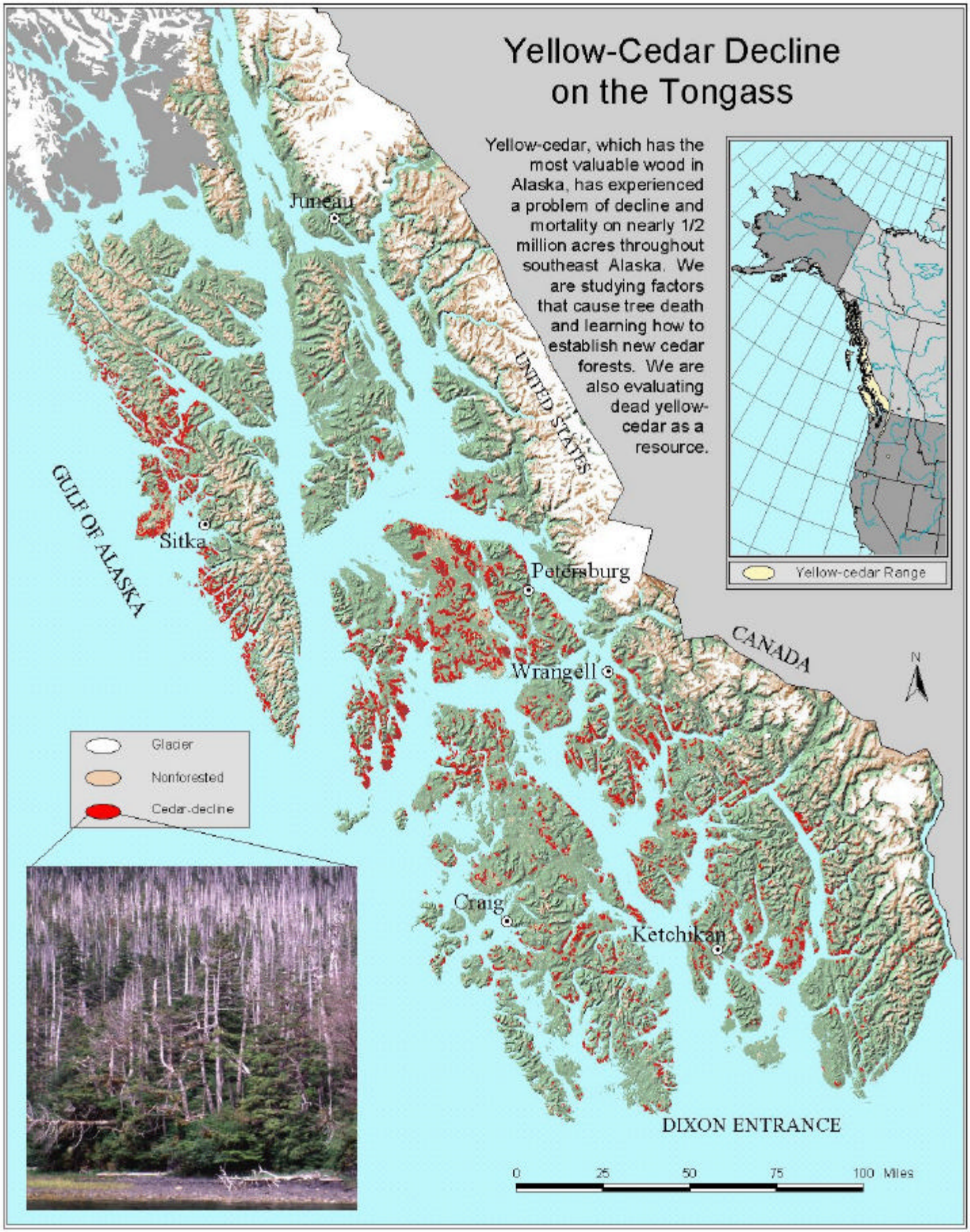

Yellow-Cedar Decline on the Tongass
Yellow-cedar, which has the most valuable wood in Alaska, has experienced a problem of decline and mortality on nearly 1/2 million acres throughout southeast Alaska. We are studying factors that cause tree death and learning how to establish new cedar forests. We are also evaluating dead yellow-cedar as a resource.
Yellow-cedar Range
Juneau
Sitka
Petersburg
Wrangell
Craig
Ketchikan
GULF OF ALASKA
UNITED STATES
CANADA
DIXON ENTRANCE
N
Glacier
Nonforested
Cedar-decline
0 25 50 75 100 Miles

Table 5. Acreage affected by yellow-cedar decline in southeast Alaska in 1999 by ownership

