Introduction

Annually, Forest Health Protection staff and State of Alaska Division of Forestry cooperators conduct surveys to monitor Alaska's forests for insects, diseases, declines, abiotic agents, and invasive organisms. These surveys consist largely of aerial detection mapping, though other efforts, including roadside surveys, permanent plots, and early detection/rapid response work, also contribute substantially to the accumulated body of knowledge. This conditions report is an aggregate and synthesis of forest health information, allowing land managers and decision makers to identify potential and current risks, discern forest health patterns, and monitor expansion or decline of a threat.

Alaska Forest Health Highlights

2005 Survey Year

Aerial detection mapping is an indispensable tool in documenting the location and extent of active forest insect and disease damage. In 2005, staff and cooperators identified over 1 million acres of forest damage from insect, disease, declines and select abiotic agents (Map 1) out of over 39 million acres aerially surveyed (Map 2). Further information regarding forest health as determined by ground surveys and monitoring efforts is also included in the report, complementing the broad-scope aerial survey findings,

Forest Health Protection staff also continually work alongside many agency partners on invasive plant issues, including roadside and high-impact area surveys, public awareness campaigns, and other general educational efforts. Trends this year indicate both ongoing range expansion of established invasives and new species establishment in Alaska. However, public familiarity and agency participation in addressing the issue increased dramatically, as well.

Insects

Amber-marked birch leaf miner affected urban areas and some native forests throughout south-central Alaska. Nearly 150,000 acres are estimated to be infested by this invasive insect, and populations appear to be expanding annually. Since its introduction in 2002, this insect has spread south from Anchorage to the Kenai Peninsula, and north to Talkeetna. Leaf miner activity has also been detected in interior Alaska and in southeast Alaska in Haines and Skagway. A biological control program, involving the release of a hymenopteran parasitoid, was initiated in 2003 and continued in 2005. This biological control program is the first of its kind in Alaska and involves multiagency partnerships.

The largest outbreak of **aspen leaf miner** on record in Alaska expanded in 2005. Activity on nearly 660,000 acres was mapped statewide with continued activity in the Yukon Flats National Wildlife Refuge, Fairbanks, and Upper Tanana River Valley and has expanded into the Upper Copper River Valley.

Acres of **spruce aphid** defoliation nearly doubled in southeast Alaska. Thirty-nine percent occurred on National Forest Lands, much of it on the western and southwestern beach fringe of Prince of Wales Island.

Although acreage increases for **spruce budworm** and **larch sawfly** were expected for 2005, there was an 80 percent decrease in spruce budworm acres mapped and only a 16 percent increase in larch sawfly. However, much of the 2004 budworm affected acreage was burned in the 2004 and 2005 fires. **Black-headed budworm** activity remained relatively unchanged in southeast Alaska.

The total area of new tree mortality caused by **spruce beetle** activity aerially mapped across Alaska declined by 45 percent in 2005 to approximately 71,000 acres. Spruce beetle populations remain at endemic levels throughout much of the state, though light to moderate activity persists in some areas of south-central Alaska, and the Copper and Kuskokwim River Valleys. **Northern spruce engraver** populations found in association with spruce beetle increased 30 percent in 2005, primarily in interior Alaska. **Western balsam bark beetle** is responsible for 785 acres of subalpine fir mortality in the Skagway river watershed, an increase of over 400 percent from 2004. Weather records suggest that conditions have become more favorable for beetle development in forests near Skagway in recent years.

Continued mild weather conditions may have led to increased **insect defoliator** populations around the Anchorage area, with noticeable damage to alder species. Damage was noted from Palmer to Seward, but heaviest in the Anchorage Bowl. The primary defoliator of thinleaf alder continues to be the introduced **woolly alder sawfly**.

Other introduced insects of interest for 2005 include the first Alaskan discovery of the **European yellow underwing** in Haines and Sitka, and the resurgence of **western tent caterpillar**, a species specifically targeted for eradication in the Anchorage area in 2004. Although **European gypsy moth** was not found in 2005, trapping efforts continue annually as part of invasive insect monitoring. A fourth insect of concern, **European pine shoot moth** was introduced on ornamental Scotch pine in Anchorage. This moth was also the focus of eradication efforts that appear initially successful.

Diseases

The most important diseases and declines of Alaskan forests in 2005 were **wood decay** and **root rot** of live trees, **hemlock dwarf mistletoe**, and **yellow-cedar decline**. Except for yellow-cedar decline, trees affected by these diseases are difficult to detect by aerial surveys. Nonetheless, diseases and declines are chronic factors, some of which significantly influence the commercial value of timber resources and alter key ecological processes such as forest structure, composition, nutrient cycling, and succession.

