Highlights from 2016

In 2016, aerial surveyors mapped over 900,000 acres of forest damage from insects, diseases, declines and abiotic agents on 26.8 million acres (Map 1 and Map 2); (Table 1 and Table 2). While the number of acres surveyed in 2016 dropped 18% due to the testing of a new sampling method (see essay page 16), the total recorded damage increased 65% from 2015 (Table 2). Much of the increase in mapped damage from last year was due to the increase acreage of spruce beetle-caused mortality, as well as large increased in aspen and willow defoliation (Map 1).

Diseases

Gemmamyces bud blight is a newly-detected disease of spruce in Southcentral and Interior Alaska caused by the fungal pathogen *Gemmamyces piceae* (Figure 1). This disease was initially detected in 2013 near Homer, but the causal agent was only identified this year. Surveys in Alaska have found it to varying degrees on white, black, Sitka, and Colorado blue spruce from Homer to Fairbanks. This disease caused significant mortality in blue spruce plantations in the Czech Republic and we are monitoring the distribution of the disease in Alaska closely. It has not previously been reported in North America.

Figure 1. Fruiting bodies of *Gemmamyces piceae* on white spruce buds.

The Dothistroma needle blight outbreak near Gustavus and Glacier Bay National Park that began around 2010 is continuing and has resulted in significant shore pine mortality (57% of shore pine trees and 34% of the pine basal area in our plots is dead). This outbreak has been aerially mapped across 11,000 cumulative acres. In 2015 and 2016, 2,200 acres of severe Dothistroma needle blight was mapped near Haines, Klukwan and Skagway. Permanent monitoring plots established near Gustavus and Haines will allow us to track disease severity and tree mortality.

An outbreak of hemlock canker disease that began in 2012 has caused mortality of western hemlock along more than 70 miles of roadway on Prince of Wales Island; outbreaks have also flared up in many other locations in Southeast Alaska, including locations farther north than previously reported (Juneau and Cordova). On Prince of Wales Island, this disease has also caused mortality of crop trees in managed stands closest to the main outbreak area near Staney Creek (Figure 2).

Figure 2. Hemlock canker-killed western hemlock crop trees in a young-growth stand harvested in 1980 on Prince of Wales Island near Naukati Bay.

New collaborations with permanent forest inventory plot networks have enabled long-term, region-wide pathogen monitoring that is the largest effort of its kind in the boreal forest. Coupled with tree inventory, vegetation, and environmental data, this level of documentation is critical to understanding the impacts of disease disturbances on forest ecosystems and the services they provide society. Initial efforts are focused upon using these robust datasets to set crucial baseline information on pathogen distributions (Map 3), particularly in Southcentral and Interior Alaska. One significant outcome of these partnerships is the discovery of a wide spread canker disease of aspen. Mortality is caused by an aggressive canker that runs along the bole and eventually girdles trees (See essay on page 13). In surveyed stands, up to 65% of aspen trees and 50% of aspen biomass is infected with or dead from this undetermined canker pathogen.

A systematic survey of alder canker conducted in 2006 was repeated this year. In 2016 FHP found canker on 80% of sites with alder, compared to 41% in 2006. From 2006 to 2016, the percentage of sites with canker increased nearly 3-fold on *Alnus viridis* (Siberian and Sitka alders), with a less dramatic increase seen on *A. incana* subsp. *tenuifolia* (thinleaf alder).

The 64th Annual Western International Forest Disease Work Conference was held in Sitka, Alaska in May 2016, the first time this professional society of forest pathologists had met in Alaska in three decades. There were over 60 participants from the USFS, universities, and other state and federal agencies. Panel topics included foliage diseases, tools for mapping root disease, signals of climate change from species shifts, and landscape dynamics of forest diseases in the boreal forest. Field trips featured yellow-cedar decline and the influence of pathogens on coastal rainforest ecology, function and structure (Figure 3).

Figure 3. Forest pathologists from the western US and Canada visit a forest with significant stem decay and windthrown trees near Herring Cove in Sitka, Alaska, during the Western International Forest Disease Work Conference. Photo credit: Kristen Chadwick, USFS.

