Highlights from 2015

In 2015, aerial surveyors mapped a little over 500,000 acres of forest damage from insects, diseases, declines and abiotic agents on 32.9 million acres (Maps 1 and 2, Table 1). The total recorded damage is down 55% from 2014 (Table 2). Much of the decrease in mapped damage from last year was due to the reduced acreage of birch with thin crowns as well as decreases in cottonwood, hemlock and willow defoliation.

Diseases

Dothistroma needle blight continues to cause significant damage and mortality to shore pine (*Pinus contorta* subsp. *contorta*) near Gustavus and Glacier Bay National Park. Aerial surveys have mapped this outbreak across 7,700 cumulative acres since 2012. Our monitoring plots revealed that over half of the shore pine trees in severely affected areas are dead; many died between 2013 and 2014 and the outbreak is ongoing. A new 950-acre outbreak began this year near Haines (Figure 2). There has been negligible mortality associated with this outbreak and monitoring plots will enable us to track tree survival over time. The species of *Dothistroma* present in Southeast Alaska has been confirmed as *D. septosporum*.

Figure 2. Dothistroma needle blight crown symptoms on shore pine north of Haines.

For the first time, a destructive canker disease of red alder (*Alnus rubra*) was observed in Southeast Alaska (Sitka, Wrangell, Zarembo, Etolin, and Prince of Wales Islands). This disease, caused by the fungus *Melanconis* spp., contributed to scattered stem and tree mortality. Warm, dry conditions in spring (http://climate.gi.alaska.edu/) may have stressed alder trees, increasing their susceptibility to this normally weak pathogen. Alder canker caused by *Valsa melanodiscus*, has contributed to widespread thinleaf alder (*A. tenuifolia*), and some Sitka alder (*A. sinuata*) and green alder (*A. fruticosa*) mortality throughout Southcentral and Interior Alaska since 2003. In 2015, it was mapped on only 12,000 acres, compared to 125,000 acres in 2014. This disease has also been confirmed but is not severe in Southeast Alaska on Sitka alder in mainland valleys along the Stikine River, Taku Inlet, and near Haines.

The hemlock canker outbreak on Prince of Wales Island continues. This outbreak, which began in 2012, has persisted longer than historic hemlock canker outbreaks in Southeast Alaska. In addition to the 70 miles of diseased western hemlock mapped along Prince of Wales Island roads, smaller outbreaks were also detected in Sitka, Zarembo Island, Kake, Juneau, Cordova, and other remote locations. An inoculation trial is under way to determine the causal pathogen, which is thought to be *Discocainia treleasei*.

Stem decays and hemlock dwarf mistletoe (*Arceuthobium tsugae*) are ubiquitous and pervasive diseases that fluctuate little annually, but are often missing from young forests following harvest. They are important disturbance agents that contribute to forest structure and function, wildlife habitat, and nutrient cycling in older forests, but also result in lost timber value and hazard trees in established recreation areas. In Southeast Alaska, we are working to determine the key stem decay pathogens of yellow-cedar and western redcedar, which cause significant defect but seldom produce fruiting structures to facilitate identification.

New collaborations with permanent forest inventory plot networks have allowed us to begin constructing robust datasets of pathogen distribution in the boreal forest. The consolidated monitoring records will allow us to characterize incidence and patterns of disease disturbance. This dataset is expected to contribute to a region-wide understanding of how changing climate and disturbance regimes affect boreal forest ecosystem dynamics.

Two aggressive canker diseases of trembling aspen have been documented at multiple locations hundreds of miles apart. One is a target canker that is associated with *Cytospora notastroma*, a newly described pathogen that has been found to be a major contributor to sudden aspen decline in the Rocky Mountains. Another aspen canker is even more widespread and lesions rapidly run the length of tree boles (Figure 3). This unknown fungus can kill trees within a single season.

Figure 3. Aggressive running canker killing a trembling aspen. Obvious discolored lesion of dead cambium showing through bark on left side of trunk (left), the right side of the trunk has only subtle discoloration and debarked margins of the two coalescing lesions (middle), and dead crown (right).

Diplodia gall (caused by *Diplodia tumefaciens*), a common disease on *Populus* species in North America, has only recently been verified on trembling aspen in Alaska. This disease is eye-catching, if unsightly, but causes little long-term damage to trees (Figure 4).

Figure 4. *Diplodia tumefaciens* gall on a trembling aspen.

