United States
Department of
Agriculture,
Forest Service,
Alaska Region

# Forest Health Protection Report

R10-TP-70
December,
1997

## Forest Insect and Disease Conditions in Alaska--1997

State of Alaska,
Department of
Natural
Resources,
Division of
Forestry

# ALASKA FOREST HEALTH SPECIALISTS

## Anchorage

Forest Health Protection
USDA Forest Service
State and Private Forestry
3301 'C' Street, Suite 522
Anchorage, AK 99503-3956
Phone: (907) 271-2575
FAX (907) 271-2897
e-mail:
lname_fname/r10_chugach@fs.fed.us

**Jerry Boughton**, Program Manager
**Edward H. Holsten**, Entomologist
**Beth Schulz**, Ecologist
**Lori Trummer**, Pathologist
**Kenneth P. Zogas**, Biotechnician
**Kathleen Matthews**, Biotechnician

Department of Natural Resources
State of Alaska
Division of Forestry, Resources
3601 'C' Street, Suite 1034
Anchorage, AK 99503-5937
Phone: (907) 269-8460
FAX (907) 561-6659
e-mail: rogerb@dnr.state.ak.us

**Roger Burnside,** Entomologist

Alaska Cooperative Extension
2221 E. Northern Lights, Suite 118
Anchorage, AK 99508
Phone: (907) 279-6575

**Michael Fastabend,** IPM Forestry Technician

## Juneau

Forest Health Protection
USDA Forest Service
State and Private Forestry
2770 Sherwood Lane, Suite 2A
Juneau, AK 99801
Phone: (907) 586-8883
(907) 586-8769
FAX (907) 586-7848
e-mail: lname_fname/r10@fs.fed.us

**Paul E. Hennon**, Pathologist
**Mark Schultz**, Entomologist
**Dustin Wittwer**, Biotechnician

# FOREST INSECT AND DISEASE CONDITIONS IN ALASKA -- 1997

General Technical Report R10-TP-70

December 1997

Compiled by:
Kathleen Matthews, Biological Technician

Contributors:
Dustin Wittwer, Biological Technician
Ken Zogas, Biological Technician
Ed Holsten, Entomologist
Lori Trummer, Pathologist
Beth Schulz, Ecologist
Paul Hennon, Pathologist
Mark Schultz, Entomologist
Roger Burnside, AK/DOF Entomologist
Michele Gorham, AK/DNR GIS Analyst/Programmer

Forest Health Protection
State and Private Forestry
Alaska Region
USDA Forest Service
3301 "C" Street, Suite 522
Anchorage, Alaska 99503

Resources
Division of Forestry
Department of Natural Resources
State of Alaska
3601 "C" Street, Suite 1034
Anchorage, Alaska 99503

# TABLE OF CONTENTS

## Table of Contents, cont.

# FOREST INSECT AND DISEASE CONDITIONS IN ALASKA -- 1997

# CONDITIONS IN BRIEF

Annual aerial mapping is conducted to document where active forest damage is occurring, that is, where current defoliation or recently killed trees are located. These aerial surveys generally cover approximately 1/3 of the forested land in Alaska; however, surveying in the interior was hampered by smoke and inclement weather in 1997. Despite these limitations, insect and disease activity in Alaskan forests declined by one third to 1.7 million acres. Major declines in three of the four most active insects, spruce beetle, spruce budworm, and larch sawfly, accounted for this reduction.

## INSECTS:

Active **spruce beetle** infestations declined by 50% from 1996 totals in both south-central and southeast Alaska to 563,741 acres. Many spruce stands are now 80-90% dead and have little or no susceptible host material remaining to support further spruce beetle activity. Visually, these stands appear to have few recently killed trees and the standing dead trees are grey in appearance. These stands are not mapped in the annual survey. It is estimated that over 2.3 million acres are in this condition as a result of spruce beetle activity over the last seven years. This factor accounts for the majority of active spruce beetle infestation reduction noted in 1997. Heavy mortality exists in most spruce stands in the lower Kenai Peninsula from Bradley Lake near Kachemak Bay northwest to Tustumena Lake and south to East End Road near Homer as well as the Copper River Valley. Although it may appear that the spruce beetle has run its course in many areas by removing susceptible host, areas remain where beetle populations could expand into.

The Homer area on the Kenai Peninsula experienced a tremendous beetle flight this year; more spruce trees will be showing red needles in 1998. The beetles have decimated most of the spruce stands in the main Copper River Valley; however, many side drainages remain under attack. Beetles have also been active in the Susitna River Valley for several years, although the loss of spruce will not be as devastating due to the hardwood forest component. Assuming that conditions favorable to beetle development continue, along with the presence of susceptible stands (i.e., stands composed of mature, even-aged, slow-growing spruce), it would be safe to predict that beetle activity is not yet over. However, it is not expected that beetle populations will reach the 1996 level of 1.13 million acres infested in the near future.

Total spruce beetle activity in southeast Alaska decreased from 35,700 acres in 1996 to 19,050 acres in 1997. The beetle outbreak in Glacier Bay National Park on the ridge east of Gustavus decreased as did the infestation at the mouth of the Stikine River. The beetle infestations in Haines and along the Taku River continued at 1996 levels.

The **spruce budworm**, which defoliated more than 230,000 acres of white spruce in 1996, declined by 84% in 1997 to 38,416 acres. Nearly all of the budworm activity has been confined to the Yukon and Tanana Rivers in interior Alaska. The major portion of this infestation has centered around Tanana; however, over the past two years the spruce budworm has migrated westward along the Yukon River to Ruby. Many trees in this area have severely diminished crowns having withstood budworm defoliation for several years. It is expected that this infestation will continue to decline toward endemic levels over the next few years.

Approximately 29,000 acres of hemlock and Sitka spruce were defoliated by the **Black-headed budworm** in Prince William Sound. While the Cordova area experienced some of the heaviest defoliation, most of the affected acres occurred in sheltered coves from Knight Island north to Valdez Arm and east to the Copper River.

A warm, early spring and summer were advantageous for the budworm. If this warm, dry weather continues in 1998, budworm populations should increase in the Sound. The budworm populations are decreasing in southeast Alaska-- only 1,200 acres were affected. These populations often rise and fall over a period of a few years and result in some tree topkill and minor mortality.

In south-central Alaska, nearly 272,000 acres of birch showed signs of stress. This condition was caused by a combination of drought and insects. Large populations of **birch leafminer** were prevalent in the Anchorage bowl and **birch aphids** were reported throughout the Mat-Su Valley. The combination of drought and insects caused most birch leaves to prematurely turn brown.

Willow defoliation by the **willow leaf blotchminer** declined 93% in 1997 to only 3,501 acres. This outbreak, which was scattered throughout the interior, the Copper River Valley and the Anchorage area, peaked at 150,000 acres in 1992. Since then, the outbreak has been in decline and appears to be returning to endemic levels.

Two other insects of note are the larch sawfly and hemlock sawfly. This marks the fifth consecutive year of defoliation by the **larch sawfly**, but it appears that this infestation is waning, as populations fell by 56% in 1997. Some mortality of larch, attributed to five years of heavy defoliation, was noted near Fairbanks. In southeast Alaska, **Hemlock sawfly** defoliation levels decreased slightly from 8,250 acres in 1996 to 6,638 acres in 1997.

## DISEASES:

The most important diseases and declines of Alaskan forests during 1997 were wood decay of live trees, root disease of white spruce, 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, all are chronic factors that significantly influence the commercial value of the timber resource and alter key ecological processes including forest structure, composition, and succession. Wildlife habitats are produced directly by wood decay fungi, hemlock dwarf mistletoe and spruce broom rust through the formation of tree cavities and witches' brooms.

In southeast Alaska, approximately one-third of the gross volume of forests is defective due to **heart and butt rot fungi**. **Hemlock dwarf mistletoe** continues to cause growth loss, top-kill, and mortality in old-growth forests; its impact in managed stands depends on the abundance of large infected trees left after harvesting. Some 477,000 acres of **yellow-cedar decline** have been mapped across an extensive portion of southeast Alaska. Snags of yellow-cedar accumulate on affected sites and forest composition is substantially altered as yellow-cedar trees die giving way to other tree species. Salvage opportunities for this valuable resource are now being recognized.

In south-central and interior Alaska, **root disease** continues to cause growth loss and mortality in white spruce stands. Impacts are greatest in young-growth managed stands where seedlings grow in close proximity to infected stumps. Volume losses of spruce due to **heart, butt, and sap rot fungi** are substantial; sap rot decay quickly develops and degrades spruce trees killed by spruce bark beetles. A high incidence of stem decay occurs in living hardwoods.

Foliar diseases of conifers had negligible ecological significance and were generally at moderate levels throughout Alaska in 1997, except for an outbreak of spruce needle cast in young-growth forests on Afognak Island. Canker and foliar fungi caused large, but unmeasured, damage to hardwood species in south-central and interior Alaska.

## Other:

In localized areas of southeast Alaska, **porcupines** continued to cause tree defect and mortality to several conifer species and **brown bears** caused a high incidence of wounding on the lower boles of yellow-cedar.

**Table 1. 1997 forest insect and disease activity (in acres) as detected aerially in Alaska by land ownership and agent[1].**

| Damage Agent | State & Private | National Forest | Other Federal | Native Corp. | 1997 Total | 1996 Total | % Change |
|---|---|---|---|---|---|---|---|
| Spruce beetle | 263,187 | 14,773 | 142,462 | 143,319 | 563,741 | 1,130,756 | -50 |
| Engravers/spruce beetle | 2,428 | 8 | 3,608 | 2,902 | 8,946 | 13,941 | -36 |
| Spruce budworm | 21,326 | -- | 8,637 | 8,453 | 38,416 | 235,936 | -84 |
| Black-headed budworm | 3,725 | 17,657 | 578 | 8,882 | 30,842 | 1,227 | +2,414 |
| Conifer Defoliation | 6,234 | -- | 97 | 17,870 | 24,201 | 5,467 | +343 |
| Hemlock sawfly | 447 | 5,961 | -- | 230 | 6,638 | 8,251 | -20 |
| Spruce needle aphid | 39 | 439 | -- | 43 | 521 | 474 | +10 |
| Large aspen tortrix | 3,913 | -- | 582 | 588 | 5,083 | 6,447 | -21 |
| Birch defoliation | 270,195 | 201 | 857 | 662 | 271,915 | 3,178 | +8,456 |
| Cottonwood defoliation | 1,672 | 134 | 105 | 1,125 | 3,036 | 6,518 | -53 |
| Willow defoliation | 2,202 | -- | 220 | 1,079 | 3,501 | 50,112 | -93 |
| Larch sawfly | 107,658 | -- | 130,317 | 29,886 | 267,861 | 606,927 | -56 |
| Spruce needle rust | 10 | -- | 34 | 10,732 | 10,776 | 3,424 | +215 |
| Yellow-cedar decline[2] | 6,971 | 454,656 | ---- | 15,913 | 477,540 | 474,864 | +.56 |
| Porcupine damage | 161 | 1,002 | -- | -- | 1,163 | 633 | +84 |
| Blowdown/windthrow | 27 | 721 | 665 | 812 | 2,225 | 618 | +260 |
| Water damage | 1,287 | 479 | 216 | 67 | 2,049 | 5,635 | -64 |
| Winter damage | 1,755 | 898 | 295 | -- | 2,948 | -- | +100 |
| Landslide damage | 111 | 123 | 156 | 59 | 449 | 498 | -10 |
| **Total acres by ownership** | **693,348** | **497,052** | **288,829** | **242,622** | **1,721,851** | **2,549,439** | **-32** |

[1] Table entries do not include many of the most destructive diseases (e.g., wood decays and dwarf mistletoe) because these losses are not detectable in aerial surveys.

[2] Value of yellow-cedar decline is not restricted to the acreage with a high concentration of dying trees for this year; it represents stands that generally have long-dead trees, recently-dead trees, dying trees, and some healthy trees. See discussion of yellow-cedar decline for a detailed listing of affected acreage by island and Ranger District.

**Table 2.** **Insect damage (in thousands of acres) by year since 1992 and the cumulative acreage figure for the last 7 years.**[1]

| ***Damage Agent*** | ***1992 Total*** | ***1993 Total*** | ***1994 Total*** | ***1995 Total*** | ***1996 Total*** | ***1997 Total*** | ***Cumulative Totals*** |
|---|---|---|---|---|---|---|---|
| Spruce beetle | 604.8 | 724.8 | 639.9 | 892.8 | 1,130.8 | 563.7 | 2,298.2 |
| Engravers/spruce beetle | 2.2 | 4.3 | 21.7 | 5.6 | 13.9 | 8.9 | 49.4 |
| Spruce budworm | 180.5 | 33.6 | 233.0 | 279.2 | 235.9 | 38.4 | 633.7 |
| Black-headed budworm | 96.3 | 259.1 | 196.9 | 13.0 | 1.2 | 29.7 | 423.0 |
| Hemlock sawfly | 6.5 | 19.0 | 6.1 | 1.1 | 8.3 | 6.4 | 21.1 |
| Spruce needle aphid | 25.2 | .6 | 2.0 | .1 | .5 | 23.2 | 29.5 |
| Large aspen tortrix | 19.5 | 63.4 | 9.8 | 32.3 | 6.4 | 5.1 | 181.6 |
| Birch defoliation | 1.7 | .2 | -- | .9 | 3.2 | 271.9 | 276.9 |
| Cottonwood defoliation | 6.3 | 2.9 | 3.2 | 3.5 | 6.5 | 2.7 | 19.7 |
| Willow defoliation | 153.7 | 40.6 | 9.0 | 5.6 | 50.1 | 3.5 | 177.0 |
| Larch sawfly | -- | 12.2 | .3 | 116.9 | 606.9 | 267.9 | 929.0 |
| **Total acres** | 1,096.7 | 1,160.7 | 1,121.9 | 1,351.0 | 2,063.7 | 1,221.4 | 5,039.1 |

Maps representing current and cumulative damage for some of the major insects can be found in Appendix E.

[1] The same stand can have active infestation for several years. The cumulative total is a union of all areas for 1992 through 1997.

# THE ROLE OF DISTURBANCE IN ECOSYSTEM MANAGEMENT

One premise of ecosystem management is that native species are adapted to the natural disturbances common to an area. Disturbance events are responsible for the way the current landscape appears and functions today, and will determine the structure and composition of future landscapes. In Alaska, glaciation, earthquakes, wind storms, fire, flooding, avalanches and landslides greatly affect ecological processes. These types of disturbances remove existing vegetation and often expose mineral soil for new plants to become established.

Disturbance events such as insect and disease outbreaks also result in shifting landscape patterns. These disturbances usually affect only a few species directly, while indirectly affecting the remaining species through reduced competition or changes in forest structure. Changes resulting from these types of disturbances often occur over varying time periods, but can be very dramatic and cover large areas. Spruce beetles have radically affected the landscape in a single decade, heartrots and other internal diseases operate for decades, whereas yellow-cedar decline has been occurring for nearly 100 years.

To a certain extent, we can predict what type of disturbance is likely to occur in a particular area: fires are frequent in interior Alaska and wind storm events are important in southeast. Spruce beetles are an important disturbance agent in south-central Alaska. Disturbance agents and patterns are generally tied to geography, climate, and vegetation. When we understand the complexities of these relationships, we are able to predict and respond to natural disturbances and mimic the desirable effects with management activities. Ecological classification is one tool available to help us understand disturbance patterns.

Many useful systems of classification have been developed for Alaska's ecosystems and vegetation. Refining and standardizing these classifications across all ownership's will promote effective ecosystem management. ECOMAP (1993) is one system of ecological classification that the Forest Service has adopted and continues to develop. Within this hierarchical system, ecosystems are delineated at multiple scales using different sets of environmental factors. The levels established at this time include Domains, Divisions, Provinces and Sections. Domains represent subcontinental climatic zones. Divisions and Provinces represent climatic subzones as reflected by dominant lifeforms (meadows vs. forests) and broad vegetation types, respectively. Sections are distinguished mainly by geomorphic and topographic features. The Section level is the first level of the hierarchy where analysis of insect and disease activity becomes applicable.

In this edition of the Forest Insect and Disease Conditions in Alaska, we introduce and make reference to the Ecosystem Sections of Alaska (Map 1). This map was developed in the Alaska Region (Nowacki and Brock 1995). Section descriptions are included in Appendix C with a list of damaging agents reported during the 1997 aerial survey. Only Sections that were covered in this year's survey are described. As the ecological hierarchy classification and mapping are developed to finer scales, they become more valuable as management tools to predict the impacts of various disturbances on forest resources.

