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State and Private Forestry
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State of Utah
Department of Natural Resources
Division of Forestry, Fire, and State
Lands

Utah Forest Insect and Disease Conditions Report 2021

North Slope Uinta Mountains: photo by Colleen Keyes (FFSL)

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FOREST HEALTH CONDITIONS SUMMARY

Introduction

A healthy forest maintains the function, diversity, and ecological resiliency of all its components, and provides a framework for all essential ecosystem processes such as fish and wildlife habitat, for many native species, riparian areas, soils, rangelands, and economic potential, while providing for human needs now and in the future. This report focuses on the impacts of insect, disease, and abiotic disturbance agents on Utah's managed forested lands using ground level observations by Forestry, Fire and State Lands (FFSL) personnel and USDA Forest Service, Forest Health Protection (FHP) personnel and other verified information. Aerial detection surveys (ADS) conducted by FHP provides the data used to describe forest pest status and trends in the state from year to year. Mortality trends are described in terms of acres affected, however, not all trees within affected acres are dead. The area of ADS coverage varies by year depending on need, resources, and flight restrictions. In Utah, due to COVID-19 protocols and travel limitations, there was no ADS done in 2020 and only partial ADS in 2021.

In 2016, FHP changed the tree damage quantification methodology from "trees per acre" to "percent of trees affected" for large areas affected by insect and disease agents. Small, affected 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 or polygon, and causal agent(s) are assigned to each feature (e.g., mountain pine beetle; Douglas-fir beetle; etc.). Depending upon feature type, damage intensity is recorded differently. For point data, trees affected are classified into one of 5 levels that correspond to the number of trees killed. For polygon data, damage is classified by the percentage of trees affected within the feature.

Table 1. Aerial detection 5-level tree damage classification system.

Point Class	Trees Affected		Polygon 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 2021 is provided in Table 2. Figure 1 shows areas that were surveyed in 2021. Over 7 million acres were surveyed primarily 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 often **not** the cause of poor forest health, but are the result. Some major factors contributing to a decline in forest health include: lack of active management, poor grazing patterns, fire exclusion, and invasive weeds. Adequate precipitation and growing space are necessary to maintain tree vigor, thereby increasing tree resistance to insects and diseases. Increasingly hot drought conditions throughout the State continue to place additional stress on forests that are already in poor health.

Refer to Tables 3 & 4 for county-level ADS information on acres affected by bark beetles, and defoliators and other agents in 2021. Acres affected may be on federal, private, State parks, or State Institutional Trust Lands. **In Utah, due to COVID-19 protocols and travel limitations there was no ADS done in 2020 and only partial ADS in 2021. Therefore, we cannot compare 2019 acres damaged to 2021 acres damaged.**

Summary

Mountain pine beetle (MPB) caused mortality in 2021 ADS affected 259 acres. Summit County had the majority of the MPB-caused mortality in lodgepole and limber pine.

Douglas-fir killed by Douglas-fir beetle (DFB) mapped in 2021 ADS showed a total of 1,038 acres affected.

Spruce beetle-caused Engelmann spruce mortality is still being mapped, in 2021 with a total of 28,875 acres affected. occurred mainly in Duchesne, Dagget, Summit and Uinta counties.

Fir engraver-caused mortality (primarily in white fir) statewide in 2021, with 645 acres affected. The largest acreage affected occurred in Salt Lake, Utah, and Sanpete counties.

Subalpine fir decline (formerly mapped as subalpine fir tree mortality complex) is believed to be due to multiple potentially interacting factors, including pathogens, bark beetles, and environmental stresses especially drought. The primary insects contributing to subalpine fir mortality are western balsam bark beetle, and western spruce budworm. Balsam woolly adelgid is also causing extensive damage in subalpine fir trees and is reported separately. Diseases caused by fungal pathogens that affect subalpine fir include Heterobasidion root disease, Armillaria root disease, and Cytospora canker. Subalpine fir decline (formerly, mortality complex) was mapped in 2021 ADS as 3,632 acres affected.

Balsam woolly adelgid (BWA) is a tiny non-native sucking insect and was first confirmed in Utah in September 2017. As of 2019, BWA was confirmed in Box Elder, Cache, Rich, Weber, Davis, Morgan, Salt Lake, Summit, Utah, and Wasatch counties. In 2021, acres affected by BWA added an additional 18,299 subalpine fir acres affected to those affected by subalpine fir mortality complex. Some of the BWA acreage may be misclassified within the ADS dataset. Areas of possible misclassification will be ground verified in 2022.