	Acres
NATIONAL FOREST LAND	***449,395***
Chatham Area Total	***116,451***
Juneau Ranger District	865
Hoonah Ranger District	1,058
Sitka Ranger District	
Chichagof I	33,489
Baranof I	48,712
Kruzof I	26,908
Sub-total	109,109
Admiralty Island Nat'l Mon. Wilderness	5,419
Stikine Area Total	***205,725***
Petersburg Ranger District	
Kupreanof I	82,226
Kuiu I	65,566
Mitkof I	5,884
Woewodski I	2,315
Mainland	6,710
Sub-total	162,701
Wrangell Ranger District	
Etolin I	17,051
Wrangell I	9,147
Zarembo I	3,969
Woronofski I	441
Mainland	12,416
Sub-total	43,024
Ketchikan Area Total	***127,219***
Craig Ranger District	
Prince of Wales I	27,580
Dall I and Long I	901
Sub-total	28,481
Ketchikan Ranger District	
Revillagigedo I	13,786
Gravina I	809
Mainland	13,765
Sub-total	28,360

	Acres
Ketchikan Area (continued)	
Thorne Bay Ranger District	
Prince of Wales I	30,304
Kosciusko I	11,862
Heceta I	1,044
Sub-total	43,210
Misty Fjords Nat'l Mon. Wilderness	
Revillagigedo I	8,998
Mainland	18,170
Sub-total	27,168
NATIVE LAND	***20,462***
Prince of Wales I	9,377
Dall and Long I	675
Kupreanof I	5,061
Baranof and Kruzof I	390
Chichagof I	714
Revillagigedo I	2,285
Annette I	984
Kuiu I	98
Mainland	878
STATE & PRIVATE LAND	***23,563***
Admiralty I	9
Baranof I	3,100
Dall and Long I	62
Chichagof I	1,142
Gravina I	1,317
Mitkof I	1,678
Kosciusko I	548
Kuiu I	897
Kupreanof I	1,687
Prince of Wales I	4,536
Wrangell area	2,101
Revillagigedo	3,742
Kruzof I	299
Other Mainland	2,445
Other Federal	***323***
Baranof I	323
Total Land Affected	***493,743****

*Acreage by ownership was tabulated using Alaska land status data from ADNR. In prior years a different ownership layer was used to tabulate this information. Other changes in acreage figures are due to a change in the resource, refined sketch-mapping or changes in GIS techniques.

Water Damage

Flood damage was noted on over 2500 acres in scattered locations across the state. In south-central and interior Alaska, flood damage occurs annually to conifer and hardwood stands adjacent to rivers and lakes.

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 and root flaring, 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 in many areas of 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, shallow soils, and a triggering mechanism during growth release (e.g., some stand management treatments). 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 sometimes is no longer outwardly visible in 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).

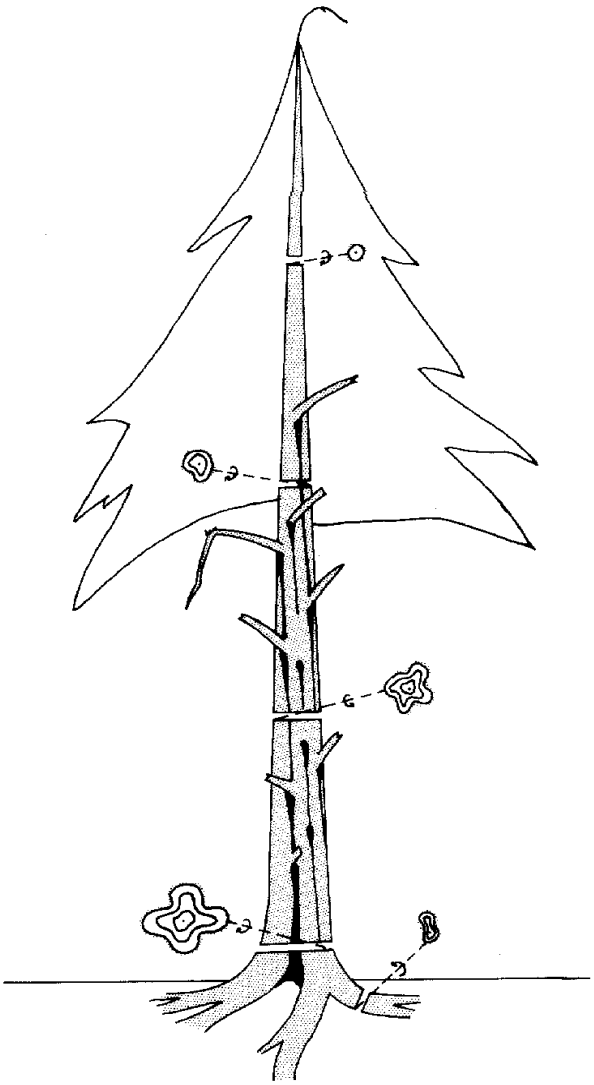


Figure 30. Hemlock Fluting Branches disrupt the vertical flow of carbohydrate in the stem causing annual rings to become asymmetrical. Flutes originate beneath decadent branches and extend downward, forming long grooves where other branches are intersected. ***(Figure and caption from Julin, K.R.; Farr, W.A. 1989. Stem Fluting of Western Hemlock in Southeast Alaska).***

