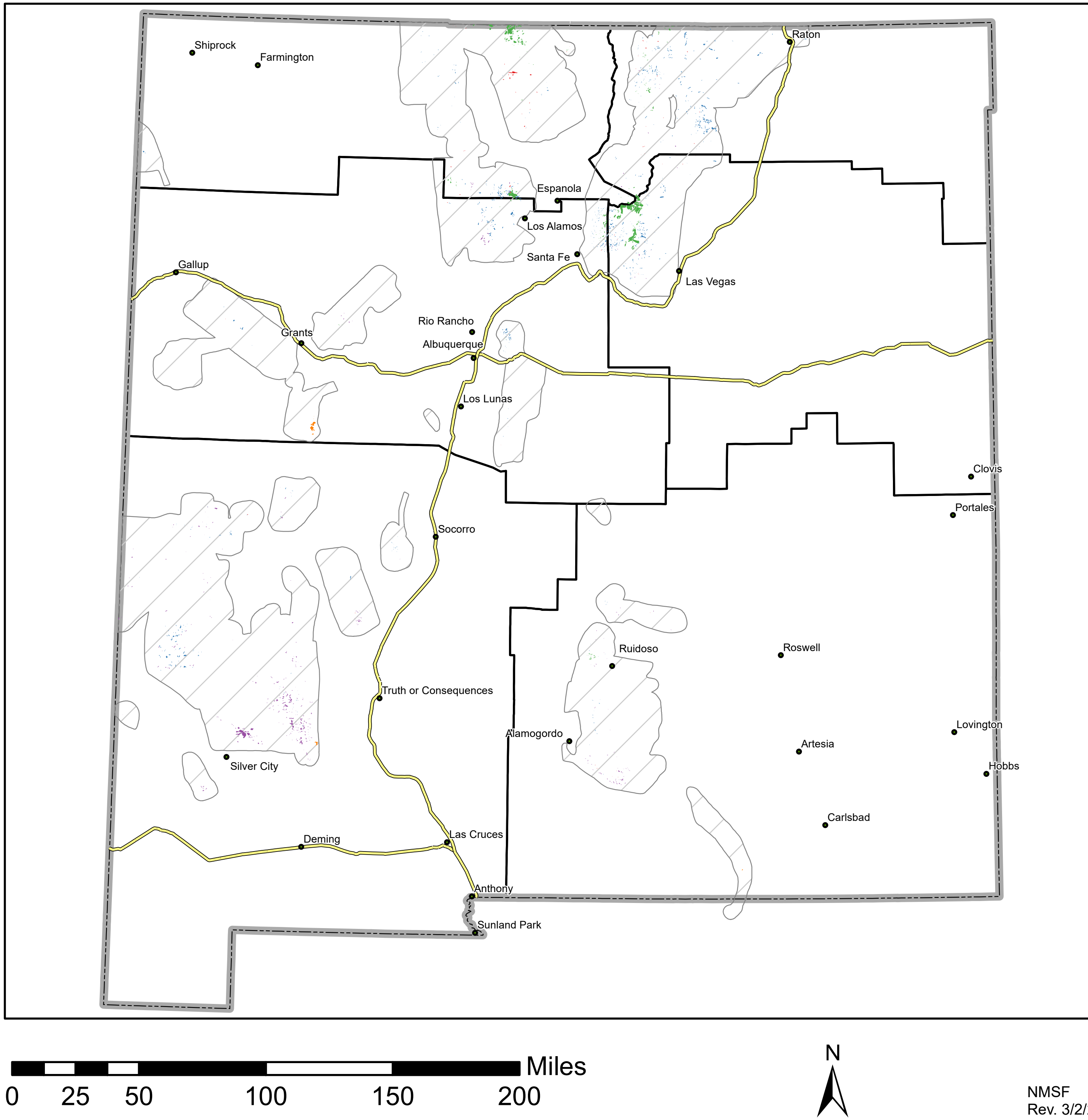
2016 Forest Insect and Pathogen Activity

Mortality

- Ponderosa pine
- Mixed conifer
- Spruce-fir
- Piñon ips
- Aspen
- Survey Extent
- NM Boundary
- NMSF Districts



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