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UTAH FOREST INSECT AND DISEASE CONDITIONS REPORT 2011

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Utah Forest Health Conditions 2011

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Table of Contents

FOREST HEALTH CONDITIONS SUMMARY 6
STATUS OF INSECTS 11
Native Defoliators 11
Douglas-fir Tussock Moth 11
Western Spruce Budworm 11
Forest Tent Caterpillar 12
Fall/Spring Cankerworm 12
Needle Insects 12
Piñon Needle Scale 12
Black Pineleaf Scale 13
Native Bark Beetles 13
Fir Engraver Beetle 13
Mountain Pine Beetle 14
Douglas-fir Beetle 14
Spruce Beetle 15
Piñon Engraver Beetle 15
Western Pine Beetle 16
Roundheaded Pine Beetle 16
Insects: Non-native 16
European Gypsy Moth 16
STATUS OF DISEASES 18
Stem and Branch Diseases 18
Dwarf Mistletoes 18
Piñon Blister Rust 18
White Pine Blister Rust 19
Sudden Oak Death 19
Thousand Cankers Disease 19
Root Diseases 20
Annosum Root Disease 21
Armillaria Root Disease 21
Black Stain Root Disease 22
Leaf and Needle Diseases 22
Aspen Leaf Spot 22
DECLINES / COMPLEXES 23
Subalpine Fir Mortality Complex 23
Aspen Decline 23
ABIOTIC DAMAGE 25
Frost Damage 25
Blowdown 25
Snow Avalanches/Mudslides 25
NOXIOUS WEEDS 26
REFERENCES: 30

List of Figures

Figure 1. Surveyed Areas for the 2011 Aerial Insect and Disease Detection Survey. 9
Figure 2. Douglas-fir tussock moth larvae..... 11
Figure 3. Black pineleaf scale on Austrian pine 13
Figure 4. Southwestern Dwarf Mistletoe..... 18
Figure 5. Trapping for Walnut twig beetle 20
Figure 6. Annosum conk..... 20
Figure 7. Armillaria fans on Ashley National Forest..... 21
Figure 8. Symptoms of aspen leaf spot. 22
Figure 9. Areas of aspen dieback symptoms reported from ADS 2003 to 2008. 23

List of Tables

Table 1. Total number of acres aerially surveyed in each county during 2011. 7
Table 2. Trees killed and acres affected by several agents in Utah counties as detected by ADS in 2011. 8
Table 3. Trees defoliated and acres affected by several agents in Utah counties as detected by ADS in 2011. 10
Table 4. Summary of damage to Utah aspen forests. 24
Table 5. The county locations of Utah noxious weeds grouped by priority class. 28

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 2011 is provided in Table 1. In 2011 as was in 2010, over ten million acres were surveyed (Table 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 2011, insect and disease-caused tree mortality generally decreased from 2010. Mountain pine beetle in lodgepole pine decreased 70%. Western spruce budworm and Douglas-fir beetle decreased 80%. Subalpine-fir mortality decreased by 50%. The decrease in insect mortality can be attributed to the depletion of suitable host type and the general weather conditions which had been cool and moist and is not conducive to insect brood establishment, development, and survival. Adequate precipitation is necessary to maintain tree vigor thereby resistance to insects and diseases increases.

Table 1. Total number of acres aerially surveyed in each county during 2011.

County	2011
Beaver	141,539
Box Elder	183,354
Cache	520,187
Carbon	219,702
Daggett	264,911
Davis	48,011
Duchesne	907,627
Emery	254,680
Garfield	956,155
Grand	105,762
Iron	381,960
Juab	203,785
Kane	177,458
Millard	251,119
Morgan	209,324
Piute	218,069
Rich	91,618
Salt Lake	143,489
San Juan	576,023
Sanpete	414,718
Sevier	821,967
Summit	648,615
Tooele	253,102
Uintah	317,898
Utah	621,983
Wasatch	633,271
Washington	115,251
Wayne	149,075
Weber	211,785

Table 2. Trees killed and acres affected by several agents in Utah counties as detected by ADS in 2011.

