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Forest Pest Conditions in Nevada 2007

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Front Cover Photos curlleaf mountain mahogany drought foliage damage in the Snake Range, July, 2007 by Joshua Simpson and Gail Durham

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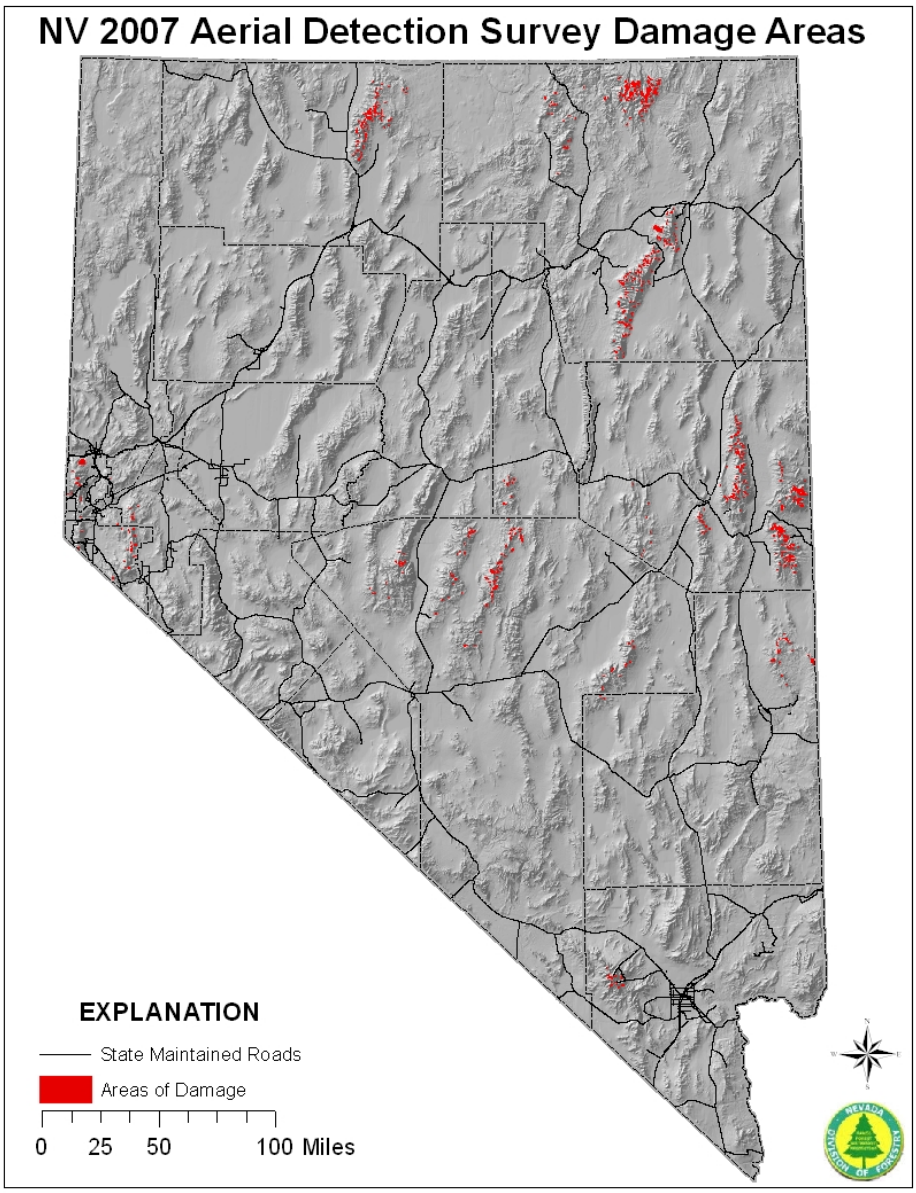

Roads
Damage areas

Table of Contents

Introduction and Summary ***1***

STATUS OF INSECTS ***9***

Insects: Native **9**
Defoliators 9
Douglas-fir Tussock Moth 9
Pinyon Sawfly 10
Bark Beetles 11
Fir Engraver Beetle 11
Jeffrey Pine Beetle 13
Mountain Pine Beetle 14
Mountain Pine Beetle – Limber/Whitebark/Bristlecone/Western White Pine 15
Mountain Pine Beetle in Lodgepole Pine 17
Mountain Pine Beetle/Western Pine Beetle in Ponderosa Pine 17
Pinyon Engraver Beetle 17
Pitch Mass Borer 20
NEEDLE INSECTS 21
Pinyon Needle Scale 21
Giant Conifer Aphid 21
Spruce Spider Mite 22
TWIG INSECTS 23
Pinyon Tip Moth 23
Insects: Non-native 24
European Gypsy Moth 24
Mediterranean Pine Engraver Beetle (MPE) and Red Haired Bark Beetle (RHBB) 26
Sirex Wood Wasp *(Sirex noctillo)/* Emerald Ash Borer Beetle *(Agrilus planipennis)*
Asian Longhorn Beetle (*Anoplophora glabripennis)* 27
European Pine Shoot Moth (EPSM) (*Rhyaclonia buoliana)* 27

STATUS OF DISEASES ***27***
Stem and Branch Diseases 27
Dwarf Mistletoes 27
Pinyon Blister Rust 28
White Pine Blister Rust 29
Sudden Oak Death 29
Root Diseases 29
Annosum Root Disease 29
Armillaria Root Disease 30
Black Stain Root Disease 30
Leaf and Needle Diseases 31
Aspen Leaf Spot 31

DECLINES / COMPLEXES ***33***
Subalpine Fir Mortality Complex 33
Aspen Decline 34

ABIOTIC DAMAGE ***38***
Drought Damage 38

Frost Damage 39
Blowdown 40
Wildfire Damage 40

Noxious weeds 41

List of Figures

Figure 1. National Oceanic and Atmospheric Administration (NOAA) Palmer Drought 3
Severity Index for Nevada from 1998-2008. 3
Figure 3. Acres with Douglas-fir tussock moth defoliation in Nevada during five years (2002-2007). 9
Figure 2. Douglas-fir tussock moth larvae. 1
Figure 4. Pinyon sawfly defoliation on the west side of Whistle Mountain in summer of 2006 10
Figure 5. Older and scattered new white fir mortality from fir engraver beetle on the east slope of the Schell Creek Mountains iin White Pine County, July, 2007. (Photo by April Johnson, United States Forest Service, Ely Ranger District)..... 11
Figure 6. Number of trees with mortality caused by the fir engraver beetle in Nevada and Alpine and Mono counties in CA during six years (2002-2007). 12
Figure 7. Jeffrey pine mortality in Nevada and in two California counties (Alpine and Mono) during five years (2002-2007). 13
Figure 8. Jeffrey pine mortality in Alpine county in California along Highway 88. (Photo by Sheri Smith, Forest Health Protection, Susanville, CA) 14
Figure 9. Number of whitebark, limber, and bristlecone pine trees killed by mountain pine beetle in Nevada in the last six years (2002-2007). 15
Figure 10. Mountain pine beetle caused mortality in ponderosa pine. Picture by D.Powell. ... 1
Figure 11. Mortality caused by pinyon ips in the Pinenut Mountains during peak outbreak in 2004..... 18
Figure 12. Number of pinyon pine killed by pinyon ips in Nevada and two California 19
counties (Alpine and Mono) during five years (2002-2007). 19
Figure 13. Pitch mass borer on pinyon pine infected with pinyon blister rust. 20
Figure 14. Giant conifer aphid (*Cinara spp*) on pinyon pine in the Virginia Highlands in 2006. 22
Figure 15. Spruce spider mite damage on Englemann spruce in the Schell Creek Mountains in July 2007. (Photo by April Johnson, United States Forest Service, Ely Ranger District). 23
Figure 16. Pinyon tip moth damage having a gray hazy appearance from the air and on the ground on the west side of Camp Valley Creek south of Pine Creek. 24
Figure 17. Adult gypsy moths, female above, male below. 25
Figure 18. Banded elm bark beetle (*Scolytus schevyrewi* Semenov) from Forestry Images (http://www.forestryimages.org). 26
Figure 19. Singleleaf pinyon pine infected at the base by pinyon blister rust. 28
Figure 20. Annosum conk at the base of a tree. 24
Figure 21 Armillaria mushrooms. 24
Figure 22. Blackstain root disease pockets (circled) in pinyon pine south of Mount Wilson in 2004..... 31
Figure 23. Symptoms of aspen leaf spot. 24
Figure 24. Number of subalpine fir killed in Nevada during five years (2002-2007). 33
Figure 25. Subalpine fir mortality. 34
Figure 26. 2006 Percent of aspen damaged and killed in National Forests/Ranger Districts. 35
Figure 27. Acres with aspen decline in Nevada during five years (2002-2007). 37

Figure 28. Drought damage on curlleaf mountain mahogany foliage on the eastern slope of the Snake Range. (Photo by Joshua Simpson, United States Forest Service, Ely Ranger District)..... 39
Figure 29. Frost damage on white fire branch tips caused by late spring/early summer frost in 2007. (Photo by April Johnson, United States Forest Service, Ely Ranger District)... 40

LIst of Tables

Table 1. Total number of acres surveyed in each of the ownership categories for the years 2002-2007. 1
Table 2. Number and percent of acres surveyed in Nevada counties in 2007. 2
Table 3. Mortality detected in 2007 by forest pest for Nevada counties[1] 4
Table 4. Insect defoliation and decline by Nevada County in 2007. 5
Table 5 - Noxious weeds by Nevada Counties in 2007 6
Table 6. 2006 aspen regeneration plots on National Forests (NF)/Ranger Districts (RD)..... 36

Introduction and Summary

In an effort to simplify discussions of forest health in Nevada, this report focuses only on the impacts of insects, diseases, and weather on the various tree species of the state. Aerial detection surveys (ADS) from USDA Forest Service and Nevada Division of Forestry are the principle data used to describe mortality trends in the state from year to year. Mortality trends are described in terms of acres affected; however, not all trees on these acres are dead. Thus, an estimate of the number of trees killed is also provided. Not all forested lands are surveyed, and not all the same acres are surveyed every year. If the same areas are surveyed and tree mortality occurred, the same acres may be counted more than once in separate years. Total acres tallied may also change between years due to increases or decreases in the total number of acres surveyed. In 2007, over a million and a half more acres were surveyed than in 2006 due to having more normal budgetary levels in 2007 (Table 1). Most of this area was the National Forest Service (FS) and Bureau of Land Management (BLM) lands in central Nevada. The ADS data encompasses most of the Humboldt-Toiyabe National Forest including portions of the Bridgeport and Carson Ranger Districts located in California. A large portion of the survey area is also composed of BLM acres with smaller acreage surveyed for Great Basin National Park, other federal lands, state lands, and private lands (Table 1).