Noninfectious Diseases & Disorders

2016 was another significant year for active yellow-cedar decline (dying trees with red-yellow crowns) in Southeast Alaska, with nearly 39,500 acres aerially mapped. Although snowpack was low in 2016, lethal cold temperatures were not reached across most of the panhandle in late winter and early spring when yellow-cedar roots are vulnerable to this form of injury. Therefore, the active mortality observed this year was likely triggered in recent years that had both low snowpack and severe cold events.

Yellow-cedar decline in young-growth is an emerging issue that we continue to track to understand the key risk factors, extent, and management impacts. We have compiled a database of young-growth stands that contain yellow-cedar to facilitate monitoring. Decline has been confirmed in multiple managed stands on Zarembo Island, and fewer stands on Kupreanof, Mitkof, Wrangell, and Prince of Wales Islands (Figure 4).

Figure 4. Yellow-red tree crowns of dead and dying yellow-cedar crop trees in a 34-year-old stand on Kupreanof Island.

Many stands with decline symptoms identified by aerial survey were ground checked in 2016. For more information on recent research and publications related to yellow-cedar, see page 38.

Invasive Plants

2016 was a year of significant milestones and accomplishments related to the invasive aquatic plant elodea. First, chemical treatments in lakes on the Kenai and in Anchorage appear to have been successful. Surveys conducted in 2016 found no live elodea in any of the seven treated bodies of water. These encouraging results suggest that maintaining herbicide concentrations at low levels in lake water for as little as two years may be sufficient to eradicate elodea from Southcentral Alaskan lakes.

In a sobering counterpoint, the elodea infestation in Alexander Lake was found in 2016 to have spread aggressively. When it was first discovered in 2014, the infestation was limited to an estimated 10 acres of this Southcentral Alaskan lake. By the time staff of the Alaska Division of Agriculture returned to treat the lake with fluridone in 2016, the infestation had expanded to an estimated 500 acres. The first partial-lake application of fluridone to Alexander Lake was completed in August, 2016, and the entire 500 acre infestation was treated later in September.

Biologists from the Chugach National Forest began the "Small-Scale Elodea Treatment Project" on the Copper River Delta. Three small ponds and a slough near Cordova were treated with fluridone in 2016, and one pond was maintained as an untreated control. Macroinvertebrates, fish, water chemistry, and pond vegetation will be monitored in both the treated ponds and the untreated control pond. This work will increase our understanding of the effects of both elodea infestation and treatment with fluridone on freshwater aquatic systems in the Copper River Delta.

In the terrestrial realm, the University of Alaska Fairbanks Cooperative Extension Service has developed a new publication on orange hawkweed (*Hieracium aurantiacum*) control. With an invasiveness rank of 79 out of 100, orange hawkweed is one of Alaska's most widespread and difficult-to-control invaders.

Chugach National Forest staff, American Hiking Society volunteers, and residents of the town of Hope collaborated on a European bird cherry (*Prunus padus*) control project.

FHP staff conducted a greenhouse study of commercially-available potting soil. The soil was found to be contaminated with at least ten different species of weed seeds, including the seeds of at least one weedy plant that has not been documented in Alaska before.

In 2016, the Alaska Committee for Noxious and Invasive Plant Management (CNIPM) changed its name and enlarged its mission. The group is now called the Alaska Committee for Noxious and Invasive Pest Management, and welcomes participation from anyone interested in any type of invasive species. CNIPM's 2016 workshop was held in Fairbanks.

Insects

Mortality caused by spruce beetle (*Dendroctonus rufipennis*) was observed on 190,000 acres this year, nearly a six-fold increase over 2015. This dramatic increase follows nearly two decades of relative calm. Most of the affected area has been a result of increased activity in the Matanuska-Susitna Valley rather than from its previous concentration on the Kenai Peninsula.

Needle discoloration and premature needle loss caused by spruce aphid (*Elatobium abietinum*) occurred on 34,000 acres, mostly on the Kenai Peninsula around Homer. Spread and intensification of this pest has been closely monitored since it was first reported on the Western Kenai in 2015 in Halibut Cove on the south side of Kachemak Bay. Ground surveys that same year noted scattered minor infestations across the bay, in Homer. By spring 2016, the number of infested trees in Homer had increased and were mostly located within the city limits. However, by October, ground surveys found infested trees 45 miles north of the Homer limits.

