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Utah Forest Insect and Disease Conditions Report 2017 & 2018

Zion Narrows: photo by Danon Hulet

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Utah Forest Insect and Disease Conditions Report 2017 & 2018

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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 2017 is provided in Table 2; and 2018 in Table 3. Figure 1 shows areas that were surveyed in 2017; and Figure 2 in 2018. 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 4 shows the number of acres affected by bark beetles in Utah counties as detected by ADS in 2017; and Table 5 in 2018. Table 6 shows the number of acres affected by defoliators & other agents in Utah counties in 2017; and Table 7 in 2018. Acres affected may be on federal, private State parks,or State Institutional Trust Lands.

Summary

Mountain pine beetle (MPB) induced mortality declined from 2016. However, mortality in 2017 was still occurring within the lodgepole and limber pines. In 2018 in Summit County, a significant increase in MPB acres affected occurred within the lodgepole.

Douglas-fir beetle induced mortality has been mapped in every county except; Daggett, Millard, Piute, and Washington counties. In 2017, a total of 3,788 acres were affected statewide, a slight increase of about 15% of acres affected in 2016. In 2018, nearly every county except Daggett, Davis and Rich counties had some acres affected with a considerable increase statewide of 12,104 total acres affected.

Spruce beetle caused mortality is still being mapped, with a total decrease of 33% in the total acres affected (124,370) from 2016. In 2017, a total of 83,348 acres were affected statewide. In 2018, there was an increase with 92,832 total acres affected. The largest number of acres affected for 2017 and 2018 occurred in Duchesne and Summit counties.

Fir engraver caused mortality (primarily in white fir) appears to have significantly increased statewide in 2017 at 15,767 acres affected and again in 2018 at 21,011total acres affected, while only 1,275 acres were affected in 2016 Most counties have some damage mapped. The largest amount of acres affected in 2017 was in Millard, Piute, Sevier, and Utah counties. In 2018, the largest was in Millard, Sevier, Sanpete and Utah counties.

Subalpine fir tree mortality complex appears to have increased significantly from 2016 with (13,593 acres affected). In 2017, 25,824 total acres affected. In 2018, damage increased again with 33,878 acres affected. Some mortality was mapped in nearly all counties in 2017except Wayne County; and in 2018, nearly all counties showed some acres affected, with the exception of Juab, Washington and Wayne counties.

Balsam woolly adelgid (BWA) is a tiny non-native sucking insect, and was first confirmed in Utah in September 2017. . In 2017, BWA was confirmed in Box Elder, Cache, Rich, Weber, Davis, Morgan, Salt Lake and Summit counties and added an additional 2,001 subalpine fir acres affected. In 2018, the number of acres affect increased considerably to 13,021 acres affected and Utah County was added to the confirmed counties list. Much of the increase in acres affected is likely due to ground survey confirmation and the increased ability of the Aerial Detection Specialists in recognizing the signature of this pest.

Western spruce budworm defoliation appears to have decreased considerably from 2016 by approximately 46%, with 65,565 acres affected in 2017. Most damage was mapped in Beaver, Garfield, Sevier, and Piute, counties. However, in 2018 acres affected increased to 83,372; with the most damage seen in Beaver, Garfield, Piute, Sevier, and Wayne 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 6,257 acres were also mapped as

"aspen decline" in 2017. In 2018, aspen dieback decreased with 1,224 total acres affected.

Aspen leaf spot (*Marssonina spp*) was mapped in 2017, with a total of 4,419 acres affected. In 2018 only 157 acres were affected. This disease is more pronounced in years when spring weather is cool and wet during initial leaf formation, which was the case in 2016, with 24,629 acres affected.

To view the survey maps go to: https://www.fs.usda.gov/detailfull/r4/forest-grasslandhealth/?cid=fseprd571329&width=full

Table 2. Total number of acres aerially surveyed in each county during 2017.