Porcupine

Erethizon dorsatum

Porcupines cause severe damage to Sitka spruce and western hemlock trees 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). 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. The majority of yellow-cedar trees in some stands have basal wounds from bear feeding. 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 may 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 and wounding tree boles. 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 branches or tree tops greater than 12 feet tall are generally out of reach and escape browsing damage. Browsing also occurs on the bole of live trees, particularly aspen and willow. Heavy, repeated browsing results in stunted malformed stems, wounds, and mortality. Wood decay fungi are known to invade trunk wounds caused by moose.

Snowshoe Hare

***Lepus* sp.**

Bole wounds, terminal and lateral bud damage, and seedling mortality were attributed to browsing by snowshoe hares on hardwoods and conifers in the interior. Old damage to mature trees and new damage to seedlings was evident in surveys of pre-commercially thinned white spruce stands near Tok. In the past, hare browsing of the terminal and lateral buds killed the main stem leader; the characteristic angled browse mark is still evident on the dead leader. Live mature trees retain the dead leader but have a pronounced stem crook at the point where a lateral branch became dominant following leader death. The dead leaders provided an infection court for heart rot by *Phellinus chrysoloma*. New terminal and lateral bud browsing was evident on white spruce, paper birch, and aspen seedlings across the Interior. Recovery potential of trees following severe browsing in not known.

APPENDICES

APPENDIX A

INTEGRATED PEST MANAGEMENT

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:

- 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. 1999 IPM Technicians were located in Fairbanks, Delta, Palmer, Anchorage, and Soldotna. The Anchorage office had two full time technicians; the remaining locations had one seasonal IPM Technician from May through the end of September. The total recorded client contacts reached well over 4500; which were more than 50% of all contacts made by Cooperative Extension. The 1999 Technicians conducted more than 1,200 educational contacts including workshops and more than forty media contacts (newspaper articles, television and radio "spots") and more than 300 site visits with more than 2,500 clients assisted via phone calls and walk-in requests. More than 50% of the IPM Technician activities occurred in the Anchorage Bowl; home to more than 40% of the state population. In addition, there is now an IPM Technician Home Page <http://www.go2net.org/pest>. This home-page describes the program and has a wealth of IPM information pertinent to Alaska.

- A spruce beetle antiaggregant field study utilizing Lindgren funnel traps was undertaken in the Anchorage Bowl in 1999 with the help of the Alaska Cooperative Extension IPM Technicians. MCH, the antiaggregant of the spruce beetle, has shown promise in reducing the number of successful attacks on standing trees. However, MCH is currently formulated and available in a bubble cap release system. The release rate of MCH bubble caps is mainly determined by ambient temperature. Such a system has proved problematic in past field studies. A new release system has been developed and is not dependent on temperature for the elution of MCH. The 1999 funnel trap study utilizing the new release system proved quite effective. We will test this release device as to its effectiveness in reducing attacks on standing spruce next summer.

- In S.L. Wood's 1982 Monograph [The Bark and Ambrosia Beetles of North and Central America], there is a reference that *Ips perturbatus* is very similar to *Ips typographus*, commonly referred to as the European spruce beetle. *I. perturbatus* has always been a sporadic tree killer of white spruce in interior Alaska In recent years, however, it has caused extensive mortality of small diameter spruce on the Kenai Peninsula. The specific semiochemicals of *I. perturbatus* are currently being identified. Past pheromone trapping, using *cis*-verbenol and racemic ipsdienol, have resulted in heavy trap catches. Previous research has shown that ipsenol will reduce trap catches of *I. perturbatus* and may serve as an antiaggregant. In 1999, we installed a field study utilizing ipsenol in a bubble cap formulation with the hopes of reducing *Ips* attacks and brood development in fresh logging debris. The results of the study show the opposite; more attacks occurred on the treated plots than the untreated checks. Further trapping studies showed that the addition of ipsenol to ipsdienol and *cis*-verbenol significantly enhances trap catches. We have now determined that the attractant pheromone is a tertiary blend. Next year's field studies will focus on the role of verbenone (identified as being produced by *I. perturbatus*) as an antiaggregant.

- Yellow-cedar wood is often devalued because of dark-staining. Some evidence suggests that insects are involved in introducing a dark-staining fungus. Wood boring insect tunnels were found in association with the dark stained areas. Since these wood wasps are believed to have only a one year life cycle, many of them can be reared from

infested logs and isolations can be made from the sac at the base of the ovipositor (of the females). It can then be determined if dark-stain fungi are being inoculated into trees at the time of egg laying. Wood wasps in other tree species are known to introduce decay fungi. Isolations reveled *Sporidesmium* sp. and *Phialophora melinii* as two of the most common dark fungi.