Noninfectious Diseases and Disorders

This was a significant year for active yellow-cedar decline (dying trees with red-yellow crowns) mortality in Southeast Alaska. The 39,500 acres of active decline mapped in 2015 came from the standard July survey (11,200 acres) and an additional comprehensive survey of Prince of Wales Island in October. For more information on this comprehensive survey, see page 28.

Yellow-cedar decline in young-growth is an emerging issue. We have compiled a database of young-growth stands that contain yellow-cedar to facilitate monitoring. Decline has been confirmed in multiple stands on Zarembo Island and one stand on Kupreanof Island. Additional stands with decline symptoms have been aerially identified and remain to be ground-checked. Affected stands tend to be 30 to 40 years old and thinned within the last decade. We have much to learn about the key risk factors, extent and potential impacts of decline in young-growth.

Invasive Plants

Elodea has now been found in more than 20 locations around Alaska. A range of government agencies and NGOs are collaborating on efforts to eradicate the species from the state, but this remains a daunting prospect. In 2015, Elodea was found in Anchorage's Lake Hood, the world's busiest seaplane base. It was treated with aquatic herbicides about 6 weeks after discovery. Chemical treatments are underway or being planned for several other places around the state. The Chugach National Forest has developed a comprehensive picture of the distribution of Elodea on the forest. A team led by the Pacific Northwest Research Station is examining the impacts on aquatic ecosystems in the Copper River Delta, and the Cordova Ranger District is laying the groundwork for a pilot herbicide application study in 2016.

Alaska Association of Conservation Districts continued its mini-grant program in 2015, awarding more than $88,000 to 10 different organizations. Metlakatla Indian Community continued its efforts to eradicate two small infestations of orange hawkweed (*Hieracium aurantiacum*) and tansy ragwort (*Senecio jacobaea*), and Homer Soil & Water Conservation District conducted invasive plant surveys in the remote village of Nanwalek on the south side of Kachemak Bay.

A partnership between FHP, the Anchorage Park Foundation and private industry has led to substantive progress in controlling invasive plants in some of the city's public parks. In 2015, this partnership led to 22 volunteer weed-pull events, twenty-one acres of bird vetch (*Vicia cracca*) was controlled and more than 70 acres of European bird cherry (*Prunus padus*) infestations were treated, using both mechanical and chemical means.

The Alaska Department of Natural Resources Division of Mining, Land, and Water Northern Region Office (NRO) has increased its attention to invasive plants within its managed lands. During routine site visits, the NRO has begun to document the presence of invasive plant species on land where it authorizes activities, specifically at material sale sites and leased land. In 2014, the focus was on the Elliot Highway and south Tok areas. Twenty-three material sites were visited, of which 15 were found to have invasive plants. In 2015, 26 material sites and 18 lease tracts were visited in the Delta Junction and north Tok areas. Invasive plants were found only at seven of the 44 material sites and lease tracts visited. This effort represents the beginning steps toward one day integrating with the Division of Agriculture's weed-free gravel program.

Alaskans can now identify invasive weeds using a new, free mobile application for both Android and iOS devices, thanks to a project spearheaded by the University of Alaska Fairbanks Cooperative Extension Service. Since the mobile application was released in late August, 2015, 788 users have downloaded the application on their devices.

The Alaska Region has convened its Regional Invasive Species Issue Team (RISIT). The Alaska RISIT is reviewing the 2006 Alaska Region invasive strategy along with current Forest Service strategic direction, policy and guidance. A new, updated invasive species strategy for the Alaska Region will be the result of the review. The strategy identifies invasive species priorities and action items, which will provide guidance and highlight priorities for the Alaska Region invasive species program.

Insects

Spruce beetle (*Dendroctonus rufipennis*) activity was observed on 33,000 acres during aerial surveys this year, roughly doubling the observations from 2014. Although spruce beetle activity mapped in 2015 remains low compared to historical numbers, spruce beetle is the leading non-fire cause of spruce mortality in the state. The bulk of the increase in spruce beetle damage appears to be concentrated primarily in the Yentna and Susitna River Valleys and the northwestern Kenai Peninsula. Spruce beetle damage was also mapped in western and Southeast Alaska. Widely scattered small pockets of spruce beetle activity continue to be observed in Northwestern Alaska, along the Noatak, Squirrel, Omar, and Kobuk Rivers. Northern spruce engraver (*Ips perturbatus*) (NSE) activity was observed on 9,300 acres in 2015, a slight increase over the NSE activity of 7,340 acres mapped in 2014. Most NSE activity occurred along or near the major river systems and their tributaries in the northeastern and

central portions of Interior Alaska. Observed western balsam bark beetle (*Dryocoetes confusus*) damage tapered off considerably in 2015, with only 24 acres mapped along the Skagway River and White Pass Fork northeast of Skagway; 186 acres of damage were observed in this area in 2014.