Table 1. Total number of acres surveyed in each of the ownership categories for the years 2002-2007.

Land Ownership/Year	2002	2003	2004	2005	2006	2007
NF H-T (NV)	3,760,500	3,551,800	3,924,900	3,697,000	2,508,400	3,739,200
NF-HT (CA)	515,900	529,400	595,000	531,600	548,000	560,700
BLM	554,300	1,069,100	1,076,400	1,109,000	712,300	938,600
Private (NV)	309,800	284,900	298,600	344,300	153,200	381,900
Private (CA within FS)	29,800	30,500	32,600	31,500	38,000	36,200
Great Basin NP	76,500	77,100	76,200	76,700	77,000	76,900
Other Federal*	2,600	1,500	42,000	2,900	10,800	4,500
NV State Lands	17,900	18,300	17,800	18,000	3,000	20,100
TOTAL	5,267,300	5,562,600	6,063,500	5,811,000	4,050,700	5,758,100

*Includes USF&W, DOD, BIA, and other tribal lands

Long term insect trend data summarizes activity detected on all surveyed ownerships in NV and CA. However, discussion of activity by individual insect and disease agents detected in 2007 is for Nevada only and summarized on a county basis. Total acres surveyed and percent of each county surveyed in 2007 are provided in Table 2.

Table 2. Number and percent of acres surveyed in Nevada counties in 2007.

COUNTY	Total Acres in County	2007 Acres Surveyed	2007 % Surveyed
Carson City	103,569	56,788	54.8
Clark	5,176,177	249,283	4.8
Douglas	478,351	246,113	51.5
Elko	10,979,963	956,993	8.7
Eureka	2,663,738	128,230	4.8
Humboldt	6,219,557	286,718	4.6
Lander	3,534,543	60,379	1.7
Lincoln	6,782,623	311,551	4.6
Lyon	1,310,315	68,578	5.2
Mineral	2,462,989	0	0.0
Nye	11,686,348	1,451,920	12.4
Pershing	3,863,680	0	0.0
Storey	167,774	15,868	9.5
Washoe	4,234,009	153,709	3.6
White Pine	5,676,727	1,174,059	20.7
Total	65,340,363	5,160,189	7.9

In 2007, insect and disease mortality numbers dropped for the third year in a row. Both 2005 and 2006 had average to above average precipitation in Nevada, but 2007 was a below average precipitation year. Precipitation is crucial for trees to remain vigorous, which increases tree resistance to insects and pathogens. With adequate rainfall or snowmelt, the trees can maintain their defenses such as repelling attacking bark beetles with pitch or growing more foliage to replace that eaten by defoliating insects. Without adequate precipitation, a tree's resistance is significantly reduced. The western states, including Nevada, experienced below average precipitation from 1999 to 2004 and in 2007 (Figure 1). In 2005 and 2006, most of Nevada's watersheds had above normal precipitation and snowfall with above normal summer precipitation in the southeastern portion of the state as well. Oftentimes mortality will show up the year after a drought or later versus the first year of below average precipitation.

In 2007, most estimates of mortality caused by insect outbreaks (acres affected and number of trees killed) declined significantly from 2006 levels, although there were local increases in mortality from specific agents in some counties (Table 3). In general, nearly every mortality agent had fewer trees killed and acres affected in 2007 than in 2006 except for the following:

1. Mountain pine beetle in white pine trees increased 150 % from 2006 due to a nearly 180% increase in Elko County, mostly in the Jarbidge area for the second year in a row..
2. Aspen decline/dieback increased from 2006, much of it can be attributed to the increased acreage covered in 2007 in central Nevada capturing the many areas of dieback in the Monitor, Toquima and Toiyabe ranges.

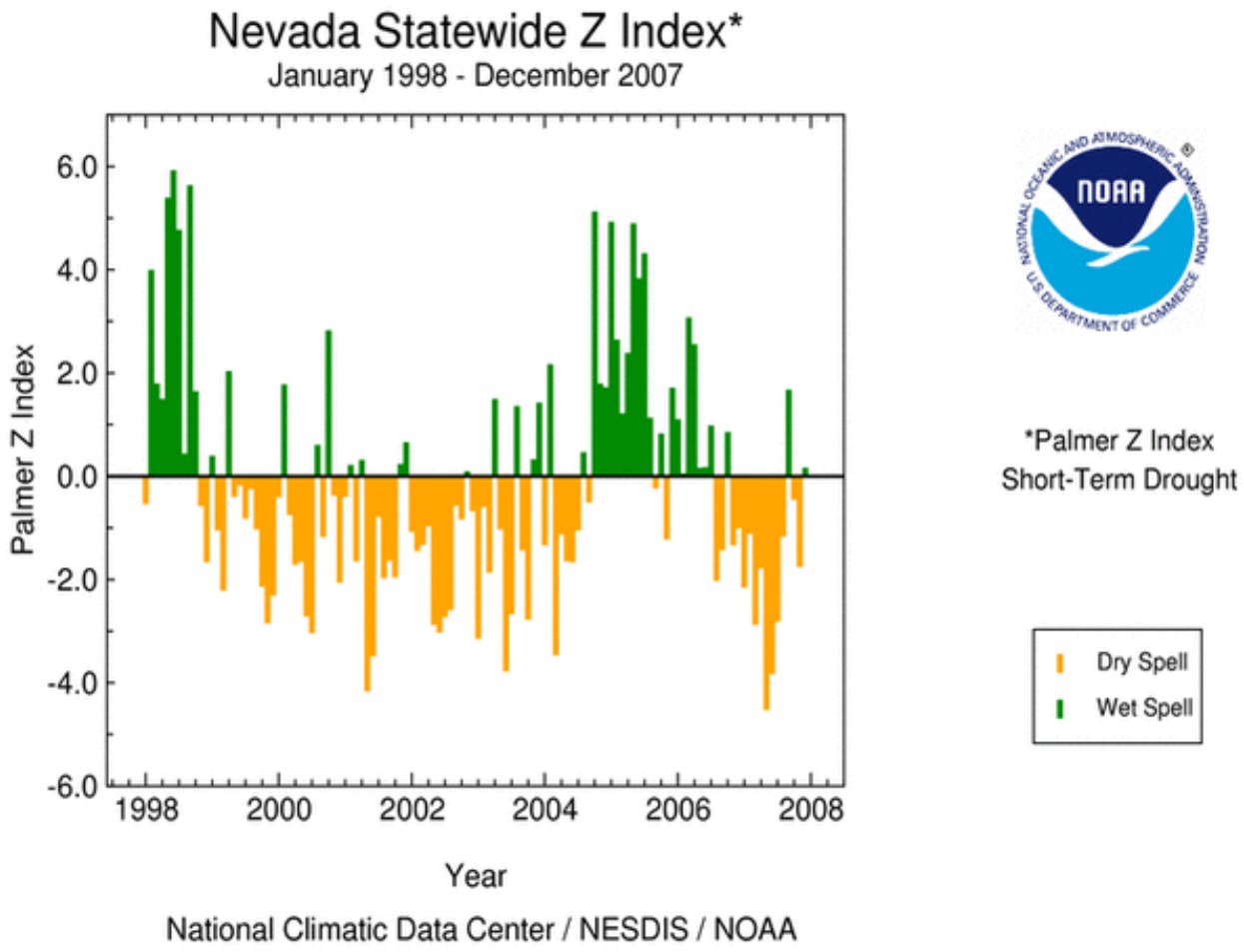

Figure 1. National Oceanic and Atmospheric Administration (NOAA) Palmer Drought Severity Index for Nevada from 1998-2008.
(**http://lwf.ncdc.noaa.gov/oa/climate/research/prelim/drought/st026dv00pcp.html**)

Most of the mortality noted in 2007 is attributed to bark beetle activity and/or fire damage. Please note that most bark beetle-killed trees are not typically symptomatic (faded foliage) until the summer following the year of attack. Therefore, the numbers of acres affected or trees killed by bark beetles as recorded by the ADS flights are typically a reflection of the previous year's beetle populations and attacks. Defoliation levels, however, reflect current year's activity or activity since bud break. Aspen and curlleaf mountain mahogany declines/drought damage are attributed to current as well as past years drought and or other factors.

Table 3. Mortality detected in 2007 by forest pest for Nevada counties[1]

	Mountain Pine Beetle White Pines[1]		Fir Engraver Beetle		Jeffrey Pine Beetle		Pinyon Engraver Beetle		Subalpine Fir Mortality Complex	
COUNTY	Trees	Acres	Trees	Acres	Trees	Acres	Trees	Acres	Trees	Acres
Carson City					27	13	30	15		
Clark	210	104	629	461			20	10		
Douglas	10	5	15	7	20	10	250	124		
Elko	7561	6976					10	5	1,200	2,745
Eureka	50	25								
Humboldt	15	7								
Lander							5	2		
Lincoln	15	7	400	714			40	20		
Lyon							35	17		
Mineral										
Nye	350	174	210	114			170	85		
Pershing										
Storey										
Washoe	118	59	10	5	39	19	20	10		
White Pine	1665	953	3,030	2,904			200	247		
Total	9991	8364	4,294	4,205	86	42	780	535	1,200	2,745

[1] Mountain pine beetle-caused mortality occurred in western white, whitebark, bristlecone and limber pines only and does not include lodgepole/ponderosa pine mortality. Mortality in lodgepole included 15 trees/4 acres and142 trees/35 acres in Douglas, and Washoe counties, respectively. Mortality in ponderosa included 55 trees/27 acres, 5 trees/2 acres, 5 trees/2 acres, and 5 trees/2 acres in Clark, Douglas, Nye and White Pine counties, respectively. Blanks in the table represent zeros.