**Map 1.** Ecosystem Sections of Alaska.

**Polar Domain, Subarctic Division,**
**131 - Yukon Intermontaine Taiga Province**
- **131A - Yukon Bottomlands Section**
- **131B - Kuskokwim Colluvial Plain Section**
- **M131A - Upper Kobuk-Koyukuk Section**
- **M131B - Nulato Hills Section**
- **M131C - Kuskokwim Mountains Section**
- **M131D - Nushagak-Lime Hills Section**

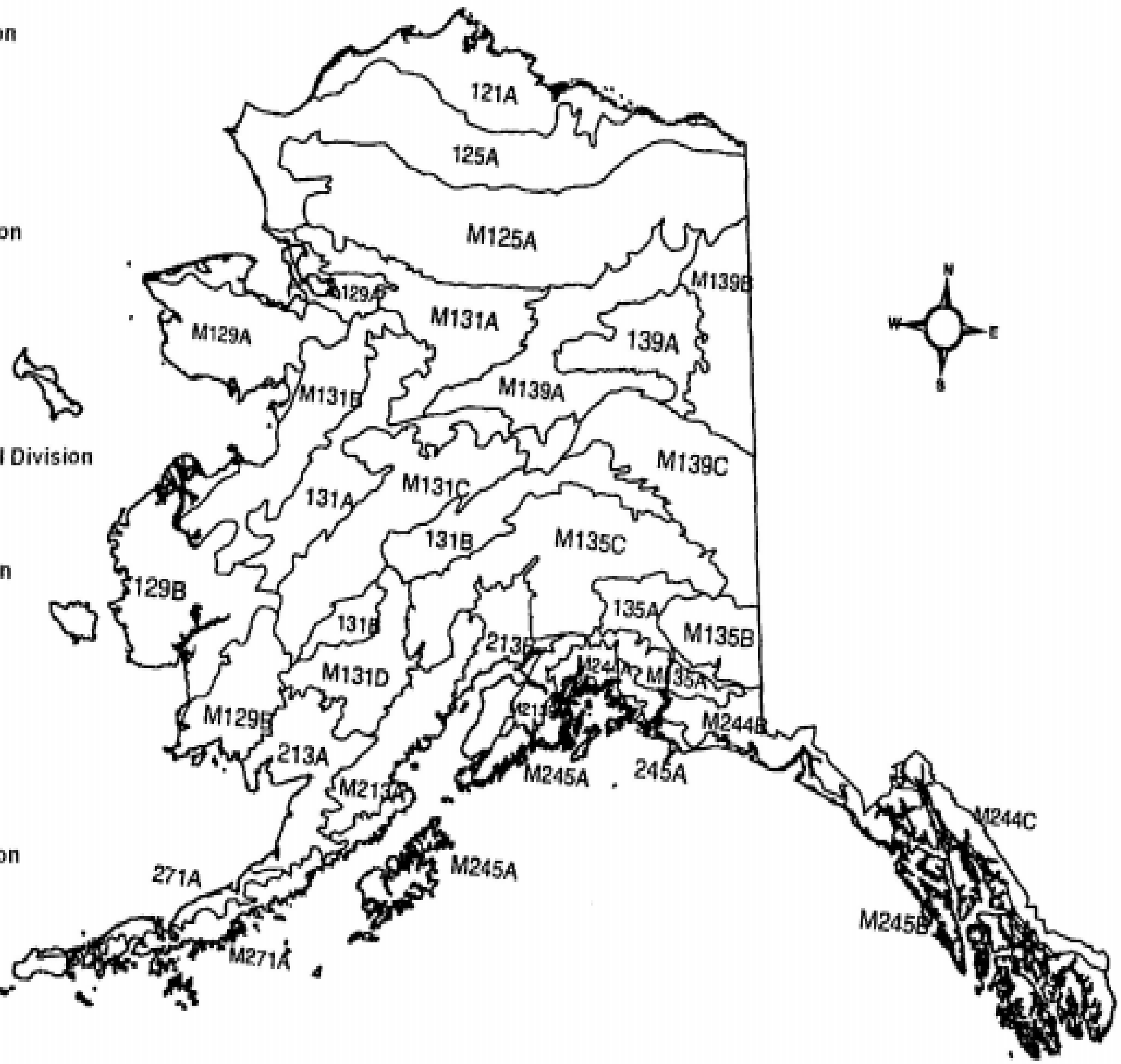
**135 - Alaska Range Taiga Province**
- **135A - Copper River Basin Section**
- **M135A - Northern Chugach Range Section**
- **M135B - Wrangell Mountain Section**
- **M135C - Alaska Range Section**

**139 - Upper Yukon Taiga Province**
- **M139A - Ray Mountain Section**
- **M139B - Ogilvie Mountain Section**
- **M139C - Dawson Range Section**

**Humid Temperate Domain, Warm Continental Division**
**213 - Alaska Mixed Forest Province**
- **213A - Bristol Bay Lowlands Section**
- **213B - Cook Inlet Lowlands Section**
- **M213A - Northern Aleutian Range Section**
- **M213B - Kenai Mountains Section**

**Humid Temperate Domain, Marine Division**
**244 - Pacific Coastal Icefields Province**
- **M244A - Chugach Range Section**
- **M244B - St. Elias Range Section**
- **M244C - Boundary Range Section**

**245 - Pacific Gulf Coast Forest Province**
- **245A - Gulf of Alaska Forelands Section**
- **M245A - Gulf of Alaska Fjordlands Section**
- **M245B - Alexander Archipelago Section**



# STATUS OF INSECTS

## INSECTS AS AGENTS OF DISTURBANCE

Alaska's insect populations are one of the most significant components of its forest ecosystems. Arctic/boreal insects are characterized by having few species and large population numbers. These insects are opportunistic in their behavior. They respond quickly to changes in climate and the availability of food and breeding material. The spruce beetle, for example, responds quickly to large scale blowdown, fire scorched trees, or spruce injured by flooding. Large numbers of beetles can be produced in such breeding material, leading to potential outbreaks.

Spruce beetles are one of the most important disturbance agents in mature spruce stands in Alaska. A variety of changes occur to forest resources when many trees are killed. Ultimately, these changes are biological or ecological in nature. There are also socio-economic consequences that can be viewed as either positive or negative, depending on the forest resource in question. Some of the impacts associated with spruce beetle infestations include, but are not limited to:

1 **Loss of merchantable value of killed trees**: The value of spruce as saw timber is reduced within three years of attack in south-central Alaska as weather checking and increased sap-rots occur. The value of a beetle killed trees as house logs, chips, or firewood continues for many years if the beetle-killed tree remains standing.

2 **Long term stand conversion**: The best regeneration of spruce and birch occurs on a seed bed of bare mineral soil with some organic material. Site disturbances such as fire, windthrow, flooding, or ground scarification provide excellent sites for germination and establishment of tree species if there is an adequate seed source. However, on some sites in south-central Alaska, grass and other competing vegetation quickly invade the sites where spruce beetles have "opened up" the canopy. This delays re-establishment of tree species.

3 **Impacts to wildlife habitat**: Wildlife populations, which depend on live, mature spruce stands for habitat requirements may decline. We expect to see decreases in red squirrel, spruce grouse, Townsend Warblers, and possibly Marbled Murrelet populations. On the other hand, wildlife species (moose, small mammals and their predators, etc.) that benefit from early successional vegetation such as willow and aspen may increase as stand composition changes.

4 **Impacts to scenic quality**: Scenic beauty is an important forest resource. It has been demonstrated that there is a significant decline in public perception of scenic quality where spruce beetle impacted stands adjoin corridors such as National Scenic Byways. Maintaining or enhancing scenic quality necessitates minimizing impacts from spruce beetle infestations. Surveys have also shown that the public is evenly divided as to whether spruce beetle outbreaks damage scenic quality in back-country areas.

5 **Fire hazard**: There is concern that fire hazard in spruce beetle impacted stands will increase over time. After a spruce beetle outbreak, grass or other fine vegetation ground cover increases; fire spreads rapidly through these vegetation types. As the dead trees break or blow down (5-10 years after an outbreak), large woody debris begins to accumulate on the forest floor. This wood is the heaviest component of the fuels complex. Heavy fuels do not readily ignite, but once ignited they burn at higher temperatures for a longer period. The combination of fine, flashy fuels and abundant large woody debris results in a dangerous fuels situation. Observations from recent fires on the Kenai Peninsula have shown an increase in crown fires.

This fire behavior is caused by fire traveling up the dead spruce trees and spotting into the crowns of adjacent beetle killed trees. In some areas, there may be an increase in the lower level winds because of a "reduction" of the wind-break characteristic of a green forest, thus augmenting fire crowning behavior.

6 **Impact to fisheries**: If salmon spawning streams are bordered by large diameter spruce and these trees are subsequently killed by spruce beetles, there is a concern as to the future availability of large woody debris in the streams. Large woody debris in spawning streams is a necessary component for spawning habitat integrity.

7 **Impact to watersheds**: Intense bark beetle outbreaks can kill large amounts of forest vegetation. The "removal" of significant portions of the forest will impact to some degree the dynamics of stream flow, timing of peak flow, etc. There have been no hydrologic studies in Alaska quantifying or qualifying impacts associated with spruce beetle outbreaks. Impact studies, however, have been done elsewhere. In Idaho watersheds impacted by the Mountain Pine Beetle, there was a 15% increase in annual water yield, a 2-3 week advance in snow-melt, and a 10-15% increase in low flows.

There are a variety of techniques that can be used to prevent, mitigate, or reduce impacts associated with spruce beetle infestations. However, before pest management options can be developed, the resource objective(s) for a particular stand, watershed, landscape, etc. must be determined. The forest manager must evaluate the resource values and economics of management actions for each stand in light of management objectives. The beetle population level must also be considered because population levels will determine the priority of management actions and the type of strategy to be invoked. The key to forest ecosystem management is to manage vegetation patterns in order to maintain species diversity, both plant and animal, while providing for a multitude of resources such as recreation, fisheries, wildlife, and the production of wood fiber. Properly applied silvicultural practices as well as fire management in south-central and interior Alaska, can maintain the forest diversity needed to provide the range of products and amenities available in the natural forest for now and in the future.

# BARK BEETLES

## SPRUCE BEETLE

***Dendroctonus rufipennis*** Kirby

Acres of spruce beetle activity declined by more than half from the 1996 level of 1.1 million acres to 544,315 acres in 1997. It should be kept in mind, however, that although current levels of infestation have declined, the spruce beetle has impacted 2-3 million acres of forested land over the past ten years. The challenges stemming from past beetle activity, such as fuel-loading, habitat changes, hydrological changes, liability issues, etc., remain for forest managers and private landowners alike.

In many areas heavily impacted by the spruce beetle over the years, such as Lake Clark Pass, Russian Lakes, Trail Lakes, Kachemak Bay, and much of the lower Kenai Peninsula as well as Tebay Lakes, Klutina Lake, and the Tiekel River in the Copper River drainage, 80-100% of the susceptible spruce component has been killed (Refer to maps in Appendix E). In areas less heavily impacted, such as the west side of Cook Inlet, beetle activity continues. In other areas that beetles had impacted in the past, for example Summit Lake on the Kenai Peninsula, there is renewed activity in the residual stands. Thus, by simply looking at single year acreage figures, it is tempting to draw the conclusion that the spruce

**Figure 1.** Light intensity, scattered spruce beetle mortality.

**Figure 2.** Medium or moderate intensity spruce beetle mortality.

**Figure 3.** High intensity spruce beetle mortality.

**Figure 4.** Old spruce beetle mortality. This stand is no longer mapped or reported as acres affected.

These pictures show a progression of mortality caused by the spruce bark beetle. Oftentimes, this progression takes several years. For this reason, many spruce beetle infested stands are mapped for several years. Many stands, especially on the Kenai Peninsula, are similar to Figure 4 and were not mapped in 1997.

beetle epidemic is over in south-central Alaska. However, it would be premature to do so. A significant potential for increased spruce beetle activity remains in many areas, most notably the Hillside area of Anchorage, the west side of Cook Inlet, Turnagain Arm of Cook Inlet, Anchor Point on the Kenai Peninsula, the upper Copper River Valley and the Chitina River Valley.

## South-central Alaska

### Kenai Peninsula:

On the **Chugach National Forest** portion of the northern Kenai Peninsula, 10,129 acres of spruce forest were impacted by spruce beetle, representing a 28% decline over 1996 levels. Although this is the second year of declining beetle populations, no trend should be inferred from this information. Assuming a continuation of conditions favorable to beetle development, this pattern of rising and falling populations can be expected to continue for the next several years.

In the **Trail Lakes/Moose Pass** area (M213B), 5,059 acres of spruce beetle activity was observed. Although this acreage figure is included in the Chugach National Forest total, this area warrants special mention because of the intensity of beetle activity over the past several years. Much of the current beetle activity has been characterized as "light" (less that 10% of the susceptible trees affected). This area is a good example of spruce beetles "re-entering" a stand, previously heavily impacted, to infest the residual trees. It is assumed that this "light" activity in the residual trees will continue in the near future.

Declining populations were noted throughout the **Turnagain Arm** area (M213B). The only area of unchanging activity was the Portage River Valley where approximately 90 acres of beetle activity was observed. From Turnagain Pass to the Hope "Y", along the Seward Highway, populations declined by 61% to 934 acres. In the Twentymile River Valley, where a fourfold increase in beetle activity was detected in 1996, populations fell by more than 50% to 300 acres in 1997. In the Sixmile Creek drainage, acres of aerially detected beetle activity declined by 69% to 300 acres in 1997. Finally, in and around Hope, Palmer Creek and Bear Creek, populations fell by 75% to 856 acres. Once again, this decline does not necessarily indicate the end of the beetle infestation in the Turnagain Arm and Hope areas. Spruce beetles most often exhibit a two-year life cycle in south-central Alaska; thus, assuming favorable developmental conditions for the beetle, an increase in the acreage of impacted stands may occur in 1998.

The spruce beetle infestation between **Lawing and Seward** (M245A), which increased dramatically between 1995 and 1996, has leveled off. Acres of beetle activity remain at approximately 1,100. As in 1996, the heaviest concentration of activity is found in the vicinity of Black Mountain. Beetle activity in the Snow River Valley and down to Seward along the Seward Highway was observed to be in the light/scattered category.

Spruce beetle activity in the northwestern portion of the Kenai Peninsula, from **Pt. Possession to Tustumena Lake** (213B) rose by 24% to 47,252 acres. 37,000 acres of this activity is categorized as light (<10% of the trees affected) to medium (10-30% affected). These stands had been heavily impacted in the 1970's and 1980's and thus, the activity noted in 1997 is the result of renewed activity in the residual stands. A large number of these beetle-susceptible residual stands remain in the northern peninsula and if conditions favorable to beetle development prevail, increasing beetle activity can be expected to continue for the next several years.

Beetle activity between **Homer and Ninilchik** (213B), which accounts for more than half of the total infested acreage in the southern Kenai Peninsula, continues to intensify. Of the 92,000 acres reported in 1997, nearly 50,000 acres is considered to be increasing in intensity.

Throughout the remaining southern Kenai Peninsula, spruce beetle activity significantly declined. From Tustumena Lake to East End Road near Homer, including the Fox River Valley at the east end of Kachemak Bay, beetle activity declined by 55% to 75,328 acres. Much of this reduction is a result of 80-90% mortality of the spruce stands in the Caribou Hills, Fox River Valley, Sheep Creek, and Bradley Lake areas. Most of these trees are entering the grey standing dead phase.

There was little new spruce beetle activity detected throughout the southeast shore of **Kachemak Bay** (M245A). Activity between Seldovia and Humpy Creek declined by 27% over 1996 levels; 27,544 acres of spruce beetle impacted stands were observed in 1997. As in many other areas of the lower Kenai Peninsula where the spruce beetle has been active for a long period of time, much of the suitable host material has been killed. It is expected that while areas of current activity may intensify, expansion of the spruce beetle to "new" areas is unlikely. Southwest of Seldovia, the small population of beetles in Seldovia Bay has decreased for the second year in a row, from 623 acres in 1996 to 311 acres in 1997.

In 1997, only two small areas of new beetle activity were observed on the southern tip of Kachemak Bay. In English Bay, 723 acres of light to moderate activity were noted and at Koyuktolik Bay, 545 acres. Ground surveys of an area in Koyuktolik Bay, logged in the early 1990's, indicated that spruce beetles were present in logging slash and windthrow in the past and had impacted standing timber, however this activity has long since declined. It is presumed that this scenario will repeat itself in these two, new areas with the maritime climate being the major limiting factor.

On the whole, active spruce beetle infestations on the Kenai Peninsula have decreased by 40% from 1996 levels of 458,203 acres to 274,821 acres in 1997.

## COOK INLET:

All previously recorded areas of spruce beetle activity on the **west side of Cook Inlet** (213B) experienced declines in 1997. A total of 33,943 acres of beetle activity were observed, down from 85,232 acres mapped in 1996 (-60%). The Tuxedni Bay infestation fell to 11,131 acres in 1997 (-61%). In Redoubt Bay, activity decreased to 13,779 acres (-34%). The most dramatic decline occurred in the West Forelands; of the 35,885 acres reported in 1996, only 9,033 acres remain active (-75%). Although the acreage figures for this area are dropping, 17,284 of the nearly 34,000 acres was categorized as increasing in intensity; the potential for beetle expansion most certainly exists.

The majority of the spruce beetle activity in the **Iliamna Lake** (M213A) area is located between Iliamna Lake and the Meadow, Moose, Copper and Kakhonak Lakes at the east end of Iliamna Lake. All of these infested areas declined in 1997. A 32% decrease in acreage over 1996 totals was observed (85,232 acres in 1996 versus 58,069 acres in 1997). This decline reverses a trend of increasing populations which was first observed in 1991.

Only one small area of new activity (311 acres) was reported in 1997. This area is located on the **Iniskin Peninsula** near Portage Creek. The source of this population was probably the large (58,000 acres) infestation near Iliamna Lake. Assuming conditions remain favorable for beetle development, the potential for this small population to expand is high.

## Anchorage & Mat-Su Valley:

In the **Anchorage Bowl** (213A), the largest urban-wildland interface in Alaska, acres of infested spruce have declined for the first time in three years. In 1997, 11,425 acres, a 25% decrease over1996 levels, was observed. Spruce beetles have already killed much of the susceptible host material in areas such as Fire Island, Kincaid Park, parts of Potter Creek, and the upper Hillside. Spruce beetle activity is expected to continue at approximately the same level in 1998.

Other areas of notable activity in the Anchorage area are: Ship Creek, 7,395 acres; Eagle River, 5,060 acres (-12% from 1996 levels); Eklutna River, 4,437 acres (-50%) and the Knik River valleys, 6,383 acres (-44%). Fort Richardson, which accounted for 5,535 acres of beetle activity in 1996, was not surveyed in 1997. Much of the beetle activity in these areas has been ongoing for several years and has been categorized as "heavy activity" (>30% of the trees affected). It is expected that spruce beetle activity should continue to decline in these areas due to the depletion of host material.

Beetle activity in the upper **Susitna River** drainage has been active at a low level for a number of years. The trend of low-level but persistent activity is expected to continue in the Susitna River Valley where mixed stands of birch and spruce limit the spread of the beetle.

## Glenn Highway:[1]

North along the Glenn Highway from **Palmer to Eureka**, aerially detected beetle activity declined by 58% to 28,213 acres in 1997. Once again, this acreage decline is a result of white spruce mortality caused by several years of heavy spruce beetle activity. Over the next few years, the acres of active infestation should continue to fall.

Within the area bounded by Tazlina Lake and the Glenn Highway, from **Eureka to Glennallen** (135A), acres infested by spruce beetle rose 27% over 1996 levels to 11,444 acres in 1997. This area is at treeline and although the number of acres infested is large, the number of trees per acre is relatively small. This equates to fewer trees killed than had the same number of acres been infested on the Kenai Peninsula or in the lower Copper River Valley. However, the intensity of this infestation is extremely high and nearly 100% of the susceptible spruce has been killed.

In the **Tazlina/Kiana Lakes** area, populations remained static with 7,551 acres infested in 1997. Moving east to the Klutina/St. Anne Lakes area, populations rose slightly (+2388 acres) in 1997 to 38,430 acres. Much of the susceptible spruce has already been killed in this area and it is expected that populations should begin to fall in the next few years.

## Copper River Basin: (135A)

In the mid-Copper River Valley, from **Copper Center to Chitina**, acres of beetle activity continue to decline; activity was mapped on 28,921 acres. This area has been heavily impacted over the past several years and much of the mature spruce has been killed. Salvage logging by native corporations is underway in some of these stands. Although characterized as light, beetle activity around Chitina continues as the spruce beetle works its way through residual stands heavily attacked in prior years.

East along the **Chitina River to McCarthy**, beetle activity has increased by 11% to 7,856 acres in 1997. Most of this increase is due to the expansion of the population around Kennicott Glacier. Much of the spruce in this area is currently under attack. There is a considerable volume of mature spruce remaining in this valley, and as a result of ground observations made in the summer of 1997, it is expected that populations will increase over the next few years.

**South of McCarthy**, light, spotty activity continues along the upper Chitina River and the Tana River. One small area (300 acres) of moderate activity persists in the Towhead Mountain area of the Tana River (M135A).

---

ilenn Highway follows the boundaries of ecological Sections, including 213B, :, M213B, and M135A, and into 135A in llen.

