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Utah Forest Insect and Disease Conditions Report 2016

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Northslope of the Uinta Mountains

Utah Forest Insect and Disease Conditions Report 2016

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And
Forest Health Protection-Ogden Field Office Staff

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FOREST HEALTH CONDITIONS SUMMARY

This report focuses only on the impacts of insects, diseases, and other disturbances on the various tree species in the state. Aerial detection surveys (ADS) conducted by the USDA Forest Service, Forest Health Protection (FHP) offices are the means of collecting data that is 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. Not all forested lands are surveyed, and not all the same acres are surveyed every year.

In 2016, FHP changed the quantification methodology from "trees per acre" to "percent of trees affected" for large areas with insect and disease damage. Small areas are still recorded as points. Table 1 shows the new 5 level classification system used to describe damage levels. Damage is recorded as a point, polygon, or grid cell feature and one causal agent is assigned to each feature. Depending upon feature type, the intensity of the damage is recorded differently. For point data, trees affected are classified into one of 5 levels that correspond to the number of trees killed associated with each point. For a polygon or grid cell data, the percentage of trees affected within each polygon or grid cell is classified into one of 5 levels for each polygon or grid cell associated with all trees within the polygon or grid cell data as estimated by the observer.

Table 1. The 5 level classification system used to describe damage levels in 2016.

Point Class	Trees Affected		Polygon or Grid Cell Class	Percent Trees Affected
1	1		1	1 to 3%
2	2 to 5		2	4 to 10%
3	6 to 15		3	11 to 20%
4	16 to 30		4	21 to 50%
5	>30		5	>50%

The number of acres flown/surveyed in each county in 2016 is provided in Table 2. Figure 1 shows areas that were surveyed. Over twelve million acres were flown and most was on National Forest Service (NFS), Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), and National Park Service (NPS) lands, in addition to state, and private lands. Long-term insect trend data summarizes activity detected on all surveyed ownerships in Utah. Forests throughout much of Utah are composed of dense stands that are relatively uniform in age, composition, and structure resulting in poor forest health conditions. Unhealthy forests are conducive to insect and disease issues. In other words, insect and disease issues are not the cause of poor forest health, but are the result. Several factors can contribute to the decline in forest health, including; lack of active management, poor grazing patterns, fire exclusion, and invasive weeds. Adequate precipitation and growing space is necessary to maintain tree vigor, thereby increasing tree resistance to insects and diseases. Drought conditions throughout the State continue to place more stress on forests that are already in poor health.

Table 3 shows the number of acres affected by bark beetles in Utah counties as detected by ADS in 2016. Table 4 shows the number of acres affected by defoliators & other agents in Utah counties.

Mountain pine beetle induced mortality has declined from 2015. However, mortality is still occurring within the lodgepole and limber pines.

Douglas-fir beetle induced mortality has been mapped in every county except Washington County. In 2016, a total of 3,288 acres have been affected statewide, a decrease of about 28% acres affected from 2015.

Spruce beetle caused mortality is still being mapped, with a total of 124,370 acres affected statewide in 2016, an increase of nearly 19% acres affected from 2015. The largest number of acres affected occurred in Duchesne and Summit counties.

Fir engraver caused mortality (primarily in white fir) appears to have decreased statewide from 2015 by about 60%, with 1,275 acres affected in 2016. Nearly all counties have some damage mapped.

Subalpine fir tree mortality appeared to have decreased from 2015 by nearly 46% with 13,593 acres affected in 2016. Some mortality was mapped in nearly all counties statewide.

Western spruce budworm defoliation appears to have increased from 2015 by approximately 80%, with 121,026 acres affected in 2016. Most damage was mapped in Beaver, Cache, Sevier, Garfield Wayne, and Piute counties.

Aspen dieback is largely caused by drought, a complex of canker diseases, and insect borers. It also appears that insect and disease-caused defoliation play a role in some areas.