- The spread and intensification of hemlock dwarf mistletoe is currently under study in even-aged stands, stands that have received different selective harvest treatments, and stands that experienced extensive wind damage 115 years ago. Plots within these stands have been used to quantify the short, medium, and long-term effects of the disease under different selective harvesting strategies. Results show a substantial difference by stand management. Impact of the disease is light to absent in later developmental stages of single-cohort stands but can be severe under some forms of selective harvesting. This indicates a remarkable range of disease severity that can be related to simple measures of inoculum load at the time of harvest. Distances and intensities of spread are being determined to provide information so that managers can design appropriate harvesting scenarios in relation to expected disease levels.

APPENDIX B

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."

APPENDIX C

BIOLOGICAL EVALUATIONS, TECHNICAL REPORTS, AND PUBLICATIONS

Degroot, R.C.; Woodward, B.; Hennon P.E. 2000. Natural decay resistance of heartwood from dead, standing yellow-cedar trees: laboratory evaluations. Forest Products Journal 50: 53-59.

Hennon, P.E. 1999. *Tsuga heterophylla*. Enzyklopadie der Holzgewachse, Landsberg, Germany: Ecomed Verlagsgesellchaft. 17: 1-8.

Hennon, Paul E.; McClellan, Michael H. 1999. Heart rot and other causes of small-scale disturbance in the temperate rain forests of southeast Alaska. In: Trummer, L., comp. Proceedings of the forty-sixth Western International Forest Disease Work Conference; 1998 Sep. 28-Oct. 2; Reno, NV. Anchorage, AK: U.S. Dep. Agric., For. Ser.: 97-105.

Hennon, Paul; Wittwer, Dustin; Stevens, John. 1999. Evaluating the Dead Yellow-cedar Resource on the Tongass National Forest. Alaska value-added forest products. Sitka, AK: U.S. Dep. Agric., For. Ser., Pac. NW Res. Sta. Sept 27-28, 1999. Sitka Alaska. Poster.

Holsten, E.H. 1999. *Ips* HTML Text Book; **www.fs.fed.us/r10/spf/fhpr10.htm**

Holsten, E.H.; Gibson, K.; Munson, S. and R. Thier. 1999. The Spruce Beetle. FI&DL No. 127 (revised), USDA For. Serv. 12 pp.

Schultz, M.E.; Hennon, P.E.; and D. Wittwer. 1999. Yellow-Cedar Heartwood Stain: What causes the concentric bands of stained wood? In: 1999 Joint Proceedings of the Western International Forest Disease and Western Forest Insect Work Conference, Breckenridge, CO. (in press)

Schultz, M.E.; Hennon, P.E.; and D. Wittwer. 1999. Spruce beetle and plant succession in the glacial rebound areas of Glacier Bay National Park. In: 1999 Joint Proceedings of the Western International Forest Disease and Western Forest Insect Work Conference, Breckenridge, CO. (in press).

Thistle, H.W.; Shea, P.; Holsten, E.; and D. Quilici. 1998. Pheromone dispersion in the canopy trunk space. In: The 1998 Brighton Conference: Pest and Disease-Proceedings of an International Conference held at The Brighton Centre & The Stakis Brighton Metropole Hotel, Brighton, UK, 16-19 November 1998.

Trummer, L.M.; Hennon, P.E.; Hansen, E.M.; Muir, P. 1998. Modeling the incidence and severity of hemlock dwarf mistletoe in 110-year old wind-disturbed forests of southeast Alaska. Can. J. For. Res. 28: 1501-1508.

Trummer, L. 1999. Tomentosus root rot. USDA Forest Service, Alaska Region Leaflet, R10-TP-80. Pamphlet, color illus.

Trummer, L. 1999. The artillery fungus, a mulch problem in Alaska? USDA Forest Service, Alaska Region Forest Health Protection Biolog. Eval. R10-TP-81. 5p.

Trummer, L. and Ott, R. 1999. Decay of white spruce in pre-commercially thinned stands in Tok, Alaska. USDA Forest Service, Alaska Region Forest Health Protection Biolog. Eval. R10-TP-78. 12p.

Wittwer, D.; Matthews, K.; Zogas, K.; Trummer, L.; Holsten, E.; Schulz, B.; Hennon, P.; Schultz, M.; Riggs, J.; Burnside, R. 1998. Forest Insect and Disease Conditions in Alaska--1998. USDA Forest Service, Alaska Region, FHM. Gen. Tech. Rep. R10-TP-74. 57 p.