Aspen leaf miner was observed on approximately 210,000 acres, which is nearly twice what was reported in 2015. This is the largest infested area for this pest since 2010, when it occurred on over 400,000 acres.

Area infested with birch leaf rollers significantly expanded in 2016. In previous years, leaf roller injury had been associated primarily with *Epinotia solandriana*, and most affected stands were located in Southcentral Alaska, south of the Alaska Range. This year, most affected stands were located north of the Alaska Range, and the damage was mostly attributed to *Caloptilia strictella*.

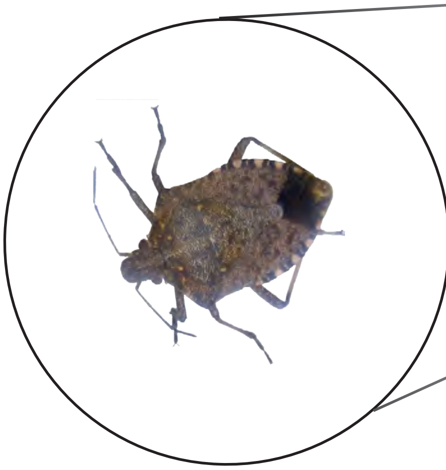
In 2016, the speckled green fruitworm (*Orthosia hibisci*) defoliated 160,000 acres of various hardwood tree and shrub species. In 2014 and 2015, similar defoliation had been recorded as "unknown hardwood defoliation" or attributed to *Sunira verberata*.

Willow leaf blotch miner (*Micurapteryx salicifoliella*) damage has been increasing since 2013. In 2016, 145,000 acres were infested, a striking increase from 38,000 acres in 2015. Infested willows were found mostly in the Interior.

Alder defoliation caused by green alder sawfly (*Monsoma pulveratum*), striped alder sawfly (*Hemichroa crocea*), woolly alder sawfly (*Eriocampa ovata*), spotted tussock moth (*Lophocampa maculata*), and several other leaf-eating insects was much less widespread in 2016 than in previous years, except for Southeast where spotted tussock moth and green alder sawfly were commonly found throughout the region.
Northern spruce engraver activity was observed on 14,400 acres in 2016, which is a 55% increase over the 9,300 acres mapped in 2015, and marks the most activity by this bark beetle since 2010.

The brown marmorated stink bug (*Halyomorpha halys*), a non-native and highly invasive insect (Figure 5), was accidentally transported to Alaska from Oregon by a scientist from the Juneau Forestry Sciences Laboratory. The scientist was in Sandy, Ore., where the stink bugs are already established and are a known nuisance pest during the fall when seeking a place to overwinter indoors. The scientist took precautions to prevent any from getting into her suitcase and bags, but despite this, after she returned to Juneau she found two stinkbugs in her office. FHP will monitor for brown marmorated stink bug activity and advise people to take precautions when visiting infested areas during the fall.

Information regarding signs, symptoms, distribution, biology, and historic activity of all damage causing agents, biotic and abiotic is currently being added to our website: www.fs.usda.gov/main/r10/forest-grasslandhealth.