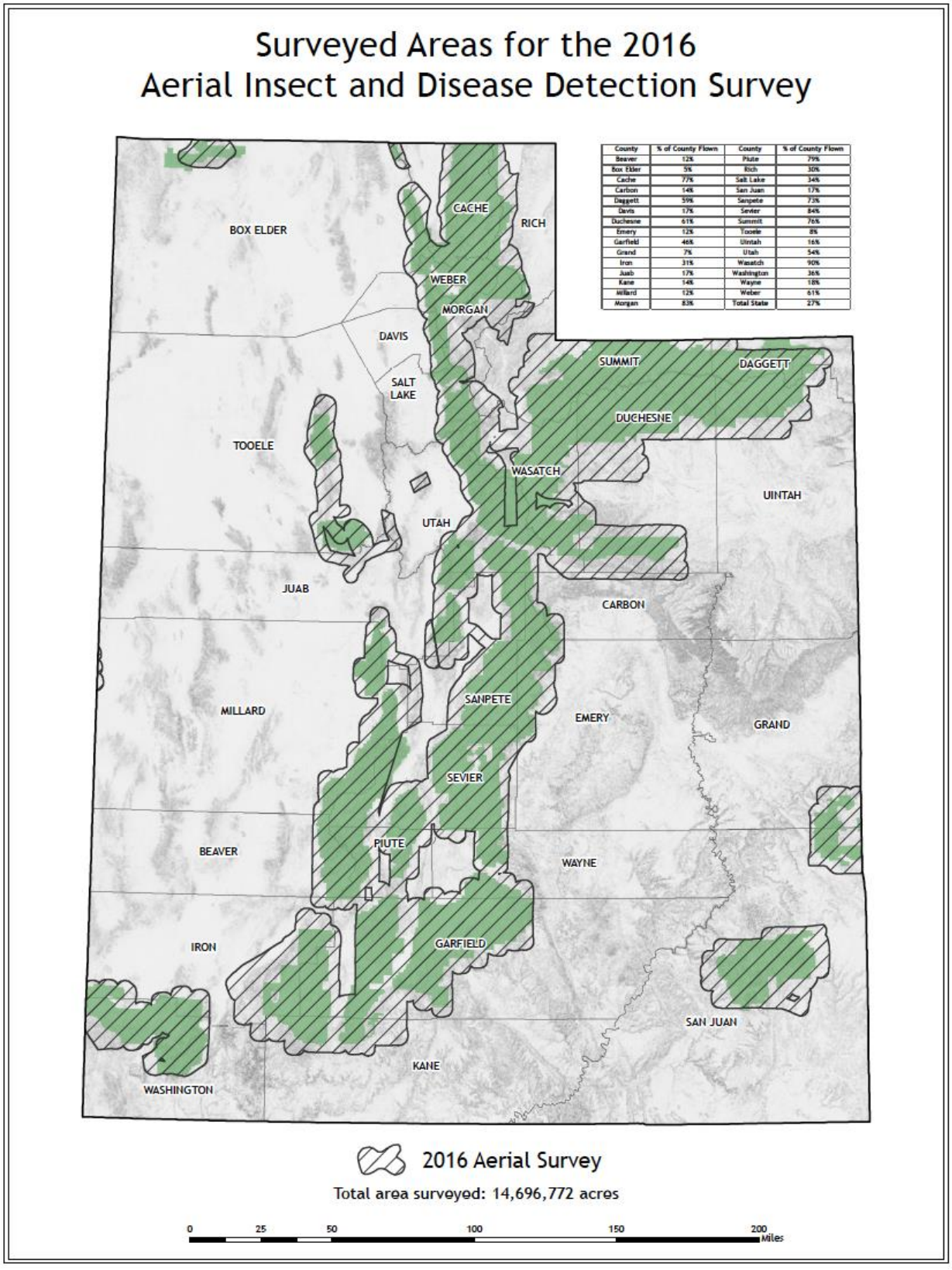
Aspen dieback has been mapped since 2003. Approximately 7,269 acres were also mapped as "aspen decline" in 2016.

Aspen leaf blight (*Marssonina spp*) was mapped in 2016, with a total of 24,629 acres affected. This disease is more pronounced in years when spring weather is cool and wet during initial leaf formation.

To view the survey maps go to: https://www.fs.usda.gov/detailfull/r4/forest-grasslandhealth/?cid=fsbdev3_016120&width=full

Table 2. Total number of acres aerially surveyed in each county during 2016.

Aerial Detection Survey 2016		
County	Acres	% of County
Beaver	195,208	11.6
Box Elder	215,046	5.0
Cache	581,529	75.9
Carbon	130,422	13.2
Daggett	277,811	61.4
Davis	69,453	17.0
Duchesne	1,276,081	61.3
Emery	341,154	12.1
Garfield	1,542,302	46.2
Grand	154,391	6.6
Iron	651,195	30.9
Juab	383,507	17.3
Kane	374,488	14.4
Millard	508,801	11.7
Morgan	324,642	83.0
Piute	389,589	79.0
Rich	201,100	30.6
Salt Lake	177,034	34.8
San Juan	871,531	17.2
Sanpete	741,419	73.9
Sevier	1,030,928	83.7
Summit	918,300	76.3
Tooele	380,324	8.2
Uintah	442,342	15.3
Utah	739,902	53.3
Wasatch	693,178	88.9
Washington	558,205	36.3
Wayne	283,328	17.8
Weber	258,300	61.3
Total	14,711,510	



County	% of County Flown	County	% of County Flown
Beaver	12%	Piute	79%
Box Elder	5%	Rich	30%
Cache	77%	Salt Lake	34%
Carbon	14%	San Juan	17%
Daggett	59%	Sanpete	73%
Davis	17%	Sevier	84%
Duchesne	61%	Summit	76%
Emery	12%	Tooele	8%
Garfield	46%	Uintah	16%
Grand	7%	Utah	54%
Iron	31%	Wasatch	90%
Juab	17%	Washington	36%
Kane	14%	Wayne	18%
Millard	12%	Weber	61%
Morgan	83%	Total State	27%

Figure 1. Surveyed Areas for the 2016 Aerial Insect and Disease Detection Survey

Table 3. Acres affected by bark beetles in Utah counties as detected by ADS in 2016.