In southeast Alaska, approximately one-third of the gross volume of forests is defective due to **stem and butt rot fungi**. **Hemlock dwarf mistletoe** continues to cause growth loss, topkill, and mortality, but also provides wildlife habitat in old-growth forests.

Yellow-cedar decline has been mapped on approximately 500,000 acres across an extensive portion of southeast Alaska. Active tree mortality occurred in many of these locations in 2005, indicating an intensification of the problem on previously-impacted acres. Although still not completely understood, the cause appears to be related to spring freezing injury in open canopy forests characterized by reduced snowpack.

Cone and other foliar diseases of conifers were generally at low levels throughout Alaska in 2005. A stem/branch **canker pathogen of alder**, *Valsa melanodiscus (Cytospora umbrina)*, continues to infect thin-leaf alder in riparian areas across thousands of acres in south-central and interior Alaska. **Canker fungi on conifers**, particularly on Sitka spruce and

subalpine fir occurred at higher than normal levels and caused branch dieback in southeast Alaska. **Canker fungi of hardwoods** were at endemic levels in south-central and interior Alaska.

In south-central and interior Alaska, **tomentosus root rot** continues to cause growth loss and mortality of white spruce in all age classes. Various stem and butt rot fungi cause considerable defect in mature white spruce, paper birch, and aspen stands.

Saprophytic decay, by many agents, but particularly the **red belt fungus**, continues to degrade spruce beetle-killed trees. A deterioration study on Kenai Peninsula indicated a rela-

Table 1. 2005 forest insect and disease activity as detected during aerial surveys in Alaska by land ownership[1] and agent[2].

Damage Agent	National Forest	Native Corp.	Other Federal	State & Private	Total Acres 2005
Alder defoliation[3]	156	3,279	2,836	11,071	17,342
Aspen defoliation[3]	0	16,622	1,336	1,379	19,338
Aspen Leaf Miner	0	139,521	309,924	210,090	659,536
Birch defoliation[3]	0	1,458	2,534	6,129	10,120
Birch Leaf Miner	0	91	197	30,222	30,510
Birch leaf roller	36	982	2,063	3,610	6,691
Black-headed budworm	890	503	0	8	1,401
Cedar decline faders[4]	30,734	1,072	0	1,389	33,194
Cottonwood defoliation[5]	1,146	613	1,195	5,005	7,958
Hemlock canker	14	0	0	0	14
Hemlock sawfly	155	0	0	0	155
IPS and SPB	0	5,330	7,629	6,893	19,852
Ips engraver beetle	186	559	1,494	749	2,990
Larch sawfly	0	4,755	3,424	8,592	16,771
Spear-marked black moth	0	31	0	127	157
Spruce aphid	10,359	2,318	357	1,947	14,982
Spruce beetle	2,451	17,912	26,573	23,978	70,913
Spruce broom rust	0	0	0	896	896
Spruce budworm	0	9,391	557	6,020	15,968
Spruce/Larch budmoth	0	0	0	276	276
Sub Alpine Fir Beetle	86	100	0	599	785
Willow defoliation[3]	770	16,061	24,870	2,837	44,537

[1] Ownership derived from 2005 version of Land Status GIS coverage, State of Alaska, DNR/Land records Information Section. State & private lands include: state patented, tentatively approved, or other state acquired lands, and of patented disposed federal lands, municipal, or other private parcels.

[2] Table entries do not include many of the most destructive diseases (e.g., wood decays and dwarf mistletoe) which are not detectable in aerial surveys. Some forest damage acres are not shown because a specific agent could not be identified. Damage acres from animals and abiotic agents are also not shown in this table.

[3] Significant contributors include leaf miners and leaf rollers for the respective host. Drought stress also directly caused reduced foliation or premature foliage loss.

[4] Acres represent only spots where current faders were noticed. Cumulative cedar decline acres can be found in Table 7.

[5] Significant contributors include cottonwood leaf beetle and leaf rollers. Acreage where both willow and cottonwood defoliation occurred concurrently is included in these totals.