2011	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	90	45	40	20	0	0	10	5	300	144
Box Elder	0	0	10	5	0	0	0	0	0	0	1,827	720
Cache	970	327	265	132	15	11	0	0	0	0	1,155	471
Carbon	0	0	5	2	0	0	0	0	25	12	140	70
Daggett	107,164	16,580	4,060	616	5	2	0	0	0	0	30	15
Davis	0	0	0	0	0	0	0	0	0	0	40	12
Duchesne	39,308	8,581	380	186	325	113	5	2	0	0	125	62
Emery	0	0	0	0	0	0	0	0	0	0	110	55
Garfield	10	2	915	443	485	230	25	13	90	45	165	82
Grand	0	0	110	55	5	2	0	0	0	0	50	25
Iron	0	0	255	122	0	0	405	186	275	137	55	28
Juab	0	0	140	70	600	181	0	0	15	8	0	0
Kane	0	0	300	124	10	5	0	0	0	0	30	15
Millard	0	0	40	20	0	0	0	0	0	0	40	20
Morgan	0	0	10	5	0	0	0	0	20	10	355	168
Piute	0	0	70	35	330	145	50	25	60	30	420	206
Rich	1,415	631	30	15	0	0	0	0	0	0	10	5
Salt Lake	0	0	20	10	70	35	0	0	5	2	405	202
San Juan	0	0	10	5	350	134	0	0	25	13	850	413
Sanpete	0	0	175	87	0	0	0	0	50	25	360	179
Sevier	0	0	160	75	20,675	11,368	60	30	45	23	510	216
Summit	314,234	35,681	160	79	1,400	686	0	0	5	2	1,240	590
Tooele	0	0	100	50	0	0	10	5	115	57	90	45
Uintah	2,838	536	4,400	524	0	0	0	0	0	0	65	33
Utah	0	0	435	215	1,300	374	0	0	125	62	205	102
Wasatch	815	490	587	285	23,325	10,125	0	0	75	38	615	312
Washington	0	0	410	201	0	0	0	0	155	77	0	0
Wayne	0	0	390	192	45	22	0	0	15	8	10	5
Weber	0	0	20	10	0	0	0	0	20	10	180	87
Total	466,754	62,826	13,547	3,608	48,980	23,453	555	261	1,130	564	9,382	4,283

Figure 1. Surveyed Areas for the 2011 Aerial Insect and Disease Detection Survey.