2016	Mountain Pine Beetle[1]	Western Pine Beetle	Douglas-fir Beetle	Spruce Beetle	Piñon Engraver	Fir Engraver Beetle	Subalpine Fir Mortality Complex
COUNTY	Acres	Acres	Acres	Acres	Acres	Acres	Acres
Beaver	16	8	44	12	28		18
Box Elder	0		22				778
Cache	161		106	4	2		273
Carbon	3		108			16	254
Daggett	2		6	199			166
Davis	0		4			2	93
Duchesne	343	6	109	58,142	2	193	88
Emery	64		101	23	2	31	583
Garfield	16	95	222	2	71	8	46
Grand	2	16	50	6	4		9
Iron	0	16	12		65	14	56
Juab	4		179		22	4	
Kane	2	82	318	6	2	50	
Millard	6		167	16	83	94	15
Morgan	0		38			6	241
Piute	84		65	408	56	62	146
Rich	164		10	2			274
Salt Lake	2		4			4	332
San Juan	8	98	362	10	75	46	69
Sanpete	134		368	2	62	275	2,349
Sevier	68	22	201	5,526	888	42	384
Summit	320		118	56,845		4	1,696
Tooele	4		46		6	18	
Uintah	4		40	27			205
Utah	34		397		76	310	408
Wasatch	54		122	2,592		44	3,719
Washington	0	2			530	50	
Wayne	0	4	4	548			2
Weber	8		65			2	1,389
Total	1,503	349	3,288	124,370	1,974	1,275	13,593

[1]Mountain pine beetle has killed several species of trees: mostly lodgepole; but also ponderosa, and limber pine throughout Utah

Table 4. Number of acres impacted by defoliators & other agents in Utah counties in 2016.

2016	Western Spruce Budworm	Marssonina blight, Aspen	Aspen Decline	Aspen Dieback
County	**Acres**	**Acres**	**Acres**	**Acres**
Beaver	20,302			
Box Elder		135	57	115
Cache	11,463	933	174	769
Carbon		23		
Daggett	87			
Davis	36			
Duchesne		201	558	177
Emery			7	355
Garfield	25,011	2,517		24
Grand	4,816		60	
Iron	5,166	37		284
Juab	269		8	35
Kane		2		
Millard	255		28	
Morgan	264	96		38
Piute	14,391		6	
Rich	2,002	95		1,030
Salt Lake	78			19
San Juan	7,685	45	481	42
Sanpete				573
Sevier	13,480	3,565	210	42
Summit		12,008		261
Tooele				
Uintah	528		30	385
Utah	407	1,226		1,185
Wasatch	284	3,452	571	627
Washington			3	
Wayne	14,502			
Weber		294	73	1,308
Total	121,026	24,629	2,266	7,269

INSECT STATUS NATIVE DEFOLIATORS

Douglas-fir Tussock Moth

Orgyia pseudotsugata McDunnough

Hosts: all true firs, Douglas-fir, and spruce

The Douglas-fir tussock moth (DFTM) is an important native insect capable of causing extensive defoliation. Caterpillars feed on the needles of trees which can lead to topkill and/or tree mortality if damage occurs in multiple years at the same location. Outbreaks are cyclical due to natural controls such as parasitic wasps, a virus, and weather conditions. The hairs on caterpillars can cause allergic reactions in some individuals.

Figure 2. Douglas-fir tussock moth larvae (Photo: D. McComb, Bugwood.org).

No DFTM defoliation was detected in Utah in 2016

Western Spruce Budworm

Choristoneura freemani Freeman

Hosts: Douglas-fir, subalpine fir, white fir, blue spruce, and Engelmann spruce

Western spruce budworm (WSBW) is the most widely distributed and destructive defoliator of coniferous forests in western North America. Trees may be extensively defoliated during outbreaks, resulting in stress that can directly kill the tree or make it susceptible to diseases and secondary insect pests, such as the Douglas-fir beetle.

Over the last few years, defoliation of subalpine fir, Douglas-fir, and Engelmann spruce has increased significantly in the high plateaus of Cache, Rich, Piute, Sevier, Grand, Beaver, Wayne, Iron, Garfield, and San Juan counties.

Uinta Wasatch Cache National Forest (NF): The most notable WSBW defoliation occurred at the top of Logan Canyon along the Sinks road. WSBW activity was also mapped on the east slopes facing Bear Lake, spanning an area from the Logan Canyon summit north to the Forest boundary. Another concentration of activity was observed around Beaver Mountain in pockets up to 200 acres in size containing moderate to heavy damage (30-70% of the trees defoliated). This is the second year of moderate to heavy defoliation in this area, and defoliation driven mortality could begin if one more year of damage occurs in this area. WSBW occurred in 6 pockets spanning almost 400 acres, with the largest concentration near Payson Lakes. A number of small (up to approximately 20 acres) pockets of WSBW activity were detected at the top of City Creek Canyon and at the top of Ward Canyon. While this activity only covered 200 acres, 30-50% of the trees in the pockets were impacted. A few pockets (covering 117 acres) of fairly heavy (up to 50% of trees defoliated) WSBW activity were mapped south of Monte Cristo.
Ashley NF: There were no records for western spruce budworm-caused defoliation in 2015; however, surveyors mapped heavy defoliation in 2016. Heavy western spruce budworm-caused defoliation (851 acres) was widespread near Little Brush Creek and Ashley Creek

Manti La-Sal NF: Western spruce budworm-caused defoliation, while not reported last year, was widespread throughout Moab and Monticello Ranger Districts in 2016. Over 10,000 acres were mapped across the Forest.