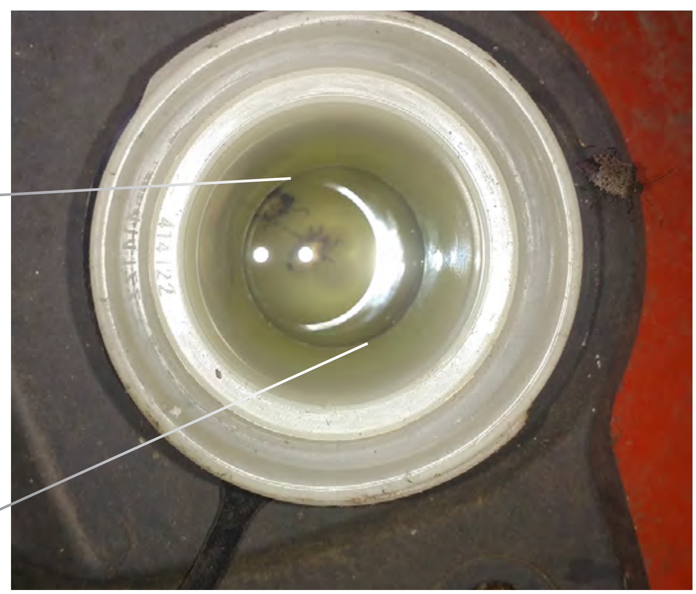
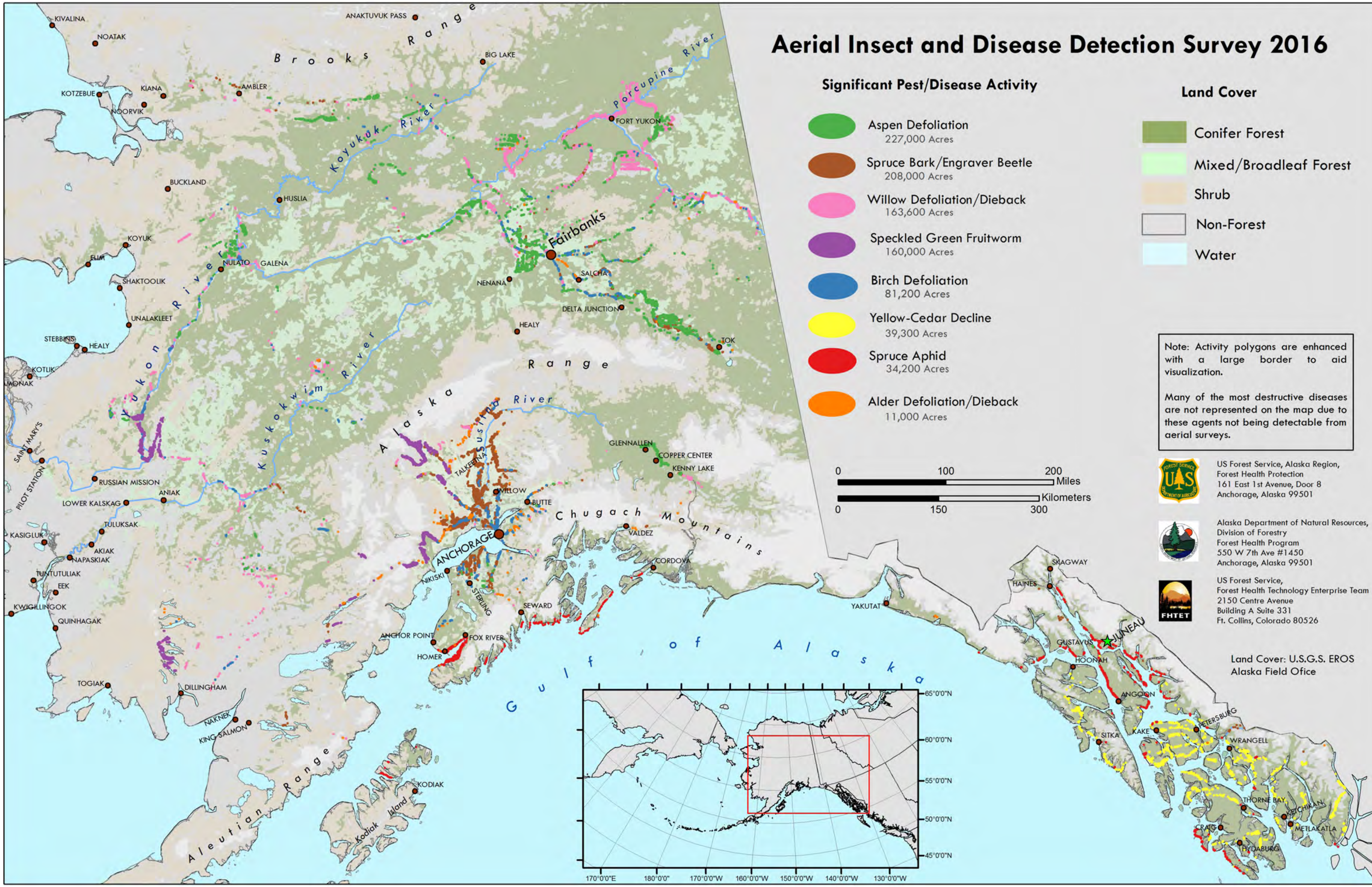