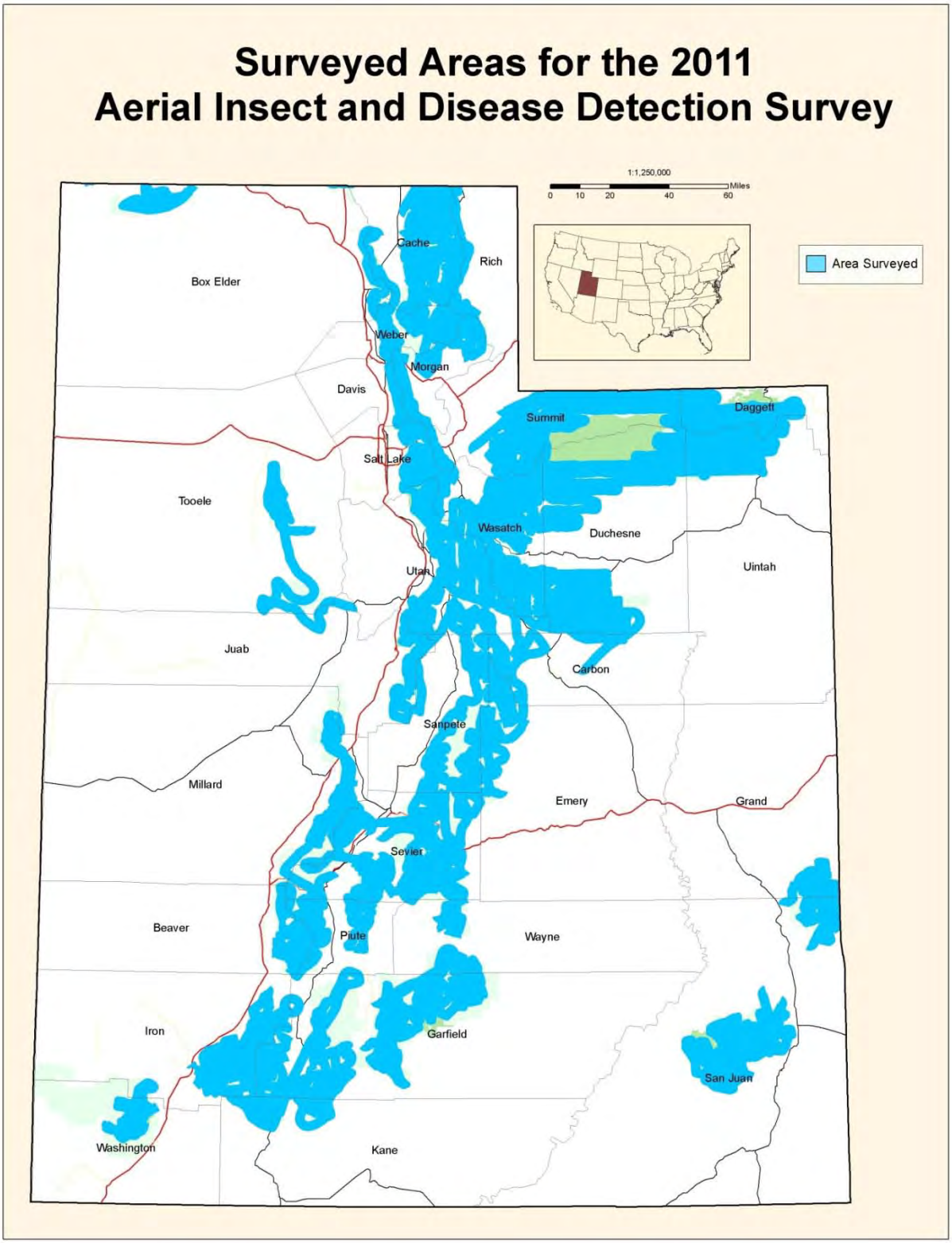

Table 3. Trees defoliated and acres affected by several agents in Utah counties as detected by ADS in 2011.

2011	Western Spruce Budworm	Unknown Aspen Defoliation	Aspen Decline/Dieback
County	**Acres**	**Acres**	**Acres**
Beaver	1,141	0	0
Box Elder	0	0	0
Cache	0	8	62
Carbon	0	73	201
Daggett	0	0	0
Davis	0	0	0
Duchesne	0	0	768
Emery	0	0	25
Garfield	15,770	0	3,023
Grand	0	0	264
Iron	745	0	1,627
Juab	0	0	0
Kane	4,623	0	0
Millard	0	0	69
Morgan	0	0	25
Piute	3,362	0	89
Rich	0	0	23
Salt Lake	0	0	0
San Juan	0	0	545
Sanpete	0	153	177
Sevier	245	0	1,975
Summit	0	47	209
Tooele	0	0	0
Uintah	958	0	158
Utah	0	134	411
Wasatch	0	421	755
Washington	0	0	27
Wayne	1,202	0	11
Weber	0	46	54
Total	28,046	882	10,498

STATUS OF INSECTS

Native Defoliators

Douglas-fir Tussock Moth
Orgyia pseudotsugata

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 the caterpillars can cause allergic reactions in some individuals.

There were 102 acres of DFTM defoliation detected in Utah County in 2011 which occurred just south of Payson Canyon.

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 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.

Defoliation by western spruce budworm had been on the rise in recent years but, decreased significantly in 2011. Defoliation decreased 80% statewide in 2011. The defoliation over the last few years has occurred on the high plateaus of Piute, Wayne, Garfield, and Kane counties.

WSBW was one of the most damaging insect agents detected on the Dixie National Forest in 2011 with 21,488 acres impacted. On the Cedar City Ranger District large polygons were mapped in Douglas-fir and subalpine fir stands on the southern edge of the Markagunt near Navajo Lake and above the Pink Cliffs. Other polygons mapped included the Upper reaches of Caddy Creek and north of Horse Valley. Severity of defoliation was high (>50% defoliation). Many areas previously impacted by WSBW activity now have DFB activity.

WSBW was the most damaging agent on the Teasdale/Escalante Ranger Districts. Large polygons of high defoliation were mapped just off the eastern rim of Boulder Top near Fish

Creek Reservoir, and on the northern end of Griffin Top in the vicinities of Iron Springs Draw, Davis Flat, and Roundy Reservoir.