In 2007, most estimates of defoliation and decline caused by insect and disease activity in Nevada (acres affected) were significantly more than 2006 levels, but less than 2005 levels (the last year that similar acreage was surveyed). Douglas-fir tussock moth defoliation increased back to approximately half of 2005 levels, and aspen decline detected in 2007 was more than 160% of 2006 levels but approximately half of 2005 levels (Table 4).

Table 4. Insect defoliation and decline by Nevada County in 2007.

	Aspen Decline	Douglas fir Tussock Moth	Curlleaf Mountain Mahogany Drought Damage
COUNTY	Acres	Acres	Acres
Carson City			
Clark			
Douglas	60		393
Elko	4,413	3,020	28
Eureka	357		
Humboldt	2,767		14
Lander			
Lincoln	241		567
Lyon			307
Mineral			
Nye	3,541		2,500
Pershing			
Storey			
Washoe	30		
White Pine	616		9,287
Total	12,025	3,020	13,096

[2] Tables 3 & 4. Produced by G. Durham, Nevada Division of Forestry, using data provided by USDA FS Forest Health Protection. Blanks in the table represent zeros.

Invasive weed species continued to spread throughout the State affecting additional counties in 2007. A few species are widespread such as salt cedar (tamarisk), perennial pepper weed, hoary cress, Russian knapweed and Scotch thistle (Table 5).

Table 5 - Noxious weeds by Nevada Counties in 2007

									Nevada	**County**							
State Declared Noxious Weeds	Carson City	Churchill	Clark	Douglas	Elko	Esmeralda	Eureka	Humboldt	Lander	Lincoln	Lyon	Mineral	Nye	Pershing	Storey	Washoe	White Pine
African Rue		X										X					
African Mustard			X							X			X				X
Black Henbane					X		X		X				X				X
Canada Thistle	X			X	X		X	X	X	X	X		X	X		X	X
Dalmatian Toadflax				X	X					X			X		X	X	X
Diffuse Knapweed				X	X		X		X	X			X			X	X
Dyer's Woad					X											X	
Fountain Grass			X														
Giant Reed																	
Goat's Rue			X														
Hoary Cress/Whitetop	X	X		X	X	X	X	X	X	X	X		X	X	X	X	X
Houndstongue					X												
Leafy Spurge	X				X		X	X					X				X

State Declared Noxious Weeds	Carson City	Churchill	Clark	Douglas	Elko	Esmeralda	Eureka	Humboldt	Lander	Lincoln	Lyon	Mineral	Nye	Pershing	Storey	Washoe	White Pine
Malta Starthistle			x														
Medusa Head grass																x	
Mediterranean Sage					x											x	
Musk Thistle		x			x		x	x	x	x	x		x		x	x	x
Perennial Pepperweed	x	x	x	x	x		x	x	x	x	x		x	x	x	x	x
Poison Hemlock				x	x		x						x		x	x	x
Puncturevine			x		x											x	
Purple Loostrife											x					x	
Rush Skeletonweed	x																
Purple Starthistle				x	x		x		x								
Russian Knapweed	x	x	x	x	x	x	x	x	x	x	x		x	x		x	x
Salt Ceder (Tamarisk)		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Scotch Thistle	x	x	x	x	x		x	x	x	x	x	x	x	x		x	x
Sowthistle													x				
Spotted Knapweed			x	x	x		x			x			x		x	x	x

State Declared Noxious Weeds	Carson City	Churchill	Clark	Douglas	Elko	Esmeralda	Eureka	Humboldt	Lander	Lincoln	Lyon	Mineral	Nye	Pershing	Storey	Washoe	White Pine
Squarrose Knapweed					X				X	X			X				X
Sulfur Cinquefoil					X												
Water Hemlock					X		X		X								
Yellow Toadflax					X												
Yellow Starthistle	X	X	X	X	X	X		X			X			X		X	

X indicates the weed is located in the respective county according to the Nevada Noxious Weed GIS database, Natural Resources Conservation Service, 5/24/02, NDOA Weed Coordinator, the various weed control districts representatives and BLM personnel. Current weed database housed at Nevada Dept. of Conservation and Natural Resources Natural Heritage Program contact kimwilliams@heritage.nv.gov

Nevada Department of Agriculture (NDOA) began receiving USDA State and Private Forestry grants in 2002. Working cooperatively with Coordinated Weed Management Areas (CWMA), they have been able to treat over 50,000 acres of noxious weeds statewide since 2002. Currently there are 31 CWMA's in the state, most created in the past six years. Each county in Nevada has at least one CWMA. In 2007, 11,255 acres were treated and 11,321acres were inventoried for weeds. In 2007, NDOA released bio-control agents on spotted knapweed in Ely in White Pine County, agents for Canada thistle in Gardnerville in Douglas County, and agents for dalmatian toadflax in Pioche in Lincoln County. Dalmatian toadflax and tamarisk beetle collections and releases are being coordinated by Jeff Knight, State Entomologist.

Insects: Native

DEFOLIATORS

Douglas-fir Tussock Moth
Orgyia pseudotsugata

Hosts: All true firs and spruce

The Douglas-fir tussock moth (DFTM) is an important native insect capable of causing significant defoliation. Heavy defoliation causes reduced growth, stress, and tree mortality. Heavy defoliation can cause top kill and mortality of advanced regeneration during a single season. Outbreaks are cyclic, usually appearing quickly followed by an abrupt decline within a one to four year period.

DFTM defoliation was light and detected on 3,020 acres in Nevada. Although this is significantly more (ten-fold) than 2006, it is only about half of 2005's 5,657 acres.

Most of the defoliation occurred in Elko County on the Mountain City and Jarbidge Ranger Districts of the Humboldt-Toiyabe National Forest.

Figure 2. Douglas-fir tussock moth larvae.

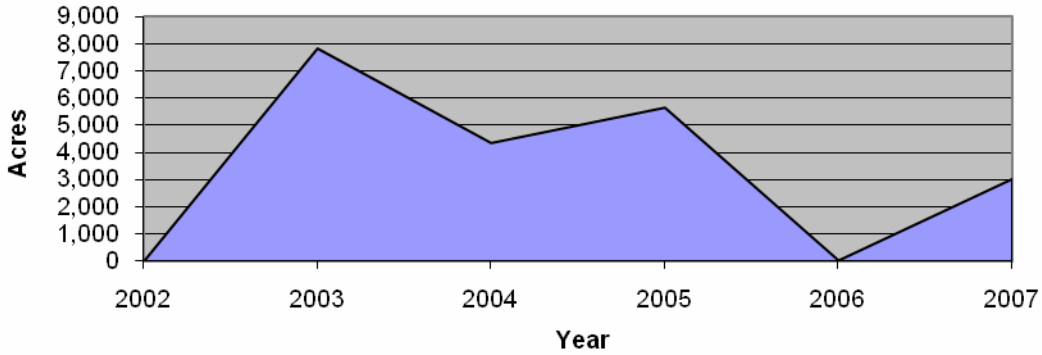

Figure 3. Acres with Douglas-fir tussock moth defoliation in Nevada during five years (2002-2007).

Elko County – Over 3000 acres of light defoliation occurred in the Jarbidge Mountains. Most of the patches of defoliation are in the north end of the Jarbidge Mountains, north, east, and west of the town of Jarbidge, in the headwaters of Buck, Deer, Dave, Cougar and Slide Creeks.

Pinyon Sawfly
Neodiprion edulicolus

Host: pinyon pine

The pinyon sawfly is an important native insect capable of causing significant defoliation, but usually goes undetected because it occurs in small numbers, and causes little damage. Heavy defoliation causes reduced growth, stress, and tree mortality. Past outbreaks have caused widespread defoliation and mortality of smaller trees. In 2006 and 2007, a large area of defoliation was reported on the west backslope (east side) of Whistler Mountain just northwest of Eureka, NV (Figure 4) This outbreak has been observed for over four years and has severely defoliated the pinyon in all size classes with mortality occurring in many of the trees in 2007. The defoliation extends across the mountain range along a mid-slope band over hundreds of acres. In 2007, the pinyon sawfly defoliation spread to the west side of Whistler Mountain, affecting hundreds of acres on this east-facing slope.

Figure 4. Pinyon sawfly defoliation on the west side of Whistle Mountain in summer of 2006

BARK BEETLES

Fir Engraver Beetle
Scolytus ventralis

Hosts: true firs

Figure 5. Older and scattered new white fir mortality from fir engraver beetle on the east slope of the Schell Creek Mountains in White Pine County, July, 2007. (Photo by April Johnson, United States Forest Service, Ely Ranger District)

Mortality due to Fir-Engraver Beetle (FEB) decreased significantly from 17,697 trees killed in 2006 to 4,294 trees killed in 2007 (Figure 6). In 2007, the number of acres affected, was approximately one quarter of 2006 at 4,205 acres,

For the fifth consecutive year, White Pine County had the highest amount of tree mortality with approximately 3,030 dead trees on about 2,904 acres in 2007, but this represents a decrease to one-quarter of the 2006 levels. Fir mortality in Carson City, Douglas, Elko, Lyon,

Nye, Washoe, and White Pine counties decreased significantly from 2005 figures but increased in Clark and Lincoln counties (primarily due to an increase in acres surveyed in 2007).

