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Forest Service

Alaska Region

R10-TP-61

February, 1996

Forest Health Management Report

Forest Insect and Disease Conditions in Alaska--1995

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How You Can Talk To Us

In the future, we will be continuously surveying our customers to evaluate how well we are meeting these standards. Your opinions are vital to us, and your experiences— good or bad— will help us improve our service to you.

Please complete a comment card and mail to our national office or drop at the nearest local office:

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"Serving People"

Forest Service Pledge
to the
American People

USDA • Forest Service

The mission of the USDA Forest Service is... "Caring for the Land and Serving People."

The USDA Forest Service is committed to strengthening the Nation and increasing its environmental, economic, and spiritual well-being. We strive for excellence in land management, research, and assistance to others.

We've been listening...
1994 was a year of reinvention in the Forest Service. Town hall meetings ... customer focus groups ... local forest planning meetings ... panel discussions ... customer group networks ... a national public opinion poll ... these are just a few of the steps we've taken to learn from you, the American people. We want you, our customers, to help us build a better Forest Service for the future.

What you said... and how we are responding...

- **You, the American people, want the forest service to maintain healthy and diverse forests and grasslands now and for future generations.**

  We are implementing principles of ecosystem management to conserve and sustain healthy forests and grasslands, and to restore deteriorated resources.

- **You want to be fully informed and consulted as owners of the National Forests and Grasslands. Communities want to participate in local decisions that affect their well-being.**

  We are committed to making decisions in an open manner that includes our Nation's diverse communities, our partners in ecosystem management, and our customers across the Nation.

- **You want customer service equal to the best in the business—simple rules, reasonable choices, flexibility, and less red tape.**

  We, your public servants, are changing the way we do business to make things simpler, easier, and friendlier for you.

- **You want your tax dollars spent to produce goods and services of value to you as taxpayers.**

  We are streamlining the Forest Service to work better and cost less, and to produce goods and services of measurable value to you as taxpayers.

- **You expect high-quality service, convenience, accurate information, and friendly, helpful assistance in a safe, healthy environment.**

Our Pledge

- *Visitors will always be welcomed with prompt, courteous service.*
- *Our offices, work sites, and visitor centers will be open at times convenient to our customers.*
- *Customers will receive the services and information they request, or we will explain why we cannot meet the request.*
- *Customers will be fully informed of the process required for grants, agreements, contracts, and permits and we will respond in a timely manner.*
- *Customers will be asked regularly to help us improve our services and business practices.*
- *Our facilities will be safe, clean, attractive, and informative.*
- *Our facilities and programs will be accessible to persons of all ages and abilities.*

— TEAR HERE —

Please let us know how we did by responding to the questions below:

State & Private Forestry, R-10

Name of Forest Service office, research lab, campground, visitor center visited

Your evaluation of our performance

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1. I received prompt, courteous service.	❑	❑	❑	❑	❑
2. I was provided the information I requested or needed.	❑	❑	❑	❑	❑
3. For my request, the procedure was clear and efficient.	❑	❑	❑	❑	❑
4. I was satisfied with the facilities I used.	❑	❑	❑	❑	❑

Specific suggestions:

____

____

STATE OF ALASKA

TONY KNOWLES, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF FORESTRY

3601 "C" Street, Suite 1034
Anchorage, AK 99503-5937

File: 9-3185.5

March 6, 1996

re: 1995 Forest Insect and Disease Conditions Report & Aerial Surveys Publications
Form to request aerial surveys for summer, 1996

Friends:

Enclosed are two reports. The first report, produced jointly by the Alaska Department of Natural Resources and USDA Forest Service, summarizes the 1995 Alaska forest insect and disease surveys with a set of maps generated by a computerized Geographic Information System (GIS). The second publication, prepared by the USDA Forest Service, provides a more detailed summary of forest insect and disease conditions throughout Alaska compiled from aerial sketch mapping records and limited ground observations during the summer, 1995.

The purpose of the statewide aerial survey is to (1) detect new insect and disease activity, (2) monitor ongoing outbreaks, and (3) alert resource managers and private landowners of insect/disease activity in their areas. In addition to the annual aerial surveys, Alaska Division of Forestry and USDA Forest Service entomologists are also available to assist with evaluations of surveyed outbreaks when requested.

Should you wish to have lands included or receive information about the aerial surveys, you may contact one of the forest health management offices responsible for arranging the surveys. For this purpose, we have enclosed an aerial survey request form which should be completed and returned by May 30, 1996.

Any questions may be directed to either the state or federal pest management offices below. The 1996 aerial detection surveys will begin approximately mid-July.

