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UTAH
FOREST INSECT AND DISEASE CONDITIONS REPORT
2012

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Utah Forest Insect and Disease Conditions Report 2012

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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 of the state. Aerial detection surveys (ADS) conducted by the USDA Forest Service, Forest Health Protection 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. Thus, an estimate of the number of trees killed is also provided. Not all forested lands are surveyed, and not all the same acres are surveyed every year. The number of acres flown in each county surveyed in 2012 is provided in Table 1. In 2012 as was in 2011, over ten million acres were surveyed (Figure 1). Most of the area flown 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.

In 2012, insect and disease-caused tree mortality generally decreased from 2011. Mountain pine beetle in lodgepole pine has decreased for the second consecutive year; however, there has been an increase in five-needle pine mortality. Western spruce budworm defoliation acreage decreased by 52% and Douglas-fir beetle mortality remained static. Subalpine-fir mortality has also remained static. Spruce beetle induced mortality acreage decreased, but numbers of trees killed increased by 30%. Decrease in insect mortality may be attributed to the depletion of suitable host type. General weather conditions have not been conducive to insect brood establishment, development, and survival. However, forest health conditions are still poor, and conducive to insect and disease activity. Adequate precipitation is necessary to maintain tree vigor, thereby resistance to insects and diseases. Drought conditions throughout the state continue to place more stress on forests that are already in poor health.

Table 1. Total number of acres aerially surveyed in each county during 2012.

County	2012
Beaver	164,433
Box Elder	181,720
Cache	513,257
Carbon	161,167
Daggett	268,349
Davis	53,384
Duchesne	924,754
Emery	254,644
Garfield	1,089,224
Grand	134,988
Iron	424,989
Juab	154,046
Kane	169,465
Millard	393,392
Morgan	241,842
Piute	251,145
Rich	116,390
Salt Lake	170,190
San Juan	605,538
Sanpete	549,900
Sevier	871,336
Summit	712,367
Tooele	0
Uintah	328,747
Utah	641,258
Wasatch	637,917
Washington	355,419
Wayne	209,643
Weber	226,445
Total	10,805,949

Table 2. Trees killed and acres affected by several agents in Utah counties as detected by ADS in 2012.

2012	Mountain Pine Beetle[1]		Douglas-fir Beetle		Spruce Beetle		Piñon Engraver		Fir Engraver Beetle		Subalpine Fir Mortality Complex	
COUNTY	Trees	Acres	Trees	Acres	Trees	Acres	Trees	Acres	Trees	Acres	Trees	Acres
Beaver	0	0	160	80	10	5	45	23	50	25	509	243
Box Elder	0	0	0	0	0	0	0	0	20	10	200	100
Cache	140	35	398	199	20	10	0	0	0	0	437	202
Carbon	0	0	20	10	0	0	0	0	5	2	336	134
Daggett	9,623	2,583	190	73	0	0	5	3	0	0	149	142
Davis	0	0	0	0	0	0	0	0	5	3	60	23
Duchesne	27,739	9,725	120	60	6,048	1,806	15	7	18	9	80	40
Emery	0	0	10	5	0	0	30	15	10	5	239	132
Garfield	0	0	1,894	927	165	83	15	8	175	87	0	0
Grand	0	0	209	105	105	52	0	0	10	5	10	5
Iron	0	0	95	47	5	3	0	0	290	145	20	10
Juab	0	0	60	30	49	49	0	0	0	0	5	3
Kane	0	0	265	101	0	0	0	0	30	15	15	8
Millard	0	0	217	109	0	0	70	34	414	207	230	115
Morgan	0	0	30	15	5	2	0	0	35	17	355	177
Piute	0	0	240	117	359	198	0	0	225	112	306	153
Rich	20	5	0	0	0	0	0	0	25	13	25	12
Salt Lake	0	0	0	0	35	17	0	0	0	0	410	176
San Juan	0	0	386	193	250	87	15	7	275	137	525	226
Sanpete	0	0	330	165	0	0	35	18	150	75	1,252	600
Sevier	0	0	1,008	473	10,053	3,927	65	32	586	292	830	392
Summit	74,351	12,653	455	236	11,842	4,766	0	0	120	60	1,715	622
Tooele	0	0	0	0	0	0	0	0	0	0	0	0
Uintah	1,145	511	200	92	45	40	0	0	0	0	66	33
Utah	0	0	285	142	192	88	70	35	585	179	344	141
Wasatch	105	39	270	135	33,870	7,830	0	0	87	44	805	373
Washington	0	0	0	0	0	0	0	0	360	180	10	5
Wayne	0	0	761	320	10	5	10	5	0	0	10	5
Weber	0	0	40	20	0	0	0	0	40	20	433	247
Total	113,123	25,551	7,643	3,654	63,063	18,968	375	187	3,515	1,642	9,376	4,318

[1]Although mountain pine beetle has killed ponderosa and limber pine throughout Utah, the data is for lodgepole pine only.