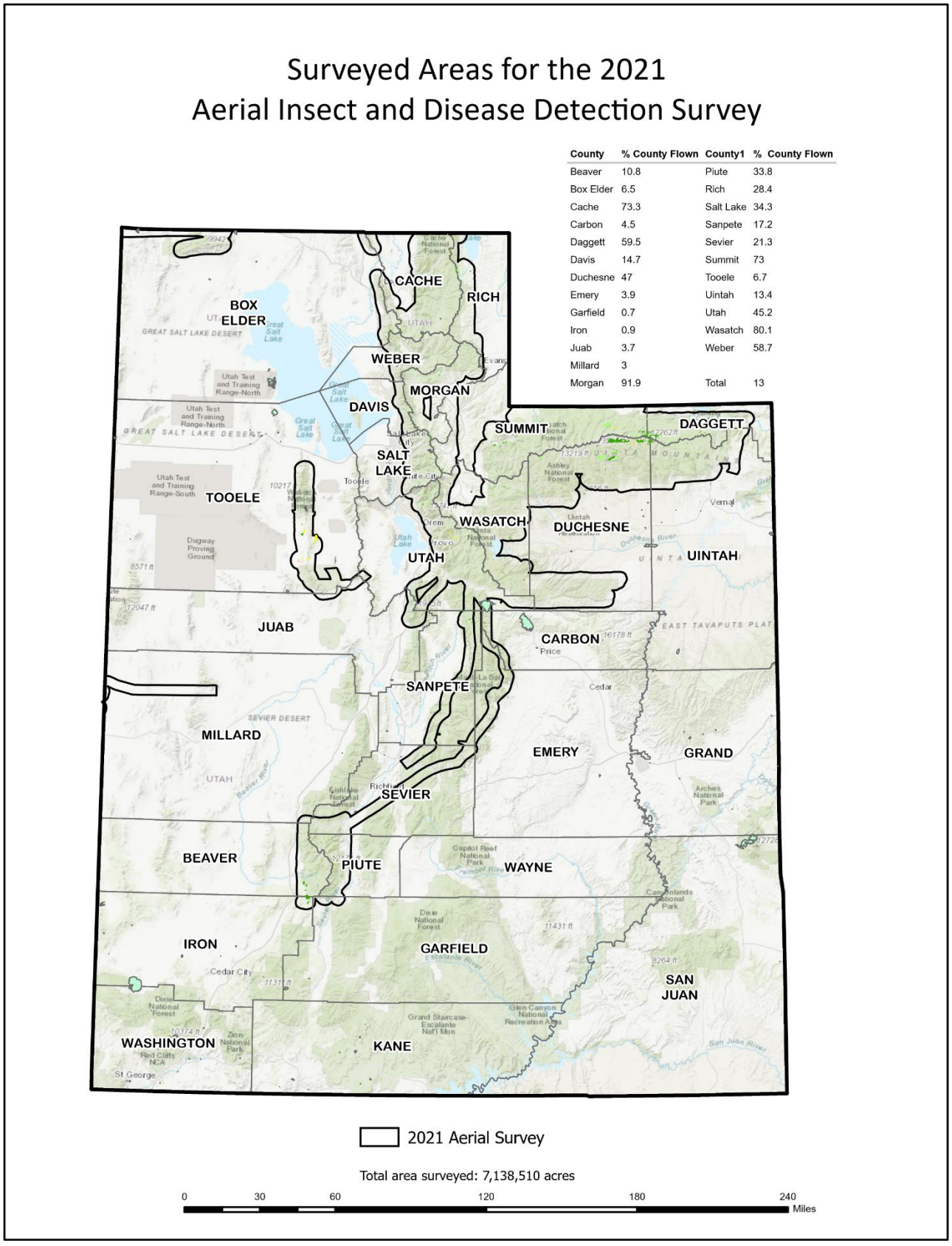
Western spruce budworm (WSB) defoliation shows a total of 1,764 acres affected in the 2021 ADS survey.

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

Table 2. Total acres aerially surveyed in 2021, by county.