Sincerely,

Roger Burnside, Insect & Disease Forester
Alaska Department of Natural Resources
Division of Forestry, State Office/Resources
3601 "C" Street, Suite 1034
Anchorage, AK 99503-5937
ph: (907) 269-8460/8463 or fax: 561-6659

Ed Holsten, Entomologist
USDA Forest Service, S&PF
Forest Health Management
3301 "C" Street, Suite 522
Anchorage, AK 99503-3956
ph: (907) 271-2573 or fax: 271-2897

Enclosures *(1996 survey request form; Forest Insect and Disease Conditions in Alaska--1995 & Alaska Forest Insect & Disease Surveys--1995)*

1996 Annual Insect & Disease Detection Survey Request

Requestor:____

General forest lands location (**attach map or marked USGS Quad**) *:

____

____

____

* best if general area location is given, such as reference to river drainage, lake system, distance to nearest locale or town/village, etc.

Specific pest information requested (if known):

____

____

Contact Name/Phone #:______________________________

Best Time of Day to Contact:______________________________

Do we have your correct mailing address? (please include below):

____

____

____

Insect & Disease Survey Requests on Federal Land:
South central & Interior Alaska: contact Kathleen Matthews (K.Matthews:R10F04A), USDA Forest Service, S&PF/FHM, 3301 "C" Street, Ste. 522, Anchorage, AK 99503-3956 - ph: (907) 271-2574/2575; fax: 271-2897.
Southeast Alaska: contact Paul Hennon (P.Hennon:R10A), USDA Forest Service, S&PF/FHM, 2770 Sherwood Ave., Ste. 2A, Juneau, AK 99801 - ph: (907) 586-7971; fax: 586-7848.
Insect & Disease Survey Requests on State or Private Land:
Statewide: contact Roger Burnside, Alaska Dept. of Natural Resources, Div. of Forestry, Resources Section, 3601 "C" Street, Ste. 1034, Anchorage, AK 99503-5937 - ph: (907) 269-8460/8463; fax: 561-6659.

c:96svyreq.frm

United States Department of Agriculture | Forest Service | Alaska Region S&PF | 3301 C Street
Suite #522
Anchorage, AK 99503
907-271-2575

File Code: 3450

Date: March 6, 1996

Dear State & Private Forestry Customer:

The mission of the USDA Forest Service is "Caring for the Land and Serving People." We would like to know how we are doing and how we can improve. Enclosed you will find a Customer Comment Card, please complete and mail (no postage necessary). Your opinion will help us improve our service to you.

Sincerely,

PAUL W. FORWARD
Acting Deputy Regional Forester
State & Private Forestry

Enclosure

FOREST INSECT AND DISEASE CONDITIONS IN ALASKA -- 1995

General Technical Report R10-TP-61

January 1996

Prepared by:

Ed Holsten, Entomologist
Paul Hennon, Pathologist
Dustin Wittwer, Biological Technician
Kathy Matthews, Biological Technician

Forest Health Management
State and Private Forestry
Alaska Region
USDA Forest Service
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FOREST INSECT AND DISEASE CONDITIONS IN ALASKA -- 1995

CONDITIONS IN BRIEF

Overall, 1995 Alaska forest insect and disease damage levels increased relative to 1994 levels; more than 1,961,000 forested acres were impacted. This year was characterized by some rather significant increases in some insect populations offset by equally dramatic declines in others. **Spruce beetle**, one of the most important disturbance agents of Alaska boreal forest ecosystems, increased by 40% this year; more than 890,000 acres of on-going and newly infested areas were aerially detected. Increased activity is occurring on the Kenai Peninsula and along the west side of Cook Inlet. Conversely, **engraver beetle** (*Ips* sp.) caused tree mortality decreased by 70% in interior Alaska; only 5,600 acres of new spruce mortality was noted; most along the Porcupine and Christian Rivers.

Hardwood defoliator activity, most notably that of the **Large Aspen Tortrix**, rose significantly this year. More than 20,000 acres of intense defoliation was noted near the Anchorage Bowl and along the Glenn Highway north of Palmer. **Spruce budworm** populations increased slightly this year with heavy defoliation occurring on more than 279,000 acres of white spruce along the Yukon and Tanana Rivers. **Larch sawfly** populations exploded and were responsible for more than 116,000 acres of heavy defoliation of larch near Delta and west of Fairbanks.