Fishlake NF: Western spruce budworm caused the greatest amount of conifer damage on the Forest with defoliation occurring on just over 53,000 acres. Large pockets of heavy defoliation (>30% of trees affected) were mapped in the vicinity of Sunset Peak, the northern end of the Sevier Plateau, Thousand Lake Mountain, and across the Tushar Range. Areas heavily defoliated by western spruce budworm have an increased risk of Douglas-fir beetle infestation.

Dixie NF: Western spruce budworm caused the greatest amount of conifer damage on the Forest with defoliation occurring on just over 35,300 acres. This was a 133% increase from 2015. Large pockets of heavy defoliation (>30% of trees affected) were mapped from Mortenson Canyon to Tippett's Valley. Heavy defoliation also occurred on Griffin Top. Areas heavily defoliated by western spruce budworm have an increased risk of Douglas-fir beetle infestation.

Western Tent Caterpillar

Malacosoma californicum Packard

Hosts: aspen, willow, cherry, cottonwood, mountain mahogany, oak, alder, and birch

The first noticeable thing about western tent caterpillar (WTC) is white silken tents formed in branch crotches. Aspen is the preferred host, but WTC may attack a wide range of deciduous trees and shrubs. Outbreaks, usually last two to three years in the western states. Repeated defoliation and other stress factors may reduce growth rates of infested trees, kill trees, or predispose them to other diseases or insect pests. Larvae are dark brown with bluish heads, reddish-brown stripes, and distinct white, keyhole-shaped markings down their backs. Western tent caterpillars are often confused with fall webworms, which are rather hairy and reddish–brown in color. The fall webworm makes large diffuse webs that encase entire branches, often found on chokecherry and other deciduous trees and shrubs.

No WTC was mapped in 2016.

Western False Hemlock Looper

Nepytia freemani Munroe

Hosts: Douglas-fir, white fir, subalpine fir, and Engelmann spruce

Young inch worm (looper) larvae begin to feed on new foliage in the upper crowns of trees during late May, progressing to the older foliage when new foliage is depleted. Eggs are often laid on defoliated twigs and the resulting larvae may feed on the new needles causing twig mortality. In late summer the ground beneath heavily defoliated trees may be carpeted with partially eaten needles and frass. During outbreaks, trees may be entirely defoliated in one season.

Needle Insects

Piñon Needle Scale

Matsucoccus acalyptus Herbert

Hosts: Colorado and singleleaf piñon pine

The piñon needle scale is a native sap-sucking insect that feeds on older needles of piñon pine trees. Damage results in tip killing, branch flagging, stunted tree growth, and needle injury. Thin crowns cause a ghostly "see-through" appearance, with trees retaining only current year's needles. Insects in the first larval stage are hard to see on the needles but insects in the second larval stage resemble tiny black beans. Small trees may be killed outright and large trees may be seriously weakened after repeated infestations, rendering them susceptible to piñon engraver beetle. Most piñon seem to recover in a few years from light to moderate defoliation.

Black Pineleaf Scale

Nuculaspis californica Coleman

Hosts: *Pinus spp.* especially Scotch/Scots and Austrian pines

Figure 3. Black pineleaf scale on Austrian pine (Photo: C. Keyes; UT, DNR, FFSL).

The black pineleaf scale attacks several pine species and on rare occasions Douglas-fir and white fir. The insect generally overwinters as a partially developed scale. Eggs and immature nymphs (crawlers) appear in June or July, depending upon temperature. If there is a second generation, egg hatch and crawlers may appear again in late summer. Sap loss due to scale insect infestations may cause yellowing or wilting of needles, stunting of the needles, needle mortality, and defoliation. Defoliation often leaves the tree with just the new growth at the tips of the branches. Infested needles sometimes look dull and light green to yellow-gray in color. Heavy infestations over several years may lead to death of all, or portions of the tree. Black pineleaf scale outbreaks have been associated with stressful growing conditions of the host tree; caused by drought, soil compaction, root injury, overwatering, and other factors that affect plant health. Additional stress, associated with scale infestation, may result in other insects and/or diseases attacking the tree.

Since about 2008, black pineleaf scale populations increased throughout urban and rural areas, mostly in Utah, Salt Lake, Davis, Weber counties. It appears to have peaked in 2010/2011. Fortunately, black pineleaf scale appears to be in decline since 2012. However, many trees in urban and rural areas are still infested throughout the state.

Native Bark Beetles

Fir Engraver Beetle

Scolytus ventralis LeConte

Hosts: true firs

Fir engraver beetle (FEB) is a major pest of true firs throughout the West. It attacks trees of any size. Tree stress due to drought, disease, and defoliation may incite outbreaks that cause severe tree mortality. This insect is often associated with other forest pests such as Douglas-fir tussock moth, spruce budworm, bark beetles, woodborers, and annosus root disease.

Mortality due to FEB decreased from 3,260 acres affected in 2015 to 1,275 acres affected in 2016; a 60% decrease, with the exception of Duchesne County which increased from 8 acres in 2015 to 193 acres affected in 2016, and Sanpete County which went from 0 acres to 275 acres affected.

Mountain Pine Beetle

Dendroctonus ponderosae Hopkins

Hosts: lodgepole, limber, bristlecone, 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 also attack small diameter trees ($\geq$4" diameter at breast height). Extensive mortality may alter large forest landscapes by converting pine ecosystems to grass and shrub landscapes for a period of 10-20 years. This conversion affects wildlife species, water yields and fuels.