Figure 1. Surveyed Areas for the 2012 Aerial Insect and Disease Detection Survey

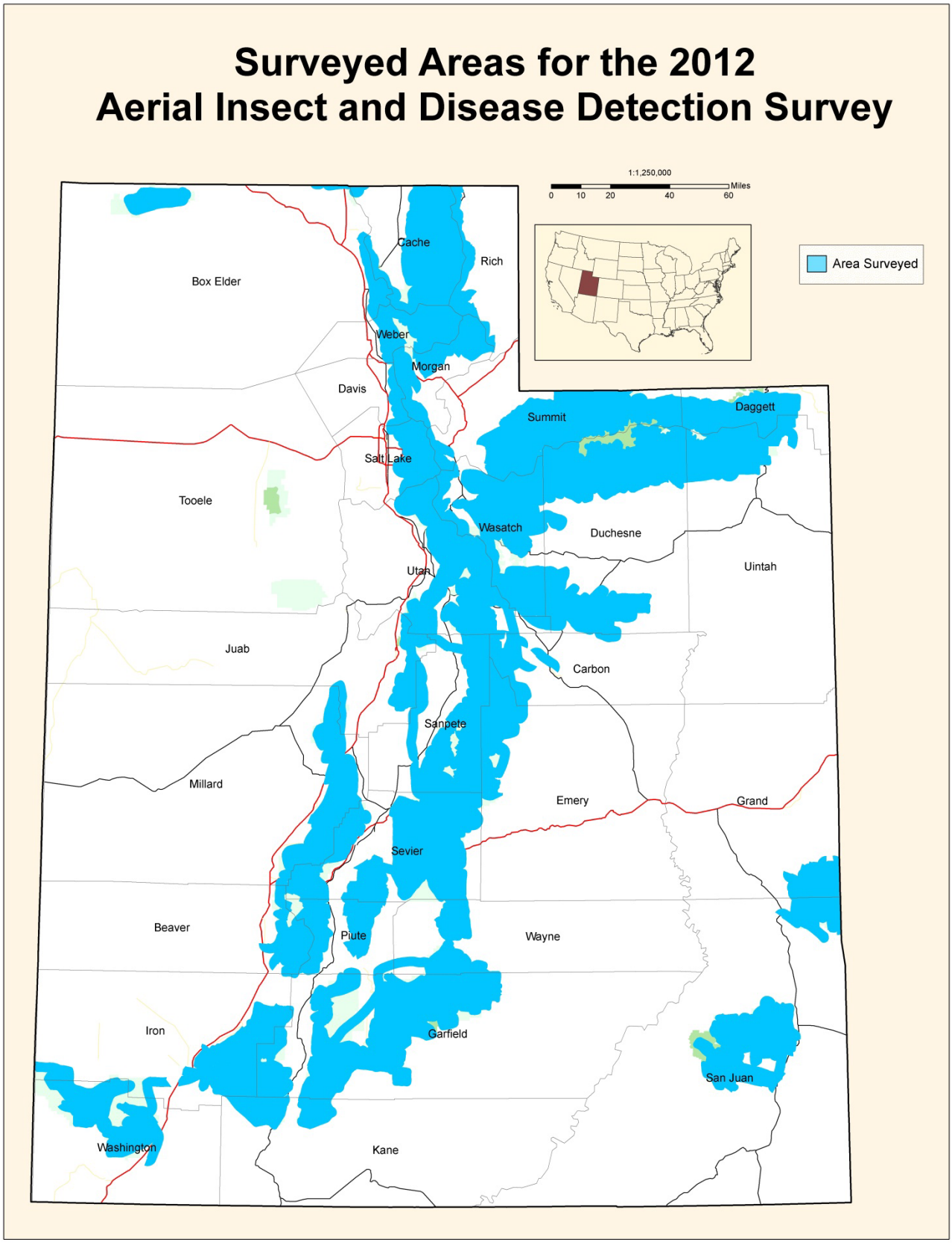

Table 3. Trees defoliated and acres affected by several agents in Utah counties, as detected by ADS in 2012.