Zogas, K., and E.H. Holsten. 1999. Bibliography/Alaska Region Forest Health Protection. USDA Forest Service, Alaska Region, FHP Technical Report R10-TP-79. 142 pp.(electronic version available at: www.fs.fed.us/r10/spf/fhpr10.htm

APPENDIX D

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 vegetation 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 (less than 1 fire/year), low (1-5 fires/year), common (6-10 fires/year), very common (11-20 fires/year), and frequent (more than 20 fires/year). Typical insect damage 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.

120 Arctic Division: Along the northern fringes of North America, with very short, cool summers and long, severe winters. Soil derived from mechanical breakup of rock with little to no chemical alteration. Permafrost layer can be up to 1000 feet in depth, with seasonal thaw reaching only 4 - 24 inches below the surface. Vegetation is dominated by grasses, sedges, lichens, and willow shrubs. Forest vegetation occurs only in the most southern areas.

125 Brooks Range Tundra Province: The Brooks Range is a northern extension of the Rocky Mountains. The Province is characterized rugged, deeply dissected mountains carved from uplifted and folded sedimentary rock, broad u-shaped valleys, and moraine topography of rolling plateaus and foothills.

M125A Brooks Range Mountain Section: The arctic climate and unstable slopes limit vegetation to dwarf scrub willow and lichen throughout most of the region. Sparse forest vegetation is found along rivers and flood plains. White spruce, birch, aspen, black spruce and balsam poplar occur in the most southern portions of the Section. Wildfires are fairly common. Defoliators, bark beetles and needle rust have been noted.

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 Intermontane 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 the past includes spruce, larch, aspen, and willow defoliators along with bark beetles.

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. Surveys can hampered by poor visibility due to smoke from wildfires. Insect damage includes larch, aspen, and willow defoliation, and *Ips*.

M131A Upper Kobuk-Koyukuk Section: Forests of white and black spruce, birch, and aspen occur on well drained sites. Black spruce and tamarack are associated with wet sites. Wildfires are common. Larch sawfly has been reported in this section.

M131B Nulato Hills Section: Most of the area supports alpine tundra, but spruce-birch-aspen forests occur at lower elevations. Wildfires are frequent. Bark beetles have been active here.

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. Defoliators and bark beetles have been observed.

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. Bark beetles and defoliators have been reported in the past.

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 can include bark beetles, defoliation, 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. Damage from bark beetles along river drainages has been reported.

M135B Wrangell Mountain Section: This section is dominated by steep rugged mountains of volcanic origin that have been covered by ice fields and glaciers. Most slopes lack vegetation. Forests of white spruce, birch or aspen occur on broad ridges, valleys, and hilly moraines at lower elevations. Willow and alder are important shrubs. Wildfire occurrence is very low. Defoliators and bark beetles can be active.

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 bark beetles and 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.

139A Yukon Flats Section: The flat, marshy basin has numerous braided, meandering streams, thaw and oxbow lakes. The lowest parts of the flood plains are poorly drained, but the natural river levees are better drained. Permafrost is present except for beneath rivers and large lakes. White spruce is found on well drained sites, black spruce where drainage is poor. Aspen and poplar occur on flood plains, willow and alder are found in the understory and in the tall scrub communities. Flooding and wildfire are both common. Bark beetles and defoliators can occur.

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. Damage from insects can include bark beetles and defoliators of both conifers and hardwoods.

M139B Ogilvie Mountain Section: Flat-topped hills eroded from former plains and pediment slopes. Karst topography is common. Forest communities occur on lower

hillslopes and valleys. Permafrost is common. White spruce grow in well drained valleys and protected sites. Aspen and poplar are on well drained warmer sites. Mixed forests on poorly drained sites are dominated by black spruce and birch. Wildfire is less common. Defoliators and bark beetles can occur.

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 bark beetles, larch sawfly, and hardwood 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: The rolling terrain developed from moraine deposits. Soil texture is coarse near the mountains, becoming finer near the coast. Dwarf scrub communities dominate, but broadleaf and mixed forest stands occur along flood plains. Birch, poplar, white spruce, willow and alder are present. Wildfire occurrence is low. Defoliators are occasional.

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. Damage from bark beetles, defoliators, foliar diseases, and flooding are common. Exotic pests are reported here more than anywhere else in Alaska.

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. Bark beetles have impacted much of the spruce forests. Cottonwood defoliators can also occur.

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. Bark beetles and defoliators occur.

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 from spruce beetle, conifer defoliators, and flooding has been reported.

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 from spruce beetles and defoliators can occur.

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. Damage can include defoliators, flooding, spruce beetle, windthrow, and porcupine feeding.

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.

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 can include 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 includes windthrow, flooding, cottonwood defoliation, conifer defoliation, 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. Other damage includes spruce beetle, conifer defoliation, porcupine damage, and 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).