In 2016 (1,503 acres affected), MPB induced mortality, in all pine species, continued to decrease from 2015 (7,621 acres affected). Despite a significant decrease damage is still occurring in small pockets affecting lodgepole and limber pines.

Douglas-fir Beetle

Dendroctonus pseudotsugae Hopkins

Host: Douglas-fir

Douglas-fir beetle (DFB) typically kills single and small groups of trees, but during outbreak conditions, pockets of 100 or more trees are not uncommon. At endemic (low) levels, DFB favors stressed and damaged trees such as; broken or wind thrown, wounded or fire–injured trees, and trees with root disease or defoliation. Beetle populations can build rapidly in newly-fallen trees and spread to adjacent healthy standing trees.

In 2016, DFB-caused tree mortality was slightly reduced statewide with 3,288 acres affected down from 4,562 acres affected in 2015. Nearly every County, with the exception of Washington County had some damage. Moderate to small increases and decreases were noted; the largest

decrease occurred in Sevier and Wasatch counties, while Kane and Garfield counties, had the largest increases.

Spruce Beetle

Dendroctonus rufipennis Kirby

Hosts: Engelmann and rarely blue spruce

The spruce beetle (SB) is the most significant natural mortality agent of mature spruce. Endemic populations usually exist in weakened or wind thrown trees, logging slash, and fresh stumps. Outbreaks typically occur when beetle populations build to high levels in concentrations of wind thrown trees. Dispersing adults may infest standing live trees, initially preferring larger diameter trees. Much of the mature spruce, throughout the state, has been killed over the last 20 years by spruce beetle. Spruce beetle caused mortality continues to impact mature spruce stands.

In 2016, SB-caused tree mortality increased again by about 19% from 2015. Most mortality was noted in Duchesne and Summit counties with less acres in Sevier and Wasatch counties. Acres affected may be on National Forest, private or State Trust Lands.

Most of the Engelmann spruce mortality occurred on the Uinta Wasatch Cache NF. Mortality from SB continued at outbreak levels across all of the spruce and spruce/fir forest types. Damage was observed in pockets up to several hundred acres in size, from where the spruce type starts near Yellow pine and heads east. SB-killed trees were mapped on 475 acres, south and southwest of Buck Knoll. Spruce beetle activity was at outbreak levels. Pockets of mortality ranged from a few acres to several hundred acres in size, throughout the spruce and spruce/fir forest types.

On the Fishlake NF, SB-caused tree mortality was mapped on 5,027 acres in 2016. Approximately five small pockets (2 to 5 trees) of spruce beetle-killed trees were mapped near Mount Catherine. Large pockets of spruce mortality were again mapped from Monroe Peak to Marysvale Peak. Large pockets were mapped on the western slopes of the Fishlake Hightop, and in the upper reaches of Doctor Canyon near Buck Flat. Spruce beetle continued to cause significant mortality on Thousand Lake Mountain. Several small pockets (2 to 5 trees) of SB-caused tree mortality occurred on the northern slopes of Shelly Baldy.

Piñon Engraver Beetle

Ips confusus LeConte

Hosts: Colorado and singleleaf piñon

Injured or stressed trees are preferred by piñon engraver beetles. Attacks by this insect girdle and eventually kill piñons. Piñon engravers produce multiple generations each year and consequently populations can build rapidly in slash and stressed green trees. Beetles can then spread into healthy stands. As with other bark beetle species, piñon engravers carry a wood staining fungus into the tree, which in combination with the feeding larva, kills the tree.

Historically, piñon pine was not aerially surveyed in Utah. Drought combined with increased piñon engraver populations contributed to considerable piñon pine mortality in 2001-2002. Piñon-juniper woodlands have subsequently been surveyed each year due to concerns over the loss of this valuable forest type.

In 2016, mortality increased from 374 acres affected in 2015 to 1,974 acres affected. Most mortality was mapped in Sevier and Washington counties. On the Fishlake NF acres affected by pinyon engraver rose from 69 acres in 2015 to 888 acres in 2016. Mortality occurred throughout the forest, with the largest amounts mapped in the Valley Mountains; along the I-70 corridor from Water Hollow Canyon to the Fremont Junction; the West Tidwell Slopes; and on the southeastern slopes of Sargent Mountain.

On the Dixie NF, pinyon engraver beetle affected 668 acres on the Forest. Most of this mortality occurred in the areas of Grassy Flat and Grass Valley. These were large pockets with 30% of trees affected. Scattered, small pockets (2 to 5 trees) were also mapped in Pinto Creek. Other pockets were mapped in the vicinities of Wide Hollow and Tebb's Hollow, and on the Sevier Plateau.

Western Pine Beetle

Dendroctonus brevicomis LeConte

Host: ponderosa pine

Western pine beetle can kill ponderosa pine from six inches in diameter at breast height or larger. This beetle usually targets weakened trees with reduced defenses. Such trees may be crowded in dense, overstocked stands; slow-growing, older ponderosa pine trees; or trees damaged by fire or lightning. When large numbers of trees are weakened across a landscape, western pine beetle populations may increase and kill hundreds of thousands of trees.

In 2016, a total of 340 acers were affected which is a decrease from 2015 in which 467 acres were affected, mostly in Garfield, Kane and San Juan counties.