Aerial Detection Survey 2017		
County	Acres flown	% of County
Beaver	221,609	13.1
Box Elder	207,461	4.8
Cache	648,982	84.7
Carbon	312,535	31.7
Daggett	268,646	59.4
Davis	78,044	19.1
Duchesne	1,185,326	57.0
Emery	313,464	11.1
Garfield	1,623,295	48.6
Grand	218,673	9.3
Iron	562,620	26.7
Juab	360,315	16.2
Kane	418,510	16.0
Millard	508,385	11.7
Morgan	364,090	93.1
Piute	407,190	82.5
Rich	223,447	34.0
Salt Lake	193,290	38.0
San Juan	880,736	17.4
Sanpete	683,100	68.1
Sevier	1,094,780	88.8
Summit	843,745	70.1
Tooele	192,396	4.1
Uintah	428,378	14.8
Utah	755,706	54.5
Wasatch	713,661	91.5
Washington	640,782	41.7
Wayne	316,161	19.9
Weber	269,042	63.8
Total	14,934,369	

Table 3. Total number of acres aerially surveyed in each county during 2018.

Aerial Detection Survey 2018		
County	Acres flown	% of County
Beaver	209,010	12.4
Box Elder	249,848	5.8
Cache	621,829	81.2
Carbon	264,441	26.8
Daggett	344,619	76.2
Davis	79,144	19.4
Duchesne	1,066,762	51.3
Emery	325,677	11.5
Garfield	1,513,392	45.3
Grand	135,101	5.8
Iron	600,702	28.5
Juab	315,587	14.2
Kane	598,237	22.9
Millard	503,493	11.6
Morgan	314,650	80.5
Piute	385,987	78.2
Rich	208,437	31.7
Salt Lake	258,816	50.9
San Juan	728,587	14.4
Sanpete	790,155	78.7
Sevier	1,164,217	94.5
Summit	965,336	80.3
Tooele	499,672	10.8
Uintah	309,595	10.7
Utah	867,632	62.5
Wasatch	692,249	88.8
Washington	193,490	12.6
Wayne	240,294	15.1
Weber	277,100	65.7
Total	14,724,059	27.1