2012	Western Spruce Budworm	Unknown Aspen Defoliation	Aspen Decline
County	**Acres**	**Acres**	**Acres**
Beaver	1,767	0	11
Box Elder	0	147	0
Cache	0	0	300
Carbon	0	0	26
Daggett	0	0	0
Davis	0	9	10
Duchesne	0	33	316
Emery	0	4	0
Garfield	2,779	0	1,545
Grand	85	0	563
Iron	1,021	461	1,088
Juab	0	0	226
Kane	0	0	46
Millard	0	0	66
Morgan	0	0	98
Piute	2,668	33	353
Rich	0	0	146
Salt Lake	0	7	0
San Juan	175	0	510
Sanpete	0	14	639
Sevier	1,159	193	1,499
Summit	0	320	79
Tooele	0	0	0
Uintah	1,131	0	74
Utah	0	0	203
Wasatch	0	0	294
Washington	0	0	26
Wayne	2,773	0	72
Weber	0	0	86
Total	13,558	1,221	8,276

INSECT STATUS

Native Defoliators

Douglas-fir Tussock Moth
Orgyia pseudotsugata McDunnough

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

The Douglas-fir tussock moth (DFTM) is an important native insect capable of causing extensive defoliation. Caterpillars feed on the needles of trees which can lead to topkill and after several seasons of defoliation, tree mortality. 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.

No DFTM defoliation was detected in Utah in 2012.

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

Western Spruce Budworm
Choristoneura occidentalis 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.

Overall, statewide defoliation by western spruce budworm decreased 52% in 2012. Defoliation over the last few years has occurred on the high plateaus of Piute, Wayne, and Garfield counties.

WSBW was one of the most damaging insect agents detected on the Dixie National Forest in 2012, with approximately 5,000 acres impacted. On the Cedar City Ranger District large polygons (100 to 500 acres) were mapped in Douglas-fir and subalpine fir stands on the southern edge of the Markagunt near Horse Valley. Severity of defoliation was heavy.

WSBW was also the most damaging agent on the Teasdale/Escalante Ranger Districts. Large polygons (100 to 500 acres) of heavy defoliation were mapped in the vicinities of Dark Valley, Cyclone Lake, and Antimony Creek.

WSBW affected about 6,500 acres on the Fishlake Ranger District. Heavy defoliation was mapped below the western rim of Thousand Lake Mountain and north of Tidwell Canyon. Widespread defoliation was mapped in the southern Tushar Range, and across the Sevier Plateau.

In Uintah County 1,120 acres of heavy defoliation was mapped south of Mosby Mountain and south and west of Brownie Canyon.

Western Tent Caterpillar
Malacosoma californicum Packard

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

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

There was no western tent caterpillar defoliation mapped in 2012.

Western False Hemlock Looper
Nepytia freemani Munroe

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

A native pest of immature Douglas-fir, this looper defoliated 99 acres of young, white fir at Timpanogas Cave National Monument. Young looper larvae begin to feed on new foliage in the upper crowns of trees during late May, progressing to the older foliage when new foliage is depleted. During outbreaks trees may be entirely defoliated in one season.

Needle Insects

Piñon Needle Scale
Matsucoccus acalyptus Herbert

Hosts: Colorado and singleleaf piñon pine

The piñon needle scale is a native sap-sucking insect that feeds on older needles of infested trees. Damage results in tip killing, branch flagging, stunted tree growth, and needle injury. Crowns appear thin, 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 damage by piñon needle scale was reported in Utah in 2012.

Black Pineleaf Scale
Nuculaspis californica Coleman

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

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

The black pineleaf scale attacks several pine species and on rare occasions Douglas-fir and white fir. The insect generally overwinters as a partially developed scale. Eggs and immature nymphs (crawlers) appear in June or July, depending upon temperature. If there is a second generation, egg hatch and crawlers may appear again in late summer. Sap loss due to scale insect infestations may cause yellowing or wilting of needles, stunting of the needles, needle mortality, and defoliation, thus leaving the tree with a tufted and unhealthy appearance. Heavy infestations over several years may lead to death of all or portions of the tree. Black pineleaf scale outbreaks have often 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 trees.

Expanding scale populations in *Pinus spp.* trees throughout urban cities within Salt Lake and Davis Counties in previous years has demonstrated significant negative health impacts and mortality. Infested pines with defoliation of more than 50% are not likely to survive even if treated with appropriate insecticides. Systemic treatments have appeared to be successful if more than 50% foliage remains. Fortunately, black pine leaf scale appears to be declining in 2012.