Aerial Detection Survey 2021					
County	Acres flown	% of County	County	Acres Flown	% of County
Beaver	179,375	10.8	Piute	165,447	33.8
Box Elder	281,397	5.3	Rich	197,189	28.4
Cache	550,470	73.3	Salt Lake	176,804	34.2
Carbon	43,176	4.5	San Juan	-	0.0
Daggett	274,640	59.5	Sanpete	176,774	17.2
Davis	59,851	14.8	Sevier	261,769	21.3
Duchesne	978,724	46.9	Summit	878,423	73.0
Emery	112,123	3.9	Tooele	310,719	6.7
Garfield	24,428	0.7	Uintah	388,237	13.5
Grand	-	0.0	Utah	621,466	45.3
Iron	20,054	0.9	Wasatch	618,072	80.1
Juab	80,397	3.7	Washington	-	0.0
Kane	-	0.0	Wayne	-	0.0
Millard	131,320	3.0	Weber	247,981	58.8
Morgan	359,307	91.9	-	-	-
Total Acreage = 7,138, 510					

Figure 1. Aerial detection survey areas flown in Utah, 2021.



County	% County Flown	County1	% County Flown
Beaver	10.8	Piute	33.8
Box Elder	6.5	Rich	28.4
Cache	73.3	Salt Lake	34.3
Carbon	4.5	Sanpete	17.2
Daggett	59.5	Sevier	21.3
Davis	14.7	Summit	73
Duchesne	47	Tooele	6.7
Emery	3.9	Uintah	13.4
Garfield	0.7	Utah	45.2
Iron	0.9	Wasatch	80.1
Juab	3.7	Weber	58.7
Millard	3		
Morgan	91.9	Total	13

Table 3. Bark beetle-affected acres in Utah by county; 2021 aerial detection survey data.

2021	Mountain Pine Beetle[1]	Western Pine Beetle	Douglas-fir Beetle	Spruce Beetle	Piñon Engraver	Fir Engraver Beetle	Subalpine Fir Decline
COUNTY	Acres	Acres	Acres	Acres	Acres	Acres	Acres
Beaver		45			1732		57
Box Elder	0		99			2	16
Cache	1		147				124
Carbon							225
Daggett	0	1	0	3750	1		602
Davis						4	
Duchesne	6	1	9	15720	34	66	741
Emery	3		1		2		
Garfield		0					0
Grand							
Iron					1307		
Juab			7		4	31	1
Kane							
Millard					2		
Morgan			7			3	0
Piute		30			481		245
Rich			2				130
Salt Lake			1			210	5
San Juan							
Sanpete	0		246			136	584
Sevier		0	1		53		171
Summit	246		38	5179		8	345
Tooele	0		105		4996	1	1
Uintah	1		5	1225	5		132
Utah	1		314		3	119	32
Wasatch	1		29	1		32	220
Washington							
Wayne							
Weber			28			2	2
Total	**259**	**77**	**1,038**	**25,875**	**8,620**	**615**	**3,632**

[1]Mountain pine beetle has killed several species of trees in Utah: lodgepole, ponderosa, and limber pine.

Table 4. Acres impacted by defoliators & other damage agents by Utah county; 2021 aerial detection survey data.

2021	Western Spruce Budworm	Marssonina blight, Aspen	Balsam Woolly Adelgid	Forest Tent Caterpillar
County	**Acres**	**Acres**	**Acres**	**Acres**
Beaver	94			
Box Elder			290	
Cache	440		2147	123
Carbon		50	48	
Daggett				
Davis			94	
Duchesne			369	
Emery			529	
Garfield				
Grand				
Iron				
Juab				
Kane				
Millard				
Morgan			1798	
Piute	689			
Rich	407		922	
Salt Lake	135		640	
San Juan				
Sanpete			766	
Sevier				
Summit			2921	
Tooele				
Uintah			1	
Utah			1576	
Wasatch			5297	
Washington				
Wayne				
Weber			900	43
Total	**1,764**	**50**	**18,299**	**166**

NATIVE INSECTS: STATUS

Defoliators

Douglas-fir Tussock Moth
Orgyia pseudotsugata McDunnough

Hosts: all true firs, Douglas-fir, blue spruce and Engelmann 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 by ADS in Utah in 2021. However, 10 moths were captured in traps placed in Cache County, near the Idaho border.

Western Spruce Budworm
Choristoneura freemani Freeman

Hosts: Douglas-fir, subalpine fir, white fir, blue spruce, and Engelmann spruce
Western spruce budworm (WSB) is the most widely distributed and destructive defoliator of coniferous forests in western North America. Trees may be extensively defoliated during outbreaks, resulting in growth/productivity reduction or stress that can directly kill the tree or make it susceptible to diseases and secondary insect pests, such as bark beetles. WSB is particularly damaging to understory host trees.