## Interior Alaska

Heavy smoke from extensive wildfire activity in the interior, as well as poor flight weather during the survey, precluded flying many areas that customarily account for much of the beetle activity, namely, the Kuskokwim River and much of the lower Yukon River (M131). Thus, only 3,522 acres of spruce beetle activity were noted in 1997 versus 18,500 acres in 1996. Therefore, it is difficult to make any comparisons with acreage figures from 1996.

## Southeast Alaska

Spruce beetle activity in southeast Alaska's Sitka spruce forests declined by 45% to 19,000 acres in 1997. There were 4,820 acres on the Chatham, 804 acres on the Stikine, and 63 acres on the Ketchikan Areas of the Tongass National Forest.

The **Haines** area (M244C) has experienced the most substantial spruce beetle pressure in southeast Alaska. There were 12,300 acres recorded along drainages of the Chilkat, Klehini and Kelsall Rivers in 1997 compared to 13,800 acres in 1996. The majority of this area is located on state lands. State personnel have increased salvage efforts in the Haines area.

Spruce beetle activity on National Forest and private land along the **Taku River** is in its fourth year. There were 4,545 acres recorded in 1997, a slight decrease from 4,850 acres in 1996. This beetle activity follows a large windthrow event that occurred in the fall of 1990. New windthrow events have occurred since 1990, providing new brood trees, but only a fraction of the number of trees wind-thrown in 1990.

The **Glacier Bay** National Park (M245B) infestation, along the west side of the ridge between Gustavus and Excursion Inlet, decreased to approximately 900 acres or about one-quarter of the 1996 acres (4,250 acres). The infestation, which has been ongoing for more than ten years, seems to have run its course. The historic outbreak in lower Glacier Bay has impacted more than 30,000 acres, resulting in mortality as high as 75%. Wood rotting fungi, such as *Fomitopsis pinicola*, have rapidly infested beetle-killed trees, resulting in bole breakage and numerous forest canopy gaps. Secondary plant succession follows in these gaps among the many jackstrawed tree boles and tops. Observations to date on Lester Island indicate a predominance of hemlock regeneration in these disturbed/altered stands.

Spruce beetle activity in the **Stikine River delta** area has decreased to approximately 785 acres or about one-third the 1996 acres (2,050 acres). These infested acres are on Dry Island, Farm Island, Rynda Island, and Kadin Island.

Scattered, small-scale spruce beetle activity occurred on Baranof Island, and the Yakutat Forelands (245A).

*Reprinted by permission of Chad Carpenter.*

## ENGRAVERS

***Ips perturbatus*** Eichh.
***I. concinnus*** Mann.

Two species of *Ips* beetles are currently causing spruce mortality. *I. perturbatus* are found primarily in interior and south-central Alaska and often cause mortality in white and Lutz spruce. *I. concinnus* are the most common species in southeast Alaska's Sitka spruce. *I. concinnus* has also been collected from south-central Alaska's white and Lutz spruce. A primary visual indication of *Ips* infestation in spruce is that all needles turn red the first season of attack, usually beginning at the top of the tree progressing down as compared to spruce bark beetle where the needles turn red a year after attack, usually starting from the bottom.

**South-central Alaska**

Spruce stands bordering the Seward Highway near the entrance to Granite Creek Campground (M213B) have come under heavy spruce beetle attack. Three years ago, Chugach National Forest personnel developed prescriptions to mitigate the losses attributed to the bark beetle by removing infested trees and thinning the stand in order to increase residual stand vigor. From a site visit in 1996, it became apparent that some of the residual spruce had been attacked by *Ips* spp. Tentative identifications (Mal Furniss, pers. comm. 1997) showed that *I. perturbatus* was the main species involved in tree mortality; a few *I. concinnus* were also identified. Approximately 18% of the residual spruce was killed in 1996. Based on field observations elsewhere on the Kenai Peninsula, it was anticipated that *Ips*-caused tree mortality would continue but at a declining rate. A ground check undertaken in the fall of 1997, however, indicated that *Ips* caused-tree mortality increased; 32% of the live residual spruce was attacked and killed this year. Based on preliminary 1997 pheromone trapping results (see Integrated Pest Management Activities section **(4)**), a suppression project using the two component *Ips* lure as a trap-out strategy will be undertaken next spring.

In **southeast Alaska** no *Ips* infested trees were Recorded in 1997.

# DEFOLIATORS

## SPRUCE BUDWORM

***Choristoneura fumiferana*** (Clemens)
***Choristoneura orae*** (Freeman)

White spruce defoliation in interior Alaska, attributed to the eastern spruce budworm, declined for the second year in a row. This -84% decline, from 235,936 acres in 1996 to 38,414 acres in 1997, is a clear indication that the budworm infestation in this area has run its course. Along the Yukon River, from Tanana to Ruby (131A), 23,886 acres of defoliation were observed representing a decline of 83%. A 95% decline was observed up the Yukon River from Tanana to Rampart (M139A) where acreage's fell from 1996 levels of 15,180 acres to a 1997 total of 778 acres. In two areas, namely along the Yukon River from Rampart to Stevens Village and the Fairbanks/ Goldstream Valley area (M139L), visible signs of spruce budworm defoliation have disappeared entirely.

The interior Alaskan spruce budworm infestation, which originally was centered around the confluence of the Tanana and Yukon Rivers for the past several years, had migrated down the Yukon River toward Ruby. One of the largest areas of activity was found along the Yukon River between Brant Island and Youngs Island (M139A) where 18,330 acres of defoliation were mapped. The infestation had doubled in size between 1995 and 1996 from 39,000 acres to 75,000. However, this area of activity declined by 76% in 1997 indicating a collapsing population.

Concern has been expressed that endemic engraver (*Ips* beetle) populations might take advantage of these trees stressed by six consecutive years of budworm defoliation. This appears not to be the case as acres of trees affected by Ips beetles have declined from 2,614 acres in 1996 to 702 acres in 1997. It is possible however, that these figures may again rise in the future.

## WESTERN BLACK-HEADED BUDWORM

***Acleris gloverana*** Walsingham

The black-headed budworm is native to the forests of coastal and southwestern Alaska. It occurs primarily in southeast Alaska and has been documented there since the early 1900's. Budworm populations in Alaska have been cyclic, arising quickly, impacting vast areas, and then subsiding within a few years (Refer to Appendix E for maps of black-headed budworm areas).

In **southeast Alaska**, a peak year for budworm defoliation occurred in 1993, totaling 258,000 acres. The last budworm outbreak of this magnitude occurred from the late 1940's to mid-1950's. Cool wet weather in early summer months retard growth and development of the budworm and may have resulted in population declines. Black-headed budworm populations crashed in 1995 with only 550 acres in 1996.

In 1997, 1,200 acres of defoliation were reported. There were 964 acres, 247 acres, and none recorded for Chatham, Stikine, and Ketchikan areas of the Tongass National Forest, respectively. Most of the defoliation in southeast Alaska (964 acres) was on Admiralty Island, south of Hood Bay. The other infested acres were at the mouth of the Stikine River.

In **Prince William Sound** (M244A), black-headed budworm outbreaks rarely occur due to the normally unfavorable climatic conditions. However, since 1900, there have been two major budworm outbreaks. The first occurred from the late 1940's to mid-1950's. The second peaked in 1988 with over 150,000 acres affected.

Warm, dry weather in Prince William Sound during 1996 and 1997 provided ideal conditions for increased budworm populations. Approximately 30,000 acres of black-headed budworm defoliation were found from Bremner River to Valdez Arm. Approximately 600 acres of light defoliation was reported near the confluence of the Bremner and Copper Rivers. The heaviest defoliation occurred in and around the city of Cordova. The balance of the defoliation occurred primarily on Sitka spruce in sheltered coves on Knight Island, Esther Island, Wells Bay, the west side of Eaglek Bay, with a few spots along Valdez Arm. Since the Sound had another warm, dry summer in 1997, budworm populations are expected to increase next year.

In Alaska, western hemlock is the black-headed budworm's preferred host, but Sitka spruce and Mountain hemlock are also fed upon. The overall ecological role of the black-headed budworm in Alaska's forests is not known. However, many aspects of the budworm's role are known and several inferences can be made from available information.

Consecutive years of budworm defoliation may cause growth loss, top-kill and in severe cases, death of the host. Heavily defoliated trees may also be more susceptible to other mortality agents. As a major forest defoliator, black-headed budworm can ultimately influence both stand composition and structure. To the extent that defoliation reduces overstory crown density (through tree death or crown thinning), less shade tolerant understory plants may become established. Such habitats favor small mammals, deer, predaceous and parasitic insects, and some insectivorous bird species. By consuming needles and depositing nutrient-rich fecal material on the forest floor, budworm larvae also accelerate the nutrient cycling processes. Recent investigations by the Pacific Northwest Research Station indicate that terrestrial insect larvae, such as budworm, may be a larger portion of the diet for some species of salmon fry than were previously understood, especially during outbreak periods.

## SPRUCE NEEDLE APHID

***Elatobium abietinum*** Walker

Following the mild winter of 1991-92, spruce needle aphid populations in southeast Alaska expanded rapidly, causing over 25,000 acres of Sitka spruce defoliation. Needle aphid populations crashed in 1993, due to extended periods of subfreezing temperatures during January and February. After a slight resurgence of activity in 1994, the 1995 population levels were low. In 1996 and 1997 the acres of trees affected were 600 and 440, respectively. The locations where defoliation occurred in 1996 were not affected in 1997.

In the Gulf of Alaska, 81 acres of spruce needle aphid was reported near the town of Kodiak (M245A). Affected trees were located along Woody I Channel and at the head of Mill Bay.

Spruce needle aphids feed on older needles of Sitka spruce, often causing significant amounts of needle drop (defoliation). Aphid defoliation causes reduced tree growth and often predisposes the host to other mortality agents, such as the spruce beetle. Likewise, severe cases of defoliation alone may result in tree mortality. Stressed spruce, such as those in urban settings and those along marine shorelines, are most seriously impacted. Spruce aphids feed primarily in the lower, innermost portions of tree crowns, but may impact entire crowns during outbreaks. Spruce aphid outbreaks in southeast Alaska are usually preceded by mild winters.

## HEMLOCK SAWFLY

***Neodiprion tsugae*** Middleton

Hemlock sawflies are common defoliators of western hemlock and are found throughout southeast Alaska. Historically, sawfly outbreaks in southeast Alaska have been larger and of longer duration in areas south of Frederick Sound (M245B). There was an increase from 1,100 acres of defoliated trees in 1995 to 8,250 acres of defoliated trees in 1996. There were 6,633 acres of defoliation in 1997. Most of the recent defoliation was classified as light. There were 911, 2,338, and 3,384 acres in Chatham, Stikine, and Ketchikan areas of the Tongass National Forest, respectively. Most of the defoliation in 1997 occurred in Pybus Bay, Admiralty Island, Chatham Area; on Kuiu Island in the Stikine Area; and on the southwest end of Prince of Wales Island, Ketchikan Area.

The highest hemlock sawfly larvae counts were from the defoliator plots on Kuiu Island, south of Frederick Sound.

Unlike the larvae of the black-headed budworm, hemlock sawfly larvae feed in groups, primarily on older hemlock foliage. These two defoliators, feeding in combination, have the potential to completely defoliate western hemlock. Heavy defoliation of hemlock by sawflies is known to cause reduced radial growth and top-kill. As forest defoliators, hemlock sawflies may ultimately influence both stand composition and structure in some areas. The sawflies themselves are a food source for numerous birds, other insects, and small mammals.

## LARCH SAWFLY

***Pristiphora erichsonii*** (Hartig)

A significant reduction in sawfly activity in interior Alaska was observed in 1997. Conservatively, 267,000 acres of light-to-moderate sawfly defoliation was observed in 1997 versus more than 600,000 acres of heavy defoliation noted in 1996. This was the fifth consecutive year of defoliation in many areas of the interior.

A 1997 ground check of defoliated larch near Fairbanks found limited reflushing of new growth later in the growing season. Larch mortality, as a result of more than five years of heavy defoliation, was also noted in the Standard Creek area (139C) near Fairbanks on the poorer growing sites. Concern still exists that a build up of the larch beetle (*Dendroctonus simplex*) in heavily defoliated areas, which could result in heavy mortality of larch over expansive areas, could occur.

## RUSTY TUSSOCK MOTH

***Orygia antigua*** (L.)

Extensive defoliation of spruce, hardwoods and ground vegetation such as blueberry occurred over thousands of acres in the Mat-Su Valley (213B), especially in the Talkeetna area. The defoliator was identified as the Rusty Tussock Moth by Alaska Cooperative Extension. This insect has previously caused wide-scale defoliation of willow in the Bethel and Palmer areas.

The Rusty Tussock Moth is the most northern and most widely distributed member of the genus. It is found across North America south to the middle Atlantic States, in northern California, the Pacific Northwest, Canada, and Alaska. There is probably one generation per year in Alaska with the egg as the overwintering stage.

## BIRCH DEFOLIATION

***Fenusa pusilla*** (Lepeletier)
***Euceraphis betulae*** (Koch.)

The spring and summer of 1997 were drier than normal throughout much of south-central Alaska. As a consequence, conditions were favorable for insect population build-up as well as water stressed trees. Many birch trees showed symptoms of water stress and defoliation by late July. Large populations of the birch leafminer (*Fenusa pusilla*), a small sawfly of the Tenthredinidae family, were prevalent throughout the Anchorage Bowl and caused widespread defoliation of birch. Birch aphids (*Euceraphis betulae*) were reported throughout the Mat-Su Valley. The combination of drought and insects caused most birch leaves to prematurely turn brown.

The birch leafminer was first reported in eastern United States in 1923. It came from Europe and has rapidly spread throughout the northern United States, Canada, and Alaska. The adult sawfly is black and about 3 mm long. Adults appear in the spring when the first birch leaves are half grown. The female sawfly deposits her eggs singly on newly developing leaves. At times, almost every leaf is mined by the developing larvae, giving it a brown color. When mature, the larva cuts a hole through the leaf and drops to the ground. There, the larvae build a cell in which pupation takes place; 2-3 weeks are usually required for transformation into the adult stage. A re-flushing of leaves may occur, and a second generation of egg-laying sawflies may develop. Two to four generations of this insect can develop in northeastern US; the number of generations in Alaska is not known.

Large populations of birch aphid on paper birch are responsible for honeydew, leaf-curling, and browning. Birch aphids are small and greenish-brown; they may be winged or wingless. Aphids usually over-winter as eggs, hatch in the spring as females which can reproduce without mating, and give birth to live young. Aphids are very responsive to changes in temperature. During warm, dry summers, enormous aphid populations appear in a relatively short time. Even so, aphid damage to Alaska birch forests is negligible.

## LARGE ASPEN TORTRIX

***Choristoneura conflictana*** Wlkr.

As predicted in 1996, populations of the large aspen tortrix continued their decline. Acres of infested aspen fell by 22% from 6,489 acres in 1996 to 5,085 acres in 1997. More than 70% of the total acres infested by the tortrix are confined to two areas. The larger of the two areas (2,140 acres) was observed in the vicinity of Manley Hot Springs along the Tanana River (131A). In the same eco-section, tortrix activity was also mapped on 646 acres approximately 8 miles west of Nenana.

The second largest area (1,498 acres) was mapped in the Matanuska Valley near the mouth of Young Creek about 15 miles northeast of Palmer (213B). Other tortrix activity in the Cook Inlet Lowlands include 221 acres on the Kenai Peninsula between Skilak and Tustumena Lakes and 99 acres about 10 miles west of Willow on the west side of the Susitna River.

Additional tortrix activity occurred on 300 acres about 12 miles south of McCarthy in the Chitina River Valley (135A) and 180 acres along the Tasnuna River, 30 miles east of Valdez (M244A).

## GYPSY MOTH

***Lymantria dispar*** (L.)

The European gypsy moth was accidentally introduced into Massachusetts from Europe in 1869 and the rest is history! Since then, the gypsy moth has been responsible for considerable damage to the hardwood forests of the eastern United States. Millions of dollars are spent annually attempting to reduce the amount of damage and restrict the distribution of this important forest pest. The European gypsy moth arrived in the western U.S. in the early 1980's.

Historically, there has been little gypsy moth activity in Alaska. In 1985, several larvae were detected by moving company employees on lawn furniture which had been shipped to Juneau from the East Coast. Every summer since 1986, USDA Forest Health Protection personnel, in cooperation with Alaska Cooperative Extension and the USDA Animal and Plant Health Inspection Service, have placed pheromone monitoring traps throughout Alaska, particularly in locations frequented by out-of-state vehicles, including campgrounds and port areas. To date, only two male European gypsy moths have been trapped: one in a campground near Anchorage in 1987 and the other in a campground near Fairbanks in 1992. Due to the recent detection of the Asian gypsy moth in the Pacific Northwest, a much more damaging race of the European gypsy moth, more than 150 detection traps were placed throughout Alaska from Petersburg to Nome, including Dutch Harbor in 1997. No Asian or European gypsy moths were collected. If the Asian gypsy moth becomes established in the western U.S., including Alaska, the potential impacts to forest and riparian areas could be tremendous. The trapping program will be carried out again next year.

## ALDER WOOLLY SAWFLY

***Eriocampa ovata*** (L.)

Heavy to moderate defoliation of Sitka and Thinleaf alder (*Alnus sinuata* and *A. tenuifolia*) was observed this summer in many parts of the Anchorage Bowl (213B). The causal agent was determined to be the alder woolly sawfly (*Eriocampa ovata* (L.)). Heavy defoliation by this insect was also observed throughout southeast Alaska (M245B) on Red alder (*A. rubra*). The alder sawfly is a European species now established throughout northern United States, British Columbia, and parts of Alaska. The larvae, except in the later larval stages, are covered with a distinctive white, woolly secretion. They skeletonize the lower leaves on young alders; the upper crown is usually not fed upon. They overwinter as prepupae in cocoons in the soil and there is probably only one generation per year in Alaska. This was the first time that such heavy defoliation has been observed; probably a result of the warmer and drier-than-normal 1997 spring and summer experienced throughout most of south-central and interior Alaska.

## WILLOW LEAF BLOTCHMINER

***Micrurapteryx salicifolliela*** (Lepidoptera: Gracillaridae)

The outbreak of willow leaf blotchminer, which peaked in 1991 at 150,000 acres, has declined to what can be considered endemic levels of 3,502 acres in 1997, a decline of 93% over 1996 figures. All but 234 acres of this activity is located in interior Alaska, primarily in the Fairbanks and Kantishna River areas (131).

Concern had been expressed over the possibility that heavy defoliation for several consecutive years could kill the affected willow. This could, in turn, adversely affect the moose population that depends heavily on willow sprouts for food. However, this impact has not been observed. Although there are patches of willow mortality scattered throughout the range of this insect, it appears that most of the affected willow has resprouted.