The aerially observed extent of alder defoliation, caused by the green alder sawfly (*Monsoma pulveratum*), striped alder sawfly (*Hemichroa crocea*), woolly alder sawfly (*Eriocampa ovata*), spotted tussock moth (*Lophocampa maculate*) and several other insect species, decreased substantially from previous years, and cottonwood defoliation was also much lower. In contrast, approximately 20,000 acres of damage was caused by the large aspen tortrix (*Choristoneura conflictana*) in 2015, which is an increase over the ~8,000 acres infested in 2014. Forested areas experiencing the greatest large aspen tortrix impact were west of Allakaket, near McGrath, the Nowitna River, and in neighborhoods around Fairbanks.

Hemlock defoliation, which is caused by feeding damage of the hemlock sawfly (*Neodiprion tsugae*), western blackheaded budworm (*Acleris gloverana*), and several other foliage-feeding insect species, was down in 2015. Most defoliation was mapped in the northern half of Southeast Alaska near Hobart Bay and on Douglas, Admiralty and Baranof Islands. Hemlock woolly adelgid (*Adelges tsugae*) was found on Prince of Wales Island; however the population was at a low density and not causing significant damage.

An unidentified generalist defoliator caused severe defoliation on several hardwood species in scattered locations around western Alaska and east of the Alaska Range: various areas around Lake Clark National Park, Yentna River and Chakachamna Lake, in Wood-Tikchik State Park, and near the confluence of the Innoko River and Yukon Rivers. Although the causal agent could not be confirmed, the damage and larvae description are consistent with *Sunira verberata* (Family Noctuidae), a species that has caused substantial damage in the past.

Approximately 38,000 acres of willow leafblotch miner (*Micrurapteryx salicifoliella*) damage was reported in 2015. Roughly 75% of this damage occurred on the Yukon Flats, and the rest was widely scattered across Interior Alaska from the Canadian border to the Holy Cross Hills. Approximately 82,000 acres of aspen forests were damaged by aspen leaf miner (*Phyllocnistis populiella*); a notable decrease from the >120,000 acres mapped in 2014. Stands heavily infested with aspen leaf miner occurred along the Yukon River near Ruby and Rampart, the Tanana Valley State Forest west of Fairbanks, and the Copper River Valley near Glennallen.

Birch leaf roller (*Epinotia solandriana*) showed a dramatic decrease in area infested during 2015 with a total of 1,600 acres affected. Most infested area occurred in the northern and eastern part of the range of its hosts. Roadside reconnaissance noted heavy leaf roller activity along the Taylor Highway between Tok Junction and Eagle.

Spruce aphid (*Elatobium abietinum*) activity is on the increase after repeated mild winters throughout Southeast Alaska (http://climate.gi.alaska.edu/). Aphid activity was prevalent in Petersburg, Juneau, Sitka, and on Prince of Wales Island, especially near Craig. Significantly, spruce aphid was also reported and positively confirmed on the south side of Kachemak Bay and in Homer. This is the first confirmation of spruce aphid on the Kenai Peninsula and represents a significant extension of its known distribution.

In 2015, the primary insect pests in urban trees included spruce beetle and birch leaf rollers. Birch leaf rollers have been reported for several years and it appears as though their populations are subsiding. Several more spruce beetle calls and site visits were addressed in Anchorage in 2015 than in 2014. Additional arthropod pests affecting urban trees in 2015 include birch aphids (*Euceraphis betulae*), yellow-headed spruce sawfly (*Pikonema alaskensis*), larch sawfly (*Pristiphora erichsonii*), pear slug sawfly (*Caliroa cerasi*), and spruce spider mites (*Oligonychus ununguis*). A notable detection in 2015 was the identification of the non-native Sitka spruce weevil (*Pissodes strobi*) in newly planted Colorado blue spruce imported from the Pacific Northwest.