Figure 3. Western spruce budworm larva (William M. Ciesla, Forest Health Management International, Bugwood.org).

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. Defoliation was noted in Beaver, Cache, Piute, Rich, and Salt Lake counties. Most damage in Cache and Rich counties runs between the two county lines from the Idaho state line south to just before Little Bear Creek

In Salt Lake County, WSB defoliation is light to severe on the east side of Big Cottonwood

Canyon (hwy 190) near Mill B Southfork T H and the Wipple Fork area.

In Piute County, moderate to light defoliation was noted north and south of Crystal Basin. In Beaver County light defoliation was noted near Birch Creek Mountain west of Kents Lake RD.

Western & forest tent caterpillars

Malacosoma californicum (WTC)
M. disstria (FTC)

Hosts: Quaking aspen, Cottonwood, willow, birch, chokecherry, mountain mahogany, oak, alder, and other

In Utah, two tent caterpillar species commonly defoliate trees and understory vegetation. The WTC is more common, but less destructive than the FTC. Quaking aspen is the preferred host for WTC, but they will also feed on plants present in the understory when populations are high. The first noticeable sign indicating WTC is dense white silken tents formed in branch crotches, while FTC typically produces small silken mats, or no tents at all. The lack of tents for FTC may make it difficult to diagnose, but the two species are readily separated by the pattern on the back of the caterpillar. Outbreaks, usually last two to three years in the western states. Repeated defoliation and other stress factors may reduce growth rates of infested trees, result in top kill or tree mortality, or predispose them to other diseases or insect pests. 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, and are often found on chokecherry and other deciduous trees and shrubs.

Figure 5. Western tent caterpillar on tent (Ryan Davis, USDA Forest Service, Forest Health Protection).

Figure 5. Forest tent caterpillar (Ryan Davis, USDA Forest Service, Forest Health Protection).

The timing of ADS survey can affect acreage delineated as FTC/WTC as trees can develop new foliage by mid-summer.

FTC defoliation was seen in Cache County in scattered pockets from Narrow Canyon, Stoddam Canyon, Lindlys Basin, Silver Mine Hollow and Wide Hollow. Ground verification and remote sensing analysis by FHP staff indicate that FTC defoliation was heavy on an estimated 1,800 acres on the east side of the Wellsville Mountains in 2021.

In Weber County light defoliation by FTC was noted north of Kellys Canyon and west of Cobble Creek. Defoliation in oak and maple was seen south of Coldwater Canyon and east of One-Horse Canyon.

Scale Insects

Oystershell Scale

Lepidosaphes ulmi

Hosts: *Populus* spp., *Salix* spp., *Fraxinus* spp., *Acer* spp.; over 100 hosts recorded. Primary hosts of concern in forested settings are trembling aspen and willows.

Figure 6. Oystershell scale on aspen (Justin Williams, USDA Forest Service, Forest Health Protection).

Oystershell scale (OSS) is a non-native hard scale insect that was introduced to north America over 300 years ago and is widely distributed throughout the United States, particularly in urban areas. In Arizona, OSS was recently found killing all size classes of aspen trees in the forest, including valuable regeneration and recruitment-sized aspen. OSS is one of many biotic factors, along with abiotic factors such as drought and heat stress, herbivory, management, etc., responsible for aspen health decline in Arizona and throughout the Intermountain West. In 2021, OSS was confirmed in an aspen stand on the Uinta-Wasatch-Cache National Forest in a drainage within Provo Canyon (Pole Canyon), Utah. Ground verification indicates that about 50 acres of aspen, of all size classes, are heavily infested with OSS, leading to tree mortality in some cases. Outward from the epicenter, OSS is found in decreasing severity over a 500-acre area. FHP staff will continue to monitor OSS in Pole Canyon and work with UWC staff to develop management strategies. Regional-scale surveys for OSS will be initiated in 2022 to help determine the distribution and severity of OSS in natural aspen stands.

Bark Beetles

Fir Engraver Beetle

Scolytus ventralis LeConte

Hosts: true firs; primarily white fir in Utah

Fir engraver beetle (FEB) is a major pest of true firs throughout the West. It attacks trees of any size. In Utah, it prefers white fir, but can attack subalpine fir. 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, western spruce budworm, balsam woolly adelgid, woodborers, and Annosus root disease (*Heterobasidion annosum*)

Mortality due to FEB Several counties had some affected acres. Duchene, Salt Lake, Utah, Sanpete, and Juab counties had the largest number of acres affected.