# MISCELLANEOUS FOREST INSECTS

## CARPENTER WORMS

***Prionoxystus robiniae*** (Peck)

rough sawn oak lumber. Infested trees are seldom killed, but young trees honeycombed by several generations of carpenter worms may be broken off wind or flooding. Tree failure is commonly by

A large lepidopteran larva sample was received by FHP personnel in the spring of 1996. These larvae had been collected from the lower stems of small (1-4" d.b.h.) black cottonwood and Sitka alder near the Lowe River, Valdez (M244A). A preliminary identification has been made: *Prionoxystus robiniae* (Lepidoptera: Cossidae). Members of the Cossidae family are medium to large moths and are commonly referred to as carpenter worms. Larvae are hairless, vary in color from reddish pink to white except for the dark brown head and light brown thoracic shield. Larvae excavate large galleries in branches, trunks, and roots of many hardwoods. Mature larvae of carpenter worms can reach 50-75 mm in length. This is the first time members of Cossidae have been recorded in Alaska. *P. robiniae* has been collected on poplar in the Yukon Territory, Canada.

Carpenter worms are native to North America and are widely distributed throughout the United States and southern Canada. Hosts include oak, elm, willow, poplar, ash, box elder, black locust, sugarberry, sycamore, and in Alaska, alder. Life cycle is 1 to 2 years in the south and 2 to 4 years in the north. Damage to large trees is in the form of lumber defect. Degrade from carpenter worm damage has been estimated at 15% of the value of

## SITKA SPRUCE WEEVIL

***Pissodes strobi*** Peck

In 1995, adult Sitka spruce weevils were collected in

encountered throughout the Lowe River flood plain in Alaska. Many heavily stocked areas of early successional species of alder and cottonwood are being dramatically thinned due to the actions of this borer.

Little is known about the biology, life cycle, and population dynamics of this borer. More ground evaluations are planned for next summer. Pheromone traps placed in known infested areas did not collect any adults of the carpenter worm. Pheromone trapping will continue next spring.

the Anchorage Bowl (213B) from blue spruce (*Picea pungens*) imported as nursery stock. Since the infested nursery stock was transported to Alaska in the summer of 1994, these adult weevils had successfully overwintered. Infested tree leaders and adult weevils were once again found in the summers of 1996 and 1997 by Alaska Cooperative Extension Integrated Pest Management Technicians in large landscape plantings of spruce in south and west Anchorage. It is not known, however, if spring/summer temperatures in Alaska are adequate for successful oviposition and brood development. Developing larvae, pupae, and callow adults (newly formed adults), however, were encountered this summer in out-

plantings of spruce in west Anchorage, an indication that the spruce weevil may be able to establish itself in Anchorage. The Sitka spruce weevil, if established, could become a serious pest of ornamental and native spruce in southeast and south-central Alaska.

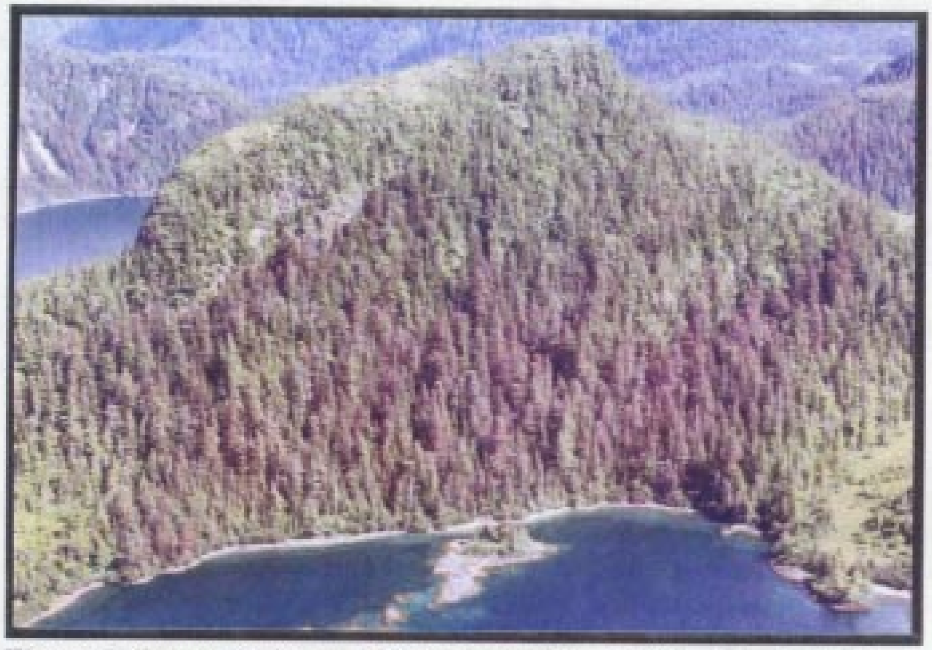


**Figure 5.** Spruce Budworm Defoliation in Prince William Sound, Alaska.

**Figure 6.** Skeletonization of alder by alder woolly sawfly, Anchorage, AK.

**Figure 7.** Alder woolly sawfly larvae. The white filaments are protective secretions.

11X17 Color state map of 4 major insect pests.  Accordion style placement.  Nothing on Back

Click here to view 1997 State Map of 4 major insect pests.

Back side of 11x17.  This page left blank.

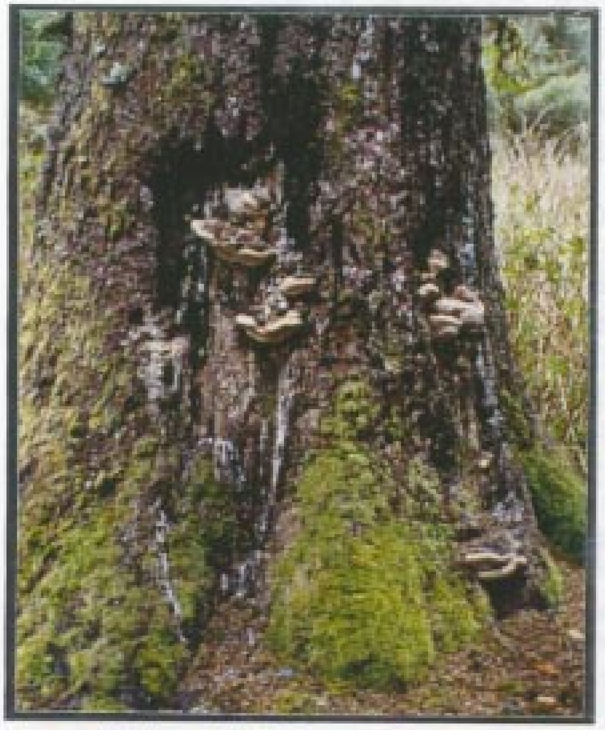


**Figure 8.** The red belt fungus, *Fomitopsis pinicola*, sporulating on a wounded Sitka spruce.

**Figure 9.** White trunk rot of paper birch caused by *Phellinus igniarius*.

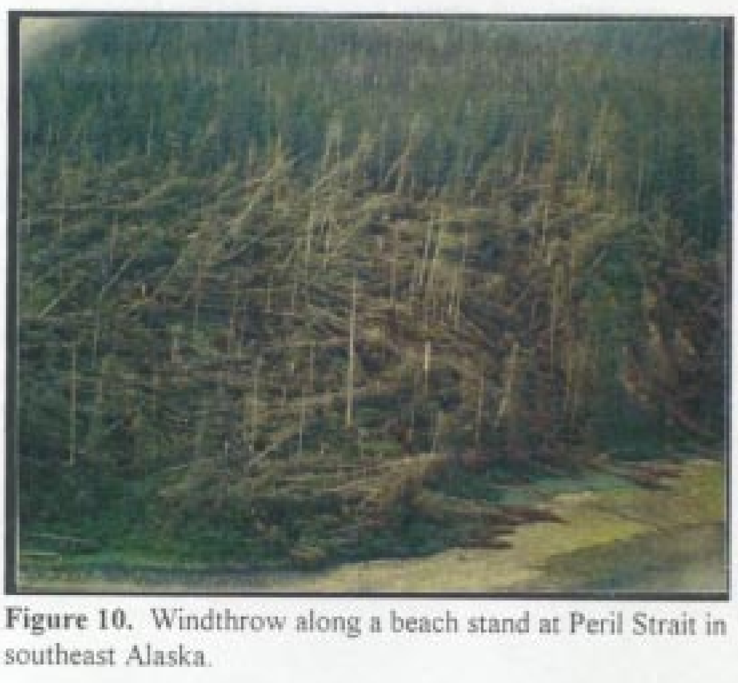


**Figure 10.** Windthrow along a beach stand at Peril Strait in southeast Alaska.

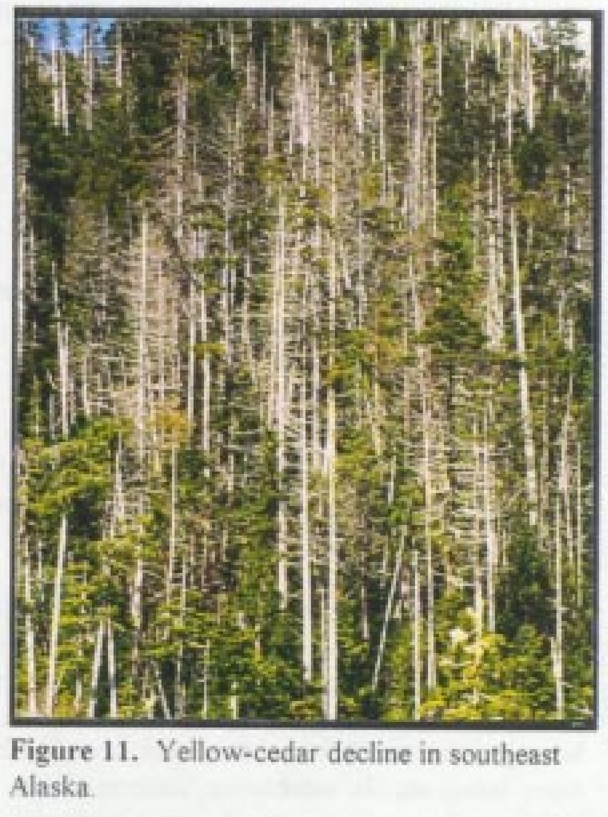


**Figure 11.** Yellow-cedar decline in southeast Alaska.

# STATUS OF DISEASES

## ECOLOGICAL ROLES OF FOREST DISEASES

The economic impacts of forest diseases in Alaska have been recognized for some time. In southeast Alaska, heart rot fungi cause substantial cull, nearly 1/3 of the gross volume, in old-growth spruce-hemlock forests. Substantial cull in white spruce and paper birch forests in the south-central and interior regions are considered severe limitations on the availability and cost of harvesting timber. Traditionally, management goals included eliminating or reducing disease to minimal levels. This perspective, however, ignores the functional ecological roles of disease in Alaska's forest ecosystems.

We are learning that diseases are key ecological factors in Alaskan ecosystems, enhancing diversity, providing wildlife habitat, and altering forest structure, composition, and succession. As agents of disturbance in the western hemlock/Sitka spruce forests of southeast, diseases are apparently responsible for the "breaking up" of even-aged stands as they are in transition (i.e., 150 to 200 years old) to old-growth phase. Then, they appear to be the primary factors that maintain the old-growth phase through small-scale (canopy-gap) level disturbance. Although much less is known about the ecological role of diseases in south-central and interior forests, diseases appear to be important factors in the transition of even-aged hardwood forests to mixed conifer/hardwood forests. Also, diseases, particularly root rots, alter successional patterns at all development stages in white spruce forests.

To reduce disease to minimal levels in all instances is to diminish the various desirable forest structural characteristics and ecosystems functions that they produce. Disease control may lead to simplified, homogeneous conditions that are not desirable for many resources. In some cases, uniform forests lacking endemic disease may be more susceptible to epidemics of other organisms. On the other hand, overly abundant levels of some diseases negatively affect nearly all resources. For example, hemlock dwarf mistletoe can build to excessive levels in stands lacking external disturbance, canopy collapse can occur through a process of retarded height growth of all overstory trees. Thermal cover and vertical structure are altered so that even resources such as habitat for most wildlife are reduced.

Two of the principal types of disease that alter forest structure in Alaska, heart rot and dwarf mistletoe, can apparently be managed to predictable, desirable levels. If reducing disease to minimal levels is a management objective, then both can be largely eliminated for many decades or centuries by clearcut harvesting and even-aged management. Managers need to consider, however, that these organisms can take a long time to recolonize clearcut sites, especially hemlock dwarf mistletoe. If structural and biological diversity is included as objectives for management, then desirable levels of disease can be attained through different strategies of selective harvesting. Most heart rot in coastal stands is associated with natural bole scars and top breakage. Levels of heart rot can be manipulated by controlling the incidence of bole wounding and top breakage during stand entries for timber removal. Levels of dwarf mistletoe can be manipulated through the distribution, size, and infection levels of residual trees that remain after alternative harvests. Our ongoing research indicates that the incidence and effects of these diseases will vary through time in a predictable manner by whatever silvicultural scheme is used. One of our objectives in ecosystem management is to develop the tools for managing for moderate disease levels that will conserve essential ecosystem processes, enhance many resource values, but also maintain productivity of the timber resource.

**Ecological roles of forest diseases, cont.**

**TABLE 3. Suspected effects of common diseases on major ecological characteristics and processes in Alaskan forests**. Effects by each disease or disorder are qualified as: - = negligible or minor effect, + = some effect, ++ = dominant effect.

| DISEASE | ECOLOGICAL FUNCTION ALTERED: STRUCTURE | COMPOSITION | SUCCESSION | WILDLIFE HABITAT |
|---|---|---|---|---|
| STEM DISEASES | | | | |
| Dwarf mistletoe | ++ | + | + | ++ |
| Hemlock canker | - | + | - | + |
| Hardwood cankers | + | + | + | - |
| Spruce broom rust | + | - | - | ++ |
| Hemlock bole fluting | - | - | - | + |
| Western gall rust | - | - | - | - |
| HEART ROTS (Many species) | ++ | + | ++ | ++ |
| ROOT DISEASES (Several species) | + | ++ | ++ | + |
| FOLIAR DISEASES | | | | |
| Spruce needle rust | - | - | - | - |
| Spruce needle blights | - | - | - | - |
| Hemlock needle rust | - | - | - | - |
| Cedar foliar diseases | - | - | - | - |
| Hardwood leaf diseases | - | - | - | - |
| SHOOT DISEASES | | | | |
| Sirococcus shoot blight | - | - | - | - |
| Shoot blight of yellow-cedar | - | + | - | - |
| DECLINES | | | | |
| Yellow-cedar decline | ++ | ++ | ++ | + |
| ANIMAL DAMAGE | | | | |
| Porcupines | + | - | - | + |
| Brown Bears | + | - | - | + |

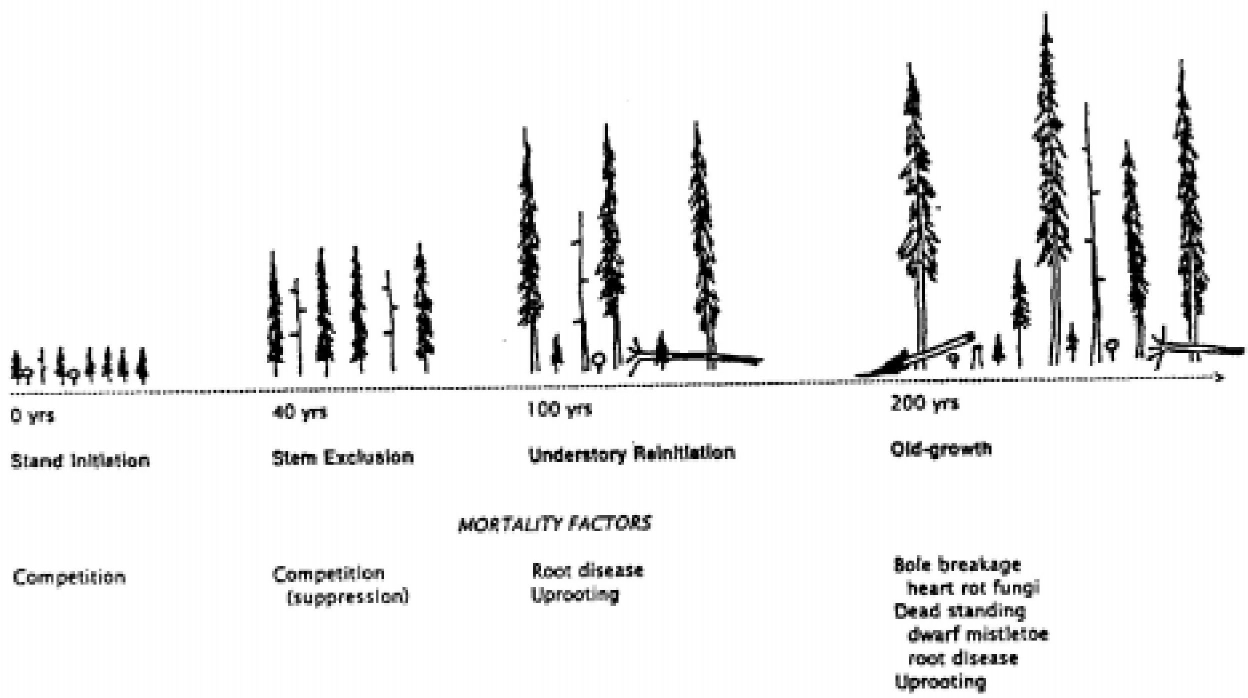



**Figure 12. Role of diseases in developmental stages following catastrophic disturbance (e.g., large-scale windthrow, clearcut harvest) in the forests of coastal Alaska.** Terms of stand development stages are from Oliver, C. and Larsen, B.C., 1990, Forest Stand Dynamics, McGraw-Hill, New York, 467p. Note the lack of major influence of disease in early successional stages where most mortality is through competition. Numerous diseases are present (e.g., foliar and shoot diseases) at these early successional stages, but none has a predominant effect on forest development. By contrast, diseases appear to be major mortality factors (i.e., disturbance agents) in the understory reinitiation stage. This stage can be interpreted as the transition from even-aged stands breaking up to enter the old-growth stage. Disease appears to be responsible for initiating this change by killing dominant and codominant trees. Heart rot fungi appear to play a critical role in the maintenance of old-growth by inducing bole breakage which is one of the most common forms of canopy gap level disturbance in old coastal forests. It is conceivable that hemlock dwarf mistletoe intensifies as a stand persists in the old-growth condition for many centuries, reaching such high disease levels that vertical structure and productivity are eroded through time. Thus, the old-growth stage in coastal Alaska may be either sustained by disease in a sort of dynamic equilibrium through the canopy gap process or it may be continually altered until the next catastrophic disturbance. Research is currently evaluating the above proposed scenario.

# STEM DISEASES

## HEMLOCK DWARF MISTLETOE

***Arceuthobium tsugense*** (Rosendhal) G.N. Jones

Hemlock dwarf mistletoe is an important disease of western hemlock in unmanaged, old-growth stands throughout southeast Alaska as far north as Haines. Although the range of western hemlock extends to the northwest along the Gulf of Alaska, dwarf mistletoe is absent from Cross Sound to Prince William Sound (M244A, 245A, and M245A). The incidence of dwarf mistletoe varies in old-growth hemlock stands in southeast Alaska from stands in which every mature western hemlock tree is severely infected to other stands in which the parasite is absent. The dominant small-scale (canopy gap) disturbance pattern in the old forests of coastal Alaska favors the short-range dispersal mechanism of hemlock dwarf mistletoe and may explain the common occurrence of the disease here. Infection of Sitka spruce is uncommon and infection of mountain hemlock is rare. The disease is uncommon on any host above elevations of approximately 1,000 feet. Heavily infected western hemlock trees have branch proliferations (witches' brooms), bole deformities, reduced height and radial growth, less desirable wood characteristics, greater likelihood of heart rot, top-kill, and severely infected trees may die.