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 to 1,642 acres in 2012 from 564 acres in 2011. In 2012, FEB–caused tree mortality was mapped throughout host trees in 22 Utah counties. Sevier County had the most trees killed by FEB – 292 acres. Most of the mortality occurred in widely scattered, 20 tree pockets. The highest concentration of mortality occurred in the vicinity of Box Creek Mountain. In Millard County, about 200 acres of white fir mortality consisting of 20 to 50 pockets of trees were widespread. Also, a high concentration of mortality occurred in the vicinity of Coffee Peak.

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 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.

In 2012, MPB–caused tree mortality in lodgepole pine dropped 60% to about 26,000 acres. The ongoing outbreak occurring in northern Utah has killed most of its host type. This outbreak which began in 2003, but is now subsiding, increased annually with most of the mortality on the Uinta–Wasatch–Cache National Forest. There is approximately 12,000 acres of mortality occurring in Daggett and Duchesne counties on the Ashley National Forest.

MPB mortality in Summit County has decreased approximately 80 percent. In 2012, more than 74,000 trees were killed over 12,653 acres. Beetle populations have collapsed along the Mirror Lake Highway. Current activity was mapped on the east side of the Evanston and Mountain View Ranger Districts. In stands with heavy MPB mortality, pine engraver and twig beetles are infesting smaller trees, which are not suitable hosts for MPB.

In Daggett County there is extensive mortality in lodgepole pine south and west of Flaming Gorge National Recreation Area. Mortality pockets range from 1-tree/acre to pockets of 400–trees/acre. Mortality is continuing to spread in areas around Spirit Lake and to the north of Weyman Lake.

On the Vernal Ranger District tree mortality has decreased to 3,500 trees. Mortality pockets were mapped along Whiterocks Canyon and south of Mosby Mountain, with scattered 5–50 tree

pockets along the northern border of the District. Activity near Queant Lake is increasing in both limber and lodgepole pine stands.

MPB-caused tree mortality in five-needle pines has increased to 2,200 acres. Duchesne County had 1,400 acres of limber pine tree mortality. Pockets were mapped near Crescent Lake and south of Milk Lake. Stands with both limber and lodgepole pine mortality were mapped west of Rainbow Lake, east of Painter Lakes, and east of Crater Lake. Sanpete County had 280 acres of high-elevation limber pine mortality. Mortality pockets of over 20 trees were mapped west of Joes Valley Reservoir, on Olsen Bench, near Wagon Road Ridge, the top of Ferron Canyon, Flagstaff Peak, and southeast of Black Mountain.

Douglas-fir Beetle
Dendroctonus pseudotsugae Hopkins

Host: Douglas-fir

Douglas-fir beetle (DFB) typically kills small groups of trees, but during outbreak conditions 100 tree mortality centers are not uncommon. At endemic levels, DFB favors weakened and less vigorous trees including; windfalls, fire–injured trees, and trees with root disease or defoliation. Beetle populations can build rapidly in newly-fallen host material and spread to adjacent healthy standing trees.

In 2012, the acreage affected by DFB remained static, at 3,600 acres. Most counties in Utah had some DFB mortality. The majority of mortality occurred in Garfield, Sevier, and Wayne counties.

Widely scattered tree mortality occurred on Barney Top, Table Cliffs Plateau, Horse Creek Top, and on the north and south sides of Boulder Top.

In Sevier County, pockets of mortality were detected north of Monroe Mountain and on the northern end of the Sevier Plateau. A large concentration of mortality occurred along the eastern side of the Fishlake Hightop just west of Fishlake.

In Cache County, mortality increased slightly with scattered pockets of 4–20 trees mapped across the Bear River Range. Some mortality was mapped in Logan Canyon near Right Hand Fork, and in Green Canyon.

Spruce Beetle
Dendroctonus rufipennis Kirby

Hosts: Engelmann and rarely blue spruce

The spruce beetle (SB) is the most significant natural mortality agent of mature spruce. Endemic populations usually exist in weakened or windthrown trees, logging slash, and fresh stumps. Outbreaks typically occur when beetle populations build to high levels in concentrations of

windthrown trees. Dispersing adults may infest standing live trees, initially preferring larger diameter trees.