In Duchesne County there are small scattered pockets of light damage just north of Hanna and east to Dry Mountain.

In Salt Lake County scattered pockets of light mortality is concentrated along Big Cottonwood Canyon Rd., starting after East Canyon Estates Rd., then east to about the Mineral Fork area. There are also several pockets of very light to moderate damage running along Little Cottonwood Canyon Rd., east to about the Maybird Gulch area.

Utah County has scattered small pockets of light damage throughout the flight area.

Sanpete County has scattered patches of light to moderate damage, most of which were noted just south of Canal Canyon.

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 (low population) levels, MPB favors weakened, less vigorous trees, and older larger diameter trees. During epidemics (high population levels), 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 continues to kill lodgepole and limber/five needle pines in Utah. Current MPB activity is occurring primarily in Summit County near the Utah-Wyoming state line where moderate-to-small patches of very-light to light damage was recorded down to West Fork Smiths Fork area.,

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 fairly common. At endemic (low) levels, DFB favors stressed and damaged trees such as those broken or wind thrown, wounded or fire–injured, and trees with root disease or defoliation. DFB populations can build rapidly in newly-fallen green trees and spread to adjacent healthy standing trees.
In 2021, ADS found several counties where DFB induced mortality was noted.

Summit County had a few pockets of DFB induced mortality near Samak Park Loop, Left Hand Canyon, and Failure Canyon areas.

Utah County had the most damage of all counties where several small pockets of DFB induced mortality was seen along American Fork Canyon in the area of Burned Canyon, Rock Canyon, Little Mill Canyon, Bear Canyon, and Pine Hollow. More pockets of very light to light damage was noted near Second Water Ridge and Millar Ridge. Larger pockets of light to moderate damage was scattered throughout Therber Ridge, Lone Pine Gulch, Left Fork Pole Canyon and Shurtz Canyon.

Sanpete County had a few small pockets of very light to light damage in the South San Pitch Canyon area. Larger pockets of very light damage were noted around Knob Mountain and Spring Canyon Road. More small to moderate sized pockets of light to severe damage were seen near Hell Hole Ridge and scattered south to Lake Hill Campground area.

Tooele County has many scattered very small to small pockets of very light to light damage along the Stansbury Mountains from Mack Canyon running south and slightly west to Pockets Fork, then continuing southeast to Bald Mountain and south to Victory Mountain and then east to Slate Rock Peak. Further south there is a couple small pockets near Cap Peak and one pocket of severe damage near Big Canyon

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 green wind thrown or downed trees. Dispersing adults may infest standing live trees, initially preferring larger diameter trees and sometimes utilizing smaller diameter hosts during outbreaks. Much of the mature spruce in Utah has been killed over the last 20+ years by spruce beetle. Spruce beetle-caused mortality continues to impact mature spruce stands.

In 2021, ADS shows that Duchesne, Dagget, Summit, and Uinta counties all have significant damage from spruce beetle induced mortality. Small to very large sized pockets of very light to light damage were noted scattered around the intersection of the four county lines, and then spreading out into all four counties. In Summit County, spruce beetle isspreading northwest to Flat Top Mountain and in Duchesne County southwest to Hell Canyon. In Dagget County spruce beetle is spreding northeast just past East Fork Eagle Creek and spreading southeast to just before Brush Park in Uinta County.

Pinyon Engraver Beetle

Ips confusus LeConte

Hosts: Colorado and singleleaf pinyon

Injured or stressed trees are preferred by pinyon engraver beetles. Pinyon 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, pinyon engravers carry a wood staining fungus into the tree, which in combination with the feeding larva, kills the tree.

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

Beaver, Piute, Tooele, and Iron County were noted for the most pinyon engraver beetle induced damage. Though a few counties that were flown in 2021 have small amounts of mapped pinyon engraver damage, it is possible that more damage in those counties occurred, as they were not fully covered by the 2021 ADS survey. Based on verbal reports from FFSL Area Foresters, there is considerable pinyon engraver induced damage in the southern part of the state (not covered in 2021 ADS) where much of the Pinyon/Juniper forest type occurs.
Iron County has a large pocket of light pinyon engraver induced damage near Rocky Basin and which crosses county lines with Beaver County. There is another large pocket of light damage southeast of Coyote Bench, and a few scattered small spots scattered within the flown area.