Injury to birch trees caused by the amber-marked birch leaf miner (*Profenusa thomsoni*) (Figure 5) and the late birch leaf edge miner (*Heterarthrus nemoratus*) was reported in birch stands at the outskirts of Anchorage, while severity levels within Anchorage remained very low. Populations in Fairbanks and North Pole have increased in the last decade and spread into parts of the surrounding area.

Figure 5. Frass filled amber-marked birch leaf miner gallery in birch foliage, with larvae still visible in the leaf.

Airport Invasive Species Panel

In 2014, Alaska FHP received special project funds to design an invasive species display for the Anchorage International Airport. In a cooperative effort between the US Fish and Wildlife Service and FHP, a 12-by-4.5-foot display titled "Unwanted arrivals: invasive species are damaging Alaska's ecosystems" was developed (Figure 6). The backlit panel highlights eight species that are invading, or are considered likely to invade the state. Because no invasive forest pathogens have been detected in Alaska, white pine blister rust and sudden oak death were shown as examples of what invasive forest pathogens can do. The panel was installed in January, 2015, will be on display through December, 2017. Passenger traffic at Anchorage International Airport averages five million people per year.

Green Alder Sawfly larvae

Green Alder Sawfly *(Monsoma pulveratum)*

Defoliates important shrubs and trees that grow along streams.

Green Alder Sawfly adult

Gypsy Moths *(Lymantria spp.)*

Attack hundreds of species of trees and shrubs, have been intercepted at Alaska's border on several occasions.

Gypsy Moth adults

Forest Pathogens

Thankfully, invasive forest pathogens have not yet established in Alaska's forests; if they do the stakes will be very high. Importation of diseased live plants is the most likely introduction pathway for invasive forest pathogens. The diseases shown here provide examples of the problems caused by invasive pathogens in the lower 48.

Sudden Oak Death *(Phytophthora ramorum)*

A disease caused by a fungus-like organism. Produces lethal stem cankers and is able to infect more than 250 hosts, including some plants native to Alaska. As of 2011, had killed more than a million trees in western North America.

White Pine Blister Rust *(Cronartium ribicola)*

A fungal disease introduced to western North America in the early 1900s; has had devastating impacts on five-needled pines across the country.

Unwelcome arrivals

Invasive species are damaging Alaska's ecosystems

What are they?

Invasive species are aggressive, introduced plants, animals, and micro-organisms that cause economic and ecological damage. They often grow rapidly, mature early, reproduce aggressively, and are difficult to control.

Why should we care?

Invasive species are harming Alaska's ecosystems by displacing native species and damaging wildlife health and habitat. Prevention is much cheaper than control.

Who can stop them?

You can! Everyone can help prevent the introduction and spread of invasive species. Travelers can make certain their shoes and hiking boots are free of soil and plant material. Campers can clean seeds and plant parts from camping equipment before leaving an area. Never release a living organism from somewhere else into Alaska's wild. Don't buy ornamental plants that are known to be invasive. Learn to identify invasive species. If you find one in Alaska's backcountry, call **1-877-INVASIV**

Leadership is needed at the village, municipal, state, and federal levels. This growing problem calls for initiative, cooperation, and fast action.

How do they get here?

People move invasive species. Living organisms hitchhike on dirty boots, clothing, equipment, and vehicles. In firewood and wood packing materials. On boats, trailers, and floatplanes. Some plants sold as ornamentals are spreading aggressively far beyond yards and gardens.

Bird Vetch *(Vicia cracca)*

Climbs and smothers other plants.

Spotted Knapweed *(Centaurea stoebe)*

Forms dense infestations and produces chemicals that reduce the growth of other plants.

Zebra Mussels *(Dreissena polymorpha)*

Deplete aquatic food sources and clog utilities. Zebra mussels have been found attached to boats being trailered into the state on the Alaska Highway.