On the Dixie NF; Western pine beetle, and possibly roundheaded pine beetle and other bark beetle species, caused ponderosa pine mortality affecting 177 acres on the Forest. Scattered ponderosa pine mortality was mapped near Duck Creek, Black Rock Valley, and Panguitch Lake. Other small pockets (2 to 5 trees) of mortality were mapped on the far southern end of the Paunsaugunt Plateau, and on the southern end of the Sevier Plateau.

Roundheaded Pine Beetle

Dendroctonus adjunctus Blandford

Host: ponderosa pine

Roundheaded pine beetle has periodic outbreaks that kill thousands of pine trees, but more commonly this beetle subsists in small groups of weaker trees, often in conjunction with other bark beetles (western pine beetle, mountain pine beetle or pine engravers). Roundheaded pine beetle may attack trees of any size, but usually trees greater than 20 inches diameter at breast height.

No mortality attributed to roundheaded pine beetle was observed by ADS in 2016. However, it is possible that this beetle contributed to the ponderosa pine mortality accredited to the Western Pine beetle.

Borers

Pitch Mass Borer

Dioryctria spp.

Hosts: piñon pine, ponderosa pine, lodgepole pine, Austrian pine, Scots pine, and occasionally Douglas-fir and true firs

In urban areas, Scots/Scotch (*Pinus sylvestris*), Austrian (*Pinus nigra*), and Ponderosa pine (*Pinus ponderosae*), have been reported damaged by this insect. New or continued infestations have been seen yearly, since 2010.

Figure 4. Pitch mass borer (Photo Eric R. Day, Bugwood.org).

Pitch mass borer attacks appear as large, oozing masses of soft, light-pink sap that forms in response to larval feeding beneath the bark. Repeated attacks can seriously weaken trees and kill branches. Heavily damaged branches and trunks are often more susceptible to breakage. The most severe damage is usually to trees less than 20 feet tall, though pitch mass borer has been attacking larger trees in the urban landscape.

Pitch mass borer may be attracted to trees that are under stress due to; drought, over-irrigation, soil compaction, root injury, improper pruning cuts, mechanical damage, or other injuries. Infested trees may also be more susceptible to attack by black pineleaf scale or pine engraver beetle. Damage is still occurring in the urban setting in 2016.

Insects: Non-native

European Gypsy Moth (GM)

Lymantria dispar

Hosts: various deciduous tree species

Since the late 1800's, gypsy moth caterpillars have defoliated millions of acres in the northeastern United States. The gypsy moth feeds on over 250 deciduous tree species and infestations can build rapidly causing widespread defoliation. Tree mortality may occur after successive years of heavy defoliation. Infested areas may be subject to quarantine to prevent the spread of the insect. The caterpillars can also be a nuisance to homeowners by crawling over homes, vehicles, and outdoor furniture. Hairs found on the caterpillars can also cause allergic reactions in some individuals.

The gypsy moth was first detected in Utah in 1988 at Mount Olympus Cove, Salt Lake County. Being notorious hitchhikers they were probably transported into Utah from an infested area in the eastern U.S. Since then, the Utah Department of Agriculture and Food in cooperation with two USDA agencies, the Animal Plant Health Inspection Service and the United States Forest Service, place detection traps throughout the state using the GMWest model BioSIM to determine areas of highest risk of introduction and establishment. This model integrates climate and elevation data to predict the probability of GM establishment. Eradication treatments have been used to treat over 73,000 acres since 1989. No aerial application projects have been conducted since 1999 within the state and no GM have been caught in traps between 2008 and 2015.

The 2016 Utah Gypsy Moth Program placed 1,823 detection traps in areas of highest risk of introduction and establishment. These trapping efforts resulted in the detection of one gypsy moth in Davis County. In 2017, the program will place a delimiting grid of traps around the detection site to determine if other moths are present in the area and if so, to what extent.

Emerald ash borer (EAB)

Agrilus planipennis

EAB is native to Asia, and was introduced through wood packing material used to ship cargo from Asia to Michigan in 2002. EAB continues to spread rapidly to states and provinces in and around the Great Lakes region in Canada and the USA. EAB quickly killed many millions of ash trees (*Fraxinus sp.*) in these areas, and can now be easily spread from infested areas by transporting infested trees and logs (especially firewood). In its native ecosystem, this insect exists in balance with competitors, natural predators, and pathogens. It does not cause economic damage in this setting. However, in North America, without these balancing factors, EAB has caused rapid tree mortality affecting all ash species it attacks. Symptoms of infestation begin with crown dieback, which is followed by epicormic shoots, splitting bark, increased woodpecker damage, serpentine galleries, and D-shaped exit holes. These symptoms progress until the tree is dead. In addition to Utah's many ornamental ash trees in urban landscapes, there are two native ash species that are part of the forest ecosystem. All of these species would be vulnerable to EAB attack, causing economic and aesthetic losses in urban areas and ecological impacts in natural settings.

Figure 5. Emerald ash borer adult. bugwood.org

In 2016, APHIS PPQ placed 69 baited traps throughout 10 counties, targeting high-risk ash trees. UDAF Plant Industry and Conservation also placed traps in trees that members of the public reported had symptoms associated with EAB infestation. No EAB were detected from either federal or state efforts. (*2016 Plant Industry and Conservation Insect Report.)*
https://ag.utah.gov/documents/Insect_2016_Insect_Report.pdf

DISEASE STATUS

Stem and Branch Diseases

Dwarf Mistletoes

Arceuthobium spp.