APPENDIX E

WORLD WIDE WEB LINKS

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

http://www.fs.fed.us/r10/spf/fhpr10.htm
USFS, State & Private Forestry, Forest Health Protection site for Alaska with information on Alaskan insects & diseases, bibliography listing, and links to other Forest Health sites. The section presents a program overview, personnel information, current forest insect and disease conditions throughout the state, forest insect and disease biology, control, impacts, Sbexpert software and other Forest Health issues. This Home Page is periodically updated and is a good source of information on Alaska Forest Health issues.

http://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 **http://www.dnr.state.ak.us/forestry/res_faq.htm.**

http://www.asgdc.state.ak.us
This is the **State of Alaska, Department of Natural Resources' Geographic Data Clearinghouse site** that is directly patterned and linked to the AGDC site maintained at the U. S. Geological Survey, EROS (Earth Resource Observation Satellite) field office in Anchorage--SEE AGDC link below. The State of Alaska-maintained section of this site contains data layers information in the form of metadata, or "data about the data", that describe the content, quality, condition, and other characteristics of the data. The metadata is compliant with federal geographic data committee (FGDC) standards. For example, data on land status, transportation, physical boundaries—such as coastline, conservation units, etc., and links to state resource information (e.g., forest pest damage surveys, Exxon Valdez restoration data, CIIMMS) and links to other agency forest pest and forest health information and data can be found here. The site is not complete since statewide participation for data submission and access links does not exist at this time, however, the goal is to make this a clearinghouse node for state and local agencies. One example of a clearinghouse node, which does presently exist for data about the Kenai Peninsula that has fairly complete agency participation, is the CIIMMS (Cook Inlet Information Management & Monitoring System) site that can be found at **http://www.dec.state.ak.us/ciimms/**

http://agdc.usgs.gov
The **Alaska Geospatial Data Clearinghouse** is a component of the **National Spatial Data Infrastructure (NSDI)**. The Clearinghouse provides a pathway to find geospatial referenced data and associated metadata. The site is a link to data available from a multiple of federal, state and local agencies. The site is currently administered at the U.S. Geological Survey, EROS field office in Anchorage. From this website the Forest Health Monitoring Clearinghouse can be reached.

http://agdc.usgs.gov/data/projects/fhm
The **Forest Health Monitoring Clearinghouse** provides special resource databases of forest health related information to land managers, scientists, and the general public. Fourteen statewide data layers are available for downloading, including Vegetation/land cover, ECOMAP and Ecoregions, Wetlands Inventory, Timber Harvest and other disturbances, Yearly Insect and Disease Damage, Fire History, Fire Protection Zones, Fire Management Boundaries, Fire Fuels Models, Land Status/Ownership, Elevation, Hydrography, Soils, and Permafrost.

http://www.fs.fed.us/r6/nr/fid/fidls/fidl127.htm
An USDA Forest Service Oregon/Washington Home-page. This is a link to the **FIDL publication #127 on the Spruce Beetle** This publication has been recently revised nationally by the U.S. Forest Service and is available in brochure form.

APPENDIX E

http://www.go2net.org/pest
There is now an **Integrated Pest Management** Technician Home-page. This home-page describes the program and has a wealth of IPM information pertinent to Alaska.

http://www.state.ak.us/local/akpages/FISH.GAME/habitat/geninfo/forestry/INFEST/infesthome.htm
The **Interagency Forest Ecology Study Team (INFEST)** home-page. This site has ecological information pertaining to wildlife and forests, spruce bark beetle, basic silvics, and other Alaska ecosystem considerations.

http://willow.ncfes.umn.edu/fhm/fhm_hp.htm
The **National Forest Health Monitoring** Home Page. Forest Health Monitoring is a national program administered by the U.S. Forest Service and member states. FHM is designed to determine the status, changes, and trends in indicators of forest condition on an annual basis. The State of Alaska provides information to the program, including its annual forest pest damage database, but is not yet a formal member. Links can also be found on this site to other forest health data and program contacts for USFS regional offices and the states that have provided data to the program.

http://www.bugwood.caes.uga.edu
A site maintained by the University of Georgia on forest and **urban pests**, including a good section on **bark beetles**. This is just one example of some of the insect and disease information resources that can be found on the World Wide Web.

http://www.borough.kenai.ak.us/sprucebeetle/default.htm
Kenai Peninsula Borough Spruce Bark Beetle Web Site. This site supplies a direct link to the Kenai Peninsula Borough's Ecosystem Level **Vegetation Mapping Initiative (ELVMI).** This initiative is a vegetation mapping project to provide detailed vegetation mapping information to support fire risk and hazard management in the aftermath of a major spruce beetle epidemic on the Kenai Peninsula. The site gives a progress update on the mapping project, which is designed to produce a forest health/hazard map and GIS data base.