Elodea *(Elodea spp.)*

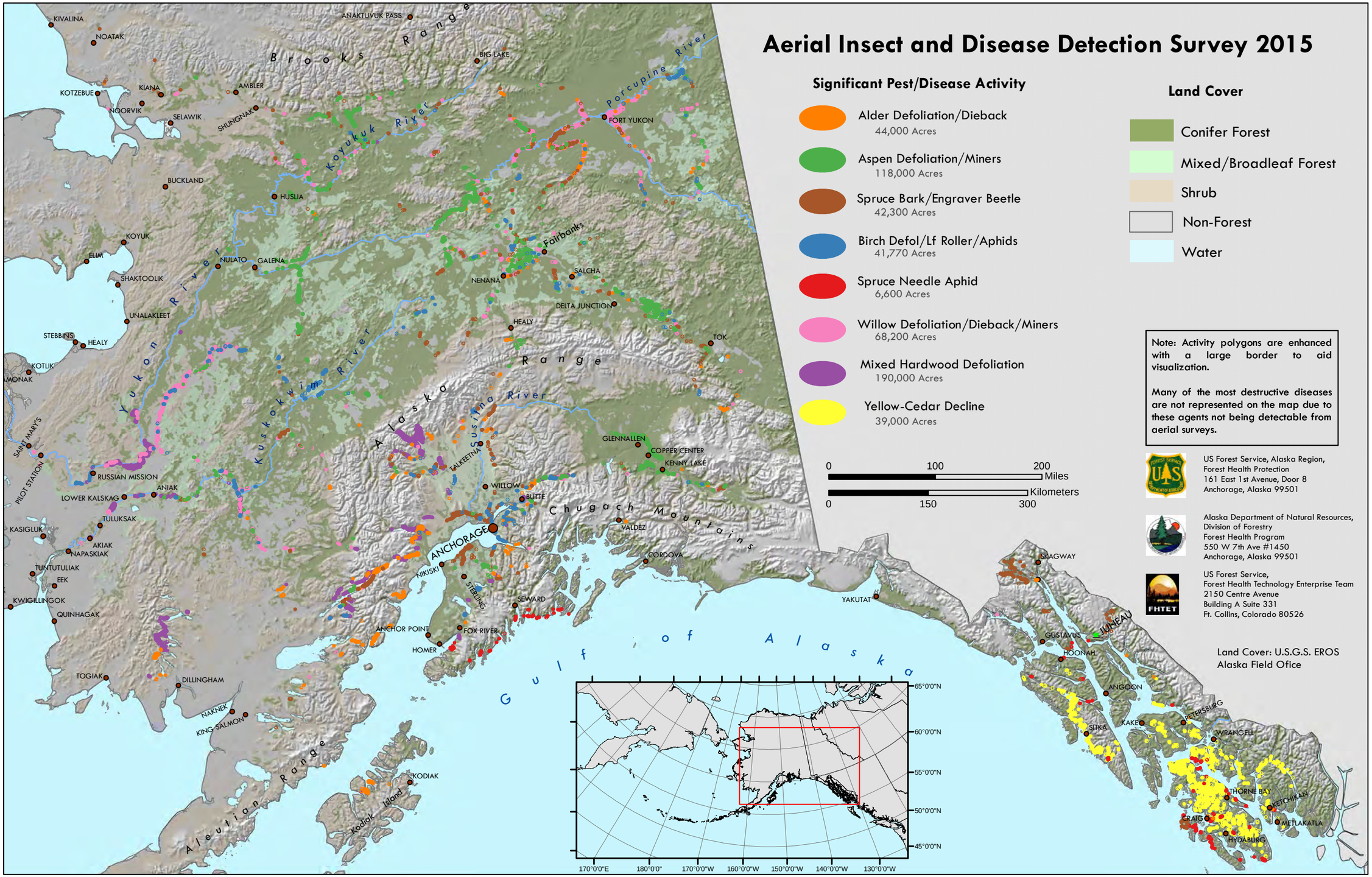
This aquarium plant was likely introduced into Alaska's wild waterways by people dumping aquaria. Now it chokes streams and lakes with dense mats of vegetation, and is being unintentionally spread by floatplanes.

Dense bed of Elodea chokes a stream

For more information, go to
www.fs.usda.gov/main/r10/forest-grasslandhealth

Figure 6. Invasive species panel located in the Anchorage International Airport. The panel will be on display through December of 2017.

Map 1. Alaska aerial insect and disease detection survey, 2015.



Map 2. Alaska aerial insect and disease detection survey flight paths, 2015.