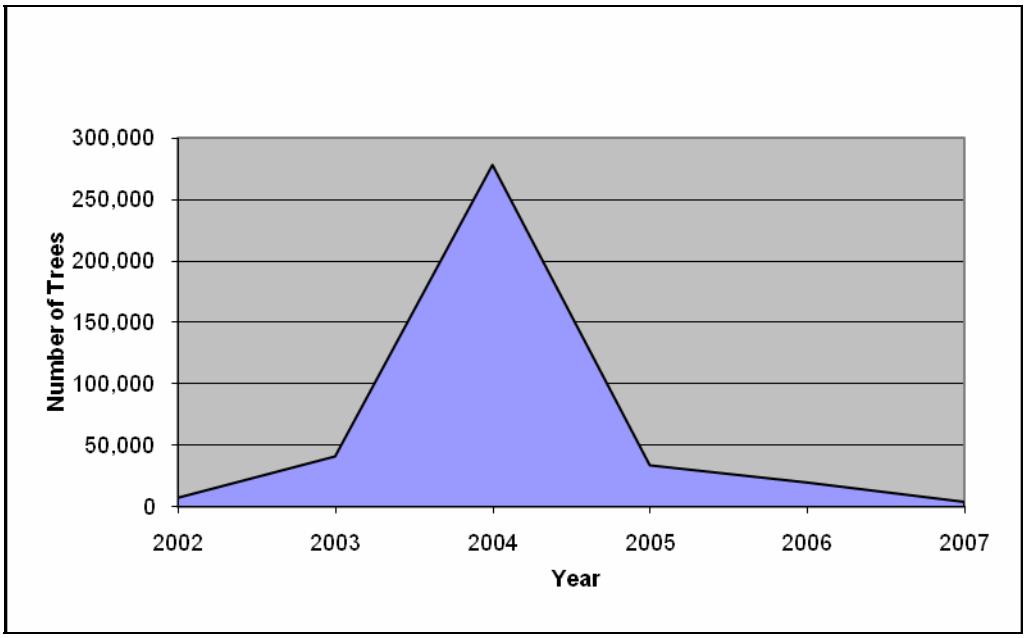

Figure 6. Number of trees with mortality caused by the fir engraver beetle in Nevada and Alpine and Mono counties in CA during six years (2002-2007).

Clark County- Mortality increased to about 180% of last year's levels. Some of this may be attributed to increased survey area in the Spring Mountains in 2007 and poor survey conditions in 2006. More than 629 trees on 461 acres were mapped as mortality in 2007. Scattered pockets were mapped throughout the upper elevations of the Spring Mountains with small areas of mortality in Kyle Canyon on the north facing slope above the Rainbow subdivision. One large area was mapped above and to the north of Williams Hole at the headwaters of Carpenter Canyon and another at the headwaters of Wallace Canyon. Another large polygon of mortality was mapped on the north-facing slope of Fletcher Peak.

Douglas County – Mortality decreased to 6% of 2006 levels with 15 trees killed on 7 acres in scattered spots near the top of the Carson Range on the east-facing slope around Genoa Peak and to the south approximately 2 miles.

Lincoln County –Because there was no survey of true fir done in this county in 2006, there was an increase shown for this county in 2007. There were 400 trees killed on 714 acres in the Wilson Creek and White Rock Mountains with small to medium sized patches of mortality around the top of Mount Wilson, at the headwaters of Bailey Creek, and along the tops of the White Rock Mountains.

Nye County – Approximately 210 trees on 114 acres were mapped, an approximately 10% decrease of 2006 levels. Most of this mortality was found on the in small spots on west facing slopes of the central Quinn Canyon Range, the southern portion of the Grant Range and the southernmost tip of the White Pine Range.

Washoe County –Approximately 10 trees on 5 acres were mapped, a less than 10% decrease compared to 2006. This mortality was found in the Carson Range just south of Hobart Creek Reservoir.

White Pine County – This county accounted for most of the mortality in Nevada – 3,030 trees on 2,904 acres. This is a decrease in acres and mortality similar to that observed in most of Nevada. The majority of the 2007 FEB activity was found in small spots or large tracts of fir throughout the Schell Creek Range south to Cave Lake State Park. In addition, FEB was found in the southwestern east facing slope near the top of Pequop Ridge of the White Pine Range, Ward Mountain, northernmost Snake Range south of White Cloud Mountain south to Hendrys Creek, scattered spots throughout Great Basin National Park, in the NFS lands to the south as well as two large polygons on the north facing slope above Strawberry Creek about half way up the creek.

Jeffrey Pine Beetle
Dendroctonus jeffreyi

Host: Jeffrey pine

The Jeffrey pine beetle is the most destructive bark beetle of Jeffrey pine. Endemic populations usually attack scattered, slower growing, mature and over-mature trees and trees struck by lightning. In Nevada, Jeffrey pine is only found along the Sierra Nevada Mountains. Field examinations of some of the mortality mapped in Alpine County, California revealed that some of the Jeffrey pine is also being killed by *Ips pini* in combination with roundhead and flat head borers. Ips on Jeffrey pine was mapped separately in 2007.

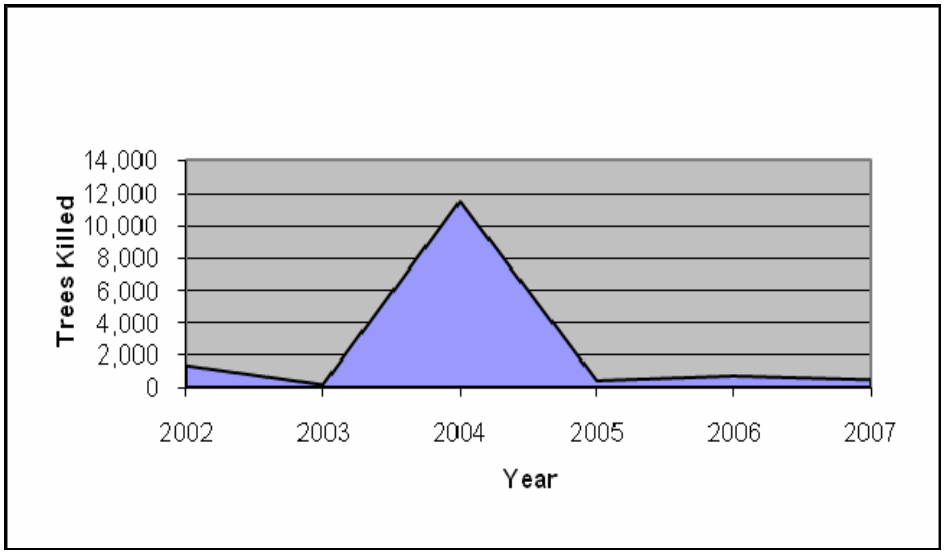

Figure 7. Jeffrey pine mortality in Nevada and in two California counties (Alpine and Mono) during five years (2002-2007).

Figure 8. Jeffrey pine mortality in Alpine county in California along Highway 88. (Photo by Sheri Smith, Forest Health Protection, Susanville, CA)

In 2007, Jeffery pine beetle-caused tree mortality decreased 26% compared to 2006, affecting only 86 trees on 42 acres in Nevada (Figure 6). The mortality was divided nearly equally among Washoe, Douglas and Carson City Counties.

> **Carson City County** – 27 trees killed on 13 acres in scattered spots in the headwaters of Ash Canyon and Clear Creek.
> **Douglas County** – 20 trees killed over 10 acres scattered throughout the Carson Range with one spot on Clear Creek below highway 50, and along Lincoln, Logan House and McFaul Creeks.
> **Washoe County** – 39 trees killed on 19 acres were scattered in small spots near the headwaters of Deep Canyon, the West Fork of Gray Creek, just above highway 28 west of Marlette Reservoir, and on the south facing slopes north of Incline Village.

Mountain Pine Beetle
Dendroctonus ponderosae

Hosts: whitebark, bristlecone, limber, lodgepole, sugar, and ponderosa pine

Mountain pine beetle (MPB) can kill thousands of trees per year during outbreak conditions and millions of trees during extended epidemics in western forests. At endemic levels, MPB favors weakened, less vigorous trees with adequate phloem thickness to complete its life

cycle. During epidemics, beetles may attack smaller diameter trees down to 4 inches diameter at breast height. Extensive mortality may alter large forest landscapes by converting pine forest ecosystems to grass and shrub landscapes for a period of 10-20 years. This conversion affects wildlife species, water yields and fuel loading.

In 2007, MPB-caused mortality in lodgepole pine decreased to half the amount reported in 2006, but limber pine increased over 250%. Whitebark/bristlecone pine mortality increased 130% and western white pine only increased 15% over the number of trees reported in 2006. This increase in upper elevation limber pine mortality mostly occurred in Clark, Nye, Elko and Humboldt counties. This increase was due to increased survey area and increased outbreaks in Elko and White Pine county's Schell and Snake Range MPB populations. The increased whitebark/ bristlecone pine mortality occurred mostly in Elko and White Pine counties due to increased outbreaks in the Jarbidge and Snake Ranges (Figure 9).

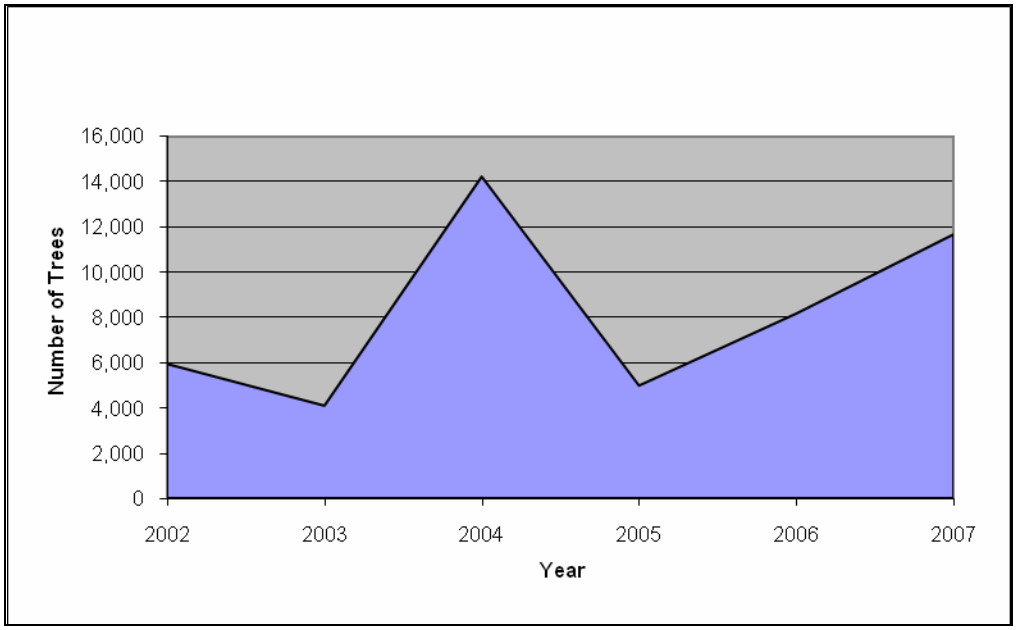

Figure 9. Number of whitebark, limber, and bristlecone pine trees killed by mountain pine beetle in Nevada in the last six years (2002-2007).