Forest Tent Caterpillar
Malacosoma disstria

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

The forest tent caterpillar is the most widely distributed and destructive tent caterpillar in North America. Aspen is the preferred host, but it will attack a wide range of deciduous trees and shrubs. Larvae do not build tents, instead they create a silken mat on leaves, branches, or trunks where they congregate while at rest or during molt. Larvae are dark brown with bluish heads, reddish- brown stripes, and distinct white, keyhole-shaped markings down their backs. Western tent caterpillars, which are reddish-brown in color, make the large webs often found on chokecherry and other 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 trees to other diseases or insect pests.

There was no defoliation mapped in 2011.

Fall/Spring Cankerworm
Alsophila pometaria/ Paleacrita vernata (respectively)

Hosts: various deciduous tree species

Fall and spring cankerworms are early summer defoliators of oaks and other hardwood tree species. Populations of these geometrid moths have since declined to endemic levels and previously defoliated trees are recovering.

Needle Insects

Piñon Needle Scale
Matsucossus acalyptus

Hosts: Colorado and singleleaf piñon

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 years 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 2011.

Black Pineleaf Scale
Nuculaspis californica

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

The black pineleaf scale may attack several pine species and on rare occasions Douglas-fir and white fir. The insect generally over-winters as a partially developed scale. Eggs and immature nymphs (crawlers) likely appear in June or July, depending upon temperature. If there is a second generation, egg hatch and crawlers may appear again in late summer.

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

Sap loss due to scale insect infestations may cause yellowing or wilting of needles, stunting of the needles and an unhealthy tree 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, over watering, 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 black pineleaf scale insect populations in *Pinus spp.* trees throughout urban cities within Salt Lake County and Davis County Utah in the previous five 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 pineleaf scale appeared to be declining in 2011.

Native Bark Beetles

Fir Engraver Beetle
Scolytus ventralis

Hosts: true firs

Fir engraver beetle (FEB) is a major pest of true firs in western forests. It attacks trees over three inches in diameter at breast height. Tree stress due to drought, disease, and defoliation may incite outbreaks that cause severe tree mortality. This insect is often associated with other forest pests such as Douglas-fir tussock moth, spruce budworm, bark beetles, woodborers, and annosus root disease.

Mortality due to FEB decreased to 565 acres in 2011 from 3,200 acres in 2010. In 2011, FEB-caused tree mortality was mapped throughout the host trees in eighteen Utah counties, mostly from Salt Lake County south through central Utah to Washington County. Iron County had the most trees affected by FEB – 137 acres.

Mountain Pine Beetle
Dendroctonus ponderosae

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 2011, MPB-caused tree mortality in lodgepole pine dropped 70% to 63,000 acres. The ongoing outbreak occurring in northern Utah has killed most of its host type. This outbreak which began in 2003 has increased annually with most of mortality occurring on the Uinta-Wasatch-Cache National Forests (36,000 acres in Summit County) but is now subsiding. There is some mortality still occurring in Daggett and Duchesne Counties on the Ashley National Forest (approximately 25,000 acres).

Douglas-fir Beetle
Dendroctonus pseudotsugae

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, less vigorous trees, including windfalls, fire-injured trees, and trees with root disease or defoliation. Beetle populations can build rapidly in abundant, newly-fallen host material and spread to adjacent healthy, green standing trees.

In 2011, the acreage affected by DFB decreased significantly from 2010 (19,000 acres to 3,600). All counties in Utah had some DFB mortality except Davis and Emery County. Daggett and Uintah Counties had the most acres affected – 616 and 543, respectively. Near Flaming Gorge, mortality was by Sheep Creek Canyon Geological Area and southeast of the Firefighters Memorial, and east of Pipe Creek.

On the Vernal Ranger District there was residual DFB activity mapped in the eastern part of the District; a large pocket of DFB-killed Douglas fir trees is expanding just north of the County and District border (between Flaming Gorge District and Vernal, north of Kettle Creek). The highest amount of DFB activity was mapped along Little Brush and Big Brush Creeks. There was a residual 5-14 tree pocket mapped near the base of Black Canyon. Mortality was also mapped between Brownie Canyon and Mosby Mountain.

On the Roosevelt Ranger District 130 trees were mapped in 2011 compared to no DFB activity mapped on the District in 2010. Mortality was mapped just northeast of the North Fork River;

along the Yellowstone River; west of Pole Creek Cave; and north of Smokey Spring in the Uinta Park area.