In 2012, spruce mortality decreased slightly, approximately 19,000 acres. In Southern Utah, the loss of host type has significantly reduced areas of current spruce mortality. Sevier, Summit, and Wasatch counties had the most acres affected. In Sevier County, spruce beetle continues to be the most damaging agent of spruce with beetles killing 11,842 trees on 4,766 acres. This was a decrease of about 50% from 2011. The largest outbreak areas were again observed on the Fishlake Hightop Plateau. Numerous pockets ranging from 20 to 1,000 acres occurred in the upper reaches of Tasha Creek, the Sevenmile Cirques, Lost Creek, Big Flat, and Na Gah Flat. There were also several pockets (20–100 trees) of mortality detected on the northern end of Boobe Hole Mountain.

Out of Richfield, the percentage of Englemann spruce trees killed and acres affected by spruce beetle decreased over 50% in 2012. Most all of the mortality occurred on the northern end of the Sevier Plateau in the Monroe Mountain area. Numerous smaller pockets were also detected south of this area to Marysvale Peak.

In Wasatch and Summit counties, substantial pockets of mortality (over 45,000 trees) were detected around Murdock Basin, north and south along the Mirror Lake Highway corridor, and over to Smith & Morehouse Canyon. Activity was also reported in the Moffit and Skow Lake areas and visible on the north and south slopes of Duchesne Ridge.

In Duchesne County, spruce beetle mortality increased significantly. There was an increasing number of pockets ranging from 5–500 trees mapped south of East Grandaddy Mountain. Also, activity is expanding east toward Rock Creek Canyon. Additional 20–100 tree pockets were detected south of Red Creek Mountain and near Tabby Mountain.

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 2012, 187 acres of piñon pine mortality was mapped. This was a slight decrease from 2011. There was no significant mortality in any county.

Western Pine Beetle
Dendroctonus brevicomis LeConte

Host: ponderosa pine

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

In Washington County, 369 acres of ponderosa pine mortality was attributed to this insect and 75 acres in San Juan County.

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 2012.

Borers

Pitch Mass Borer
Dioryctria spp.

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

Over the last few years in urban areas, Scots/Scotch (*Pinus sylvestris*), Austrian (*Pinus nigra*), and Ponderosa pine (*Pinus ponderosae*), have been reported damaged by this insect.

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

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

trees less than 20 feet tall, though pitch mass borer has been known to attack larger trees.

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.

Insects: Non-native

European Gypsy Moth
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. Isolated single male moth catches have been recorded almost annually. 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.

In 2012, 2,050 detection traps were deployed throughout the state with no gypsy moths caught.

Between 2,000 and 2,500 traps will be placed statewide in 2013.

DISEASE STATUS

Stem and Branch Diseases

Dwarf Mistletoes
Arceuthobium spp.

Hosts: Douglas-fir, pines, and true firs

Figure 5. Southwestern dwarf mistletoe (Photo: John Guyon; FHP, OFO).

Dwarf mistletoes (DM) are the single most damaging agent of coniferous trees. These parasitic plants remain the most widespread and frequently observed disease within the state. Profusely branched, dense masses of host branches called "witches brooms" are typically observed in infected trees. Heavy dwarf mistletoe infections can predispose trees to insects and other diseases, reduce incremental growth, affect the forest canopy structure, lower resistance to drought, and influence wildlife habitat, recreation and aesthetics. Since dwarf mistletoe infects trees of all ages, infection may exist in secondary growth and regeneration, as well as young and old forests.

Piñon Blister Rust
Cronartium occidentale

Hosts: Colorado and singleleaf piñon

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

White Pine Blister Rust
Cronartium ribicola

Hosts: limber and bristlecone pine

This introduced disease is common throughout its hosts range in southern Idaho and western Wyoming. It is present in the Sierra Mountains of California and Nevada near Lake Tahoe and in the Jarbidge Mountains, and has been found on the alternate host in Utah, but not yet detected on pines. The disease has been found one canyon to the north of the Utah border in southern

Idaho. This disease has a complex life history requiring two hosts to survive. Thus, it is not able to spread directly from pine to pine, but must develop on intermediate hosts consisting of gooseberries or currants (*Ribes spp*.).

Five-needled pine trees are of low occurrence and frequency in Utah. Often relegated to rugged, cold and dry sites, these pines grow slowly but, provide important ecosystem functions such as: facilitating snow retention for maintaining watershed integrity, recreation, aesthetics, as well as, food and habitat for wildlife. High levels of white pine blister rust would be devastating to these ecologically important high elevation five-needled pines.

Sudden Oak Death
Phytophthora ramorum

Hosts: tanoaks, quercus spp., and rhododendron spp.