These symptoms are all potential problems in stands managed for wood production. Growth loss in heavily infested stands can reach 40% or more. On the other hand, witches' brooms, wood decay associated with bole infections, and scattered tree mortality can result in greater diversity of forest structure and increased animal habitat. Witches' brooms may provide hiding or nesting habitats for birds or small mammals, although this topic has not been adequately researched in Alaska. The inner bark of swellings and the seeds and shoots of the parasitic plants are nutritious and often consumed by small mammals. However, heavily infected hemlock stands can begin to decline and collapse to the extent that vertical structural diversity and animal habitat are diminished. Stand composition is altered when mixed-species stands are heavily infected; growth of resistant species such as Sitka spruce and cedar is enhanced.

Spread of the parasite into young-growth stands that regenerate following "clear cutting" are typically by: 1) infected non-merchantable hemlock trees (residuals) which are sometimes left standing in cut-over areas, 2) infected old-growth hemlocks on the perimeter of cut-over areas, and 3) infected advanced reproduction. Residual trees may play the most important role in the initial spread and long-term development in young stands. Managers using alternative harvest techniques (e.g., large residuals left standing in clearcuts, small harvest units, or partial harvests) should recognize the potential reduction in timber volume and value from hemlock dwarf mistletoe under some of these silvicultural scenarios. But substantial reductions are only associated with very high disease levels. High levels of hemlock dwarf mistletoe will only result if numerous, large, intensely-infected hemlocks are well-distributed after harvest. Mistletoe management appears to be a good tool in balancing several resource objectives. Selective harvesting techniques will be the silvicultural method for maintaining desirable levels of this disease if management intends to emphasize structural and biological diversity along with timber production.

## HEMLOCK CANKER

***Xenomeris abietis*** Barr. and other fungi

Hemlock canker, which occurred at outbreak levels in southeast Alaska during the early 1990's, was at low levels in 1997. It had been conspicuous along unpaved roads on Prince of Wales Island, Kuiu Island (Rowan Bay road system), Chichagof Island (Corner Bay road system) and near Carroll Inlet on Revillagigedo Island (M245B). It was also observed in several roadless areas. Infection of new trees was infrequent or absent in 1997.

The causal agent has not been conclusively determined. Road dust and a fungus appear to be responsible for outbreaks of this disease.

Ecologically, changes in stand composition and structure are the primary effects of hemlock canker. Tree species, other than western and mountain hemlock, are resistant and benefit from reduced competition. Wildlife habitat, particularly for deer, may be enhanced where the disease kills understory hemlock; which tends to out-compete the more desirable browse vegetation.

## SPRUCE BROOM RUST

***Chrysomyxa arctostaphyli*** Diet.

Broom rust is common throughout interior and south-central Alaska but is found in only several local areas of southeast Alaska (e.g., Halleck Harbor area of Kuiu Island and Glacier Bay (M245B)). The disease is abundant only where spruce grow near the alternate host, bearberry or kinnikinnick (*Arctostaphylus uva-ursi*) in Alaska. The fungus cannot complete its life cycle unless both host types (spruce and bearberry) are present. Due to the formation of brooms by this rust fungus, it is frequently mistaken for hemlock dwarf mistletoe.

Infections by the rust fungus result in dense clusters of branches or witches brooms on white, Lutz, Sitka, and black spruce. The actual infection process may be favored during specific years, but the incidence of the perennial brooms changes little from year to year.

Ecologically, the dense brooms provide key nesting and hiding habitat for birds and small mammals. In interior Alaska, research on northern flying squirrels suggests that brooms in white spruce are an important habitat feature for communal hibernation and survival in the coldest periods of winter.

## WESTERN GALL RUST

***Peridermium harknessii*** J.P. Moore

Infection by the gall rust fungus *P. harknessii* causes spherical galls on branches and main boles of shore pine. The disease was extremely common throughout the distribution of pine in Alaska in 1997 (M244B & C, M245B). Infected pine tissues are swollen but not always killed by the rust fungus. Another fungus, *Nectria macrospora*, colonized and killed many of the pine branches with *P. harknessii* galls this year. The combination of the rust fungus and *N. macrospora* frequently caused top-kill. The disease, although abundant, does not appear to have a major ecological effect in Alaskan forests.

# HEART ROTS OF CONIFERS

Heart rot decay causes enormous loss of wood volume in Alaskan forests. Approximately 1/3 of the old-growth timber volume in southeast Alaska is defective largely because of heart rot fungi. These extraordinary effects occur where long-lived tree species predominate such as old-growth forests in southeast Alaska. The great longevity of individual trees allows ample time for the slow-growing decay fungi to cause significant amounts of decay. Wood decay fungi play an important role in the structure and function of coastal old-growth forests where fire and other forms of catastrophic disturbance are uncommon. By predisposing large old trees to bole breakage, these fungi serve as important disturbance factors that cause small-scale canopy gaps. All major tree species in southeast Alaska have been found killed in this manner.

In south-central and interior Alaska, heart rot fungi cause considerable volume loss in white spruce forests. Wood recovery studies in mature (120-200 year old) spruce bark beetle-killed stands on the Kenai Peninsula indicate that volume losses caused by heart rot fungi exceeded defect from sap rot fungi. We have a limited understanding, however, of the role of heart rot fungi in forest development. In the boreal forests, large scale disturbance agents, including wildfire, flooding, and insect outbreaks (e.g., spruce beetle), are key factors influencing forest structure and composition. The importance of small-scale disturbances caused by decay fungi is unknown but currently under study.

Heart rot fungi enhance wildlife habitat -- indirectly by increasing forest diversity through gap formation and more directly by creating hollows in live trees or logs for species such as bears and cavity nesting birds. Wood decay in both live and dead trees are a center of intense biological activity and should be viewed as a site of great biological diversity for small organisms. Wood decay is the initial step in nutrient cycling of wood substrates, has associated bacteria that contribute nitrogen fixation, and contributes large masses of stable structures (e.g., partially modified lignin) to soils.

The importance of decay fungi in managed young-growth conifer stands is less certain. Wounds on live trees caused by logging activities allow for the potential of decay fungi to cause appreciable losses. Heart rot in managed stands can be manipulated to desirable levels by controlling bole wounding and top breakage during stand entries. In some instances, bole breakage is sought to occur in a specific direction (e.g., across steams for coarse woody debris input). Artificially wounding trees on the side of the bole that faces the stream can increase the likelihood of the eventual tree fall in that direction. In southeast Alaska, studies in progress are investigating how frequently fungi enter wounds of different sizes and the rate of subsequent decay in these wounded trees. Generally, larger, deeper wounds and larger diameter breaks in tops result in a faster rate of decay. Preliminary results indicate that heart rot development is much slower in southeast Alaska than areas studied in the Pacific Northwest.

In southeast Alaska, the following fungi are the most important causes of wood decay in live trees:

**Western hemlock**

*Fomitopsis pinicola*
*Laetiporus sulphureus*
*Phaeolus schweinitzii*
*Phellinus hartigii*
*Phellinus pini*

**Sitka spruce**

*Fomitopsis pinicola*
*Phellinus pini*
*Phaeolus schweinitzii*
*Laetiporus sulphureus*

**Western redcedar**

*Ceriporiopsis revulosa*
*Phellinus weirii*

In south-central and interior Alaska, the following fungi are the most important causes of wood decay in live trees:

**White and Lutz spruce**

*Fomitopsis pinicola*
*Phellinus pini*
*Coniophora sp.*
*Phaeolus schweinitzii*
*Laetiporus sulphureus*

**Mountain hemlock**

*Phellinus pini*
*Echinodontium tinctorium*
*Fomitopsis pinicola*

Wood decay fungi decompose branches, roots, and boles of dead trees; therefore, they play an essential role in recycling wood in forests. However, sap rot decay also routinely and quickly develops in spruce trees attacked by spruce beetles. Large amounts of potentially recoverable timber volume are lost annually due to heart and sap rot fungi on the Kenai Peninsula, where salvage logging has not kept pace with tree mortality from the continuing spruce beetle epidemic. Several species of sap rot fungi are associated with spruce beetle-caused mortality with *Fomitopsis pinicola* being the most common.

# STEM DECAY OF HARDWOODS

Stem decay is the most important cause of volume loss in Alaskan hardwood species. The incidence of stem decay in paper birch and trembling aspen in south-central and interior Alaska is generally high by the time a stand has reached maturity, approximately 75 years old. These fungi will limit harvest rotation age of forests that are managed for wood production purposes. Studies are currently underway in paper birch forests to identify the most important stem decay fungi and assess rates of decay as related to stand age and site conditions.

Ecologically, stem decay fungi alter stand structure and composition and appear to be important factors in the transition of even-aged hardwood forests to mixed spruce-hardwood forests. Bole breakage of hardwoods creates small openings in the previously closed canopy, allowing spruce that were slowly growing in the understory to achieve dominance on a site. Wildlife habitat is enhanced directly by the creation of cavities in live trees. Several mammals, including the northern flying squirrel, are known to utilize tree cavities year-round for nest and cache sites.

In south-central and interior Alaska, the following fungi are the primary stem decay causing organisms in live trees:

**Paper birch**

*Phellinus igniarius*
*Pholiota* spp.
*Inonotus obliquus*

**Trembling aspen**

*Phellinus tremulae*
*Pholiota* spp.

A number of fungi cause stem decay in balsam poplar, black cottonwood, and other hardwood species in Alaska.

# SHOOT DISEASES

## SIROCOCCUS SHOOT BLIGHT

***Sirococcus strobilinus*** Pruess.

Young-growth western hemlock shoots were killed in moderate levels by the blight fungus *S. strobilinus* in southeast Alaska during 1997. Sitka spruce and mountain hemlock were attacked but less frequently and less severely. Thinning may be of some assistance in reducing damage by the fungus as thinned stands have fewer infections than unthinned stands.

This disease is typically of minimal ecological consequence because infected trees are not often killed and young hemlock stands are so densely stocked. Species composition may be altered to some degree where trees other than western hemlock may be favored by the disease.

## SHOOT BLIGHT OF YELLOW-CEDAR

***Apostrasseria sp.***

Yellow-cedar regeneration suffered infection and shoot blight by the fungus *Apostrasseria* sp. in southeast Alaska in 1997 as it does every year. The disease, however, does not affect mature cedar trees. Attack by the fungus causes terminal and lateral shoots to be killed back 10 to 20 cm on seedlings and saplings during winter or early spring. Entire seedlings up to 0.5m tall are sometimes killed. The newly discovered fungus that causes the disease, *Apostrasseria* sp., is closely related to other fungi that cause disease on plants under snow. The fungus *Herpotrichia juniperi* is often found as a secondary invader on seedlings after they die.

This shoot blight disease probably has more ecological impact than similar diseases on other host species because the natural regeneration of yellow-cedar is limited in many areas. By killing the leaders of yellow-cedar seedlings and diminishing their ability to compete with other vegetation, the pathogen reduces the regeneration success of yellow-cedar and thereby alters species composition.

## CANKER FUNGI

***Cryptosphaeria populina*** (Pers.) Sacc.
***Cenangium singulare*** (Rehm.) D. & Cash
***Ceratocystis fimbriata*** Ell. & Halst.
***Cytospora chrysosperma*** Pers. ex Fr.
***Nectria galligena***

These fungi primarily cause trunk deforming cankers and wood decay of many hardwood species, particularly trembling aspen, in south-central and interior Alaska. Although most are considered weak parasites, *C. singulare* can girdle and kill a tree within six years. All the canker-causing fungi were at endemic levels in 1997.

Ecologically, canker fungi alter stand structure and composition through trunk deformity and bole breakage. Succession is altered as conifer trees will benefit from reduced competition.

# FOLIAR DISEASES

## SPRUCE NEEDLE BLIGHTS

***Lirula macrospora*** (Hartig) Darker
***Lophodermium picea*** (Fuckel) Höhn.
***Rhizosphaera pini*** (Corda) Maubl.

The fungus *Lirula macrospora* is the most important needle pathogen of Sitka spruce. In 1997 it occurred at moderate to high levels in most areas within the range of Sitka spruce. One outbreak of note was in young growth Sitka spruce on Afognak Island
On Sitka spruce, the primary ecological consequence

(M245A). While the size of the outbreak was not determined, it was estimated to occur on at least several thousand acres. Throughout southeast Alaska, the disease was most common on young Sitka spruce and the lower crowns of larger trees. *Lophodermium picea* was present at low infection levels in 1997. This disease is more typical of larger, older trees of all spruce species in Alaska. *Rhizosphaera pini* continued at endemic levels after causing damage several years ago in coastal Alaska although it was associated with branch mortality at one site at Echo Cove near Juneau (M245B). Damage closely resembles that caused by spruce needle aphid and microscopic observation of the tiny fruiting bodies on infected needles is necessary for proper identification.

The primary impact of these needle diseases is generally one of appearance. They can cause severe discoloration or thinning of crowns but typically have only negligible ecological consequence. However, repeated heavy infections may slow the growth of spruce and benefit neighboring trees, thereby altering species composition to some degree.

## SPRUCE NEEDLE RUST

***Chrysomyxa ledicola*** Lagerh.
***Chrysomyxa weirii*** Jacks.

Spruce needle rust, caused by *C. ledicola*, occurred at moderate levels across the state. The primary outbreak, over 10,000 acres, occurred on white and Lutz spruce growing on poorly drained sites in the Kenai National Wildlife Refuge (213B).

The spores that infect spruce needles are produced on the alternate host, Labrador-tea (*Ledum* spp.), a plant that is common in boggy areas; thus the disease on spruce is most pronounced in these boggy (muskeg) areas. Although the disease can give spruce trees the appearance of being nearly dead, trees rarely die of this disease even in years of intense infection.
of the disease may be to reduced tree vigor of a

species already poorly adapted to boggy sites. Repeated infection of spruce may alter forest composition by favoring other tree species.

The foliar rust fungus *C. weirii* was found sporulating on one-year-old Sitka spruce needles in several areas of southeast Alaska but it has never been detected at threatening levels. Unlike most other rust fungi, no alternate host is necessary to complete its life cycle. Little ecological or economic impact results from this disease.

## HEMLOCK NEEDLE RUST

***Pucciniastrum vaccinii*** (Rab.) Joerst.

Hemlock needle rust was found at endemic levels in 1997 after last year's high incidence. In 1996, the disease was most damaging near Yakutat (245A) where it caused defoliation of western hemlock, especially on trees growing adjacent to harvested sites. Elsewhere, infected needles were found, but hemlock trees were not heavily defoliated. The alternate hosts for the rust fungus include several blueberry species (*Vacinium*). Infection levels usually return to endemic levels in a year or so and the disease is not expected to influence major ecological change.

## FOLIAGE DISEASES OF CEDARS

***Gymnosporangium nootkatense*** Arth.
***Didymascella thujina*** (Durand) Maire

Two fungi that infect the foliage of cedar, *G. nootkatense* on yellow-cedar and *D. thujina* on western redcedar, occurred at endemic levels this year. *D. thujina* was the more damaging of the two and was common wherever its host was found. Neither fungus resulted in severe defoliation nor death of cedar trees. Neither disease has major ecological effects.

# ROOT DISEASES

Root diseases cause substantial volume loss and mortality of conifers in Alaskan forests. Bole breakage, uprooting, and mortality are caused by extensive decay of root systems and the lower bole of trees. In stands managed for timber production, root rot fungi are considered long-term site problems because they remain alive in the roots of infected stumps for decades after harvest operations. Root disease pathogens may affect groups of neighboring trees in progressively expanding disease centers. Typically, disease centers contain dead trees that have died within the last several years and living but infected trees in various stages of decline. Within centers, resistant tree species, including all hardwoods, are favored.

In south-central and interior Alaska, root disease exerts a major influence in early successional stages through mortality of spruce seedlings and saplings. After harvesting operations root rot fungi remain on the site, harbored in infected spruce stumps. Spruce seedlings growing within close proximity of infected stumps have a high probability of becoming infected. Root diseases appear to have an important role in late successional stages by slowly killing dominant or co-dominant trees and causing substantial decay of the butt log. In southeast Alaska, root disease impacts are only apparent in the later successional stages (See Figure 12).

Ecologically, root diseases are considered natural, perhaps essential, parts of the forest altering stand structure, composition, and increasing plant community diversity. Resistant tree species, including all hardwood trees, benefit from reduced competition within infection centers. Wildlife habitat is enhanced by small-scale mortality centers, increased volume of large woody downed material, and increased hardwood browse vegetation.

The laminated root disease caused by a form of the fungus *Phellinus weirii*, so important in some western forests of British Columbia, Washington, and Oregon, is not present in Alaska. A non-root disease form of the fungus is present in southeast Alaska, where it causes a white rot in western redcedar, contributing to the very high defect of this tree.

## STAND OPENING DISEASE

***Inonotus tomentosus*** (Fr.:Fr.) Teng.

*I. tomentosus* causes root and butt-rot of white, Lutz, and Sitka spruce stands. The fungus can also attack lodgepole pine and black spruce. The disease is widespread in south-central and interior Alaska (213B, 135A), but does not occur in southeast Alaska.

Spruce trees of all ages are susceptible to infection through contact with infected roots. Infected trees exhibit growth reduction or mortality, depending on age. Younger trees may be killed rapidly while older trees may persist in a moribund condition for many years. Trees with extensive root decay are vulnerable to windthrow. Butt-decay of infected spruce trees typically extends eight feet up the stem.

In young growth managed stands, spruce seedlings planted within close proximity of infected stumps are highly susceptible to infection. While individual mortality centers are typically small, coalescing centers can occupy many acres. Studies are currently underway to assess mortality in young growth stands and determine site factors that influence disease incidence and severity.

Levels of root disease can be manipulated by changes in species composition through stand conversion to non-susceptible (hardwood) species. Recognition of this root disease is important in managed stands where natural regeneration of white and Lutz spruce is limited and adequate restocking requires planting. Hardwood trees are resistant and may colonize infection centers. Wildlife habitat, particularly for moose, may be enhanced by increased hardwood browse vegetation.

## ANNOSUS ROOT AND BUTT ROT

***Heterobasidion annosum*** (Fr.) Bref.

Annosus commonly causes root and butt-rot in old-growth western hemlock and Sitka spruce forests in southeast Alaska (M245B, M244C). It is not known to occur in south-central or interior Alaska.

Spores of the fungus are known to readily infect fresh stump surfaces, such as those found in clearcuts or young pre-commercially thinned stands. However, studies in managed stands have indicated limited stump inoculation and survival of the fungus. Thus, this disease poses minimal threat to young managed stands.