Figure 1. Surveyed Areas for the 2017 Aerial Insect and Disease Detection Survey

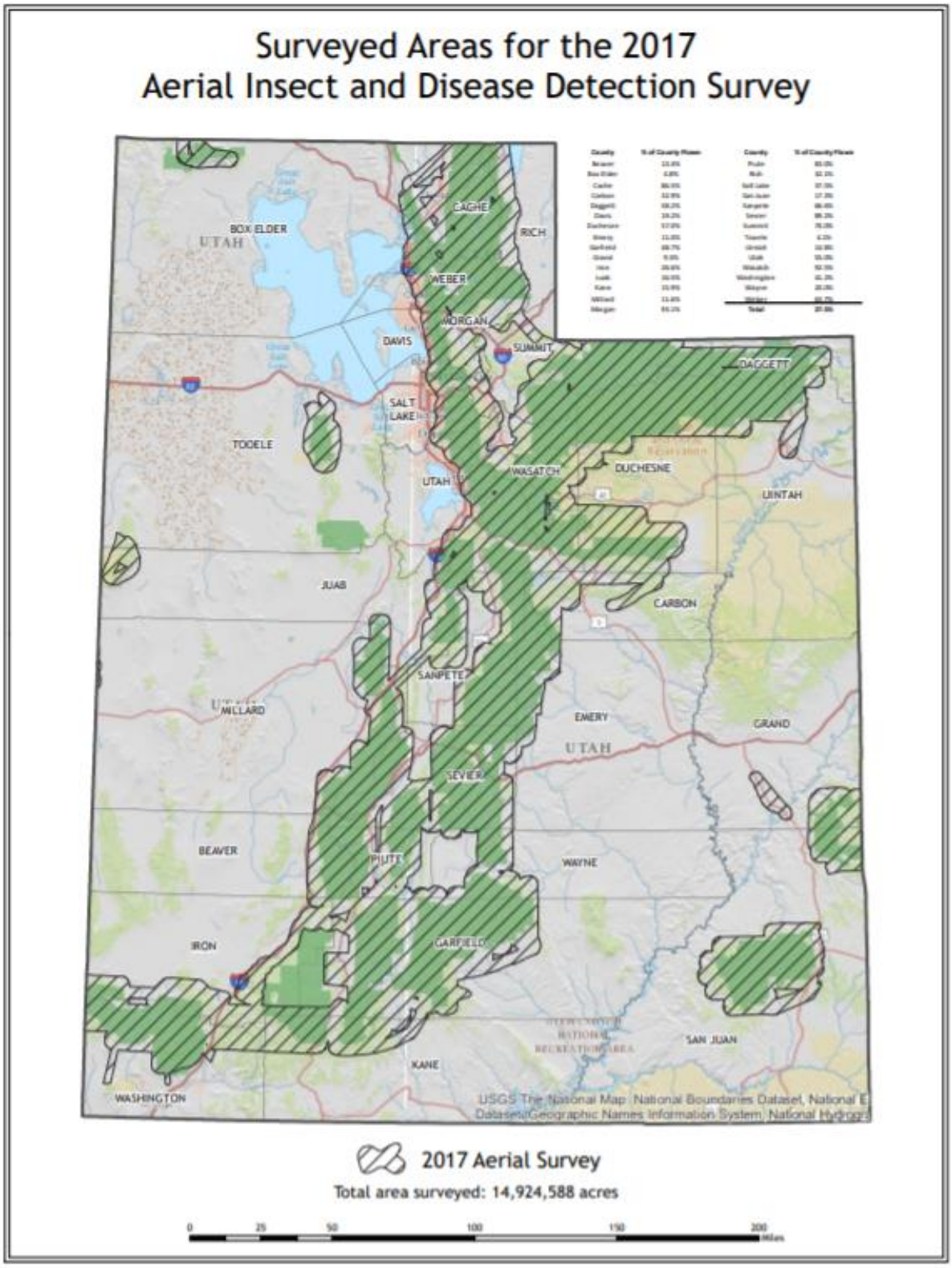
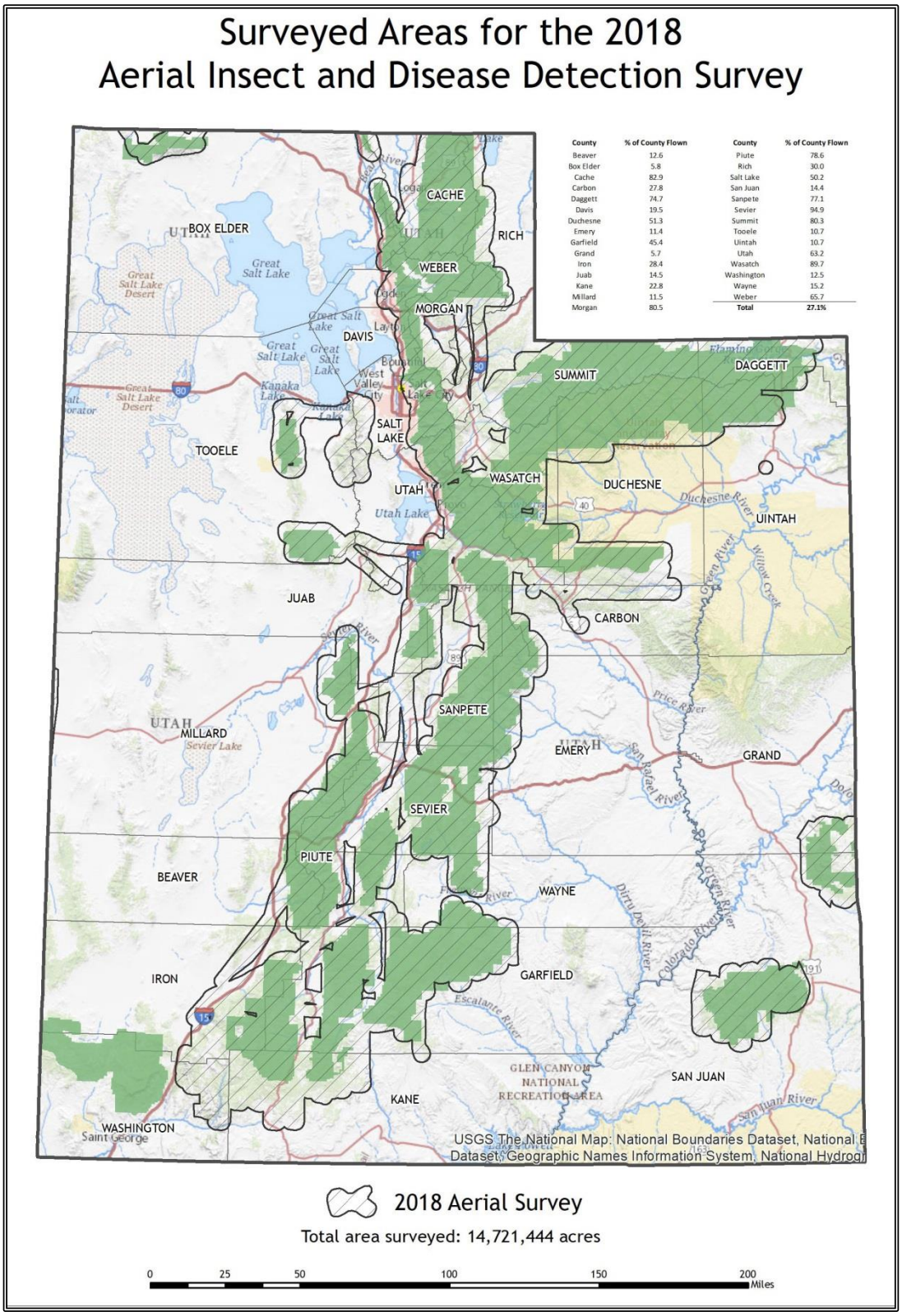