Beaver County shares a large pocket of light pinyon engraver induce damage with Iron County southeast of Beaver Canyon. There are several large to small pockets of very light to moderate damage running slightly west and north in the flown area up to Black Mountain area, and a few small spots around Cork Ridge.

Piute County has some considerable number of pockets of pinyon engraver induced damage which runs northeast along the eastern Piute County line staring from the north Garfield County line up to just north of Tenmile Creek.

Tooele County has many small to moderate sized pockets with very light to severe pinyon engraver induced damage throughout the area flown that runs northward both west and east starting at the Juab County line to Deadmans Canyon and Slate Rock Hollow.

As stated above the 2021 ADS included only a small portion of the State's pinyon-juniper acreage where pinyon engraver activity would occur.

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 as trees growing in crowded, 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.

A small amount of WPB induced damage was noted on the 2021 ADS, most of which was seen in Beaver and Piute counties. WPB main host is ponderosa pine, most of which are located in the southern part of the state, not flown in 2021.

Beaver County there are small to moderate sized pockets of mostly light WPB induced damage around and north of Birch Creek Mountain area. Piute County has several very small to small pockets of light to moderate WPB induced damage northeast of Jeans Pasture running north to just west of Park Creek.

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 2021. 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.

Woodboring Moths

Pitch Mass Borer (*Dioryctria* spp.) [Lepidoptera: Pyralidae]
Pine pitch moth (*D. ponderosae* Dyar)
Sequoia pitch moth (*Synanthedon sequoiae*) [Lepidoptera: Sesiidae]

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

Figure 7. Pine pitch moth larva (Whitney Cranshaw, Colorado State University, Bugwood.org).

Pitch moth 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.

Pitch moths 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 pine engraver beetle. These borers have been seen in many counties in 2021, mostly in pinyon pine. Sequoia pitch moth is also common in Austrian and Scots pine in urban areas.


Figure 8. Sequoia pitch moth resin masses (Christine Buhl, Oregon Department of Forestry, Bugwood.org).

Woodboring Beetles

Flatheaded fir borer (*Phaenops drummondi* prev. *Melanophila*) [Coleoptera: Buprestidae]

Figure 9. Flatheaded fir borer larvae and galleries (Dave Powell, USDA Forest Service, Forest Health Protection).

Hosts: Douglas-fir, true firs; occasionally spruce and western hemlock and larch (not in UT)

Flatheaded fir borer typically attacks trees that are under stress from mechanical injury, mistletoe infection, fire damage, drought stress or recently felled trees. Under recent climate conditions flatheaded fir borer has been found infesting and killing drought stressed Douglas-fir growing at lower elevations and on dry, rocky sites with shallow soils.

It is difficult to distinguish Douglas-fir mortality caused by Douglas-fir beetle and flatheaded fir borer via ADS, but workers should be aware that there could be an increase in flatheaded fir borer-caused mortality if hot dry conditions persist.

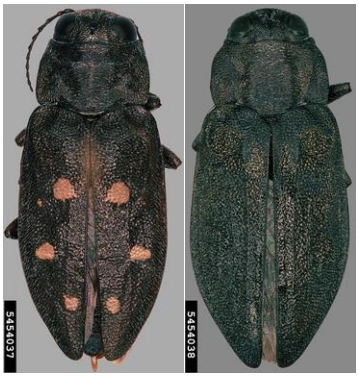


Figure 10. Flatheaded fir borer adults - color variation (Steven Valley, Oregon Department of Agriculture and Food, Bugwood.org).

NON-NATIVE/INVASIVE INSECTS: STATUS

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

Moth Defoliators

Spongy moth (SM)
Lymantria dispar

Hosts: various deciduous tree species

Since the late 1800's, spongy moth caterpillars have defoliated millions of acres in the northeastern United States. The spongy 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 spongy 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 SM 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 SM have been caught in traps between 2008 and 2015.

The 2016 Utah SM Program placed 1,823 detection traps in areas of highest risk of introduction and establishment. These trapping efforts resulted in the detection of one SM 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. No moths have been detected since 2016.

Woodboring Beetles

Emerald ash borer (EAB)

Agrilus planipennis

Figure 11. Emerald ash borer adult (Bugwood.org).