APPENDIX F

INFORMATION AVAILABLE FROM STATEWIDE AERIAL SURVEYS

Each year, forest damage surveys are conducted over approximately 30 million acres. This annual survey is a cooperative effort between 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 (AKDNR/DOF) forest health staffs 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, are not estimated from aerial surveys since this damage is not visible from aerial surveys as compared to the pronounced red topped crowns of bark beetle-killed trees.

In this way, forest damage information is sketched on 1:250,000 scale USGS quadrangle maps at a relatively small scale. For example, at this scale one inch would equal approximately 8 miles distance on the ground. When cooperators request specialized surveys, 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 to efficiently cover 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 nominations. The federal and state biological technicians and entomologists decide which areas are highest priority from the nominations. In addition, areas are selected where several years' data are collected to establish trends from the year-to-year mapping efforts. In this way, general damage trend information is assembled for the most significant pests and compiled in this annual Conditions Report. The sketch-map information is also digitized and put into a computerized Geographic Information System (GIS) for more permanent storage and retrieval by users.

Information listed in this Appendix is a sample of the types 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. In addition, maps which show the general extent of forest insect damage from 1999 and previous 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:

Submit data and map information requests to:

Roger Burnside, Entomologist
State of Alaska Department of Natural Resources
Division of Forestry Central Office
Resource Section-Forest Health
550 W. 7th Avenue, Suite 1450
Anchorage, AK 99501-3566
Phone: (907) 269-8460
Fax: (907) 269-8902
E-mail: roger_burnside@dnr.state.ak.us

Kathy Matthews, Biotechnician
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: kmatthews03@fs.fed.us

APPENDIX F

Map information included in this report: "Forest Insect And Disease Conditions In Alaska -1999"

- **Aerial Detection Survey, Significant Pest Activity,** 11x17 in. format, depicting spruce beetle, *Ips*, larch beetle, larch sawfly defoliation, willow defoliation and cedar decline "hot spots" (color; showing enhanced representation of damage areas).

- **1999 Alaska Forest Damage Surveys Flight Lines and Major Alaska Landownership Blocks** (includes table listing acres surveyed by landowner based on flight lines flown for the 1999 aerial surveys).

- **Kenai Peninsula Region Spruce Beetle Activity 1994-1999**, 8 ½ x 11 in. format, depicting sequential year-by-year spruce beetle activity in south-central Alaska, including the Kenai Peninsula, Cook Inlet area to Anchorage & Talkeetna (includes vegetation base layer).

- **Copper River Region Spruce Beetle Impact**, 8 ½ x 11 in. format, depicting 1999 damage in red and prior damage, 1989-1998 in yellow (includes color shaded relief base showing extent of forest landscape and sample photos of spruce beetle impact).

- **Southeast Alaska Cedar Decline 1999 Aerial Detection Surveys**, 8 ½ x 11 in. format, depicting cumulative Alaska yellow-cedar decline over several years (includes a sample photo of cedar decline. Forested areas are delineated with color shaded relief background)

[Map data for maps provided by USFS/S&PF and AKDNR, Anchorage; cedar decline data provided by USFS/S&PF, Juneau]