Sudden Oak Death (SOD), a forest disease first reported in 1995, has been killing millions of tanoak and coast live oaks in the coastal areas of California, but is not known to exist in Utah. The disease is present only in California and southwestern Oregon. On coastal live oaks and tanoak, cankers form on the main stems which can lead to crown dieback and then death. Since SOD can infect rhododendron and several other species of ornamentals there is the risk of the disease spreading from other states via nursery stock. Monitoring of nurseries to detect SOD has been ongoing.

Thousand Cankers Disease

Hosts: all walnut species (in UT: Eastern, black, and English)

Figure 6. Adult Walnut Twig Beetle (Photo: Javier Mercado, Bugwood.org).

The walnut twig beetle, *Pityophthorus juglandis*, along with a fungus, *Geosmithia morbida*, are two agents causing dieback and mortality of walnut trees in many western states (Figure 6). The tiny, reddish-brown beetles (1/16" long) create galleries in branches, and introduce *Geosmithia morbida*. *Geosmithia morbida* causes cankers to form under the bark, and these cankers coalesce, eventually girdling off entire branches and the bole of the tree (Figure 7). The large numbers of cankers associated with this disease give it its' name – thousand cankers disease.

Figure 7. Black walnut with branch dieback (Photo: Danielle Reboletti; FHP, OFO).

The fungus and beetle only occur on walnut species. In the Western US, it takes about 8-10 years of continuous feeding of the beetle to deliver enough fungus to kill a

black walnut tree. Thousand cankers disease and walnut twig beetle were identified in Tennessee in August 2010. It is not known how the beetle and fungus will act and what the impact of TCD might be in native eastern black walnut ecosystems. Movement of infected black walnut wood products could further spread TCD. Many states have now instituted quarantines on the movement of walnut.

Figure 8. Lure and funnel trap (Photo: Danielle Reboletti; FHP, OFO).

In Utah, a detection and trapping project was implemented in 2011 at 20 sites from Utah County to Box Elder County (Figure 8). Positive catches were found at 19 sites. In 2012, the detection and trapping project continued and was expanded to southern Utah (Juab County). Two additional subsets were added in 2012. First, a dispersal test was conducted at two of the trap sites to determine the flight range of the beetle (Figure 9), and a baited branch study was initiated to identify life history, number of generations per year, and overwintering life stages of the walnut twig beetle. The dispersal test is complete, and the results have been incorporated into the national trapping guidelines. The project continues in 2013 with the baited branch portion of the study included at ten sites with the highest trap catches of walnut twig beetle. In addition, traps have been placed at four of these ten sites.

Figure 9. Dispersal study of walnut twig beetle (Phonto: Steve Seybold; FS, PSW, Davis, CA).

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 annosum

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 frequently acts 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 10). 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 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. In southern Utah, it may act as a primary pathogen killing mature and immature ponderosa pine and mature fir and spruce on cool sites at higher elevations. 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 11). The fungus produces rhizomorphs that resemble 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: 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 2012.

Leaf and Needle Diseases

Aspen Leaf Spot
Marssonina populi

Host: aspen

Figure 12. Symptoms of aspen leaf spot.

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 12). 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, it is likely a contributing factor to aspen dieback and decline.

DECLINES / COMPLEXES

Subalpine Fir Mortality Complex

Host: subalpine fir

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

Last year, the total acreage of subalpine fir affected by this mortality complex (SAFMC) remained static at 4,300 acres. All counties in Utah except Garfield and Tooele had some associated mortality. Most mortality was mapped in Summit, Sanpete, and Sevier counties.

Aspen Decline

Host: aspen

Figure 13. Areas of aspen dieback symptoms reported from ADS 2003 to 2008.

A decrease in aspen forest acreage, and a reduction in stand health, has been reported throughout the western U.S. since the 1970's. The principle reasons associated with the above observations are related to the succession of aspen forests to other vegetation types due to fire exclusion, heavy ungulate damage, and insect and disease activity. Increasing aspen decline and dieback due to insect and disease agents has been mapped since 2003. Information on agents involved in dieback and decline was summarized recently (Guyon and Hoffman, 2011). This dieback and decline was part of a trend of increasing damage reported across the western United States (Figure 13). Damage has been reported in Canada as well. In Utah, decline and dieback peaked in 2007; with 126,000 acres damaged. Decline and dieback has then decreased every year since. Decline and dieback damage (Table 4) was largely caused by a complex of canker diseases and insect borers, but defoliators played a role in some areas. This complex of damaging agents reduced numbers of larger trees (trees over 5" DBH) by about 1/3 in affected areas,

damaged another 1/3 (severity 2-3 out of 3) and also impacted 39% of the regeneration. Overall, most stands in Utah had adequate regeneration to maintain aspen on the site unless grazing pressure was also heavy. Much of this decline and dieback appeared to be tied to the aftermath of drought in 2003-2005.