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 spp.* 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 *Fraxinus* species (ash) 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 (singleleaf and velvet ash). 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. Since 2016 no EAB were detected from either federal or state efforts. In 2021, the UDAF Insect Program placed a total of 72 EAB traps throughout Cache, Carbon, Davis, Duchesne, Salt Lake, Tooele, Uintah, Utah, and Weber counties. Utah DNR placed an additional 29 traps across Emery, Grand, Iron, Juab, Millard, San Juan, Sevier, Washington, and Wayne counties. Trap site placement was prioritized for high-risk areas such as: places that were likely to have out-of-state firewood introduced, vicinities where trees have been reported as potentially infested by arborists or homeowners, and neighborhoods identified as having numerous ash trees in decline. In 2022 the UDAF Insect Program will continue leading task force efforts such as regulatory measures, trapping and monitoring visual symptoms. For more information contact the Utah Department of Agriculture and Food.

https://ag.utah.gov/wp-content/uploads/2022/02/2021-Insect-Report-Web-Edition-V1.0-Compressed.pdf

Sap Feeders

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. Although we attribute BWA as the insect that is the mortality agent, this may not be the case, as generally BWA is a constant stress factor that makes the infested tree more vulnerable to other insects. Therefore, actual mortality may be a complex of several insects and diseases.

Figure 12. Gouting (twig swelling) caused by balsam woolly adelgid feeding (Ryan Davis, USDA Forest Service, Forest Health Protection).

Figure 13. White woollike wax covering balsam woolly adelgids ("woollies") (Ryan Davis, USDA Forest Service, Forest Health Protection).

In September 2017 BWA was confirmed in Utah. It has now been detected via ADS and ground verified in Box Elder, Cache, Davis, Morgan, Rich, Salt Lake, Summit, Utah, Wasatch, and Weber, counties. In 2019, ADS mapped 35,955 total acres affected. A comparison with previous years cannot be done, as in 2020 no ADS was conducted and in 2021, only part of the state was flown showing a total of 18,299 acres affected. It appears that BWA is located in the northern counties, wherever there is subalpine fir. Because BWA is a wind-dispersed; insect infestation, and infestation severity, are patchy.

DISEASE STATUS

Stem and Branch Diseases
(typically not detectable by ADS)

Figure 14. Southwestern dwarf mistletoe (Maria Newcomb, USDA Forest Service, Forest Health Protection).

Dwarf Mistletoes
Arceuthobium spp.

Hosts: Douglas-fir, pines, and true firs

Dwarf mistletoes (DM) are the single most damaging parasitic disease agent of coniferous trees. These parasitic flowering plants are the most widely distributed forest pathogen in the state and across the western forests. Dwarf mistletoe infection causes re-allocation of growth in host trees resulting in obvious distortions including profusely branched, dense masses of host branches called "witches brooms". Heavy dwarf mistletoe infection reduces growth, predispose trees to insects and other diseases, can cause topkill or tree mortality, affects forest canopy structure, lowers resistance to drought, and influences 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.

In Utah, dwarf mistletoe is so extensive throughout the state that it is not practical to describe heavily infected areas in this publication. Different species of dwarf mistletoe are host specific and are often seen on Douglas fir, lodgepole pine, ponderosa pine, and pinyon pine. It is rarely seen on white fir or subalpine fir.

Pinyon Blister Rust
Cronartium occidentale

Figure 15. Pinyon blister rust on branch.

Hosts: Colorado and singleleaf pinyon

This native rust causes stem rust cankers and branch flagging on both Colorado piñon and singleleaf pinyon in Utah. This disease can kill small trees and cause branch dieback and dead tops in host trees of all age classes. These rust infections are commonly associated with attacks by the pitch mass borer and tend to be more abundant in areas where the alternate host (*Ribes* spp., commonly called 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 lifespan of the trees on that site and even across generations in many situations. Susceptibility of the tree hosts and virulence of the pathogens involved varies among root diseases and regions. In Utah, root diseases tend to be 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 weaken trees and are intimately associated with bark beetles. Endemic bark beetle populations are often associated with and maintained in root disease pockets and scattered trees impacted by root diseases.

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 can rapidly turn 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 thinning in the crown. In general, the production of conspicuous fruiting bodies (conks) of root disease pathogens 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.

Heterobasidion Root Disease

Heterobasidion occidentale and H. irregulare

Most common hosts: Douglas-fir, pines, spruce, and subalpine fir

Figure 16. Annosum (Heterobasidion) conk at the base of a tree (John Guyon, USDA Forest Service, Forest Health Protection).