Mountain Pine Beetle – Limber/Whitebark/Bristlecone/Western White Pine

In 2007, mortality of limber pine caused by MPB increased to 1,558 acres and 2,860 trees, which is 282% of the 2006 acreage and 269% of the 2006 tree mortality. Most of the mortality occurred as small spots of up to five trees on tops of the mountain ranges surveyed. Whitebark, bristlecone and western white pine tree mortality in 2007 increased over 153% in the entire state, mostly from continued increases in Elko County in the Jarbidge area.

Clark County – Significant increases from 2006 were due to an increase in the area surveyed as well as higher levels of MPB in the Spring Mountains. Most of the mortality was in scattered spots of five trees each throughout the higher elevations of the Spring Mountains.

Douglas County – Five acres with ten western white pine trees were observed in one spot along the California border south of Montezuma Peak and in another spot at East Peak Lake in the Heavenly Ski area.

Elko County – 840 limber pine trees on 554 acres, and 6,721 whitebark pine trees on 6,422 acres. Most of the limber pine mortality was scattered in small pockets at moderately high elevations throughout the Ruby Mountains, on the northern end of the East Humboldt Mountains, in the Bull Run Mountains, and in the north half of the Independence Mountains. Numerous limber pine mortality spots in the southern Jarbidge mountains were mapped. There were large areas of whitebark pine mortality throughout the higher elevations of the Ruby and East Humboldt Mountains, with the majority of the mortality in the Jarbidge Mountains. Many of these areas also had mortality reported in 2006.

Eureka County – 50 acres, 25 limber pine trees in five spots at the north end of the Monitor Range around Summit Mountain and Antelope Peak.

Humboldt County - Fifteen limber pine trees were killed at the headwaters of Buffalo Canyon in the south western Santa Rosa Range on seven acres.

Lincoln County – Fifteen limber pine trees on seven acres in a two spots near the top of Mount Wilson in the Wilson Creek Mountains and one spot in the southernmost end of the Quinn Canyon Range.

Nye County – 350 dead limber pine trees on 174 acres. Numerous small spots of limber pine mortality mapped throughout the Toiyabe, Toquima and Monitor Ranges with the vast majority of the spots in the Arc Dome, Alta Toquima, and Table Mountain Wilderness Areas. In addition, eight spots at the highest elevation of the southernmost Quinn Canyon range were also mapped.

Washoe County – 113 acres, 115 western white pine and whitebark pine trees scattered throughout the higher elevations of the Carson Range mostly in the Mount Rose Wilderness Area with one large area with 40 dead trees just northwest of Mt. Rose.

White Pine County – 687 acres with 1,380 killed limber pine trees observed in small spots of scattered mortality along the tops of Ward Mountain in the Egan Range, throughout the Snake Range (including Great Basin National Park), throughout the Schell Creek Range, and in one spot on Pequop Ridge in the White Pine Range. This represents a 250% increase in limber pine mortality in White Pine County from 2006. There were also 285 bristlecone pine trees killed on 286 acres along the ridgelines in Great Basin National Park and on Mount Moriah in the Snake Range; this represents a 300% increase of bristlecone pine mortality from 2006 in these areas.

Figure 10. Mountain pine beetle caused mortality in ponderosa pine. Picture by D.Powell.

Mountain Pine Beetle in Lodgepole Pine
In 2007, MPB activity in lodgepole pine in Nevada decreased to nearly half of 2006 numbers with 157 dead trees on 39 acres.

> **Douglas County** – Fifteen trees in three small spots (four acres total) around East Peak Lake area of Heavenly Ski Area in the Lake Tahoe Basin watershed.
> **Washoe County** – 35 acres, 142 trees in small spots scattered throughout the Carson Range and on the west side of Little Valley.

Mountain Pine Beetle/Western Pine Beetle in Ponderosa Pine
In 2007, bark beetle activity increased slightly from 2006 and was found in three counties killing 65 trees over 31 acres.

> **Clark County** – 27 acres, 55 trees scattered in small spots in the northern half of the Spring Mountains.
> **Douglas County** – 2 acres, 5 trees in one spot on the East Fork of the Carson River just below the Bryant Creek confluence..
> **White Pine County** – 2 acres, 5 trees were reported in the Snake Range just above Upper Lehman Creek Campground in Great Basin National Park .

Pinyon Engraver Beetle
Ips confusus

Host: single leaf pinyon

The pinyon engraver is a pest in pinyon-juniper ecosystems often affecting valuable home landscape trees. The insect produces multiple generations each year and consequently populations can build and spread rapidly.

Figure 11. Mortality caused by pinyon ips in the Pinenut Mountains during peak outbreak in 2004.

Prior to 2003, pinyon pine was not frequently surveyed. In response to increasing concern of pinyon pine mortality in 2003, a multi-state effort was made to survey the extent of pinyon Ips-caused pinyon mortality. Approximately 3 million of the estimated 11.9 million acres of single-leaf pinyon that occur in Nevada were surveyed in 2003. In 2004, approximately 3.5 million acres of pinyon-juniper woodlands were flown and pinyon Ips-caused mortality of single leaf pinyon increased again. Again in 2005, 2006 and 2007, a dramatic decrease of pinyon mortality was seen within the surveyed area, in twelve counties.

In 2007 only 535 acres were infested by pinyon Ips, affecting over 780 trees. This was 13% of 2006 numbers despite an increase in Nevada acreage surveyed. (Figure 12). For a third year, Douglas County had the greatest number of trees killed (250 trees, 32%of the state total).

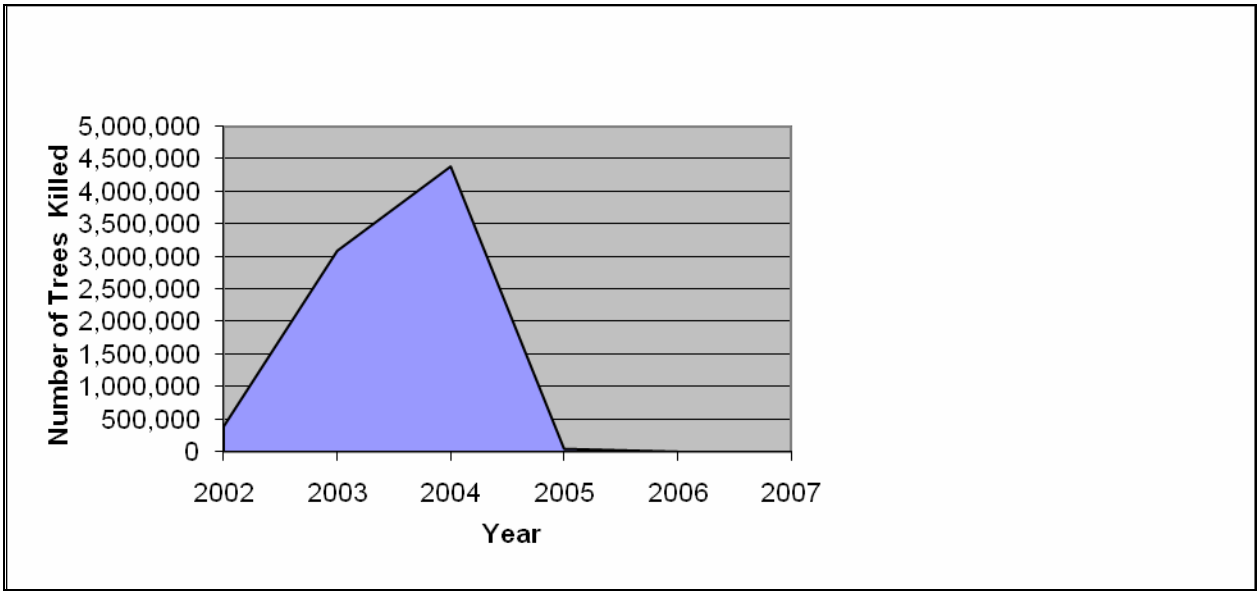

Figure 12. Number of pinyon pine killed by pinyon Ips in Nevada and two California counties (Alpine and Mono) during five years (2002-2007).

Carson City County - 15 acres with 30 trees; small spots of mortality were recorded in the headwaters of Brunswick and Sullivan Canyons in the Pine Nut Range .
Clark County –10 acres, 20 trees in two spots in the lower watershed of Trout Canyon in the south end of the Spring Mountains.
Douglas County - 124 acres and 250 trees with mortality was a substantial reduction (3% of the acres and 5% of the trees) from 2006. Mortality was recorded in the Pine Nut Mountain Range from the Highway 395 at Holbrook Junction north into Lyon/Carson City Counties. Small areas (20 to 25 tree polygons) of mortality still exist in Pinenut Valley.
Elko County –Two spots (five acres total) with ten trees in the southern Ruby mountains; one just above Shanty Town on the east side and the other on the southern tip just north of Overland Pass
Lander County –Two acres and five trees in one spot in Clipper Gap Canyon just north of Clipper Gap in the northern Toquima Range.
Lincoln County - There were 40 trees on 20 acres scattered in small spots throughout the Wilson Creek and White Rock Ranges.
Lyon County - 17 acres, 35 trees. Most of this light mortality is a continuation of the mortality in the northeast Pine Nut Range east of El Dorado Canyon. This is less than 28% of the 2006 mortality.
Mineral County –Although not mapped, no morality was noted on the northeastern portions of the Wassuk Range when flown over on August 14th, 2007. This area had been mapped with extensive pinyon Ips mortality in 2004.
Nye County – 85 acres, 170 trees. Scattered spots of mortality occurred throughout the eastern Quinn Canyon Range, southern Toiyabes, and southern Shoshone Mountains. A single spot located about one mile north of East Manhattan in the Toquima Range and another spot located at the headwaters of the middle fork of Georges Canyon in the Monitor Range.