Table 2. Affected area (in thousands of acres) for each host group and damage type over the prior five years and a 10-year cumulative sum

Host Group/ Damage Type[1]	2000	2001	2002	2003	2004	2005	Ten Year Cumulative[2]
Alder Defoliation[3]	5.6	1.2	1.8	2.8	10.5	17.3	39.9
Aspen Defoliation	12.6	9.4	301.9	351.4	591.5	678.9	1,864.7
Birch Defoliation	2.8	3.2	83	217.5	163.9	47.5	689.2
Cottonwood Defoliation	5.4	9.9	19.9	13.1	16.7	8.0	90.1
Hemlock Defoliation	5.2	1.3	1.4	0.2	0.5	0.2	27.5
Hemlock Mortality	0.0	0.1	0.2	0	0.0	0.1	0.6
Larch Defoliation	64.9	17.8	0	0.6	14.2	16.8	1521.1
Larch Mortality	0.0	0.0	4.8	22.5	11.8	0.0	57.4
Spruce Defoliation	84.7	61.1	11	61.5	93.4	31.9	629.5
Spruce Mortality	120.9	104.2	53.6	92.8	145.2	93.8	3168.0
Spruce/Hemlock Defoliation	0.0	50.7	3.4	15.1	1.5	1.4	99.6
Spruce/Larch Defoliation	0.0	0.0	0.0	0.3	0.0	0.3	0.3
Sub Alpine Fir Mortality	0.0	0.1	0.2	0.0	0.2	0.8	1.3
Willow Defoliation	36.5	10.9	0.3	83.9	111.2	44.5	658.3
Total damage acres	338.6	269.9	481.5	861.7	1160.5	941.5	7595.5
Total acres surveyed	27,185	22,296	24,001	25,588	36,343	39,206	94,583.0
Percent of acres surveyed showing damage	1.2	1.2	2.0	3.4	3.2	2.4	8.0

[1] Summaries identify damage, mostly from insect agents. Foliar disease agents contribute to the spruce defoliation and hemlock mortality totals. Damage agents such as fire, wind, flooding, slides and animal damage are not included. Cedar mortality is summarized in Table 7.

[2] The same stand can have active infestation for several years. The cumulative total is a union of all areas from 1996 through 2005 and does not double count acres.

[3] This total includes defoliation on alder from alder canker, drought and insects.

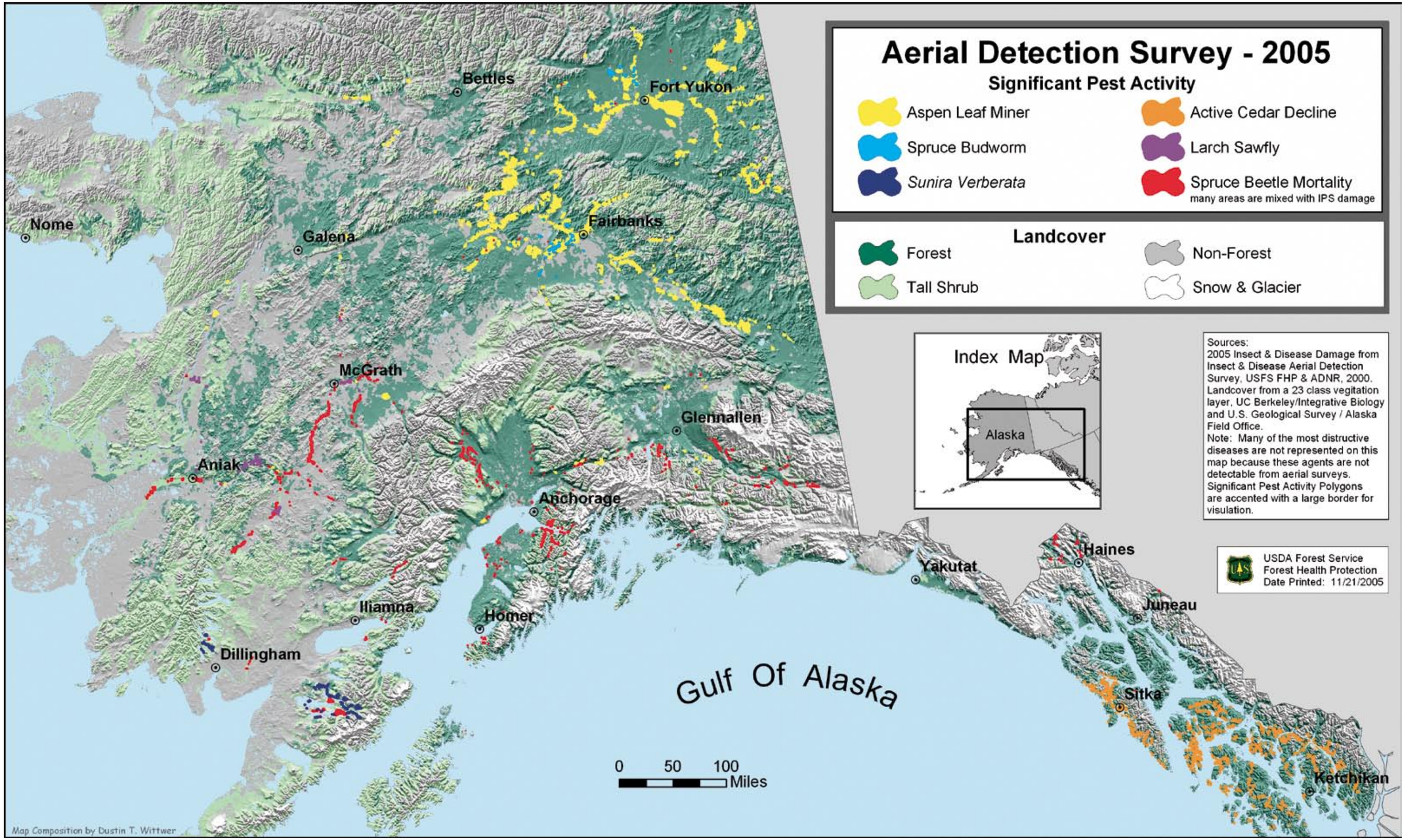
tively slow overall decomposition rate (1.5 percent/year). Thus, beetle-killed trees are likely to influence fire behavior and present a fuels hazard for over 75 years.