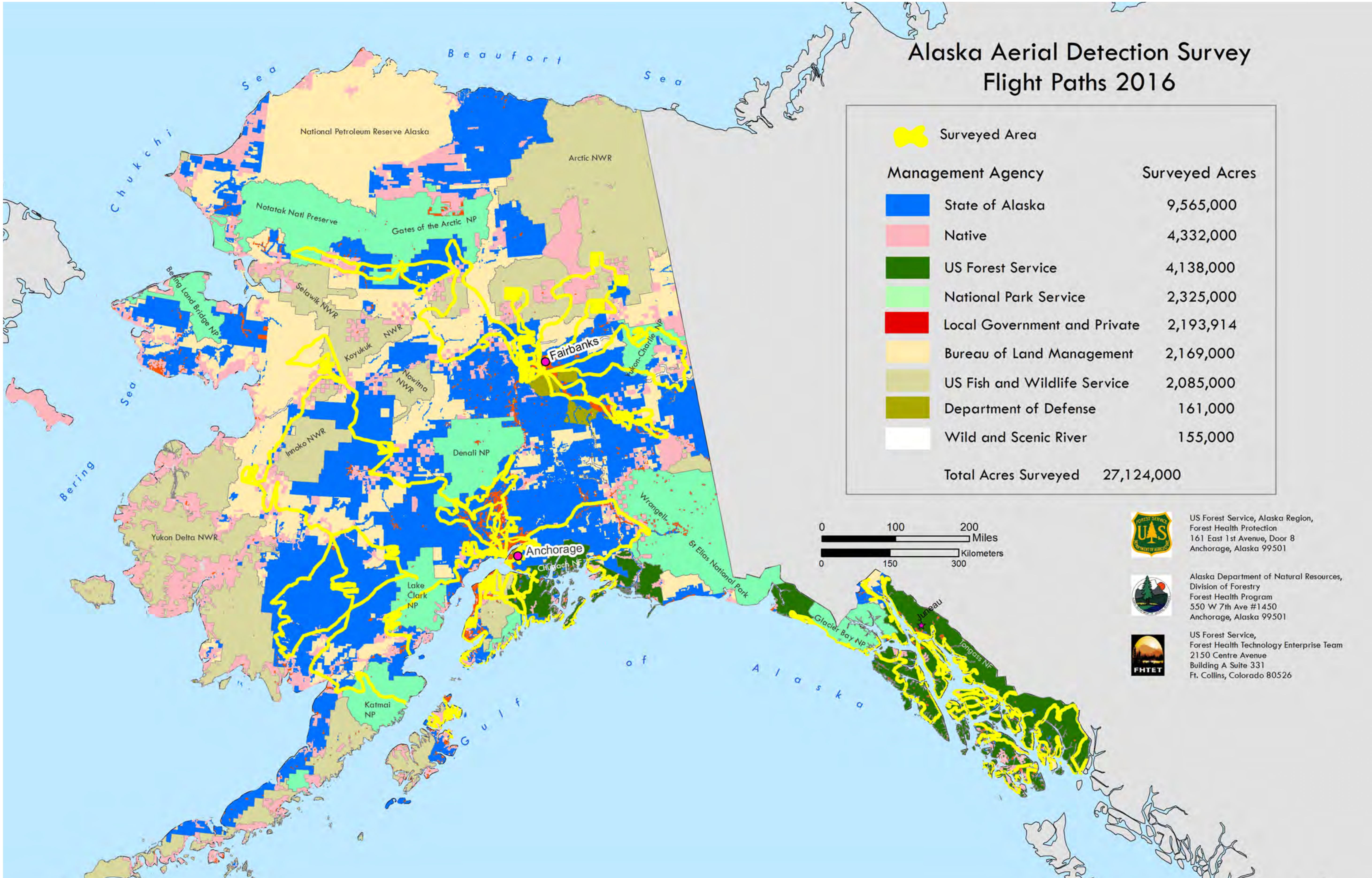