Figure 2. Surveyed Areas for the 2018 Aerial Insect and Disease Detection Survey



County	% of County Flown	County	% of County Flown
Beaver	12.6	Piute	78.6
Box Elder	5.8	Rich	30.0
Cache	82.9	Salt Lake	50.2
Carbon	27.8	San Juan	14.4
Daggett	74.7	Sanpete	77.1
Davis	19.5	Sevier	94.9
Duchesne	51.3	Summit	80.3
Emery	11.4	Tooele	10.7
Garfield	45.4	Uintah	10.7
Grand	5.7	Utah	63.2
Iron	28.4	Wasatch	89.7
Juab	14.5	Washington	12.5
Kane	22.8	Wayne	15.2
Millard	11.5	Weber	65.7
Morgan	80.5	**Total**	**27.1%**

Table 4. Acres affected by bark beetles in Utah counties as detected by ADS in 2017.

2017	Mountain Pine Beetle[1]	Western Pine Beetle	Douglas -fir Beetle	Spruce Beetle	Piñon Engraver	Fir Engraver Beetle	Subalpine Fir Mortality
COUNTY	Acres	Acres	Acres	Acres	Acres	Acres	Acres
Beaver	6		2	8	78	437	15
Box Elder	2		134				643
Cache	44		96	2		2	397
Carbon	8	4	66				2,924
Daggett	16	6		24	4		443
Davis	2		6			2	28
Duchesne	175	8	113	45,775	22		229
Emery	42	8	28	2		4	1,101
Garfield	2	154	138	12	108	18	31
Grand		32	22	18	8		35
Iron	4	6	14		177	28	46
Juab	38		28		2	210	6
Kane		88	35	11		90	19
Millard	4			4	28	5,143	62
Morgan			32			152	52
Piute	12	4		206	106	1,595	35
Rich	12		8	6			212
Salt Lake	4		10			140	202
San Juan		130	202	53	14		117
Sanpete	52	29	296		40	659	7,400
Sevier	52	102	108	26	232	3,922	1,417
Summit	12		139	36,000		14	732
Tooele	10		337			6	10
Uintah	20	2	20	217			1,251
Utah	48	4	1,762		78	2,803	2,995
Wasatch	22		148	608	4	121	5,366
Washington	24	10		30	164	382	20
Wayne		2	28	346			
Weber			16			39	36
Total	611	589	3,788	83,348	1,065	15,767	25,824

[1]Mountain pine beetle has killed several species of trees: lodgepole, ponderosa, and limber pine; However, in 2017 mostly 5 needle pines ; throughout Utah

Table 5. Acres affected by bark beetles in Utah counties as detected by ADS in 2018.

2018	Mountain Pine Beetle[1]	Western Pine Beetle	Douglas-fir Beetle	Spruce Beetle	Piñon Engraver	Fir Engraver Beetle	Subalpine Fir Mortality
COUNTY	Acres	Acres	Acres	Acres	Acres	Acres	Acres
Beaver			2			227	87
Box Elder			86				535
Cache	1		10	1		1	911
Carbon	1		25		1	83	554
Daggett	93			1,815			3,247
Davis							8
Duchesne	14		47	30,960	3	107	498
Emery	3		1		1	1	754
Garfield		151	14	1	3	2	377
Grand		1	379				1
Iron		1	1	1	2	1	1
Juab			577			361	
Kane		4	321		2	3	19
Millard			36		4	5,567	175
Morgan			12			17	1,448
Piute			1			332	900
Rich				1			455
Salt Lake			1	2		7	257
San Juan		19	1,256		26	61	19
Sanpete	8		3,648		2	4,528	4,191
Sevier	1	1	499	16	154	1,931	1,023
Summit	1,641		311	54,198		2	3,741
Tooele	1		28			11	10
Uintah	1		7	290			499
Utah	5		3,756	22	1	7,257	2,567
Wasatch	1		1,071	5,524		511	11,224
Washington			5				
Wayne			2	1			
Weber			8			1	377
Total	1,770	177	12,104	92,832	199	21,011	33,878

[1]Mountain pine beetle has killed several species of trees: lodgepole, ponderosa, and limber pine; However, in 2017 mostly 5 needle pines ; throughout Utah

Table 6. Number of acres impacted by defoliators & other agents in Utah Counties in 2017.

2017	Western Spruce Budworm	Marssonina blight, Aspen	Aspen Dieback	Balsam Woolly Adelgid
County	**Acres**	**Acres**	**Acres**	**Acres**
Beaver	12,262			
Box Elder				64
Cache	338	32	49	270
Carbon		111	564	
Daggett				
Davis				263
Duchesne	128	31	257	
Emery				
Garfield	12,297		150	
Grand	3,574	432	393	
Iron	373	93	127	
Juab	156		28	
Kane	752		28	
Millard			54	
Morgan			104	290
Piute	12,048	11	165	
Rich	189		194	5
Salt Lake		34		
San Juan	5,110	824	784	
Sanpete	2	13	504	
Sevier	11,070	33	697	
Summit	3	26	5	43
Tooele				
Uintah	137	417	155	
Utah	239	155	1,265	
Wasatch	2,446	2,029	528	
Washington	244		157	
Wayne	4,197	137	37	
Weber		41	12	1,066
Total	65,565	4,419	6,257	2,001

Table 7. Number of acres impacted by defoliators & other agents in Utah Counties in 2018.