Although 2005 approached "normal" temperatures and precipitation across Alaska, many areas of the state continued to experience above average temperatures and below average precipitation. Moreover, the record-breaking conditions in the recent past (2003 and 2004) have continued to contribute to stressed forest conditions. Drought stress and yellow-cedar decline may be the forest health issues most significantly related to **climate change**.

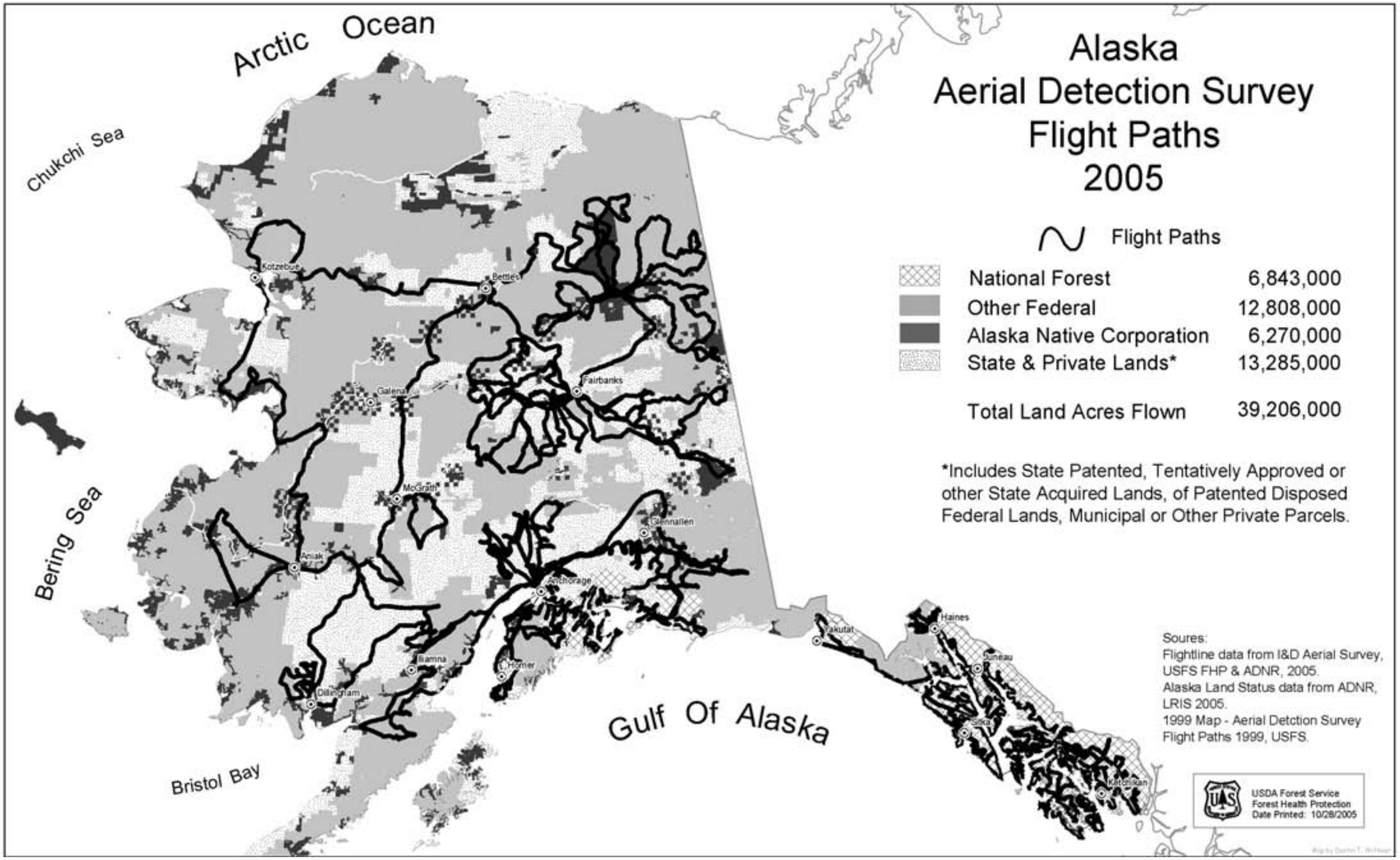
Invasive Organisms

Invasive pests (introduced exotic plants, animals, insects, and microbes which spread aggressively and displace native species) are a serious threat to biological diversity and, consequently, have gained increased publicity both nationally and within Alaska. For example, amber-marked birch leaf miner (mentioned above) has spread from Anchorage to much of south-central and interior Alaska, white pine blister rust has recently been discovered on an ornamental pine in southeast, and orange hawkweed is one of two invasive plants currently being debated in the Alaska Legislature. Of primary concern for Alaska is the introduction of organisms from the continental United States, Canada, and the Russian Far East. As global climate change drives warming trends in arctic regions, the probability increases that organisms introduced into Alaska, either accidentally or intentionally, will become

Map 1. General Forest Pest Activity, 2005



Map 2. Survey Flight Paths and General Ownership, 2005



established and begin to spread. Alaska's soaring tourism industry and strategic location as an international trade and travel hub elevates the risk of introduction dramatically. Many newly initiated and ongoing programs specific to Alaska are described in this report.

Once established, invasive pest populations can be extremely difficult to manage. In general, invasive organisms are not subject to the complement of parasites and predators that served to check their population sizes in native habitats. Further, Alaska's native species have not had the chance to develop the defenses and survival strategies that would allow them to compete with newly-introduced invasive species. Alaska's forests are also fairly homogenous, largely characterized by one of six canopy-dominant species. This relative lack of biodiversity makes the state's forests much more susceptible to large-scale, severe disturbance were an invasive insect or disease to establish.