Spruce Beetle
Dendroctonus rufipennis

Hosts: Engelmann and 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 2011, spruce mortality remained constant with approximately 23,000 acres affected. In Southern Utah the loss of host type has significantly reduced areas of spruce mortality. Sevier and Wasatch Counties had 11,000 and 10,000 acres (respectively) affected. In Sevier County, SB continues to be the most damaging agent of spruce with beetles killing 12,923 trees on 8,243 acres in 2011. The largest outbreak areas were again observed on the Fishlake Hightop Plateau and around Hilgard Mountain. Numerous pockets ranging from 20 to 3,000 acres in size occurred in the upper reaches of Tasha Creek, the Sevenmile Cirques, Lost Creek, Big Flat, and Na Gah Flat. There are also several small pockets (5-14 trees) of mortality detected on the top and NW side of Thousand Lake Mountain.

Out of Richfield, the percentage of Englemann spruce trees killed and acres affected by SB increased again in 2011. Most all of the mortality occurred on the northern end of the Sevier Plateau in the Glenwood Mountains and Cove Mountain areas. Numerous smaller pockets were also detected south of these areas to Marysvale Peak.

In Wasatch County substantial pockets of mortality (over 20,000 trees killed) were detected on the northern end of the Heber Ranger District. High levels of Engelmann spruce mortality were mapped centered around Duchesne Ridge and extending south to Trout Creek Ridge, north to Soapstone Basin, west to Bald Knolls and along the Lake Creek drainage, and east to the District boundary.

The spruce beetle still poses important management concerns for the heavily used recreation areas along the Wasatch Front.

Piñon Engraver Beetle
Ips confusus

Hosts: Colorado and singleleaf piñon

Injured or stressed trees are preferred by the piñon engraver beetles. Mass attacks of this insect girdle and eventually kill piñons. Piñon engravers produce multiple generations each year and consequently populations can build rapidly in slash and other stressed green trees and 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 2011, 261 acres of piñon pine mortality was mapped. This was a third of the mortality from 2010. Iron County had the most piñon pine affected on 186 acres.

Western Pine Beetle
Dendroctonus brevicomis

Host: ponderosa pine

Western pine beetle kills ponderosa pine 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, overmature 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 Utah, ponderosa pine mortality attributed to this insect is at endemic levels.

Roundheaded Pine Beetle
Dendroctonus adjunctus

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 are usually found in trees greater than 20 inches diameter at breast height.

No mortality attributed to roundheaded pine beetle was observed by ADS in 2011.

Insects: Non-native

European Gypsy Moth
Lymantria dispar

Hosts: various deciduous tree species
Gypsy moth caterpillars have defoliated millions of acres in the northeastern United States since the late 1800's. 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 in 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 Forest Service, place detection traps throughout the state. Isolated single male moth catches are 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 2011, 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 2012.

STATUS OF DISEASES

Stem and Branch Diseases

Dwarf Mistletoes
Arceuthobium spp.

Hosts: Douglas-fir, pines, and true firs,

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.

Figure 4. Southwestern Dwarf Mistletoe
(Photo: John Guyon- FHP-OFO).

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 and causes branch flagging on larger 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 has not yet been detected on pines. The disease has been found one canyon to the north of the Utah border in southern Idaho. The 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, and 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: eastern black and English walnut

The walnut twig beetle, *Pityophthorus juglandis,* along with a fungus, *Geosmithia morbida,* are causing dieback and mortality of eastern black walnut trees in many western states. The tiny beetles create galleries in branches, resulting in fungal infections and canker formation. The large numbers of cankers associated with the dead branches gives the disease's name –thousand cankers disease.

The fungus and beetle occur only on walnut species. An infested tree usually dies within three years of initial symptoms. It has not been found east of the Great Plains but, a number of factors suggest that the disease could get established in eastern forests and decimate the eastern black walnut.

In Utah a detection and trapping project was implemented last year at 20 sites from Utah County to Box Elder County. Positive catches were found at 19 sites. In 2012 the detection and trapping project will be implemented again and expanded to other counties. Also, a dispersal test will be conducted at some trap sites to determine flight range of the beetle.

Figure 5. Trapping for Walnut twig beetle
(Photo: 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.

Figure 6. Annosum conk
(Photo John Guyon- FHP-OFO)

Several tree conditions are symptomatic of all root diseases. The symptoms can vary if the 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, decaying dead material.

Annosum Root Disease
Heterobasidion annosum

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

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 6). 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

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 7). 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.