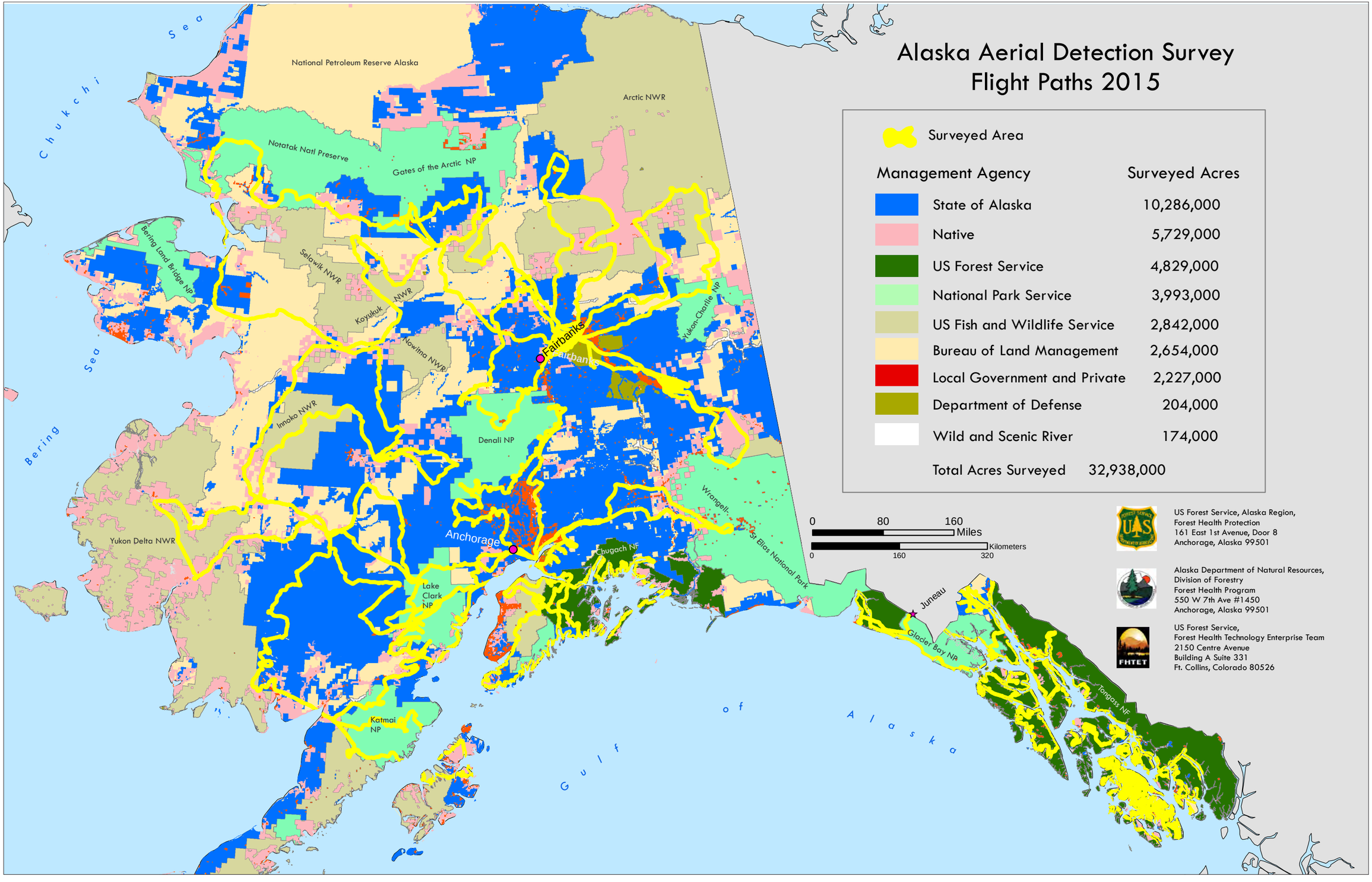


Table 1. Forest insect and disease activity detected during aerial surveys in Alaska in 2015 by land ownership[1] and agent. All values are in acres[2].