Ecologists now recognize that it is far easier and more economical to prevent the introduction of invasive species and respond quickly to small, incipient populations, than to wait until they have become widely established. The recent introduction of the amber-marked birch leaf miner for instance, has served to highlight the increasing risk to Alaskan forests and emphasize the need to further develop an early warning system with a wider scope for detecting introductions. USDA Animal & Plant Health Inspection Service (APHIS), the State of Alaska Divisions of Agriculture and Forestry (AK DOA, AK DOF), University of Alaska Cooperative Extension Service (CES), and the USDA Forest Service, Forest Health Protection has programs in place to monitor and detect potential insect, disease, or plant introductions. For further information about invasive species of concern in Alaska, or to report invasive species, contact CES, APHIS, or AK DOF. Alaska residents, resource professionals, and land managers all have roles and responsibilities to address exotic invasive species prevention, early detection, and rapid response.

Invasive Plants

Invasive plant infestations in Alaska continue to expand. Several new exotic invasive plant species were discovered in 2005, most notably the wetland invader **purple loosestrife**. Invasive **exotic thistles**, **knotweeds**, **hawkweeds**, **sweetclovers**, and s**potted knapweed** remain high concern, high priority species in Alaska. All of the above are proving to be well-suited to Alaskan climates, and continue to spread aggressively and become established in new locations.

Mapping and inventory of these and many other exotic invasive plant species continues around the state. The **Alaska Exotic Plant Information Clearinghouse** (AKEPIC) statewide database now contains over 37,000 records of invasive species, all accessible on-line. Important strides have been made in the area of public awareness of invasive plants issues. Education and outreach efforts are fueling a growing demand for information and assistance, as land managers turn their attention to invasive plants prevention, detection, and control. **Cooperative Weed Management Areas** are being created, in collaboration with NRCS Soil and Water Conservation Districts and the Alaska Association of Conservation Districts, to address regionwide invasive plant problems across geopolitical boundaries.