Table 4. Summary of damage to Utah aspen forests.

	Mean	Max	Min	ST Dev.
Elevation feet	9143.8	10363.0	7295.0	847.6
TPA (Trees per acre) 5" +DBH	382.3	720.0	160.0	136.8
TPA 2-5" DBH	151.4	1000.0	0.0	206.3
TPA dead 5" +DBH	113.7	360.0	0.0	89.1
TPA dead 2-5" DBH	55.0	500.0	0.0	119.1
Percent dead 5" +DBH	32.2	88.9	0.0	24.1
Percent dead 2-5" DBH	18.5	100.0	0.0	36.1
Percent Damaged (Severity 2-3) 5"+ DB	34.0	95.6	12.5	22.1
Percent Damaged (Severity 2-3) 2-5" DE	51.1	100.0	0.0	24.5
TPA Regeneration (<2")	2840.0	12900.0	0.0	3597.6
TPA Regeneration damaged <2"	1152.0	8200.0	0.0	1862.4
% Regeneration damaged <2"	39.0	100.0	0	36.2

Damage severity was defined by three categories:

- Low-unlikely to cause significant damage to the stem such as, light defoliation, minor wounds and small cankers that had ceased to expand, small wounds or single insect borer attacks, etc.
- Moderate-causing significant damage to the stem but unlikely to kill the stem in the next 2-3 years such as, cankers or wounds on less than 1/3 of the stem, up to 75% defoliation, or borer attacks on over 1/3 of the stem, etc.
- High-stem mortality is likely to occur within 2-3 years such as, damage caused by repeated borer attacks, expanding cankers over 1/3 of the stem, or complete defoliation with serious dieback, etc.

In Utah, 8,276 acres of aspen decline and 1,222 acres of an unknown aspen defoliator were mapped in 2012. The number of affected acres has dropped down from 2011 numbers. Garfield, Iron, and Sevier counties all had over 1,000 acres of decline mapped. These acres were not concentrated in any particular area, but were scattered widely over the counties.

ABIOTIC DAMAGE

Frost Damage

Hosts: maple, gambel oak, aspen, Douglas-fir, and spruce

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 was no frost damage mapped in Utah in 2012.

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.

There was no blowdown mapped in Utah in 2012.

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 was no avalanches or mudslides mapped in Utah in 2012.

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. As of 2012, approximately 338 species of exotic aquatic and terrestrial plants infest lands in the State of Utah (EDDMapS 2012- Early Detection & Distribution Mapping System at the University of Georgia, Center for Invasive Species and Ecosystem Health). Utah has declared 27 of these species as noxious weeds. Noxious weeds are grouped into one of three classes, depending upon their management priority. "Class A" weeds have a sparse distribution throughout the state and/or generally low population levels with eradication being the primary management goal. Management strategies for Class A weeds typically include; preventing new infestations, early detection, and rapid/repeated treatment. "Class B" weeds are more broadly distributed, and/or exist at moderate population levels. These weeds can largely be controlled using integrated management strategies. "Class C" weeds are generally established throughout the state at high population levels. Management of Class C weeds is limited to reducing spread by containing large infestations. Table 5 (pages 29 and 30) lists Utah's noxious weeds by class and indicates the counties infested. Most counties in Utah have listed additional noxious weeds that are of local concern.

Of Class A weeds, spotted knapweed, leafy spurge, diffuse knapweed, Johnson grass, and purple loosestrife are the most widespread throughout Utah, with each occurring in over 50% of counties. Canada thistle, field bindweed, tamarisk, Russian knapweed, Scotch thistle, and quackgrass are the most reported noxious weed species in Utah. The exact acreage of lands infested by noxious weeds in each county is unknown however; counties with the most noxious weed species are Cache (25), Box Elder (24), Salt Lake (23), Tooele (23), Utah (23), Weber (23), and Davis (21). Rich, Sanpete, Uintah, and Wasatch counties each have 20 noxious weed species. Counties with the least noxious weed species reported include; Wayne (10), Piute (10), Daggett (11), Garfield (13), and Grand (14) (Table 5).

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

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

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 information on how to manage pests, educational resources, and research information.