Storey County – Five acres with ten trees were mapped in the Virginia Range just north of Geiger Grade in eastern Virginia Highlands.
Washoe County - 10 acres, 20 trees. Mortality was mapped in the northwestern portion of the Virginia Range, south of Geiger Grade
White Pine County - 247 acres, 200 trees. In western White Pine county, small pockets of scattered mortality occurred in the eastern White Pine range up into Mormon Ridge with one spot on the northeast footslope of Ward Mountain. In eastern White Pine County, spots of mortality occurred in the Snake Range from Osceola south to Decathon Canyon just south of the southern border of Great Basin National Park. This represents an approximately 200% increase of pinyon tree mortality from 2006 even though nearly the same acreage was mapped each year. .

Figure 13. Pitch mass borer on pinyon pine infected with pinyon blister rust.

Pitch Mass Borer
Dioryctria spp.

Hosts: Singleleaf pinyon, ponderosa pine, Jeffrey pine

In the larval stage, *Dioryctria spp.* bore into the cambium of the trunk, branches, and shoots. This borer kills lateral branches and treetops of singleleaf pinyon and Jeffrey pine. With prolonged drought, this injury has weakened pinyon trees sufficiently to allow pinyon

engraver beetle to successfully attack and kill the smaller pinyon pine trees. Pitch mass borer is found throughout the state of Nevada in most counties with singleleaf pinyon. The heaviest concentrations seem to occur in western Nevada where it also affects Jeffrey and ponderosa pine. Many young Jeffrey pines on the east slope of the Carson Range that came in after fires have been affected by this insect. In 2006 several entomologists, pathologists and foresters conducted a pinyon blister rust (*Cronartium occidentale)* search through the central portion of Nevada. They noted that pitch mass borer frequently uses rust cankers as an entry point (Figure 13). The rust and borer were found extensively across the state.

NEEDLE INSECTS

Pinyon Needle Scale

Matsucoccus acalyptus
Host: singleleaf pinyon

The pinyon needle scale causes tip killing, branch flagging, stunted growth, and needle injury. Small trees may be killed outright and large trees may be seriously weakened after repeated infestations, rendering them susceptible to pinyon engraver beetle. Pinyon needle scale is found throughout Nevada wherever singleleaf pinyon occurs. Small populations of pinyon needle scale were found on pinyon pine on BLM land at Currant Summit in the Horse Range of Nye in 2007.

Giant Conifer Aphid

Cinara spp.

Host: singleleaf pinyon, Jeffrey pine

Small populations of giant conifer aphid (Figure 14) were found on pinyon pine on private land in the Virginia Highlands of Storey County and in spots on BLM land north of Eureka Nevada on the east side of the Mountain Boy Range east of Whistler Mountain in 2006.

Figure 14. Giant conifer aphid (*Cinara spp*) on pinyon pine in the Virginia Highlands in 2006.

Spruce Spider Mite
Oligonychus spp.

Host: Engelmann Spruce

The spruce spider mite causes a yellowing of the older spruce foliage by piercing the needles and feeding on fluids. A large outbreak over hundreds of acres was noted throughout the Schell and Snake Creek Range in White Pine County.

Figure 15. Spruce spider mite damage on Engelmann spruce in the Schell Creek Mountains in July 2007. (Photo by April Johnson, United States Forest Service, Ely Ranger District).

TWIG INSECTS

Pinyon Tip Moth
Dioryctria albovitella

Host: Singleleaf pinyon

The pinyon tip moth causes tip killing, branch flagging, and stunted growth. Larvae of this small gray moth feed in the tips of branches (hence the name) killing new shoots and giving the tree a conspicuous scorched appearance. Pinyon tip moth is found throughout Nevada wherever singleleaf pinyon occurs. In 2007, a large outbreak over hundreds of acres was noted throughout the lower elevations of the east side of the Wilson Creek Mountains west of Camp Valley Creek, and south of Pine Creek (Figure 16).

Figure 16. Pinyon tip moth damage having a gray hazy appearance from the air and on the ground on the west side of Camp Valley Creek south of Pine Creek.

INSECTS: NON-NATIVE

European Gypsy Moth
Lymantria dispar

Hosts: various deciduous species

Statewide detection surveys conducted by Nevada State Department of Agriculture and Animal and Plant Health Inspection Service (APHIS) using pheromone attractants resulted in no male moth captures in 2007. Five hundred traps were placed throughout all 17 Nevada

counties. All traps were negative. The last identified adult male was discovered in an RV park in Winnemucca in 1999.

Figure 17. Adult gypsy moths, female above, male below.

Banded Elm Bark Beetle
Scolytus schevyrewi

Hosts: various deciduous species, primarily elm

Statewide detection surveys from 2003 to 2005 conducted by the Nevada State Department of Agriculture's entomologist using pheromone attractants showed banded elm bark beetle (BEBB) from Washoe (2003), Pershing, White Pine, Douglas, Lyon, Churchill, Elko, and Storey counties. In 2006 and 2007, studies by UC Davis and USDA, FS Pacific Southwest Research Station showed that BEBB occurs in western Nevada in Douglas, Washoe and Carson City counties.

Figure 18. Banded elm bark beetle (*Scolytus schevyrewi* Semenov) from Forestry Images (http://www.forestryimages.org).

Mediterranean Pine Engraver Beetle (MPE) and Red Haired Bark Beetle (RHBB)
Orthotomicus erosus, and *Hylurgus ligniperda*

Nevada Dept. of Agriculture placed 58 Lindgren traps in 10 Nevada counties along with five Colossus traps placed in Washoe and Lincoln counties for various wood borers, MPE and RPBB and did not capture any. None have been found in Nevada to date. Steve Seybold and Jana Lee of the FS Pacific Southwest Research Station and the University of California

Davis checked for these beetles in Las Vegas in March 2007 and found none in their prime habitats.

Sirex Wood Wasp *(Sirex noctillo)/* **Emerald Ash Borer Beetle** *(Agrilus planipennis)* **Asian Longhorn Beetle (***Anoplophora glabripennis)*

In 2007, Nevada Dept of Agriculture placed 58 Lindgren traps and 50 Sirex traps in 10 Nevada counties along with 5 Colossus traps placed in Washoe and Lincoln counties for various wood borers, no Sirex Wood Wasp, Emerald Ash Borers or Asian Longhorn Beetles were found. Visual surveys were conducted in Washoe and Carson City for EAB and ALB.

European Pine Shoot Moth (EPSM) (*Rhyaclonia buoliana)*

In 2007, Nevada Dept of Agriculture trapped for EPSM in Douglas County in 2006 and with 141 traps in 9 counties in 2007. Four traps were positive in Douglas County in 2006 and one trap was found positive in Washoe County in 2007.

STATUS OF DISEASES

STEM AND BRANCH DISEASES

Dwarf Mistletoes
Arceuthobium spp.

Hosts: Douglas-fir, pines, true firs, and single-leaf pinyon

Dwarf mistletoes (DMT) are the single-most damaging agent of coniferous trees. These parasitic plants remain the most widespread and frequently observed disease within the state. Profusely branched, dense masses of host branches called “witches brooms” are often observed. Heavy dwarf mistletoe infestation can predispose trees to insects and other diseases, reduce incremental growth, affect the forest canopy structure, lower resistance to drought, affect production of seed, and affect recreation and aesthetics. Since dwarf mistletoe infests trees of all ages, infestation problems may exist in secondary growth and regeneration, as well as mature and overmature tree stands.

Dwarf mistletoe on pinyon pine can be found throughout the state, but it has never been comprehensively surveyed. The State Forest Health Specialist has found DMT from the Spring Mountains in the south and north through the Toiyabes and east and west to both borders of the state. Pinyon engraver beetle-caused mortality was observed in some of the heavy dwarf mistletoe infected pinyon pine stands around the state of Nevada. Some of the dwarf mistletoe-weakened trees succumbed to pinyon engraver beetle attacks

Pinyon Blister Rust
Cronartium occidentale

Host: singleleaf pinyon pine

An informal survey of central Nevada by various FS pathologists and entomologists as well as BLM and Nevada State Foresters revealed that the disease is prevalent throughout the state. It attacks and kills small trees (Figure 19) and causes branch flagging on larger more resistant trees. Many of the rust infections were attacked by pitch mass borer. This disease is mainly found in a band between 6000 and 7000 feet of elevation near drainages that are suitable for the alternate host (*Ribes* spp).

Figure 19. Singleleaf pinyon pine infected at the base by pinyon blister rust.

White Pine Blister Rust
Cronartium ribicola

Hosts: limber, bristlecone, whitebark, sugar, and western white pine

White pine blister rust has been known to exist in western Nevada on the east side of the Sierra Nevada Mountains for several years. The rust has expanded its range in Nevada in recent years, with populations of rust now confirmed in the Jarbidge Mountains. Forest Health Protection conducted a ground survey for white pine blister rust in the mountain ranges in eastern Nevada primarily focused on high elevation Great Basin bristlecone pine in 2004. No newly infected areas were discovered, and the previously reported rust infection in the Ruby Mountains was found to be dwarf mistletoe. At this point the only confirmed population of white pine blister rust in eastern Nevada is in the Jarbidge Mountains.

Sudden Oak Death
Phytophthora ramorum

Sudden Oak Death (SOD), a newly identified forest disease caused by the pathogen *Phytophthora ramorum*, has been killing thousands of tanoak and oaks in the coastal areas of California, but has not been known to exist in Nevada. However, with the release of potentially infected nursery stock into all 50 states from a single California nursery, NDOA officials contracted with the USFS to conduct surveys in forest areas on host and potential host species near nurseries or where landowners may have out planted this potentially infected stock. Nevada Division of Forestry personnel have assisted NDOA officials with these surveys. NDOA forest SOD survey data showed no SOD for all regions surveyed to date.

ROOT DISEASES

Annosum Root Disease
Heterobasidion annosum

Hosts: Douglas-fir, lodgepole pine, ponderosa pine, spruce, true firs, and incense cedar

This disease can be found throughout the state on true firs, but it frequently acts as butt decay or as a saprophyte on dead trees, stumps, roots, and cull logs or fallen stems. The fungus occasionally kills young ponderosa pine, especially in plantations on droughty soils. Symptomatic small trees can frequently be found around stumps that had butt decay. The symptoms on larger trees include a thinning crown and fruiting

Figure 20. Annosum conk at the base of a tree.

bodies that develop at the base of the tree or inside stumps.

Armillaria Root Disease
Armillaria spp.

Hosts: All trees

Figure 21 Armillaria mushrooms.