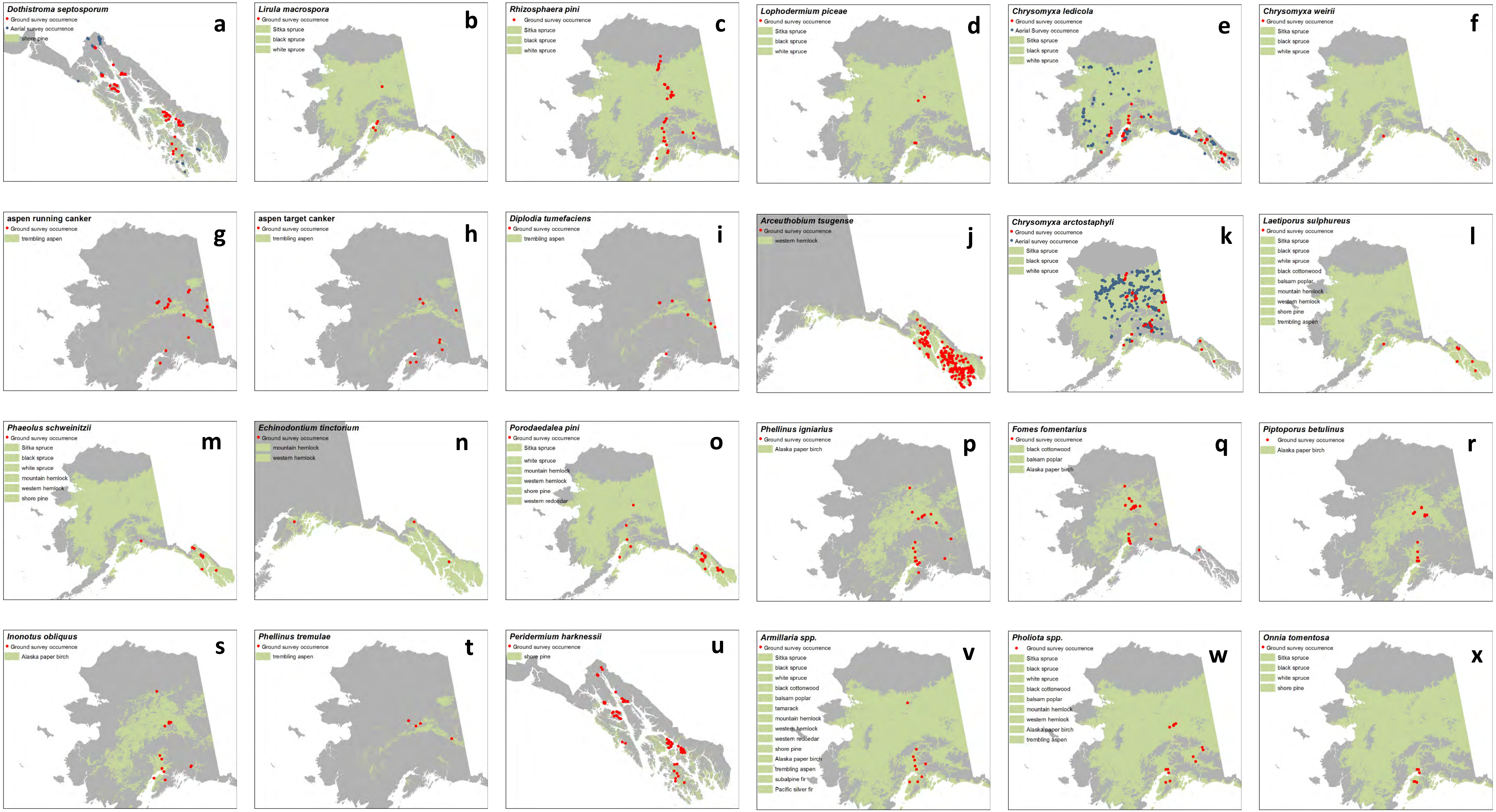
Figure 5. Brown marmorated stink bugs (insert) look for places to overwinter in the fall, thereby increasing the chance of being accidentally transported to a new area. These stink bugs were less successful, trying to overwinter in the gas tank of a lawn mower, however it demonstrates they get into everything. Photo credit: Leif Branter.