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

http://invader.dbs.umt.edu
The University of Montana's INVADERS Database 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 and most identified plants have additional information and links to more information.

http://cdfa.ca.gov/phpps/ipc/encycloweedia/encycloweedia_hp.htm
California Department of Food and Agriculture has a very comprehensive website. Information includes description, biology, distribution, habitat, and management of plants and control methods. 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 buffalobur, goatsrue, houndstongue, johnsongrass, diffuse, Russian and spotted knapweed, purple loosestrife, silverleaf nightshade, yellow nutsedge, perennial pepperweed, puncturevine, leafy spurge, St. Johnswort, yellow starthistle, Canada thistle, musk thistle, scotch thistle, Dalmation toadflax, velvetleaf, and dyer's woad. Topics include description, economic importance, geographic distribution, habitat, history, growth and development, reproduction, response to herbicides, response to cultural controls, and biocontrol potentials.

http://www.invasive.org/weedus/index.html
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, that assists users with identification, early detection, prevention, and management of invasive plants.

EDDMapS 2012- Early Detection & Distribution Mapping System. University of Georgia - Center for Invasive Species and Ecosystem Health. Available online at: **http://www.eddmaps.org/**.

Table 5. The county locations of Utah noxious weeds grouped by priority class. Sources: Noxious Weed Field Guide for Utah (Belliston et al. 2010), USDA National Plants Database (http://plants.usda.gov/index.html), EDDMapS 2012-Early Detection & Distribution Mapping System. The University of Georgia-Center for Invasive Species and Ecosystem Health. Available online at http://www.eddmaps.org/

	Utah Counties																												
State Declared Noxious Weeds	Beaver	Box Elder	Cache	Carbon	Daggett	Davis	Duchesne	Emery	Garfield	Grand	Iron	Juab	Kane	Millard	Morgan	Piute	Rich	Salt Lake	San Juan	Sanpete	Sevier	Summit	Tooele	Uintah	Utah	Wasatch	Washington	Wayne	Weber
Class A Weeds (Early Detection, Rapid Response)																													
Black Henbane	x	x	x	x	x		x		x	x					x		x		x	x		x	x			x			x
Diffuse Knapweed	x	x	x			x			x	x	x	x		x	x		x	x	x			x	x	x	x				x
Johnson grass	x	x	x	x		x			x			x	x			x		x	x	x		x		x	x		x	x	x
Leafy Spurge		x	x	x	x	x	x	x				x		x	x		x	x	x	x	x	x	x	x	x	x		x	x
Medusa head		x	x																										
Oxeye Daisy			x				x						x				x	x		x		x		x	x	x			x
Purple Loosestrife		x	x	x		x	x	x		x	x	x	x	x	x			x				x	x	x	x				x
St. Johnswort		x	x			x						x											x						
Spotted Knapweed	x	x	x	x	x	x	x	x		x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x		x
Sulfur Cinquefoil																			x					x	x				x
Yellow Starthistle		x	x			x							x				x	x					x		x	x	x		x
Yellow Toadflax	x			x		x	x		x					x		x	x	x		x	x	x	x			x		x	x
Class B Weeds (Control)																													

State Declared Noxious Weeds	Beaver	Box Elder	Cache	Carbon	Daggett	Davis	Duchesne	Emery	Garfield	Grand	Iron	Juab	Kane	Millard	Morgan	Piute	Rich	Salt Lake	San Juan	Sanpete	Sevier	Summit	Tooele	Uintah	Utah	Wasatch	Washington	Wayne	Weber
Bermuda grass	x	x	x			x		x		x		x	x	x	x			x	x				x		x		x		x
Dalmation Toadflax	x	x	x			x	x	x	x	x	x		x				x	x	x	x		x	x	x	x	x			x
Dyer's Woad		x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x
Hoary Cress	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
Musk Thistle	x	x	x	x	x		x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Perennial Pepper weed	x	x	x	x	x	x	x	x		x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x		x
Poison Hemlock	x	x	x			x	x		x			x			x		x	x		x	x	x	x	x	x	x	x		x
Russian Knapweed	x	x	x			x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
Scotch Thistle	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Squarrose Knapweed	x	x	x									x	x	x	x			x	x	x	x		x		x	x	x		
Class C Weeds (Containment)																													
Canada Thistle	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Field Bindweed	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Hounds tongue	x	x	x	x		x	x	x			x	x		x	x		x	x		x	x	x	x	x	x	x	x		x
Quack grass	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
Saltcedar	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x

References:

Guyon, J., Hoffman, J. 2011. Survey of Aspen Disease in the Intermountain Region. USDA Forest Service, State and Private Forestry, Forest Health Protection, OFO-PR-11-01, 21 p.