Evidence of Armillaria root disease can be found throughout the state causing mortality in all species of trees. This disease also frequently functions as a weak pathogen or saprophyte. Fruiting bodies grow in clusters from the roots or at the base of the tree during moist conditions. There is a close association between root disease pockets and endemic level bark beetle populations. Armillaria was observed on pinyon pine roots in the Virginia Highlands of Storey County and on white fir in the Success Summit area of the Schell Creeks of White Pine County in 2006.

Black Stain Root Disease
Ophiostoma wageneri

Hosts: pinyon pine, ponderosa pine, and Douglas-fir

Figure 22. Black stain root disease pockets (circled) in pinyon pine south of Mount Wilson in 2004.

Black stain root disease is an important disease of several hosts, but it is only found on pinyon pine in the state of Nevada. It usually kills affected trees within a few years, and it can produce groups of mortality several acres in size. Pockets of infected trees are preferred host for low-level populations of pinyon engraver beetles. No new pockets of black stain root disease were observed by aerial survey in 2007.

LEAF AND NEEDLE DISEASES

Aspen Leaf Spot
Marssonina populi

Host: Aspen

Blight and leaf spot caused by this disease have been seen in the past throughout the host type. Although it was not observed in aerial surveys in

Figure 23. Symptoms of aspen leaf spot.

2007, it was seen in the northern Toiyabes in heavily frost damaged aspen stands.

Subalpine Fir Mortality Complex

Host: Subalpine fir

The western balsam bark beetle (WBBB) is the most significant mortality agent in a complex of forest insects and disease causing subalpine fir mortality. Endemic populations will occur in storm-damaged trees, slash, or trees of poor vigor. WBBB infestations may build to epidemic levels, where mortality can occur in groups of 100 to 10,000 trees. Annosum root disease, woodborers and several species of smaller bark beetles are also involved in this complex. Environmental stress due to drought or overcrowding may also have a role in the death of trees in this category.

In 2007, mortality caused by WBBB decreased to 70% of 2006 levels to 1,200 trees (Figure 24). The acreage affected in 2007 was 2,745 acres. Most of this subalpine fir mortality was on the Mountain City and Jarbidge Ranger Districts of the Humboldt-Toiyabe National Forest.

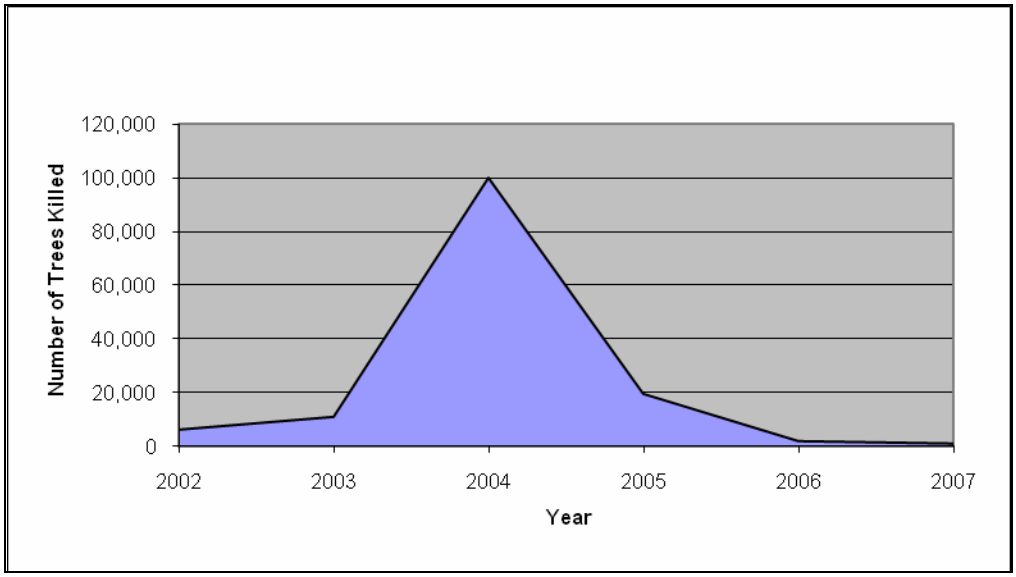

Figure 24. Number of subalpine fir killed in Nevada during five years (2002-2007).

Figure 25. Subalpine fir mortality.

Elko County – Over 1,200 trees in scattered mortality were mapped in the northern Jarbidge Mountains, including the Jarbidge Wilderness. Additional mortality was reported in the western Bull Run Mountains.

Aspen Decline

Host: Aspen

A decrease in the amount of aspen forest acreage has been reported throughout the western U.S. for many years. The primary forces involved are succession of aspen forest to other vegetation types due to fire exclusion, and damage to young aspen sprouts by grazing animals. This phenomenon has been labeled “aspen decline” by some authors. This type of “decline” should be distinguished from the aspen dieback that has been detected in aerial survey that is caused by several agents including drought stress, insects, diseases and other stresses. This dieback can impact aspen clones that have been impacted by fire exclusion and grazing pressure causing them to decline and die.

Aspen dieback has been noted anecdotally for many years in the Intermountain Region, and dieback has been recorded by aerial survey since 2003. In 2004, Intermountain Region FHP examined what had been mapped as insect defoliator damage or Cytospora canker in

several areas in north-central Nevada and discovered that a number of insect and disease agents were involved. In 2006, FHP established monitoring plots in several areas in Nevada.

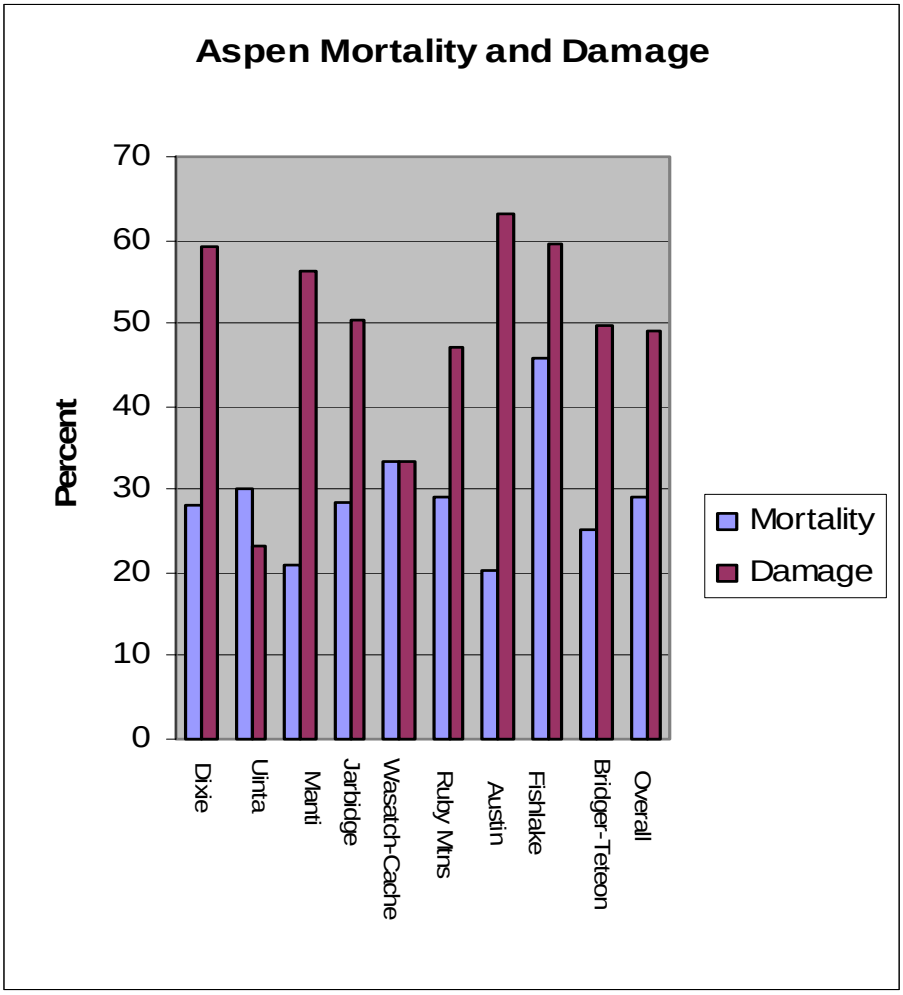

Figure 26. 2006 Percent of aspen damaged and killed in National Forests/Ranger Districts.

Data analysis of these plots is ongoing but a few trends were evident from an early review of the data. In the areas evaluated, there were observed high levels of mortality and moderate to heavy damage in the trees over 2 inches in diameter at breast height (Figure 26). The most common agents involved were canker diseases and insect borers. In the aspen regeneration, trees per acre was highly variable (Table 6). In some cases regeneration was heavily damaged, primarily by animal browsing.

In many cases, if grazing pressure was not heavy, the clones involved seemed to be recovering and had produced a good crop of new sucker sprouts. However, in some cases heavy grazing pressure was removing sucker sprouts produced as a response to death of overstory trees which may contribute to the eventual death of these clones. In other cases, the clones were not recovering even in the absence of grazing pressure.

Table 6. 2006 aspen regeneration plots on National Forests (NF)/Ranger Districts (RD).

Forest (District)	Trees per acre	Percent Damaged
Dixie NF	2300	57.4
Uinta NF	416	5.2
Manti NF	5600	25.4
Wasatch-Cache NF	4300	11.6
Humboldt-Toiyabe NF (Jarbidge RD)	3360	36.9
Humboldt-Toiyabe NF (Rubies RD)	1450	47.8
Humboldt-Toiyabe NF (Austin RD)	1813	68.9
Fishlake NF	3550	47.9

In 2007, 12,025 acres of aspen dieback were mapped in eight counties. This is a significant increase from 2006's figures of 7,477 acres (Figure 27). There were decreases in some counties such as Douglas, Elko, Lyon, White Pine and Washoe, but significant increases in Humboldt , Lincoln, and Nye counties.