Reasons for the limited stump inoculation in southeast Alaska as compared to other regions of the Pacific Northwest are not completely understood but may be related to climate. High rainfall and low temperatures, common in Alaska's coastal forests, apparently hinder infection by spores.

## ARMILLARIA ROOT DISEASE

***Armillaria spp.***

Several species of *Armillaria* occur in the coastal forests of southeast Alaska, but in general, the species are less-aggressive, saprophytic slash decomposers that only kill trees when they are under some form of stress. Studies in young managed stands indicate that *Armillaria* spp. can colonize stumps, but will not successfully attack adjacent trees. In south-central and interior Alaska, there is a poor understanding of the species that are present and their aggressiveness.

# DECLINES AND ABIOTIC FACTORS

## YELLOW-CEDAR DECLINE

Decline and mortality of yellow-cedar persists as one of the most spectacular forest problems in Alaska.  Approximately 477,000 acres of decline have been mapped during aerial detection surveys. The difference between 1996's total and those of 1997 is due to better mapping and GIS abilities; the areas have not changed substantially.  Concentrated mortality occurs in a wide band from western Chichagof and Baranof Islands to the Ketchikan area (M245B).  Of the three administrative areas of the Tongass National Forest, the Stikine Area has the greatest concentration of cedar decline at just under 200,000 acres.

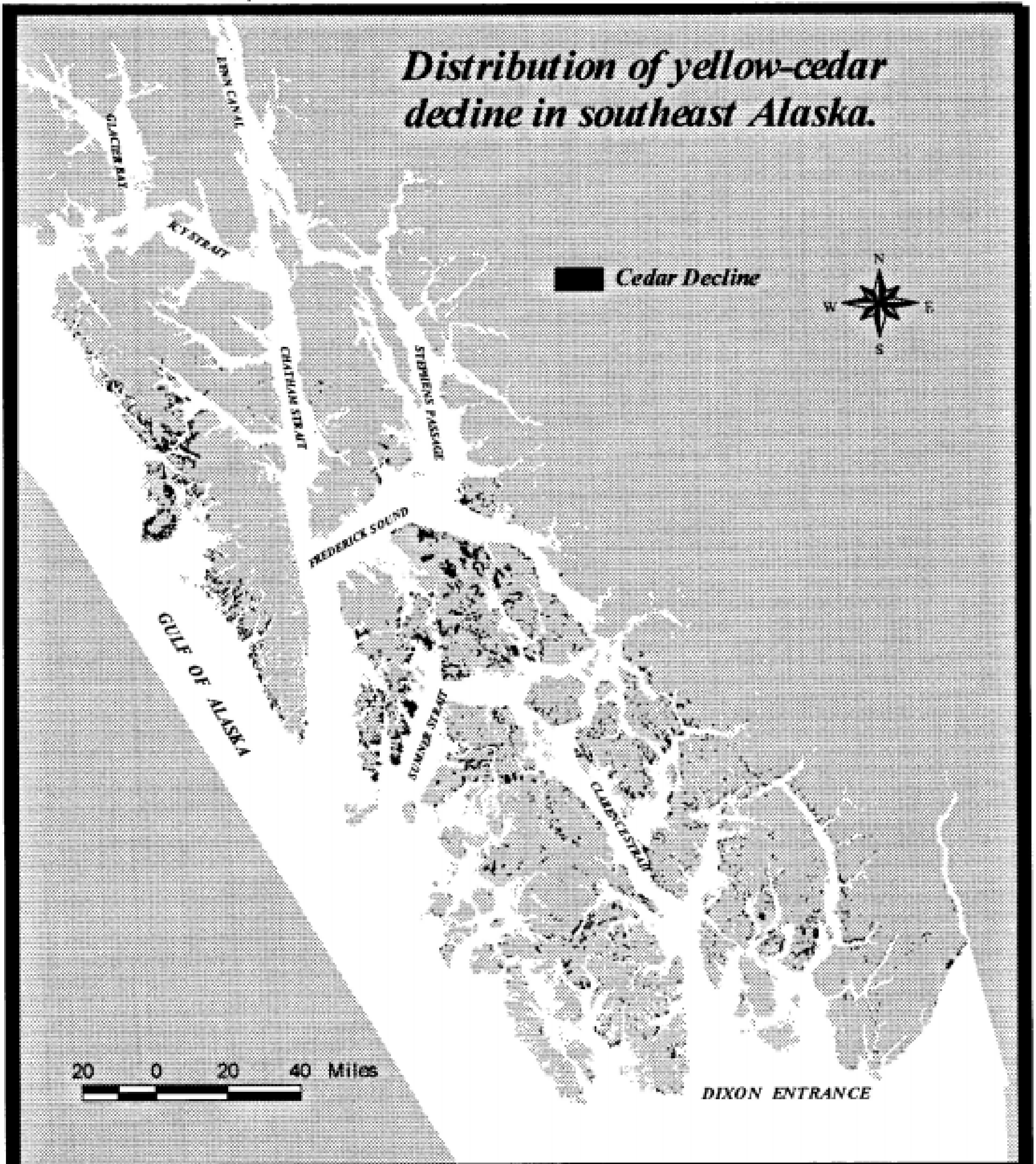
All research suggests that contagious organisms are not the primary cause for this extensive mortality. Some site factor, probably associated with the poorly-drained anaerobic soils, appears to be responsible for initiating and continuing cedar decline.  Two hypotheses have been proposed to explain the primary cause of yellow-cedar decline: death could result from (1) toxins produced by decomposition in the wet, organic soils or (2) freezing damage to shallow fine roots associated with climatic warming and reduced insulating snowpack in the last century.  These hypotheses are developed in some detail (Hennon and Shaw 1994). Interestingly, considerable concentrations of newly-killed trees were evident in declining forests during 1996 and 1997, perhaps a response to the unusually prolonged cold temperatures with little snowpack that persisted during the previous two winters. Whatever the primary cause of this mysterious decline, all available information indicates that it is probably a naturally-occurring phenomenon.

Research suggests that the total acreage of yellow-cedar decline has been increasing very gradually; the slow increase in area has been a result of the expansion of existing decline (<3 feet/year) into adjacent stands.  Most stands contain trees that died up to 100 years ago (snags still standing), as well as recently killed cedars, dying cedars (with yellow, red, or thinning crowns), healthy cedars, and other tree species.  Numerous recently-killed trees and dying trees with full, but off-color crowns were present in many stands during 1997.

Ground surveys show that 65% of the basal area of yellow-cedar is dead on this acreage.  Other tree species are affected in different ways:  on some sites they produce increased growth, presumably due to less competition, and on other sites they experience slowed growth and mortality because of site deterioration (poor drainage).  Species change to western hemlock and mountain hemlock and large increases in biomass accumulation for brushy species appear to be occurring in some stands where decline has occurred for up to a century.

Little is known about wildlife use and dependency of yellow-cedar forests, and whether these forests are experiencing excessive mortality or not.  The primary ecological effect of yellow-cedar decline is to alter stand structure (i.e., addition of numerous snags), composition (i.e., yellow-cedar diminishing and other tree species becoming more numerous), and the eventual succession to other conifer species. The creation of numerous snags is probably not particularly beneficial to cavity-using animals because yellow-cedar wood is less susceptible and slow to decay, although this has not been studied. Region-wide, this excessive mortality of yellow-cedar may lead to diminishing populations (but not extinction) of yellow-cedar, particularly when the poor regeneration of the species is considered.

The large acreage of dead yellow-cedar and the high value of its wood suggest opportunities for salvage. Cooperative studies with the Wrangell Ranger District, the Forest Products Lab. in Madison, Wisconsin, and State and Private Forestry are investigating the mill-recovery and wood properties of snags of yellow-cedar that have been dead for varying lengths of time.




**Map 3.** Distribution of yellow-cedar decline in southeast Alaska.

**Table 4.** Acreage affected by yellow-cedar decline in southeast Alaska in 1997.

| | Acres |
|---|---|
| **NATIONAL FOREST LAND** | **454,656** |
| **Chatham Area Total** | **118,140** |
| Juneau Ranger District | 856 |
| Hoonah Ranger District | 973 |
| Sitka Ranger District | |
| Chichagof I | 34,033 |
| Baranof I | 49,747 |
| Kruzof I | 27,110 |
| Sub-total | 110,890 |
| Admiralty Island Nat'l Mon. Wilderness | 5,421 |
| **Stikine Area Total** | **199,924** |
| Petersburg Ranger District | |
| Kupreanof I | 82,556 |
| Kuiu I | 63,598 |
| Mitkof I | 6,021 |
| Woewodski I | 2,155 |
| Mainland | 7,566 |
| Sub-total | 161,896 |
| Wrangell Ranger District | |
| Etolin I | 17,005 |
| Wrangell I | 9,428 |
| Zarembo I | 3,527 |
| Woronofski I | 441 |
| Mainland | 7,627 |
| Sub-total | 38,028 |
| **Ketchikan Area Total** | **136,592** |
| Craig Ranger District | |
| Prince of Wales I | 30,880 |
| Dall I and Long I | 993 |
| Sub-total | 31,873 |
| Ketchikan Ranger District | |
| Revillagigedo I | 16,956 |
| Gravina I | 1,151 |
| Mainland | 18,241 |
| Sub-total | 36,348 |

| | Acres |
|---|---|
| **Ketchikan Area (continued)** | |
| Thorne Bay Ranger District | |
| Prince of Wales I | 29,798 |
| Kosciusko I | 11,642 |
| Heceta I | 867 |
| Sub-total | 42,307 |
| Misty Fjords Nat'l Mon. Wilderness | |
| Revillagigedo I | 8,884 |
| Mainland | 17,180 |
| Sub-total | 26,064 |
| **NATIVE LAND** | **15,913** |
| Prince of Wales I | 7,897 |
| Dall and Long I | 643 |
| Kupreanof I | 3,597 |
| Baranof and Chichagof I | 851 |
| Ketchikan area | 2,037 |
| Annette I | 851 |
| Gravina I | 37 |
| **STATE AND PRIVATE LAND** | **6,971** |
| Admiralty I | 9 |
| Baranof I | 1409 |
| Chichagof I | 144 |
| Gravina I | 943 |
| Mitkof I | 512 |
| Kosciusko I | 519 |
| Kuiu I | 16 |
| Kupreanof I | 633 |
| Prince of Wales I | 1,489 |
| Wrangell area | 572 |
| Revillagigedo | 725 |

TOTAL LAND AFFECTED 477,540

## HEMLOCK FLUTING

Deeply incised grooves and ridges extending vertically along boles of western hemlock characterize hemlock fluting. Fluting is distinguished from other characteristics on tree boles, such as old callusing wounds, in that fluting extends near or into the tree crown and fluted trees have more than one groove. Bole fluting is common on western hemlock throughout southeast Alaska. This condition reduces the value of hemlock logs because they yield less sawlog volume and bark is contained in some of the wood. The cause of fluting is not completely known, but associated factors include: increased wind-firmness of fluted trees, fluted trees commonly occur on sites with shallow soils, and growth release triggers fluting. The asymmetrical radial growth appears to be caused by unequal distribution of carbohydrates due to the presence of dead branches. Researchers have documented the development of fluting in young hemlock stands that regenerated following clearcut harvesting or other disturbance. After several centuries, fluting is no longer outwardly visible in some trees because branch scars have healed over and fluting patterns have been engulfed within the stem.

Bole fluting has important economic impact, but may have little ecological consequence beyond adding to windfirmness. The deep folds on fluted stems of western hemlock may be important habitat for some arthropods and the birds that feed upon them (e.g., winter wren).

## WATER DAMAGE

Flood damage was noted on over 2,000 acres in scattered locations across the state. Approximately 500 acres of conifer stands were affected in southeast Alaska. Some small areas of high water damage to conifers were the result of beaver dams.
In south-central and interior Alaska, flood damage to mixed conifer and hardwood stands adjacent to rivers occurred on approximately 1,500 acres. Most flooding occurred as a result of natural stream channel changes or high water.

## WINDTHROW

There was approximately 700 acres of windthrow in the Chatham Area, Hoonah Sound, Chichagof Island in 1997 (M245B). Another 600 acres occurred in Glacier Bay National Park between Harbor Point and Icy Point, west of the Fairweather Mountain Range (245A). Both windthrow areas were in the spruce/hemlock forest type. Since spruce beetles prefer windthrown spruce as habitat, there is a possibility that large volumes of potential brood material may predispose these areas to spruce beetle infestations; the extent will be determined by weather.

A 55 acre area of windthrown spruce was mapped on the east side of Twentymile River (M213B). Spruce bark beetle have been present but not aggressive in the Twentymile River drainage. This windthrow could attract the beetles and may become the focal point for the infestation in that valley.

Windthrow was also noted in Koyuktolik Bay at the southern end of Kachemak Bay (M245A). The 741 acres of scattered windthrow occurred in residual trees of old logging units. This site was ground checked in 1997. No potential for bark beetle infestation is expected.

## WINTER DAMAGE

Most of the 2,950 total acres of winter damage to lodgepole pine occurred in the Chatham Area of the Tongass National Forest in 1997.

# STATUS OF ANIMAL DAMAGE

## PORCUPINE
***Erethizon dorsatum***

Porcupines cause severe damage to Sitka spruce and western hemlock in numerous local areas of southeast Alaska. An extensive survey has documented the level of porcupine damage in young-growth stands. Feeding injuries to trees are confined to the known distribution of porcupine. Damage is especially serious on Mitkof Island in southeast Alaska. Other damage has been noted at Thomas Bay, Cleveland Peninsula, Bradfield Canal, Anita Bay and other areas of Etolin Island, Douglas Island, and the Juneau area(M245B). Shore pine near Haines has been damaged the last few years (M244C). Porcupines also damage trees throughout interior Alaska. Bark beetles, including *Ips* spp., have been found infesting the damaged trees.

In southeast Alaska, the feeding behavior of porcupines changes as forests develop and trees become larger and older. Porcupines climb smaller trees and kill or cause topkill by removing bark along the entire bole, or the bole near the top of the tree. As trees become larger, around 40-50 years old, most of the damage is in the form of basal wounding. Most of these larger trees are not killed, but the large basal scars allow fungi to enter the bole and begin to cause wood decay.

The primary ecological consequences of porcupine feeding are: (1) to provide greater diversity of structure and vegetation in young, even-aged conifer stands through mortality and (2) to provide greater levels of heart rot decay by wounding older trees. This latter effect can alter mortality patterns in old forests as trees may often die through bole breakage.

## BEAR
***Ursus arctos***
***Ursus americanus***

Yellow-cedar trees were wounded in the spring by brown bears on Baranof and Chichagof Islands (M245B). Brown bears rip the bark away from the lower boles of these trees, apparently to lick the sweet cambium. Other tree species in southeast Alaska are unaffected. Black bears caused injury to the lower boles of white and Lutz spruce and occasionally aspen in the lowland forests of the Kenai Peninsula (213B). Trees with old scars have associated columns of wood decay that will limit the value of their butt logs.

## MOOSE
***Alces alces***

At many locations across south-central and interior Alaska, moose cause severe damage to hardwood species by repeatedly browsing stems. In the winter, moose congregate in areas containing young hardwoods, often consuming the new growth on the same trees year after year. Snow cover typically protects stems less than 20 inches tall, while stems greater than 12 feet tall are generally out of reach and escape from damage. Heavy, repeated browsing results in stunted malformed stems, branch wounds, and mortality. Wood decay fungi penetrate branch wounds resulting in a high incidence of stain and decay in browsed stems.

## SAPSUCKER
***Sphyrapicus sp.***

A notable increase in sapsucker activity was noted in the Granite Creek area of the Glacier Ranger District on the Chugach National Forest (M213B). Lutz spruce in several permanent plots were observed with the characteristic series of holes around the circumference of their trunks, accompanied by profuse bleeding of clear sap. Spruce beetle activity is high in the area, but beetles were not attacking the trees with sapsucker damage. We will continue to monitor sapsucker activity in this area and watch for it in other areas.

# INTEGRATED PEST MANAGEMENT ACTIVITIES

Integrated pest management (IPM) has been described as a "systems approach to alter pest damage to acceptable levels through a variety of techniques, including predators and parasites, genetically resistant hosts, natural environmental modifications, and when necessary and appropriate, chemical pesticides." Current IPM activities in Region 10 include:

**1** Participation in a cooperative effort with the Alaska Cooperative Extension (ACE) to provide pest management information to Alaska residents. The program, which includes education, research and survey activities, also provides integrated pest management information concerning urban forestry as well as garden and greenhouse pests. The program is educational in nature and provides the public with a means to learn about pest management in an informal and accessible manner. 1997 IPM Technicians were located in Anchorage, Palmer, Soldotna, Fairbanks, and Delta Junction. They also served surrounding communities within their districts. The Anchorage site had a full time and a half time Technician; the remaining locations had one seasonal IPM Technician from May through the end of September. The total recorded client contacts reached well over 5,000; which were more than 50% of all contacts made by Cooperative Extension. The 1997 IPM Technicians conducted 34 workshops and 16 media contacts (newspaper articles, radio and television “spots”). This successful outreach results largely from the Technicians enthusiastic and professional approach. As more Alaskans become informed of the availability and services of the IPM Technician Program, the Technicians, as part of the statewide ACE-IPM program, will continue to provide the most current and accessible pest identification and management information available.

In an effort to expand the outreach program, ACE and Forest Health Protection initiated the Alaska Forestry IPM Technician regional position in 1995. The 1996/97 Forestry IPM position was a full time, 12-month position and allowed us to meet the needs of Alaskans with more specific forest pest and woodlot management issues and concerns. The Forestry Technician’s activities included: answering 1,250 telephone inquiries on forest health issues (mostly spruce beetle); 395 site visits on approximately 3,000 acres in total; 47 media contacts resulting in 7 radio interviews; and 5 television appearances. We are looking closely at increasing our support for this excellent program in 1998.

2 Two thinning studies aimed at reducing spruce beetle-caused tree mortality have been established on the Kenai Peninsula. The first study was established in 1989 in a mature (148-year-old Lutz spruce stand) in the Granite Creek area of the Kenai Peninsula. The second study was initiated in 1995 in a younger 70-year-old Lutz spruce stand near Tustumena Lake further south on the Kenai Peninsula. The objectives of these studies are to determine efficacy of thinning from below, pruning, and fertilization in reducing spruce beetle caused tree mortality. Changes in understory vegetation as a result of treatments (e.g., logging and fertilization) and those which occur in untreated stands are also being monitored. Preliminary results have indicated a significant reduction in beetle-caused tree mortality in thinned vs. unthinned spruce stands in the Granite Creek area. The Tustumena Lake area experienced an enormous spruce beetle flight. Cumulative spruce beetle caused-tree mortality in the unthinned stands up through 1996 averaged less than 2%. After the 1997 spruce beetle flight, more than 60% of the trees, down to 3" in d.b.h., had been heavily attacked. 1997 attacked trees were beginning to fade in color by the end of the first season. On the other hand, approximately 15% of the residual spruce trees in the thinned plots were attacked. We are expecting another heavy beetle flight throughout this area next year.