Hosts: Douglas-fir, pines, and true first

Figure 6. Southwestern dwarf mistletoe (Photo: John Guyon; FHP, OFO).

Dwarf mistletoes (DM) 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 typically observed in infected trees. Heavy dwarf mistletoe infections can kill trees, predispose trees to insects and other diseases, reduce incremental growth, affect the forest canopy structure, lower resistance to drought, and influence wildlife habitat, recreation and aesthetics. Since dwarf mistletoe infects trees of all ages, infection may exist in secondary growth and regeneration, as well as young and old forests.

Piñon Blister Rust

Cronartium occidentale

Hosts: Colorado and singleleaf piñon

This native rust causes stem rust cankers and branch flagging on both Colorado piñon and singleleaf piñon in Utah. This disease kills small trees. These rust infections are commonly associated with attacks by the pitch mass borer and tend to be located near streams and wet areas where the alternate host (primarily *Ribes spp*, currants and gooseberries) are located.

Root Diseases

When present, root diseases spread from the roots of one tree to another, and to a limited extent through the soil. Root diseases are often called "diseases of the site", indicating that once present in a forest they tend to persist throughout the entire lifespan of the trees on that site. Susceptibility of the trees and virulence of the pathogens involved varies from one area to another. In Utah, root diseases are less damaging than in other areas with moister climates and forests that have been impacted by exotic pathogens. True "root disease centers", areas with a high concentration of root disease, are rare in the state. More commonly, evidence of root disease is scattered throughout many forests, with varying degrees of impact. Root diseases are intimately involved with populations of bark beetles, with endemic bark beetle populations often associated with root disease centers.

Several tree conditions are symptomatic of all root diseases. The symptoms can vary if trees are killed rapidly or with size of the tree. The foliage of small trees that have been killed rapidly often turns red. On older trees many of these agents can act as butt or root decays without killing the tree. Trees that have a portion of their root system impacted by root diseases often exhibit several symptoms, including; thinning in the crown from the lowest part towards the highest, and from older foliage towards the younger. In general, the production of conspicuous fruiting bodies of root diseases is rare in Utah, occurring most often in relatively moist years. Several of these diseases can also act as saprophytes, which induce decaying of dead material.

Annosum Root Disease

Heterobasidion occidentale and H. irregulare

Hosts: Douglas-fir, pines, spruce, and subalpine fir

Figure 7. Annosum conk at the base of a tree (Photo: John Guyon; FHP, OFO)

This disease can be found throughout the state, but is most commonly as *H. occidentale* acting as butt decay or as a saprophyte on dead trees, stumps, and roots. It occurs in trees of all ages. The symptoms on larger trees include a thinning crown and fruiting bodies or conks that develop in decayed stumps and roots. The conks are woody to leathery with a dark brown upper surface and cream colored pore surface (Figure 7). Advanced decay in the root tissues looks white, stringy, and somewhat laminate.

Armillaria Root Disease

Armillaria spp.

Hosts: Douglas-fir, Engelmann spruce, subalpine fir, white fir, and pines

Figure 8. Armillaria fans on the Ashley National Forest (Photo: John Guyon; FHP, OFO).

Evidence of Armillaria root disease can be found throughout the state. It often functions as a weak parasite killing trees experiencing environmental stress. It may act as a primary pathogen killing trees of all size class in several host species. In recent years this disease seems to becoming more prevalent in central and south central Utah. It often acts as a thinning agent in young stands or in areas with shallow, poor soils. Symptoms of Armillaria include heavy resinosis at the root collar, and thick fan-shaped mats of white fungus tissue under the bark where root and root collar tissue are dying (Figure 8). The fungus produces rhizomorphs, black string-like structures that can move through the soil a few feet to infect other roots. When present, Armillaria mushrooms grow in clusters from the roots or at the base of the tree. The decay caused by the fungus is yellowish and stringy/spongy and often contains black lines called zone lines.

Black Stain Root Disease
Leptographium wageneri

Host: Colorado and singleleaf piñon pine

Black stain root disease is an important disease of several hosts, but it is only found on piñon pine in Utah. It usually kills infected trees within a few years, and can result in groups of tree mortality several acres in size. Pockets of infected trees are preferred hosts for low-level populations of piñon engraver beetles (*Ips confusus*). No new pockets of black stain root disease were observed by aerial survey in 2016.

Leaf and Needle Diseases

Aspen Leaf Spot
Marssonina populi and M. brunnae

Host: aspen

Aspen leaf spot is the most common leaf disease of aspen in the West. Severe outbreaks may cause foliar browning in midsummer and nearly complete defoliation by early August. Re-growth usually follows in late summer and early autumn. Symptoms include small brownish spots on infected leaves in mid- to late-summer. The spots later enlarge and turn black in color. They will vary in size and appear irregular in shape with a yellowish border (Figure 9). Blight and leaf spot caused by this disease have been seen in the past throughout the host type, and although not indicated on ADS maps, plays a role in aspen dieback and decline.

Figure 9. Symptoms of aspen leaf spot.

In 2016, spring weather conditions were again very favorable for aspen leaf spot. ADS mapped 15,228 acres affected in 2015 and 24,629 acres affected by this disease in 2016. This number is likely lower than the actual acres as sometimes it is difficult to discern foliar damage from the air. Symptoms and early defoliation associated with this disease was noted statewide, especially in high elevations sites.