Douglas County – 60 acres dieback in the Pinenut Mountains in two spots in the headwaters of Red Canyon and one spot on the lower eastern flank of Mt. Como with about half the acreage as 2006.
Elko County - 4,413 acres dieback was mapped in the south and west Jarbidge, in small spots throughout the Tennessee, Bull Run Mountains, Independence Mountains, and around the Mahoganies. Many spots of mostly light dieback occurred throughout the Ruby Mountain and East Humboldt Ranges.
Eureka County - 357 acres dieback was mapped in the north end of the Monitor Range.

Humboldt County - 2,767 acres; light to heavy aspen dieback occurred throughout the Santa Rosa Mountains in small to medium sized pockets. This is over 600% of the acreage of 2006, but similar to the acreage of 2005.
Lincoln County - 241 acres; light to heavy aspen dieback occurred throughout the Wilson Creek Range in small to medium sized pockets. Aspen dieback was mapped in Lincoln County in 2006, but because less of Lincoln county was mapped in 2005, the 2006 survey reported 150% of the acreage of 2005.
Nye Counties – 3,541 acres. Dieback was mapped in scattered small spots in the Grant Range, Arc Dome Wilderness of the Toiyabe Range, throughout the Toquima and Monitor Ranges with some large patches in the Table Mountain Wilderness Area of the southern Monitors. Much of the Nye County acreage surveyed in 2007 was not

surveyed in 2006, but was surveyed in 2005. The acreage of dieback was much less than 2005, but obviously much greater than 2006.
Washoe County – 2007 acreage at 30 acres was only 17% of the 2006 acreage found in small pockets in the headwaters of Bull Ranch Creek, and Galena Creek.
White Pine County – The 616 acres in 2007 is a more than 60% decrease from 2006. Most of the dieback was from the small patches scattered throughout the central and northern Schell Creek range and Ward Mountain. There were also one large area on the slope due east and below Bald Mountain in Great Basin National Park in the Snake range and one spot east of Pequop Ridge in the White Pine range.

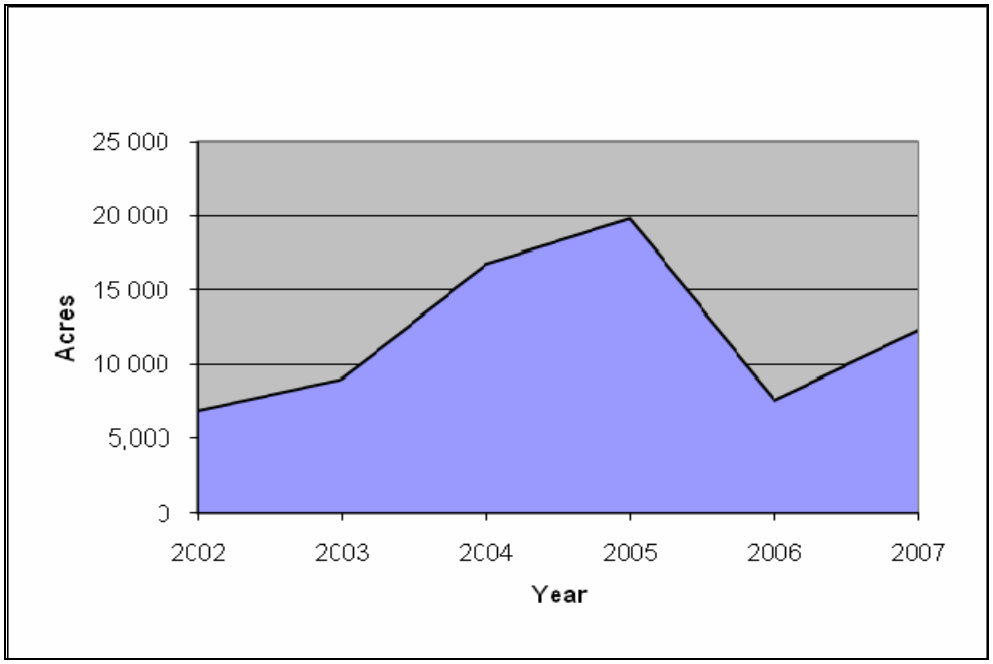

Figure 27. Acres with aspen decline in Nevada during five years (2002-2007).

Cytospora Canker
Cytospora spp.

Host: aspen

Cytospora canker is one of the most common diseases affecting aspen in ornamental situations and often attacks stressed trees through wounds. This fungus girdles branches by killing the cambium. Large, vigorous trees can withstand the disease and are rarely killed. Activity from this pathogen is most likely a symptom of several years of drought or defoliation from other insects or diseases. From the air, dieback due to Cytospora canker looks similar to dieback by forest tent caterpillar defoliation. The dieback was mistakenly identified by aerial observers as forest tent caterpillar defoliation in 2002 and 2003. Further field study is needed to determine all the dieback causes. In 2007, almost all the aspen dieback showed overstory decline but the understory was coming back in.

ABIOTIC DAMAGE

Drought Damage

Hosts: curlleaf mountain mahogany

Extensive yellowing and rusting of curlleaf mountain mahogany foliage was seen during the 2007 ADS throughout the state. These evergreen leaves had turned yellow or red, depending on how advanced the state of desiccation was, and then dropped off. In many areas only small tips of green leaves remained on the trees (Figure 28). Approximately 13,100 acres were mapped in seven counties with exceptionally extensive damage noted on the eastern Snake Ranges' shallow, limestone backslopes. White Pine County had the highest level of damage at 9,287 acres followed by Nye County with 2,500 acres mostly in the northern Quinn Canyon range, and central and southern Toquima and Monitor ranges. Light damage was found in Lincoln, Douglas and Lyon Counties at 567,393, and 307 acres respectively. Elko and Humboldt Counties had very little damage at 28 and 14 acres respectively. Light damage was noted in Washoe County in the Fox Mountain area.

Figure 28. Drought damage on curlleaf mountain mahogany foliage on the eastern slope of the Snake Range. (Photo by Joshua Simpson, United States Forest Service, Ely Ranger District)

Frost Damage

Hosts: white fir, aspen

No frost damage was mapped during the 2007 survey, but large areas throughout the state had tip die back on white fir and aspen from heavy frost/late snows that occurred in late spring and early summer, 2007 (Figure 29)

Figure 29. Frost damage on white fire branch tips caused by late spring/early summer frost in 2007. (Photo by April Johnson, United States Forest Service, Ely Ranger District)

Blowdown

Areas of concentrated, high velocity winds can cause trees to blow over. Blowdown occurs in groups or as scattered trees within the landscape. Depending on the tree species, patches of blowdown in coniferous forests can provide a food source for various bark beetles, enabling populations to build to epidemic levels. These epidemic populations may then attack and kill standing, live trees adjacent to the blowdown.

Wildfire Damage

A small fire of over 2,800 acres burned over approximately 1,000 aspen trees on the lower slopes of the West Fork of Boulder Creek on the west facing slope of the East Humboldt Range due west of Tent Mountain.

Approximately 600 Jeffrey pine trees were burned in a fire south and west of Reno, NV on the eastern edge of the Mount Rose Wilderness.

Noxious weeds

Noxious weeds are a continuing problem for all Western states. They have the ability to colonize disturbed habitats aggressively displacing native plant species and altering ecosystems. Several state and federal agencies have the responsibility for monitoring and controlling noxious weeds. Our intention by including this information is to increase awareness of these potential problems. Table 5 at the beginning of this document is the list of plants declared noxious weeds by the State of Nevada for specific counties. The NDOA in coordination with the Nevada Department of Conservation and Natural Resources' Natural Heritage Database Program has hired a Weed Geographic Information System Mapping Coordinator which will significantly help with monitoring weed populations in Nevada. For more up-to-date information on Nevada Noxious Weeds and the newly adopted three-tier State List go to **http://www.agri.nv.gov/PLANT_NoxWeeds_index.htm.**

The following noxious weed websites, while not inclusive, give additional information on noxious weeds such as biology, history, and control.

http://www.invasivespecies.gov
This website is the gateway to federal and state efforts concerning invasive species. There are links to numerous invasive species databases. This website should be one of your first stops.

http://www.agri.nv.gov/PLANT_NoxWeeds_index.htm
This website contains any information you need about noxious weed prevention, control and management for all land managers in the state of Nevada. Another good site to look at first.

http://www.cdfa.ca.gov/phpps/ipc/encyclowedia/encyclowedia_hp.htm
California Department of Food and Agriculture has a very comprehensive website. Information includes: identification, biology, and management. Pictures of the plants in various stages are just a click away.

http://www.nwcb.wa.gov/index.htm
State of Washington's noxious weed control board website has information on black henbane, buffalo bur, camel thorn, Canada thistle, Dalmatian toadflax, dyer's woad, goatsrue, houndstongue, johnsongrass, jointed goatgrass, diffuse, Russian and spotted knapweed, leafy spurge, Mediterranean sage, musk thistle, perennial pepperweed, purple loosestrife, puncturevine, rush skeletonweed, silverleaf nightshade, scotch thistle, St. Johnswort, yellow nutsedge, purple and yellow starthistle, and velvetleaf. Topics include description, economic importance, geographic distribution, habitat, history, growth and development, reproduction, response to herbicides, response to cultural controls, and biocontrol potentials.

http://www.ipm.ucdavis.edu/PMG/selectnewpest.landscape.html#WEED

University of California pest management website has information on Bermuda grass, field bindweed, Russian thistle, yellow starthistle, and others. Topics include identification, biology, and management through cultural and chemical control options.

http://www.ext.colostate.edu/pubs/natres/pubnatr.html
Colorado State University Cooperative Extension website in the Range section has fact sheets on musk thistle, leafy spurge, Canada thistle, diffuse, Russian, and spotted knapweeds. Information includes description, phenology, and management options such as cultural, chemical, mechanical, and biological.

http://www.weedcenter.org
An interagency website housed at the Montana State University. The Center for Invasive Plant Management (CIPM) promotes the ecological management of invasive plants in the West through education, by facilitating collaboration among researchers, educators, and land managers, and by funding research projects and weed management areas. The center serves as an information clearinghouse, providing examples of ecological management, and delivering implementation tools and products to land managers. The center operates in partnership with federal, state, counties, private industry, universities, foundations, and landowners.

http://invader.dbs.umt.edu
The University of Montana's Invaders Database has a search engine that links the user to informational websites on most of the invasive weeds. You can search the database for the list of Noxious Weeds by state and most identified plants have additional information and links to more information.