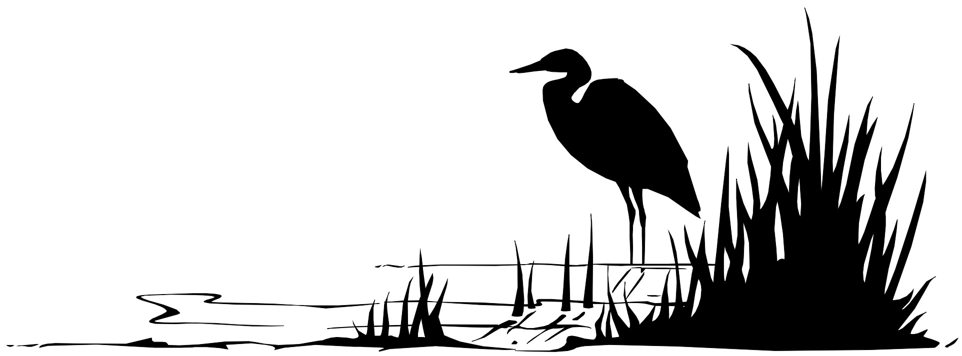
3 During the 1992 aerial surveys of interior Alaska, a scolytid, *Trypophloeus striatulus*, was found by Dr. Malcolm Furniss of the Department of Entomology, University of Idaho, Moscow, to be one of the most important willow infesting insects. This is important because it is the primary insect involved in killing stems in Alaska. Also, this scolytid's biology and population dynamics have not been previously studied in Alaska. A two-year study was initiated in 1996 to determine the beetle's biology, host species, and factors associated with susceptibility of willows to infestation, including browsing damage, willow senescence, and plant-pathogenic fungi. Results of Dr. Furniss' field studies documented five new hosts; of which, feltleaf willow, *Salix alaxensis*, was being infested most frequently as well as most heavily browsed by moose. Willow stems are infested by several beetle generations and die slowly. Some factors associated with the presence of the beetle are severe browsing damage by moose, plant senescence, and infection by a pathogenic fungus, *Cytospora* sp. The mode of transmission of *Cytospora* sp. remains unknown.

4 Past *Ips perturbatus* studies have used Ipsdienol as the aggregating pheromone for attracting dispersing *Ips*. A literature search found reference to the fact that the addition of cis-verbenol to Ipsdienol greatly enhanced trap catches of *I. tridens* in British Columbia. Two concurrent funnel trap studies were undertaken, one in Fairbanks and the other on the Kenai Peninsula near Granite Creek. The results of the studies showed that the addition of cis-verbenol increased trap catches of *Ips* tenfold. More than 13,000 adult *Ips* beetles were caught in five funnel traps in a thinned area on the Kenai Peninsula. This stand experienced approximately 24% mortality from attacking *Ips* beetles in 1997. In a neighboring thinned stand, where no *Ips* trapping occurred, more than 40% of the residual spruce was killed by *Ips*. There appears to be a correlation between trapping and reduced *Ips*-caused tree mortality. This will be explored in more depth next summer with a trap-out study to determine if the amount of *Ips* beetle-caused tree mortality can be reduced by mass trapping dispersing *Ips* adults.

5 Two additional cooperative projects involving *Ips perturbatus* and funnel trapping using attractant pheromones (racemic ipsdienol and cis-verbenol) were undertaken during 1997 by the Alaska Department of Natural Resources, Division of Forestry with cooperation from USFS/S&PF and the Tanana Chiefs Conference (TCC), an Alaska Native corporation.

A study at Tok compared trap catches using ipsdienol bubblecaps alone as well as a combined cis-verbenol + ipsdienol treatment in thinned spruce stands. Another objective of the Tok study was to test a limited trapout using a predefined grid placement (200-250 foot centers) of funnel traps over three 20-acre parcels. Due to the added costs of thinning slash disposal/removal, the land manager (TCC) was also interested in testing the potential for funnel trapping in thinned stands without the significant added cost of slash disposal. Study results showed that the addition of cis-verbenol provided an over thirty-fold increase in trap catches compared to catches using ipsdienol alone. The trapout portion of the study appeared to be effective in preventing green tree attacks since no "spillover" attacks occurred into the residual thinned stand. However since no *Ips* attacks occurred in an untreated, thinned 20-acre control plot, trapout efficiency could not be demonstrated even though initial sampling showed infestation in the thinning slash. Preliminary results also suggest that the cis-verbenol + ipsdienol combination may be cost effective to use in a standard monitoring program (with limited trapout) to minimize *Ips* buildup from harvest operations or significant accumulations of spruce slash. This study will be repeated in 1998 in interior Alaska to further test these *Ips* attractant pheromones for potential trapout and monitoring purposes.

Another funnel trap study was conducted near Fairbanks within the Standard Creek timber management block administered by the Alaska Division of Forestry. This project was primarily a monitoring study to measure relative numbers of overwintering, emerging *I. perturbatus* adults using the attractant, racemic ipsdienol, in funnel traps (previous trapping results had identified ipsdienol as a significant component of the *Ips* pheromone complex). The 1997 test was part of a two-year study to determine patterns of dispersal of overwintering adults and to quantify relative numbers of emerging adults expected in harvest areas during logging operations. For this reason, cis-verbenol was intentionally not used for efficacy comparison. Areas selected for the ipsdienol trap monitoring included stands that had sustained impacts from *I. perturbatus* and spruce budworm infestation, harvested openings near log decks/landings, harvested clear-cut openings away from landings, and residual spruce stands that had received no previous significant bark beetle attacks or budworm defoliation. Final results from the combined study have not been tallied. However, preliminary data suggests that dispersing *Ips* beetles are significantly more active near stand openings (in terms of relative numbers of beetles caught) compared to within-stand trap catch numbers. This "edge effect" is quite apparent from the aerial surveys that were completed during 1997. It is hoped that results of the Standard Creek study may be compared to other research data being collected in a University of Alaska-Fairbanks graduate student study begun in 1996.



This page blank.

## SUBMITTING INSECTS AND DISEASES FOR IDENTIFICATION

The following procedures for the collection and shipment of specimens should be used for submitting samples to specialists:

I. Specimen collection:

1. Adequate material should be collected
2. Adequate information should be noted, including the following:
    a. Location of collection
    b. When collected
    c. Who collected the specimen
    d. Host description (species, age, condition, # of affected plants)
    e. Description of area (e.g., old or young forest, bog, urban);
    f. Unusual conditions (e.g., frost, poor soil drainage, misapplication of fertilizers or pesticides?).
3. Personal opinion of the cause of the problem is very helpful.

II. Shipment of specimens:

1. General: Pack specimens in such a manner to protect against breakage.
2. Insects: If sent through the mail, pack so that they withstand rough treatment.
    a. Larvae and other soft-bodied insects should be shipped in small screw-top vials or bottles containing at least 70% isopropyl (rubbing) alcohol. Make certain the bottles are sealed well. Include in each vial adequate information, or a code, relating the sample to the written description and information. Labels inserted in the vial should be written on with pencil or India ink. Do not use a ballpoint pen, as the ink is not permanent.
    b. Pupae and hard-bodied insects may be shipped either in alcohol or in small boxes. Specimens should be placed between layers of tissue paper in the shipping boxes. Pack carefully and make certain that there is very little movement of material within the box. Do not pack insects in cotton.
3. Needle or foliage diseases: Do not ship in plastic bags. Sprinkle lightly with water before wrapping in newspaper. Pack carefully and make sure that there is very little movement of material within the box. Include the above collection information. For spruce and other conifers, include a description of whether current year's-needles, last-year's needles, or old-needles are attacked.
4. Mushrooms and conks (bracket fungi): Do not ship in plastic bags. Either pack and ship immediately, or first air dry and then pack. To pack, wrap specimens in dry newspaper and pack into a shipping box with more newspaper. If on wood, include some of the decayed wood. Be sure to include all collection information.

III. Shipping:

1. Ship as quickly as possible, especially if specimens are fresh and not air-dried. If samples cannot be shipped rapidly, then store in a refrigerator.
2. Include address inside shipping box.
3. Mark on outside: "Fragile: Insect-disease specimens enclosed. For scientific purposes only. No commercial value."

This page blank.

## FOREST INSECT AND DISEASE BIOLOGICAL EVALUATIONS, TECHNICAL REPORTS, AND MISCELLANEOUS PUBLICATIONS

Eglitis, A.; Hennon, P. 1997. Porcupine feeding damage in precommercially thinned conifer stands of central southeast Alaska. Western Journal of Applied Forestry. 12: 115-121.

Hennon, P.E. 1997. Brown crumbly rot. P. 23. In: Hansen, E.M.; Lewis, K.J. Compendium of coniferous diseases. American Phytopathological Society Press. St. Paul, MN. 101 p.

Hennon, P.E. 1997. Pole blight. Pp. 71-72. In: Hansen, E.M.; Lewis, K.J. Compendium of coniferous diseases. American Phytopathological Society Press. St. Paul, MN. 101 p.

Hennon, P.E. 1997. Yellow-cedar decline. Pp. 70-71. In: Hansen, E.M.; Lewis, K.J. Compendium of coniferous diseases. American Phytopathological Society Press. St. Paul, MN. 101 p.

Hennon, P.E.; Harris, A.S. 1997. Annotated bibliography of *Chamaecyparis nootkatensis*. Gen. Tech. Rep. PNW-GTR-413. Portland, OR: U.S. Dep. Agric., Pacific Northwest Research Station. 112 p.

Hennon, P.; Shaw, C. III. 1997. The enigma of yellow-cedar decline: what is killing this long-lived, defensive tree in Alaska? Journal of Forestry. 95(12): 4-10.

Holsten, E.H.; Jeffery, A. (Co-producers). 1997. "The role of disturbance in boreal forest ecosystems": An 18 minute video describing the effects of avalanches, fire, flooding, earthquakes, and spruce beetle outbreaks on successional trends of boreal forest vegetation in south-central Alaska.

Holsten, E.H.; Burnside, R. 1997. Forest Health in Alaska: An Update. Western Forester, Society of American Foresters, Portland, Ore. Vol. 42(4): pg. 8-9.

Holsten, E.H. 1997. Sitka Spruce Weevil (Coleop:Curculionidae; *Pissodes strobi* Hopk.): A Risk to Ornamental and Native Spruce in South-Central Alaska?? *In*: Proceedings of the 16th Alaska Greenhouse and Nursery Conference; Feb. 20-21, 1997; Soldotna, AK. Pg. 25-29.

Matthews, K.; Wittwer, D.; Zogas, K.; Holsten, E.; Trummer, L.; Hennon, P.; Schultz, M.; Burnside, R. 1997. Forest Insect and Disease Conditions in Alaska--1996. USDA Forest Service, Alaska Region, FHM. Gen. Tech. Rep. R10-TP-67. 42 p.

McDonald, Kent A.; Hennon, Paul E.; Stevens, John H.; Green, David W. 1997. Mechanical properties of salvaged dead yellow-cedar in southeast Alaska. Research Paper FPL-RP-565. Madison, WI: U.S. Dep. Agric., Forest Products Lab. 9 p.

Reynolds, K.M.; Holsten, E.H. 1997. SBexpert (Version 2.0) Users Guide: A Knowledge-Based Decision-Support System for Spruce Beetle Management. USDA For. Serv., Pacific Northwest Research Station, General Technical Report PNW-GTR-401. 62 p.

**Bibliography, cont.**

Schulz, B. 1997. Cooper Landing Regeneration Surveys - Preliminary results. USDA Forest Service, Alaska Region. Special Report R10-TP-66. 23pp.

Schulz, B. 1996. Response of residual spruce in beetle-impacted stands in Resurrection Creek drainage, Kenai Peninsula, Alaska. USDA Forest Service, Alaska Region. Tech. Rep. R10-TP-62. 21pp.

Scott, G.M.; D.W. Bormett; N.R. Sutherland; S. Abubakr; E. Lowell. 1996. Pulpability of Beetle-Killed Spruce. USDA For. Serv., Forest Products Laboratory Research Paper FPL-RP-557. 8 pp.

Werner, R.A.; Holsten, E.H. 1977. Dispersal of the Spruce Beetle, *Dendroctonus rufipennis*, and the Engraver Beetle, *Ips perturbatus*, in Alaska. USDA For. Serv. Pacific Northwest Research Station, Research Paper PNW-RP-501. 8 pp.

Willson, M.; Hennon, P.E. 1997. Natural history of skunk cabbage in southeast Alaska. Canadian Journal of Botany. 75: 1022-1025.

## ECOMAP Section Descriptions

The Sections included in this report are briefly described below, along with descriptions of the appropriate Domains, Divisions, and Provinces. The prefix "M" attached to codes represents mountainous Sections where soil and vegetational zones are present. Fire frequency classification at the section level is adopted from Gallant et al (1995). The classification categories are based on frequency of lightning fires and are as follows: very low (< 1 fire/yr), low (1-5 fires/yr), common (6-10 fires/yr), very common (11-20 fires/yr), and frequent (> 20 fires/yr). Types of insect damage reported during the 1997 survey are noted for each Section.

**100 Polar Domain:** Climate is controlled primarily by polar air masses. Winters are severe and total annual precipitation is small.

- **130 Subarctic Division:** Climate has great seasonal range. Permafrost prevails under large areas. Despite low temperatures and long winters, the valleys were not glaciated during the Pleistocene. Boreal forests and open woodlands with abundant lichen predominate.
  - **131 Yukon Intermontaine Taiga Province:** Series of broad valleys covered with alluvial deposits and low mountains and hills. The Province lies between the Brooks and Alaska Ranges, with Yukon, Tanana, Koyukuk, and upper Kuskokwim rivers providing drainage. The climate is semi-arid. Forest vegetation includes white spruce and hardwoods along river bottoms and uplands near rivers, and black spruce dominates on uplands.
    - **131A Yukon Bottomlands Section:** Closed forests of spruce, birch, and aspen on better drained sites, open black spruce forests on wetlands interspersed with willow thickets. Wetlands occupy much of the land cover, and permafrost is wide spread but discontinuous. Wildfire is frequent. Insect damage reported in 1997 includes spruce budworm, larch sawfly, large aspen tortrix, willow defoliation, spruce beetle, and Ips.
    - **131B Kuskokwim Colluvial Plain Section:** Forest vegetation includes spruce-poplar forests, open black spruce woodlands, and flood plain thickets of willow and alder. Wildfire is very common to frequent and river flooding frequent in the spring. Insect damage for 1997 includes larch sawfly, Ips, and willow defoliation. Surveys were hampered by poor visibility due to smoke from wildfires.
    - **M131A Upper Kobuk-Koyukuk Section:** Closed forests of spruce, birch, and aspen occur on well drained sites. Wildfires are common. The only insect damage reported in this Section was larch sawfly.
    - **M131B Nulato Hills Section:** Most of the area supports alpine tundra, but spruce-birch-aspen forests occur at lower elevations. Wildfires are frequent. No insect damage was recorded for the portions covered by the 1997 aerial survey.
    - **M131C Kuskokwim Mountains Section:** Open black spruce forests are abundant, alpine tundra cover the hills. White spruce - paper birch communities predominate on lower hillslopes. Wildfires are frequent. Insect damage recorded this year include larch sawfly, Ips, and willow defoliation.
    - **M131D Nushagak-Lime Hills Section**: Alpine tundra dominates the rounded to flat topped ridges, and spruce, aspen, and birch prevail in the broad and gentle sloping valleys. Wildfires are frequent. No damage was recorded in the areas covered by aerial surveys in 1997.
  - **135 Alaska Range Taiga Province:** This Province is composed of a broad basin surrounded by steep, rugged mountains of the Alaska, Wrangell, and Chugach Ranges. Rivers originate in valley glaciers at high elevations and are often swift and braided with heavy sediment loads. The Copper River is the primary drainage. Forest vegetation includes open black spruce woodlands, with white spruce occurring on better drained soils and along riparian zones in the mountainous Sections.

**135A** **Copper River Basin Section:** The basin consists of rolling to hilly moraines and nearly level alluvial plains that occupy the site of a Pleistocene glacial lake. Elevation is 1000 feet or greater. Open black spruce forests are interspersed with large areas of brushy tundra. White spruce occurs on south-facing gravelly moraines. Cottonwood occurs on large flood plains. Fire occurrence is low, and flooding is an important natural disturbance. Damage reported in the 1997 aerial survey include spruce beetles, Ips, birch defoliation, willow defoliation, large aspen tortix, and flooding.

**M135A** **Northern Chugach Range Section:** Forest vegetation is limited to spruce and hardwoods along the larger rivers. Snow and rock avalanches are common, wildfire occurrence is very low. Insect damage reported include spruce beetle and Ips along river drainage's.

**M135B** **Wrangell Mountain Section:** Forest vegetation occurs, but no portion of this Section was surveyed in 1997.

**M135C** **Alaska Range Section:** Steep mountain ridges are separated by broad valleys, where spruce and hardwood forests occur along riparian zones. Snow avalanches occur frequently, but wildfire occurrence is low. Insect damage reported include spruce beetle, willow defoliation, Ips, and birch defoliation.

**139** **Upper Yukon Taiga Province:** The Province contains the Yukon Flats Section, a flat marshy basin, and the surrounding the rounded mountains and hills. The climate is extreme with large seasonal temperature ranges. Winters are long and cold, and the short summers are hot and dry; some areas at higher elevations are moisture-deficit in summer. Wildfire is very common. Permafrost is semi-continuous, and highly subject to alteration from disturbance.

**M139A** **Ray Mountain Section:** Low mountains and hills to the west of the flats. Permafrost, surface water, hillslope, and wildfire interactions result in a complex plant community mosaic. Forests of white spruce, birch, and aspen dominate the lower slopes in the south and south-facing slopes in the north. Black spruce occurs at higher elevations, on north-facing slopes, and all but steep south-facing slopes. Wildfire is very common to frequent. This year's surveys report damage from birch defoliation, Ips, larch sawfly, and spruce budworm.

**M139B** **Ogilvie Mountain Section:** Forest vegetation occurs, but no portion of this Section was surveyed in 1997.

**M139C** **Dawson Range Section:** This section has steeper rounded ridges with some rugged peaks. Forest vegetation occurs at lower elevations. Open spruce forests are dominated with white spruce, with black spruce sometimes co-dominating. Birch and aspen also occur. Wildfire is very common. Damage reported include Ips, larch sawfly, spruce beetle, cottonwood defoliation, and willow defoliation.

**200** **Humid Temperate Domain:** Climate is influenced by both marine and polar air masses.

**210** **Warm Continental Division:** Distinct seasons with snowy winters and warm summers. Needle-leaf forests are common.

**213** **Alaska Mixed Forest Province:** This Province has smooth and irregular plains and surrounded by high mountains. It is centered around Cook Inlet in south-central Alaska. Climate is transitional between polar and maritime. This is reflected in the range of forest cover types: spruce - hemlock to mixed hardwoods. Permafrost is rare.

**213A** **Bristol Bay Lowlands Section:** Forest vegetation occurs, but no portion of this Section was surveyed in 1997.