Category	Agent	*Total Acres*	*National Forest*	*Native*	*Other Federal*	*State & Private*
Forest Diseases	Alder dieback	12,000	354	5,013	3,021	3,655
	Dothistroma needle blight	2,800	223	196	642	1,783
	Willow dieback	1,200		142	323	782
	Spruce broom rust	490		185	69	238
	Pine dieback	550	531	20		3
	Hemlock canker	200	96	101		3
Defoliators, Miners, Aphids	Hardwood defoliation	190,000	68	53,668	76,123	56,444
	Aspen leaf miner	82,000		26,461	17,018	38,109
	Willow leafblotch miner	38,000		22,296	12,403	2,990
	Birch defoliation	39,000		7,534	14,921	16,083
	Alder defoliation	26,000	26	5,871	14,158	6,324
	Willow defoliation	29,000	10	10,772	13,109	5,604
	Large aspen tortrix	20,000		773	6,932	12,772
	Aspen defoliation	16,000		1,768	7,091	6,901
	Cottonwood defoliation	9,200		3,510	3,694	1,989
	Spruce needle aphid	6,600	3,365	738	166	2,293
	Conifer defoliation	3,100	2,398	108		582
	Spruce defoliation	1,700	1,536	202		
	Birch leaf roller	1,600		15	243	1,344
	Birch aphid	630			620	10
	Birch leaf miner	540			20	519
	Dwarf birch defoliation[3]	190				189
	Hemlock defoliation	120	116			6
Insect Mortality	Spruce beetle	33,000	1,493	4,999	5,244	21,365
	Northern spruce engraver	9,300		2,533	3,292	3,495
	Hemlock mortality	250	71			176
	Western balsam bark beetle	24	1			23
Abiotic and Animal Mortality	Yellow-cedar decline[4]	39,000	34,143	3,472	46	1,816
	Flooding/High-water damage	9,700	445	2,446	1,819	5,007
	Porcupine damage	1,000	131	799		95
	Windthrow/Blowdown	820	768		19	35
	Drought	320		23		298
	Landslide/Avalanche	110	44	19		51
Total	Total damage acres	574,444	45,818	153,666	180,974	190,984

[1] Ownership derived from the 2014 version of Land Status GIS coverage, State of Alaska, DNR

[2] Acre values are only relative to survey transects and do not represent the total possible area affected. Table entries do not include many diseases (e.g. decays and dwarf mistletoe), which are not detectable in aerial surveys.

[3] Defoliation of birch trees and dwarf birch has been reported separately. “Dwarf birch defoliation” primarily represents defoliation of dwarf birch, but also includes defoliation of woody shrubs by several external leaf-feeding insects.

[4] Acres represent only areas with actively dying yellow-cedars. More than 400,000 acres of cedar decline have been mapped over the years in Southeast Alaska.

Table 2. Affected area (in thousands of acres) for each host group and damage type from 2011 to 2015. Note that the same stand can have an active infestation for several years. For detailed list of species and damage types that compose the following categories, see Appendix II on page 74.

Host Group / Damage Type[1]	2011	2012	2013	2014	2015
Abiotic damage	16.3	15.8	6.2	13.6	11.0
Alder defoliation	123.0	58.5	83.9	51.5	26.0
Alder dieback	142.0	16.4	15.7	125.4	12.0
Aspen defoliation	145.6	82.7	53.4	138.6	118
Birch defoliation	76.7	177.8	278.2	586.7	42.0
Cottonwood defoliation	23.4	27.1	9.4	53.4	9.2
Fir mortality	0.0	0.0	0.0	0.2	0.0
Hardwood defoliation	5.5	2.7	2.8	42.1	190
Hemlock defoliation	11.1	5.5	13.3	46.0	0.1
Hemlock mortality	6.2	0.0	0.0	0.0	0.5
Porcupine damage	0.2	0.0	0.5	1.8	1.0
Shore Pine damage	0.0	2.9	4.8	4.5	3.4
Spruce damage	5.5	14.2	7.5	60.1	8.8
Spruce mortality	55.5	19.8	35.1	22.1	42.3
Spruce/hemlock defoliation	0.0	0.0	121.2	4.1	3.1
Willow defoliation[2]	63.9	47.7	16.2	146.1	67.0
Willow dieback	0.3	0.0	0.0	3.4	1.2
Yellow-cedar decline	26.8	17.4	13.4	19.9	39.0
Total damage acres	**702**	**488.5**	**661.6**	**1320**	**574.6**
Total acres surveyed	31,392	28,498	31,497	32,172	32,938
Percent of acres surveyed showing damage	2.2%	1.7%	2.1%	4.1%	1.7%

[1] Values summarize similar types of damage, mostly from insect agents, by host group. Disease agents contribute to the totals for spruce defoliation, hemlock mortality and alder dieback. Damage agents such as fire, wind, flooding, slides and animal damage are not included.

[2] Although these acreage sums are due to defoliating agents, a large portion of the affected area has resulted in mortality.