2018	Western Spruce Budworm	Marssonina blight, Aspen	Aspen Dieback	Balsam Woolly Adelgid
County	**Acres**	**Acres**	**Acres**	**Acres**
Beaver	16,906			
Box Elder		7	319	585
Cache	146	128	53	1,159
Carbon			14	
Daggett				
Davis			10	307
Duchesne	74			
Emery	67		113	
Garfield	42,053		45	
Grand	121			
Iron	636		71	
Juab			202	
Kane	519		1	
Millard			6	
Morgan				1,941
Piute	7,586			
Rich	105			966
Salt Lake		6	5	1,364
San Juan	1,623		7	
Sanpete	1,723			
Sevier	7,041		58	
Summit	222			2,051
Tooele			4	
Uintah				
Utah	317		273	522
Wasatch	704	16	8	583
Washington	32		30	
Wayne	3,497		5	
Weber				3,543
Total	83,372	157	1,224	13,021

INSECT STATUS NATIVE INSECTS

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

One male moth was detected in 2017. However, no DFTM defoliation was detected in Utah in 2018

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, white fir, Douglas-fir, and Engelmann spruce has increased significantly in the high plateaus statewide, with most counties having some damage. Western spruce budworm defoliation appears to have decreased from 2016 (121,026 acres) by approximately 46%, with 65,565 acres affected in 2017. Most damage in 2017 was mapped in Beaver, Piute, Garfield, Sevier, and counties. However, in 2018 acres affected appears to increase with 83,372 acres affected. Most defoliation was in Beaver, Piute, Garfield, Sevier, and Wayne counties.

In Beaver County, most defoliation starts just north of South Fork North Creek and runs south to the Iron County line. Then to a lesser amount of defoliation, starts west to Tim Reed Creek and Birch Creek and is scattered throughout the Tusher Mountains with moderate to heavy defoliation.

In Piute County, there is scattered small to large pockets with defoliation being moderate to heavy in areas from the Sevier County line east from picnic Creek to Deer Creek, and running south

along the Piute and Beaver County line, to just past west of City Creek and just north of Cottonwood Creek. Also, from the Sevier County line near North Fork Box Creek, running south to southwest to just north of Rock Canyon.

In Sevier County, there is moderate to heavy defoliation over Zedds Mountain, near West Tidwell Canyon; and large areas of moderate defoliation west and east of Fish Lake and north of Mytoge Mountain Range.

In Garfield County, there are very large areas of moderate to heavy defoliation starting south of Pine Creek to Deep Creek, then south to southwest to Hall Creek. Large pockets of moderate defoliation near Iron Springs Draw, and large heavy defoliation areas west of Big Swell and running south to above Griffin Top. Smaller pockets run east of Birch Creek to North of Berry Top.

In Wayne County, most damage was seen west of Boulder Top in Bone Flat

Western Tent Caterpillar
Malacosoma califomicum 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 2017, but several counties had some acres affected in 2018, with the most damage seen in San Juan County; near Woodenshoe Rd/Elk Mtn, which is north of Bears Ears.

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. No pinyon scale was mapped by ADS in 2017 or 2018.

Black Pineleaf Scale

Nuculaspis californica Coleman

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

Figure 2. 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, as of 2018 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 increased significantly, from 1,275 acres affected in 2016, to 15,767 acres affected in 2017; then increased again in 2018, to 21,011 acres affected. Most counties had some affected acres. Sevier, Millard, Piute, Sanpete, and Utah counties had the largest damage. Most of the affected acres are scattered small to medium sized pockets of light to moderate damage.

Sevier and Millard counties had a few larger areas near Cedar Mountain with light damage and small to medium pockets scattered across the Pavani Range. Millard County had medium to large areas of light damage, west of Scipio Lake/Round Valley area and small to medium sized pockets scattered southward across the Pavani Range.

Piute County had large to small pockets of damage north and south of Powerhouse Ridge, around Manti Canyon, and near Order Mountain.