**213B** **Cook Inlet Lowlands Section:** This broad basin has been shaped by many glacial events. Spruce/hardwood forests are most widespread across the level to rolling plains. Wildfire occurrence from lightning strikes is low, but fires resulting from human activity are very common. This area is heavily populated and has been influenced by agriculture, urban development, petroleum extraction, and human recreation. The 1997 survey reported damage from spruce beetle, large aspen tortrix, birch, cottonwood, and willow defoliation, spruce needle rust, Ips, and flooding.

**M213A** **Northern Aleutian Range Section:** This section contains steep, rugged mountains of volcanic origin. Large lakes occupy the glaciated valleys. Open spruce forests occur in well drained sites in some valleys and lower hill slopes. Avalanches are common, wildfire occurrence is low. Insect damage reported in 1997 was limited to spruce beetles in the forests adjacent to rivers.

**M213B** **Kenai Mountains Section:** This Section is dominated by the Kenai and western Chugach mountains. The area has been heavily glaciated. Forest vegetation occurs from mid to low elevations and along rivers and coast lines. Avalanches and flooding are important disturbance events. Wildfire occurrence from lightning strikes is low, but fires resulting from human activity are common. Past land clearing activities, including fire, have influenced the present landscape. Damage reported in 1997 includes spruce beetles and Ips.

**240** **Marine Division:** This zone receives abundant rainfall from maritime air masses. Temperature ranges are narrow due to the marine influence.

**244** **Pacific Coastal Icefields Province:** This Province stretches from the Coast Mountains of southeast Alaska through the St. Elias mountains up to the Chugach-Kenai Mountains. Glaciers and icefields cover the higher portions of the mountains. Rock, ice, and alpine vegetation prevails. The lower elevations support some forests of hemlock and Sitka spruce. Willows and black cottonwood are found infrequently along the glacial river beds.

**M244A** **Chugach Range Section:** Alpine vegetation dominates. Forest vegetation is confined to the lowest side-slopes and river bottoms. Hemlock, spruce and cottonwood are predominant. Snow and rock avalanches are common, and flooding events are significant. Wildfire occurrence is very low. Damage reported included spruce beetle, black-headed budworm, and flooding.

**M244B** **St. Elias Range Section:** Alpine tundra dominates, with forest vegetation confined to river drainages, mostly spruce and hardwoods. Avalanches and flooding are major natural disturbances. Wildfire occurrence is very low. Damage due to spruce beetles was reported in 1997.

**M244C** **Boundary Range Section:** This section straddles the international boundary with Canada. Forest vegetation of hemlock, spruce, and cottonwood only occurs along river corridors within mountain passes. Snow avalanches and landslides create large-scale disturbances. Wildfire occurrence is very low. Damages mapped during the 1997 survey include cottonwood leaf beetle, flooding, spruce beetle, windthrow, and porcupine damage.

**245** **Pacific Gulf Coast Forest Province:** This Province consists of fjords and mountainous terrain. The Province has the mildest winters in Alaska and abundant precipitation. Hemlock, Sitka spruce, and cedar dominate the coastal rainforests.

**ECOMAP section descriptions, cont.**

**245A** **Gulf of Alaska Forelands Section:** The coastal lowlands feature alluvial fans, uplifted mudflats, moraine deposits, and river deltas. Spruce-hemlock forests occur on well-drained sites, whereas alder, willow, and birch dominate wetland areas, with cottonwood occurring along major river channels. Glacial outburst floods and earthquakes causing uplift and subsidence are significant disturbances. Strong winds also influence forest vegetation structure. Wildfire is rare. Damage reported this year includes black-headed budworm, spruce beetle, and flooding.

**M245A** **Gulf of Alaska Fjordlands Section:** Islands and headlands with steep cliffs from eroded bedrock characterize this section. They support Sitka spruce and hemlock forests. Landslides and avalanches are common and outer islands are subject to intense winds from winter storms. Wildfire is rare. Damage reported during surveys includes windthrow, flooding, cottonwood defoliation, black-headed budworm, landslide, spruce beetle, and thinning spruce crowns.

**M245B** **Alexander Archipelago Section:** The rugged islands and mountains of southeast Alaska are dominated by rainforests of hemlock, Sitka spruce, and cedar. Wildfires only occur during drought. Landslides and avalanches are frequent in the steeper terrain. The outer islands are subject to extreme winds from winter storms, and so windthrow is common. Damage reported this year includes windthrow, landslides, spruce beetle, hemlock sawfly, porcupine damage, black-headed budworm, spruce needle aphid, and some minor flooding.

---

**References:**


Bailey, R.G. 1995. Description of the ecoregions of the United States. 2nd ed. revised and expanded (1st ed. 1980). Misc. Publ. No. 1391 (rev.), Washington DC. USDA Forest Service. 108p.

Bailey, R.G. 1996. Ecosystem Geography. Springer-Verlag New York, Inc. New York, NY. 204p.

ECOMAP. 1993. National hierarchical framework of ecological units. Unpublished administrative paper. Washington DC: USDA Forest Service. 20 p.

Gallant, A.L., E.F. Binnian, J.M. Omernik, and M.B. Shasby. 1995. Ecoregions of Alaska. USGS Prof. Pap. 1567. Washington DC. USDI Geological Survey. 73p.

McNab, W.H. and P.E. Avers. 1994. Ecological Subregions of the United States: Section Descriptions. WO-WSA 5. Washington DC. USDA Forest Service.

Nowacki, G. and T. Brock. 1995. Ecoregions and Subregions of Alaska. USDA Forest Service - Alaska Region. ECOMAP Ver. 2 (map).

# INFORMATION AVAILABLE FROM STATEWIDE AERIAL SURVEYS

Each year, forest damage surveys are conducted over approximately 25-30 million acres. This annual survey is a cooperative effort of the U.S. Forest Service, State and Private Forestry, Forest Health Protection (S&PF/FHP) and State of Alaska, Department of Natural Resources, Division of Forestry (AK-DNR/DOF) entomologists to assess general forest conditions on Alaska's 129 million acres of forested area. About 25% of Alaska's forested area is covered each summer using fixed-wing aircraft and trained observers to prepare a set of sketch-maps depicting the extent (polygons) of various types of forest damage including recent bark beetle mortality, various hardwood and conifer defoliation, and abiotic damage such as yellow-cedar decline. A number of other damage types are noted including flooding, wind damage, and landslide areas during the survey. The extent of many significant forest tree diseases, such as stem and root decays, is not estimated from aerial surveys since this damage is not visible from aerial surveys.

Forest damage information is sketched onto 1:250,000 scale USGS quadrangle maps. At this scale one inch would equal approximately 8 miles distance on the ground. When specialized surveys are requested by cooperators, larger scale maps are sometimes used for specific areas to provide more detailed assessments. Due to the short Alaska summers, long distances required, high airplane rental costs, and the short time frame when the common pest damage signs and tree symptoms are most evident (i.e., usually only during July and August), sketch mappers must strike a balance of efficiently covering the highest priority areas with available personnel schedules and funding.

Prior to the annual statewide forest conditions survey, letters are sent to various state and federal agency and other landowner partners for survey requests. The federal and state entomologists decide which areas are highest priority from the requests in addition to selecting areas where yearly data are collected to establish trends from the year-to-year mapping efforts. In this way, general trend information is assembled from the sketch-maps for the most significant pests and damage encountered for this annual Conditions Report. The sketch-map information is digitized and put into a computerized Geographic Information System (GIS) for permanent storage and retrieval by users.

Information listed in this Appendix and Appendix E is a sample of the type of products that can be prepared from the statewide surveys and GIS databases that are available. Due to the relatively high cost of mass-producing hard copy materials from the survey data, including colored maps, a number of other map products that are available have not been included with this report. Maps which show the general extent of forest insect damage from the 1997 statewide aerial surveys, landowner boundaries, and other types of map and digital data can be made available in various formats depending on the resources available to the user:

*Map information included in this report: "Forest Insect And Disease Conditions In Alaska-1997"*

**REFER TO APPENDIX E FOR THESE MAPS:**

1. Kenai Peninsula Region Spruce Beetle Activity 1989-1997 Aerial Detection Surveys (8.5"x 11" format), depicting cumulative spruce beetle activity in south-central Alaska, including the Kenai Peninsula, Cook Inlet area to Anchorage and Talkeetna.
2. Kenai Peninsula Region Spruce Beetle Activity 1997 Aerial Detection Survey (8.5"x 11" format.)
3. Copper River Region Major Forest Pests 1989-1997 Aerial Detection Survey (8.5"x 11" format), depicting cumulative spruce beetle and black-headed budworm activity based on aerial detection surveys.
4. Copper River Region Spruce Beetle Activity 1997 Aerial Detection Survey (8.5"x 11" format.)
5. Southeast Alaska Major Forest Pests 1989-1997 Aerial Detection Survey (8.5"x 11" format), depicting cumulative spruce beetle, spruce budworm, and black-headed budworm activity from aerial detection surveys.

Click here to view Appendix E maps.

**Additional Map and GIS Products Available by Request:**

1. Individual GIS quadrangle maps for 1997 surveys on 11" x 17" format (request individual map(s)); maps will be second generation copies from master proof set--SEE USGS MAP LOCATOR FOR SPECIFIC AREA OF INTEREST.
2. Digital file information in a miniature quad format showing individual pest damage, major waterways and USGS place names (appropriate data disk must be provided by user.)
3. Digital data file of 1997 forest damage coverage in Arc Info (ESRI, Inc.) format --requires a specific written or electronic request if provided through AK-DNR/DOF (nominal fee may be required)
4. Digital forest insect damage data is also available from an internet file transfer site (ftp) maintained for the Alaska Department of Natural Resources at the Alaska Geographic Data Clearinghouse: <www.agdc.usgs.gov/data/state/dnr/beetle.html>. The site will be updated periodically with additional forest damage and forest health coverages.
5. Cumulative forest damage or specific-purpose damage maps prepared from AK/DOF geographic information system database (specific written or electronic request required; a fee may be assessed depending on specific project(s) or map products needed)

**Submit data and map information requests to:**

Roger Burnside, Entomologist
State of Alaska, Department of Natural Resources
Division of Forestry
3601 C Street, Suite 1034
Anchorage, AK 99503-5937
phone: (907) 269-8460
fax: (907) 561-6659
E-mail: roger_burnside@dnr.state.ak.us

Kathy Matthews, Bio-technician
USDA Forest Service, State and Private Forestry
Forest Health Protection
3301 C Street, Suite 522
Anchorage, AK 99503-3956
phone: (907) 271-2574
fax: (907) 271-2897
E-mail:
Matthews_Kathleen/r10_chugach@fs.fed.us

# World Wide Web

Forest insect and disease survey information and general forest health information:

www.agdc.usgs.gov/data/state/dnr/beetle.html

Digital forest insect damage data from the 1997 aerial survey. This is a file transfer site (ftp) maintained for the Alaska Department of Natural Resources at the Alaska Geographic Data Clearinghouse. The site will be updated periodically with prior years forest damage and forest health coverages.

www.dnr.state.ak.us/forestry/index.htm

An Alaska Department of Natural Resources, Division of Forestry home page was assembled in late 1996 for the fire and resource management programs. The site is currently under development but information is available on several of Forestry's programs, including forest health and forest insect surveys. Information will be updated as personnel and funding permit. Users may check the site for information relating to forest health. A link is provided on the home page for accessing forest health and insect survey information and to send an e-mail message. The URL for this insect and disease link is <www.dnr.state.ak.us/forestry/res_faq.htm>.

www.alaska.net/~cnfspf/fhpr10.htm

An USDA Forest Service, State and Private Forestry, Alaska Region Home-page was developed and put on-line in the spring of 1997. The extensive Forest Health Protection section presents a program overview, who's who in Forest Health Protection, current forest insect and disease conditions throughout the state, sections on spruce bark beetle biology, control, impacts, Sbexpert software, Alaska forest diseases, as well as an abbreviated bibliography of Forest Health Management publications. This Home Page is periodically updated and is a good source of information on Alaska Forest Health issues.

**USGS Quadrangle Areas Flown During 1997 Statewide Aerial Surveys:**

* Quads with no insect damage for 1997 is marked with an asterisk.

South-central Alaska

Afognak
Anchorage
Bering Glacier
Blying Sound
Cordova
Gulkana
Kenai
Kodiak
McCarthy
Seldovia
Seward
Talkeetna
Talkeetna Mts.
Tyonek
Valdez

Interior Alaska

Bettles*
Big Delta
Dillingham*
Fairbanks
Healy
Holy Cross*
Hughes*
Iliamna
Kantishna River
Kateel River*
Lake Clark*
Lime Hills*
Livengood
McGrath

Interior Alaska, cont.

Medfra
Melozitna
Mt. Hayes
Mt. McKinley
Nabesna
Nulato
Ophir*
Ruby
Russian Mission*
Shungnak*
Sleetmute*
Survey Pass*
Tanacross
Tanana
Taylor Mountains*
Unalakleet*
Wiseman*

Southeast Alaska

Bradfield Canal
Craig
Dixon Entrance
Juneau
Ketchikan
Mt. Fairweather
Petersburg
Port Alexander
Sitka
Skagway
Sumdum
Taku River
Yakutat

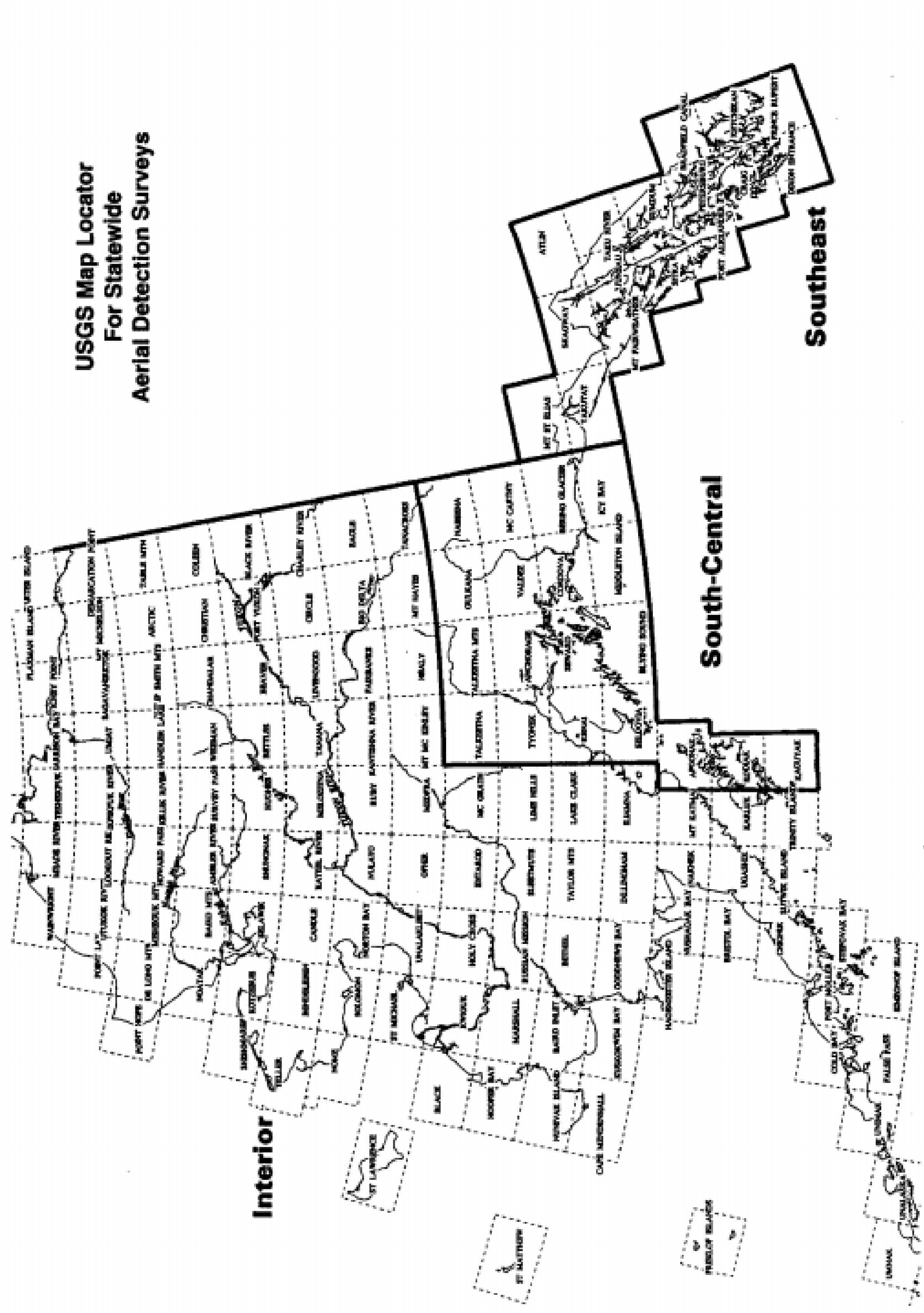
**Tree damage codes used in 1989-1997 aerial surveys and GIS map products.**

* The codes used for 1997 aerial surveys and GIS maps are marked with an asterisk.

| | | | |
|---|---|---|---|
| ALB | Aspen leaf blight | IPB* | IPS and SPB* |
| ALR | Alder leafroller | IPS* | Ips engraver beetle* |
| ASD | Aspen defoliation | LAB | Larch beetle |
| ASF | Alder sawfly | LAS* | Larch sawfly* |
| BAP* | Birch aphid* | LAT* | Large aspen tortrix* |
| BHB* | Black-headed budworm* | OUT* | Out (island of no damage)* |
| BHS | BHB/HSF | POD* | Porcupine damage* |
| BID* | Birch defoliation* | SBM* | Spruce/Larch budmoth* |
| BLR | Birch leaf roller | SBR* | Spruce broom rust* |
| BSB | BHB/SPB | SBW* | Spruce budworm* |
| CDL | Cedar decline | SLD* | Landslide* |
| CLB* | Cottonwood leaf beetle* | SMB | Spear-marked black moth |
| CLM | Cottonwood leaf miner | SNA* | Spruce needle aphid* |
| COD* | Conifer defoliation* | SNR* | Spruce needle rust* |
| CTB | Conifer top breakage | SPA | Spruce aphid |
| CWD* | Cottonwood defoliation* | SPBL* | Spruce beetle (“light “ damage)* |
| CWW | CWD and WID | SPBM* | Spruce beetle (“moderate” damage)* |
| FIR* | Fire damage* | SPBH* | Spruce beetle (“heavy” damage)* |
| FLO* | Flooding/high-water damage* | SPC | SPB and CLB |
| HCK | Hemlock canker | WID* | Willow defoliation* |
| HLO | Hemlock looper | WNT* | Winter damage* |
| HSF* | Hemlock sawfly* | WTH* | Windthrow/Blowdown* |
| HTB | Hardwood top breakage | | |
| HWD | Hardwood defoliation | | |

Note: For all insect activity, the 4th character (L, M, or H) denotes intensity.

L = 1%-10% of the area affected.
M = 11%-30% of the area affected.
H = over 30% of the area affected.


USGS Map Locator
For Statewide
Aerial Detection Surveys
Interior
South-Central
Southeast