DECLINES / COMPLEXES

Subalpine Fir Mortality Complex

Host: subalpine fir

The western balsam bark beetle (WBBB) is one of the most significant mortality agents in a complex of forest insects and diseases causing subalpine fir mortality. Endemic populations can 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 2016, a total of 13,593 acres of subalpine fir was affected by this mortality complex. Only Tooele, Iron, Juab and Washington counties had no mortality reported.

Aspen Decline

Host: aspen

Aspen dieback/decline mapped by aerial detection survey decreased nearly 64% in 2016 from 2015 numbers, and remained at low levels compared to the peak in aspen dieback/decline recorded from 2006 through 2008. Aspen dieback/decline has been attributed to including number of factors including drought, grazing, poplar borer (*Saperda calcarata*), bronze poplar borer (*Agrilus liragus*), Cytospora canker (*Valsa sordida*) and sooty bark canker (*Encoelia pruinosa*). The borers and Cytospora canker disease agents are commonly considered secondary pests. Sooty bark canker is usually considered a disease of older stands.

In recent years, aspen bark beetles (*Trypophloeus populi* and *Procryphalus mucronatus*) have been associated with damage. Aspen bark beetles are now common in many Utah stands with dieback and decline symptoms. Field observations indicate that *Trypophloeus* attack trees that still have a large component of "green bark", while *Procryphalus* is found in trees in which the bark is almost entirely dead. Aspen mortality caused by bark beetles, borers, and canker diseases increased as a result of significant drought periods during the last decade. In most of the Intermountain Region, aspen stands have at least some suckering and do not have the symptoms of sudden aspen decline reported in other Regions

ABIOTIC DAMAGE

Frost Damage

Hosts: Hardwoods like maple, gambel oak, aspen are impacted during years with late frosts, and all conifers can be affected, but Douglas-fir, and spruce are more susceptible.

Freeze damage occurs when temperatures drop 2˚ to 5˚ below freezing after tree growth has started in the spring. The young branch tips of trees affected by freeze damage droop, and turn brown, and new shoots or needles of breaking buds are killed. This damage may result in branch dieback, stunted growth, and poor tree form.

There were 284 acres affected in Tooele County in 2016.

Blowdown

Areas of concentrated, high velocity winds can cause trees to blow over often referred to as blowdown. 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. Epidemic beetle populations may then attack and kill standing live trees, most often adjacent to the blowdown.

In 2016, there was no blowdown mapped in Utah.

Snow Avalanches/Mudslides

Like blowdown damage, snow avalanches and mudslides knock down trees and may provide an abundant, local food source for certain bark beetles, enabling populations to build.

There were no avalanches or mudslides mapped in Utah in 2016.

Drought

Drought can influence insect and disease activity. Drought- related damage was not mapped in 2016.

NOXIOUS WEEDS

Noxious weeds are a continuing problem for all Western states. They have the ability to aggressively colonize disturbed habitats thus displacing native plant species and altering ecosystems. Several state and federal agencies have the responsibility for monitoring and controlling noxious weeds. Early in 2016 the Utah Department of Agriculture and Food updated the noxious weed list, increasing the list from 27 to 54 weeds. Additionally noxious weeds have been newly classified into the following five categories:

1A= Not known to exist in Utah. Significant risk of invasion.
1B= Limited distribution in Utah. EDRR (Former A Class)
2= Widely distributed in Utah, considered controllable (Former B Class)
3= Widely distributed in Utah, considered beyond control, control expansion (Former C Class)
4= Present in Utah. Prevent distribution through Seed law

For more up-to-date information on Utah Noxious Weeds go to: **http://www.utahweed.org**

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

http://www.invasivespeciesinfo.gov/
This website is the gateway to federal, state, local, and international efforts concerning invasive species.
http://www.ipm.ucdavis.edu
University of California integrated pest management website has educational resources, and research information, as well as information on how to identify and manage pests.

http://invader.dbs.umt.edu
The University of Montana's INVADERS Database is a comprehensive database of exotic plant names and weed distribution records for five states in the northwestern United States. It is used as 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, additional information on common weeds, and links to more information.

https://www.cdfa.ca.gov/plant/ipc/encycloweedia/encycloweedia_hp.html
California Department of Food and Agriculture has a very comprehensive website on weeds. The site has information including botanical description, biology, distribution, habitat, and management of weed. Pictures of the plants in various stages are just a click away.

http://www.nwcb.wa.gov
State of Washington's noxious weed control board website has information on numerous weeds. Topics include identification, why it's a noxious weed, geographic distribution, reproduction, and control options such as mechanical, herbicide, cultural, and biocontrol.
http://www.invasiveplantatlas.org

The Invasive Plant Atlas of the United States website is a collaborative project between the National Park Service, The University of Georgia Center for Invasive Species and Ecosystem Health, the Invasive Plant Atlas of New England, and the Lady Bird Johnson Wildflower Center. The atlas assists users with identification, early detection, prevention, and management of invasive plants.

EDDMapS 2016- Early Detection and Distribution Mapping System. University of Georgia - Center for Invasive Species and Ecosystem Health. Available online at: **http://www.eddmaps.org/**.

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