Utah County had scattered small to medium sized pockets of light to moderate damage. Some larger areas of light damage was seen just north of Red Mountain, around Powerhouse Mountain and many large to moderate size pockets were mapped around Payson Canyon and Nebo Loop Rd.

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 (≥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.

MPB induced mortality, in all pine species, continues. In 2016, acres affected, in all species of pine, totaled statewide was 1,503. Damage is still occurring in small pockets, affecting lodgepole and limber/five needle pines. In 2017, most damage was in limber and/or five needle pine (535 acres affected), and all pines statewide was 611 total acres affected. Acres In 2018 more acres were affected in lodgepole pine (1,735) than in five needle pines or limber pine (35) than in 2017, with a total of 1,770 acres affected of all pines statewide.

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 2018, DFB induced mortality increased significantly with 12,104 acres affected statewide. While in 2017, DFB-caused tree mortality statewide was 3,688 acres affected, which is a slight increase from that of 2016, where a total of 3,288 acres were affected. Nearly every county, had some acres affected. Moderate to small increases and decreases were noted. The most notable increases from 2017 to 2018 occurred in; Wasatch, San Juan, Sanpete, and Utah counties. Also, significant increases in acres affected were seen in; Grand, Juab, Kane, and Sevier counties.

Spruce Beetle

Dendroctonus rufipennis Kirby

Hosts: Engelmann spruce 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 2018, SB-caused tree mortality (92,832 acres affected) increased slightly from (83,348 acres affected) in 2017. This was a decrease from 124,370 acres affected in 2016. Some moderate to low activity was noted in most counties. A significant decrease was noted in Sevier County, 5,526 acres affected in 2016, where in 2017 only 26 acres were affected and in 2018, 16 acres were affected. As in 2016, most mortality was noted in Duchesne and Summit counties. Mortality from SB continued at outbreak levels across all of the spruce and spruce/fir forest types. Damage was observed in very large areas to small pockets scattered throughout the two counties. However, in 2018, significant damage was also mapped in Daggett County with 1,815 acres affected.

In Summit County small to large areas were noted from the Idaho border east to Kabell Ridge and south to the Duchesne County line, including Flat Top Mountain, West Basin, and Middle Basin.

In Duchesne County small to very large areas west from Mount Emmons and south to Hells Canyon and north to the Summit County line. These areas included; Four Lakes, Naturalist Basin, East Basin, Ottoson Basin, Brown Duck, and Garfield Basin.

In Daggett County small to moderate pockets of damage was noted in the southwest corner of the county; around the areas of South Fork Sheep Creek and West Fork Carter Creek.

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 2018, total pinyon engraver induced mortality decreased statewide to 199 acres affected. In 2017, a total of 1,065 acres were affected where as in 2016, a total of 1,974 acres were affected. Increases and decreases were mapped in most counties. Mortality was noted as scattered small pockets throughout the Pinyon/Juniper forest type. Most mortality in 2017 was mapped in Garfield, Piute, Iron, Sevier and Washington counties. Garfield, Piute, and Iron counties increased slightly in mortality, but mortality decreased significantly in Sevier and Washington counties in 2017. The most mortality in 2018 was in Sevier and San Juan counties with 154 and 26 acres affected, respectively

Western Pine Beetle

Dendroctonus brevicomis LeConte

Host: ponderosa pine

Western pine beetle (WPB) can kill ponderosa pine that are 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 2017, a total of 589 acres were affected which is an increase from 2016 in which 340 acres were affected. Most damage in 2017 was noted in Garfield, Kane, Sevier, and San Juan counties. In 2018, WPB induced mortality decreased statewide to a total of 177 acres affected. Most acres affected were mapped in Garfield County where 151 acres were affected.

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 2017 or 2018. However, it is possible that this beetle, and/or a complex of other beetles, 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 3. 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 2018.

Insects: Non-native/Invasive

Invasive species are non-native insects, which may become established, spreading rapidly, causing significant economic and ecological impacts to forest and urban trees.