Map 1. Alaska aerial insect and disease detection survey, 2016.



Map 2. Alaska aerial insect and disease detection survey flight paths, 2016.



Map 3. Locations where disease agents have been found in ground surveys (2013-2016), published literature, and Aerial Detection Surveys (1989-2016). These maps do not include pathogen locations that are known but lack explicitly georeferenced observations. Modeled host tree layers were developed by the Forest Health Technology Enterprise Team in 2011 (240m-resolution, presence based on dominant tree species by tree diameter).

Table 1. Forest insect and disease activity detected during aerial surveys in Alaska in 2016 by land ownership and agent. All values are in acres[1].

Category	AGENT	Total Acres	national forest	native	other federal	state & private
Forest Diseases	Alder dieback	8,393	43	524	1,213	6,614
	Dothistroma needle blight	4,850	225	144	3,630	853
	Willow dieback	2,750	0	962	1,554	238
	Spruce broom rust	151	0	0	91	60
Defoliators	Aspen leaf miner	207,926	478	56,576	51,191	99,833
	Speckled green fruitworm	160,000	0	47,265	37,124	75,709
	Willow leafblotch miner	145,000	134	46,045	77,251	21,514
	Birch defoliation	52,500	103	7,225	8,466	36,679
	Spruce aphid	34,200	12,628	1,916	1,036	18,662
	Birch leafroller	27,000	0	2,687	2,868	21,395
	Aspen defoliation	18,900	0	1,447	14,921	2,516
	Willow defoliation	15,916	5	4,051	5,732	6,124
	Spear-marked black moth	4,650	0	110	54	4,490
	Conifer defoliation	3,100	1,336	36	1,666	62
	Alder defoliation	2,911	101	0	581	2,227
	Hardwood defoliation	1,890	0	524	881	488
	Birch leaf miner	1,790	0	41	718	1,027
	Cottonwood defoliation	1,326	701	37	169	419
	Spruce defoliation	1,000	680	229	0	93
	Large aspen tortrix	930	0	0	623	307
	Spruce budworm	786	0	529	0	257
	Spruce bud moth	87	0	0	0	87
	Cottonwood leaf beetle	7	0	0	7	0
Insect Mortality	Spruce beetle	193,479	319	38,014	12,035	143,592
	Northern spruce engraver	14,400	3	2,223	1,720	10,435
	Western balsam bark beetle	27	8	0	0	19
Abiotic and Animal Mortality	Yellow-cedar decline	39,300	34,800	2,272	145	2,121
	Porcupine damage	3,530	390	2,304	205	632
	Flooding/high-water damage	2,650	322	323	633	1,370
	Windthrow/blowdown	232	52	26	40	113
	Landslide/avalanche	195	61	38	2	93

[1] 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.

Table 2. Mapped affected area from 2012 to 2016 from aerial survey. All figures in thousands of acres. 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 63.

Damage Type	2012	2013	2014	2015	2016
Abiotic damage	15.8	6.2	13.6	11.0	3.0
Alder defoliation	58.5	83.9	51.5	26.0	2.9
Alder dieback	16.4	15.7	125.4	12.0	8.4
Aspen defoliation	82.7	53.4	138.6	118	229.3
Birch defoliation	177.8	278.2	586.7	42.0	85.5
Cottonwood defoliation	27.1	9.4	53.4	9.2	2.3
Fir mortality	0.0	0.0	0.2	0.0	0.027
Hardwood defoliation	2.7	2.8	42.1	190	161.9
Hemlock defoliation	5.5	13.3	46.0	0.1	0
Hemlock mortality	0.0	0.0	0.0	0.5	0
Porcupine damage	0.0	0.5	1.8	1.0	3.5
Shore pine damage	2.9	4.8	4.5	3.4	4.9
Spruce damage	14.2	7.5	60.1	8.8	36
Spruce mortality	19.8	35.1	22.1	42.3	204.5
Spruce/hemlock defoliation	0.0	121.2	4.1	3.1	3.1
Willow defoliation	47.7	16.2	146.1	67.0	156.3
Willow dieback	0.0	0.0	3.4	1.2	2.8
Yellow-cedar decline	17.4	13.4	19.9	39.0	39.0
Total damage acres	**488.5**	**661.6**	**1320**	**574.6**	**949.8**
Total acres surveyed	28,498	31,497	32,172	32,938	26,876
Percent of acres surveyed showing damage	1.7%	2.1%	4.1%	1.7%	3.5%