This disease can be found throughout the state and on a wide range of tree hosts, but is most commonly found as *H. occidentale* on true firs, Douglas-fir, and spruce acting as butt decay or as a saprophyte on dead trees, stumps, and roots. Trees of all ages can be infected, and in some cases killed. 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 a cream-colored bottom pore surface. 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 17. Armillaria fans on the Ashley National Forest (John Guyon, USDA Forest Service, Forest Health Protection).

Evidence of Armillaria root disease can be found throughout the state and on a wide range of tree hosts. 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 be increasing in prevalence 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. The fungus produces rhizomorphs, black string-like structures that can move through the soil a few feet to infect other roots. When present, Armillaria fruiting bodies 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

Hosts: Colorado and singleleaf pinyon pine

Black stain root disease is an important disease of several hosts, but it is only found on pinyon pine in Utah. It often kills infected trees within a few years, and can result in groups of tree mortality several acres in size. In 2021, black stain root disease was detected during ground surveys in individual declining and dead single-leaf piñon pines and small disease pockets at locations in Box Elder County, Utah, and additionally in two-needle pinyon pine stands in the foothills of the La Sal Mountains in San Juan County, Utah. Many of the trees with signs of black stain root disease were also attacked by pinyon engraver beetle (*Ips confusus*). Pockets of infected trees are preferred hosts for low-level populations of piñon engraver beetles (*Ips confusus*). There are very likely pockets of black stain root disease amongst the acres affected by pinyon engraver beetle, which was mentioned earlier in this report.

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 (leaf tissue necrosis) in midsummer and nearly complete defoliation by early August. Re-growth of new leaves usually follows in late summer and early autumn. Symptoms include small necrotic spots on infected leaves in mid- to late-summer. The spots later enlarge and often coalesce. They will vary in size and appear irregular in shape with a yellowish border. Blight and leaf spot caused by this disease have been seen in the past throughout the host type, and in years when the disease is severe is detectable by ADS. While direct mortality from this disease is rare, trees weakened by consecutive years of defoliation are more susceptible to other damage agents and stresses.

Figure 18. Aspen leaf spot on aspen leaf (John Guyon, USDA Forest Service, Forest Health Protection).

In 2021, only 50 affected acres were noted in Carbon County. However, there was only a partial ADS done in 2021, therefore there may be other acres affected statewide, but not flown.

DECLINES / COMPLEXES

Subalpine Fir

Subalpine Fir Decline (formerly 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. Root diseases, woodborers, Balsam Wooly Adelgid, and several species of smaller bark beetles are likely involved in this complex. Environmental stress due to drought or overcrowding may also have a role in widespread subalpine fir mortality.

Though in 2021, there was only a partial flight, some SAF mortality was noted in most counties flown. However, it is difficult to determine from the air the actual agent or agents affecting the Subalpine Fir.

Aspen

Aspen Dieback

Host: aspen

Aspen dieback mapped by 2021 partial ADS did not map any acres of aspen dieback. The recorded acres affected by aspen dieback peaked in 2007 at 126,057 acres affected across the state. Aspen dieback has been attributed to a number of factors including: drought, grazing, lack of disturbance, 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* spp. attack trees that still have a large component of "green bark", while *Procryphalus* spp. 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 tend to have at least some suckering and do not show the symptoms of sudden aspen decline reported in other Regions such as Colorado.

ABIOTIC DAMAGE

Climate/Weather

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˚F to 5˚F 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 reported acres affected in 2021.

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 forested landscapes. 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 2021, there was 986 acers of wind caused damage mapped in 7 of the partially flown counties in Utah.

Drought

Drought can influence insect and disease activity as well as directly impact forest health. Trees stressed by drought are less able to resist insect or disease, which may allow these agents to build to outbreak levels. Drought-related damage was noted in 2 of the counties flown in 2021, though drought is likely one of the major stress factors in Utah forests in the past several years. Since 2018, reports of juniper dieback and mortality have been reported from southeast Utah, the Uinta Basin, western and southwestern Utah and west of Tooele. This dieback and mortality, in most or all cases, is being driven by hot, drought conditions.

Physical/Mechanical

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.

Within the partial 2021 ADS there were no Avalanches/Mudslides noted.

Flood

In 2021 ADS, there was one acre in Salt Lake County where flooding damage was noted crossing over Little Cottonwood Canyon Road.

NOXIOUS WEEDS

Overview

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**

Useful Links

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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