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 placed a delimiting grid of traps around the detection site to determine if other moths were present in the area and if so, to what extent. No additional moths were captured in 2017. In 2018, 2,138 traps were placed with zero moths detected.

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

Figure 4. Emerald ash borer adult. bugwood.org

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.

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. Traps were placed again in 2017 and no EAB were detected. In 2018, 40 EAB traps were placed in areas with ash trees throughout the state, no EAB were detected. Traps will again be placed in 2019. For more information contact the Utah Department of Agriculture and Food. *https://ag.utah.gov/documents/2018InsectReport.pdf*

Balsam Woolly Adelgid, (BWA)

Adelges piceae (Ratzeburg)

BWA is a tiny sucking insect that was introduced to North America from Europe and is a damaging insect of true fir. In Utah, subalpine fir (*Abies lasiocarpa*) is a highly susceptible host tree; white fir (*A. concolor*) is also a host, but is more tolerant.

In September 2017 BWA was confirmed in Utah. It has now been confirmed in Box Elder, Cache, Rich, Weber, Davis, Morgan, Salt Lake and Summit counties. In 2017, 2,001 acres were mapped as being affected by BWA. In 2018, Utah County was added to the list of counties with confirmed infestations and BWA was mapped with aerial detection surveys showing 13,021 total acres affected (see Table 6 and 7 for more detailed data). The large increase in acres affected may partially be attributed to ground survey confirmation and the increased ability of the Aerial Detection Specialists in recognizing the signature of this insect.

Figure 7. Balsam woolly adelgid gouting; photo USU

Figure 8. BWA white woolly masses on tree

DISEASE STATUS

Stem and Branch Diseases

Dwarf Mistletoes

Arceuthobium spp.

Hosts: Douglas-fir, pines, and true first

Figure 9. Southwestern dwarf mistletoe (Photo: John Guyon; FHP, OFO).

Dwarf mistletoes (DM) are the single most damaging parasitic 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, 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 10. 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 11. 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 2017 or 2018.

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 12. Symptoms of aspen leaf spot.

In 2016, spring weather conditions were very favorable for aspen leaf spot. ADS mapped 24,629 acres affected by this disease in 2016. In 2017, spring weather conditions were somewhat less favorable. However, 4,419 total acres were affected, most counties had some damage. In 2018, only 157 acres were affected, most of which was noted in Cache County in the area of Right Fork Logan Canyon, Long Hollow and Trail Hollow. These numbers may be lower than the actual acres, as sometimes it is difficult to discern foliar damage from the air.

DECLINES / COMPLEXES

Subalpine Fir Mortality Complex

Host: subalpine fir

The western balsam bark beetle (WBBB) is thought to be 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. In 2017, a total of 25,824 acres were affected statewide, with Wayne County the only county without any noted acres affected. In 2018, the name of this complex changed from SAF Mortality Complex to "Root Disease & Beetle Complex (SAF mortality)". Using this name change, the ADS mapped 38,878 total acres affected statewide, with only Juab, Washington and Wayne counties showing no acres affected.

Aspen Decline

Host: aspen

Aspen dieback/decline mapped by aerial detection survey decreased in 2017 with 6,250 acres affected and decreased again in 2018 at 1,224 acres affected from those of 2016 (7,269 acres affected). The acres affected remained at low levels compared to the peak in aspen dieback/decline recorded from 2007 of 126,057 acres affected. Aspen dieback/decline has been attributed to a 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, and aspen are impacted during years with late frosts. 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 no acres affected in 2017 or 2018.

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 2017 and 2018, 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 2017 or 2018.

Drought

Drought can influence insect and disease activity. Drought- related damage was not mapped in 2017 or 2018.

Flood

There were 77 total acres affected in 2018. Flood damage was reported in; Grand (4 acres), Piute (54 acres), Sevier (19 acres), Summit (1 acre), and Wasatch (1 acre) counties.

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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