Figure 7. Armillaria fans on Ashley National Forest (Photo John Guyon- FHP-OFO).

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 2011.

Leaf and Needle Diseases

Aspen Leaf Spot
Marssonina populi

Host: aspen

Aspen leaf spot is the most common leaf disease of aspen in the West. Severe outbreaks may cause foliar browning in midsummer and nearly complete defoliation by early August. Regrowth 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 8).
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.

Figure 8. Symptoms of aspen leaf spot.

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) decreased in half to 4,300 acres. All counties in Utah except Juab and Washington had some associated mortality. Most of the mortality though was mapped in Box Elder, Cache, and Summit counties.

In Box Elder County mortality was mapped in the Wellsville Mountains and in the Sawtooth National Forest - Raft River Range that is in Utah. In Cache County, subalpine fir mortality remained fairly steady, with populations of beetles up many of the side drainages along the upper end of Logan Canyon. Pockets of 20-100 dead trees could be found along the Sinks Road and in the Franklin Basin area.

In Summit County mortality was mapped near Elizabeth Mountain, Moffitt Peak, Smith and Morehouse, and the South Fork Weber River.

Aspen Decline

Host: aspen

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 two principle reasons associated with these observations are: succession of aspen forests to other vegetation types due to fire exclusion, and heavy ungulate damage. Increasing aspen decline and dieback due to insect and disease agents has been mapped since 2003. Information on the agents involved in dieback and decline was summarized recently (Guyon and Hoffman,

Figure 9. Areas of aspen dieback symptoms reported from ADS 2003 to 2008.

2011). This dieback and decline was part of a trend of increasing damage reported across the western United States (Figure 9), and damage has been reported in Canada as well. The damage peaked in 2007 with 126,000 acres damaged, and then decreased every year since, with only 10,000 acres in 2011. Damage (Table 4) was largely caused by a complex of canker diseases and insect borers, but defoliators played a role in some areas. Damage 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. The damage appeared to be tied to the aftermath of a 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"+ DBH	34.0	95.6	12.5	22.1
Percent Damaged (Severity 2-3) 2-5" DBH	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 Garfield County large areas of aspen decline were mapped on the southern end of Boulder Mountain and scattered across the west side of the Teasdale/Escalante Ranger Districts. In Iron County, several areas of declining aspen were detected on the lower elevation stands near Houston Mountain and Haycock Peak. Large polygons were detected on the southwestern side of Cedar Mountain. In Sevier County, aspen decline was mapped in the southern portion of the Pahvant Range and in scattered stands in the north end of the Richfield District.

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. New shoots or needles of breaking buds are killed. This damage may result in branch dieback, stunted growth, and poor tree form.

Frost damaged maple and oak on 743 acres in Weber and Box Elder Counties in 2011. The damage was detected in Ogden Canyon, on the west side of Mt. Ogden, north of Willard Peak, east of Ben Lomond Peak, and on the eastern side of Lewis Peak.

Blowdown

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

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.

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 2011, approximately 338 species of exotic aquatic and terrestrial plants infest lands in the State of Utah (EDDMapS. 2012. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health). Utah has declared 27 of these species as noxious weeds. These 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 28 and 29) 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.

Tamarisk, cheatgrass, houndstongue, Canada thistle, black henbane, goatsrue, halogeton, crested wheatgrass, musk thistle, scotch thistle, hoary cress, and field bindweed are the most abundant noxious weed species in Utah, and Russian olive, Canada thistle, field bindweed, common mullein, bull thistle, and cheatgrass are among the most widespread. The exact acreage of lands infested by noxious weeds is unknown; however, every county in Utah is infested by at least ten noxious weed species. Counties with the most noxious weed species reported include Cache, Box Elder, Utah, Weber, and Salt Lake. Counties with the least noxious weed species reported include Garfield, Piute, Wayne, Kane, and Washington (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. The 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/

Noxious Weeds																													
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	x	x		x	
Diffuse Knapweed	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
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																			x			x				x
Oxeye Daisy			x		x	x																x							
Purple Loosestrife		x	x	x		x		x		x		x	x	x				x						x	x	x			x
St. Johnswort		x	x		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	x
Sulfur Cinquefoil			x																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		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	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
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	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	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	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	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	x	x
Squarrose Knapweed			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	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	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

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.