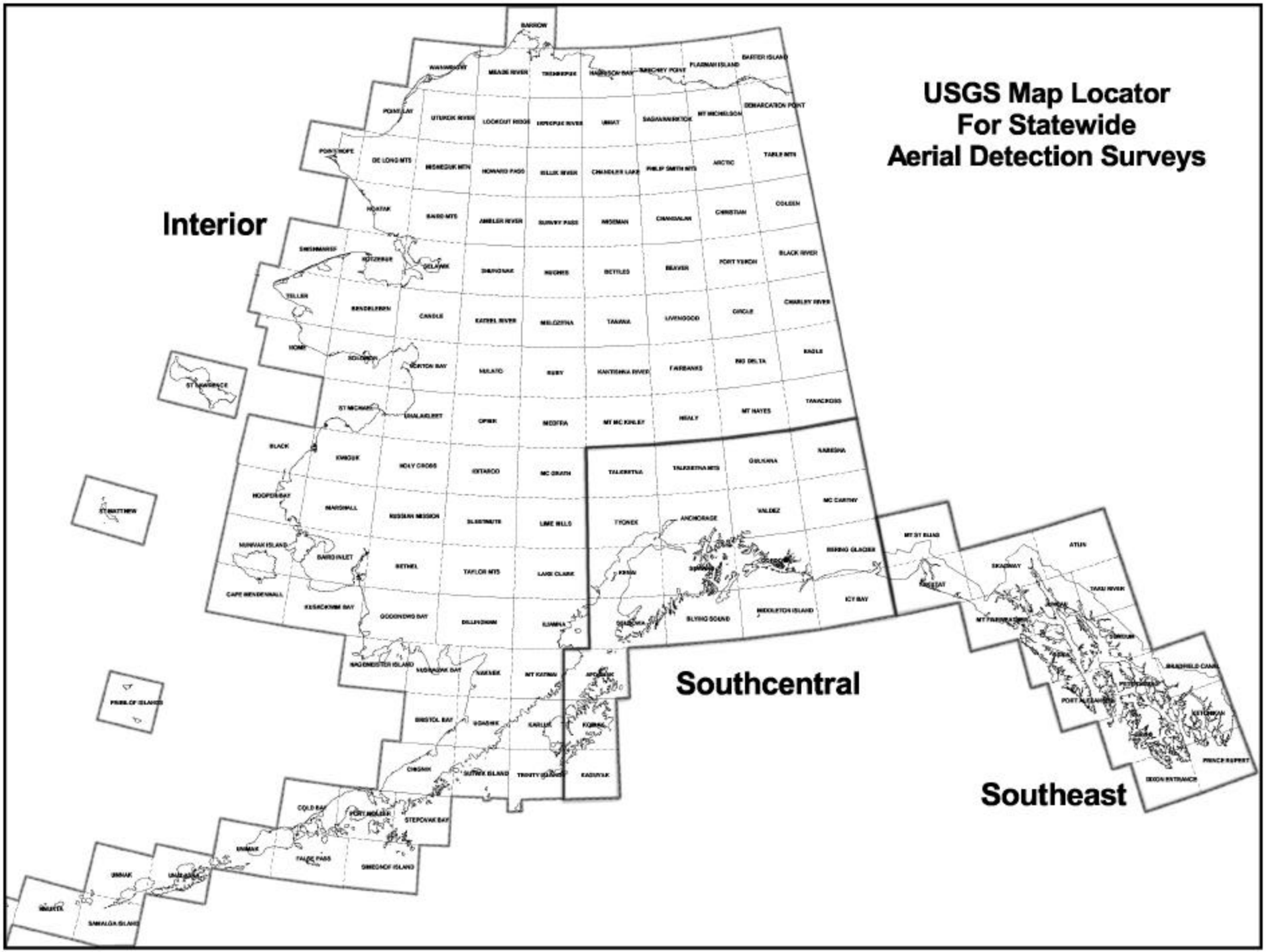
Map and GIS Products Available Upon Request:

1. Digital data file of 1999 forest damage coverage in ArcInfo cover or ArcView shapefile(ESRI, Inc.) format. GIS data files are available at the following URL: **http://agdc.usgs.gov/data/projects/fhm/**.

2. An electronic version of this report, including maps and images, will be available at the Alaska USFS, State & Private Forestry, Forest Health Protection web site (URL: **http://www.fs.fed.us/r10/spf/fhpr10.htm).**

3. Cumulative forest damage or specific-purpose damage maps prepared from AK/DOF or AK USFS, S&PF, FHP geographic information system database.

4. Forest Insect & Disease Conditions in Alaska CD-ROM (includes most of digital forest damage coverages in the AKDNR/DOF database in viewable formats and a copy of the 1999 Alaska Forest Insect & Disease Conditions Report in .pdf format; a fee may be assessed depending on availability of copies and amount of data required for the project).


USGS Map Locator
For Statewide
Aerial Detection Surveys
Interior
Southcentral
Southeast

Quadrangle Areas Flown During 1999 Statewide Aerial Surveys:

*Quads with no insect damage for 1999 is marked with an asterisk.

South-central Alaska
Anchorage
Blying sound*
Cordova
Gulkana
Kenai
Kodiak*
McCarthy
Nabesna
Seldovia
Seward
Talkeetna
Talkeetna Mts.
Tyonek
Valdez

Interior Alaska
Ambler River
Arctic*
Baird Mts.
Beaver
Bering Glacier
Bethel*
Bettles
Big Delta
Black River
Candle
Chandalar
Charley River
Christian
Circle
Coleen
Dillingham*
Eagle
Fairbanks
Fort Yukon
Healy
Holy Cross
Hughes
Iditarod
Iliamna
Kantishna
Kateel River
Kotzebue*
Lake Clark
Lime Hills
Livengood
McGrath
Medfra
Melozitna
Mt. Hayes
Mt. McKinley
Nulato
Ophir
Ruby
Russian Mission
Selawik
Shungnak
Sleetmute
Survey Pass*
Tanacross
Tanana
Taylor Mts.*
Unalakleet
Wiseman

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

Tree damage codes used in 1989-1999 aerial surveys and GIS map products.

* The codes used for 1999 aerial surveys and GIS maps are marked with an asterisk.

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

Note: For all insect activity, the 4th character in the digital data (L, M, or H) denotes intensity. For quantitative descriptors of the intensity levels refer the metadata accompanying the digital data. Digital data can be found at the following URL: http://agdc.usgs.gov/data/projects/fhm/

Federal Recycling Program
Printed on Recycled Paper