In southeast Alaska, insect populations were characterized by some rather dramatic changes in 1995. The level of defoliator insects showed the most significant decline with a crash of the **black-headed budworm** outbreak, ongoing since 1990. Budworm defoliation was recorded on nearly 13,000 acres, down significantly from the 194,000 acre value in 1994. Budworm activity was concentrated in large mainland river drainage areas, most notably the Taku River, in proximity to spruce beetle outbreaks. **Hemlock sawfly** defoliation levels dropped to 1,100 acres, approximately 1/3 of the level recorded in 1994; the second year of dramatic decline. Sawfly activity is primarily concentrated in southern southeast Alaska, while budworm activity is typically concentrated north of Frederick Sound. Top-kill was evident among western hemlock in several heavily defoliated areas from 1994. **Spruce needle aphid** was apparent on and near populated private lands on Chichagof Island.

While defoliator activity in southeast Alaska seems to have subsided, the total **spruce beetle** activity rebounded in 1995 to 16,500 acres, after a sharp decline in 1994. The beetle infestation in Haines continues, with approximately 8,400 acres of new and on-going activity. The 1994 spruce beetle outbreak on the north side of the Taku River has expanded to 3,900 acres and now includes both sides of the river, to become the second largest beetle outbreak in southeast Alaska during 1995. The beetle outbreak in lower Glacier Bay has shifted to a ridge east of Gustavus impacting 2,200 acres, while there was no new activity evident in areas of historic infestations. New spruce beetle activity was noted in scattered locations throughout southeast Alaska, including the outer-coast of Glacier Bay NP, areas near Sitka, and the Stikine River delta. The largest of these new infestations, the Stikine River area, covered over 2,000 acres. Damage from ***Ips* engravers** occurred scattered throughout southeast, but was most evident near Haines and Wrangell.

Wood decay of live trees, **hemlock dwarf mistletoe**, and **Yellow-cedar decline** were the most important diseases of Alaskan forests during 1995. All three altered ecological conditions including forest structure, composition, and succession. In addition, each caused commercial loss. Heart rot and butt rot fungi cause significant cull in all tree species in Alaska, particularly in coastal forests where approximately 1/3 of the gross volume of forests is defective. Decay in living hardwoods throughout the state is considerable. Wildlife habitat is produced directly by heart rot and dwarf mistletoe through the formation of tree cavities and witches brooms, respectively. Hemlock dwarf mistletoe continued to cause growth loss, top-kill, and mortality in old-growth forests of southeast Alaska; its impact in managed stands depends on the presence of large infected trees left after harvesting. More than 595,000 acres of yellow-cedar decline have been mapped throughout an extensive area 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.

Foliar diseases of conifers are usually of little ecological significance and were generally at moderate levels throughout Alaska in 1995. **Spruce needle rust** infection was visible from the air on over 2,800 acres of Sitka spruce near Yakutat. The fungus *Rhizosphaera pini*, a spruce needle blight which occurred at high levels in southeast Alaska during the previous two years, dropped back to naturally low levels in 1995. Hemlock canker also subsided in 1995 after causing mortality along roads on several islands in southeast Alaska during the early 1990's. Canker and foliar fungi caused a large, but unmeasured damage to hardwood species in interior Alaska.

Porcupines continued to damage Sitka spruce and western hemlock in valuable young-growth stands. **Brown bears** caused a high incidence of wounding on the lower boles of yellow-cedar in southeast Alaska.

Table 1 on the next page summarizes Alaska forest insect and disease activity by ownership and causal agent.

Table 1. 1995 Forest insect and disease activity (acres) in Alaska by land ownership and agent[1]

Damage Agent	*State & Private*	*National Forest*	*Other Federal*	*Native Corp.*	*Total*
Spruce beetle	400,882	33,927	248,207	209,815	892,831
Engravers	2,276	366	1,551	1,428	5,621
Spruce budworm	77,800	--	102,632	98,736	279,168
Black-headed budworm	387	10,737	1,871	--	12,995
Hemlock sawfly	5	529	517	52	1,103
Spruce needle aphid	--	68	--	--	68
Large aspen tortrix	25,824	476	5,822	225	32,347
Conifer defoliation	865	495	7	4,100	5,467
Aspen defoliation	--	--	437	--	437
Birch defoliation	239	--	657	--	896
Cottonwood defoliation	1,951	101	1,453	--	3,505
Willow defoliation	3,913	--	1,447	213	5,573
Larch sawfly	48,974	--	67,908	--	116,882
Spruce bud moth	--	1,243	--	--	1,243
Spruce needle rust	--	2,855	--	--	2,855
Porcupine damage	26	349	--	--	375
Blowdown/windthrow	--	49	--	--	49
Flood damage	992	1,664	2,053	66	4,775
Landslide damage	135	239	39	52	465
Yellow-cedar decline[2]	11,930	563,400	----	19,670	595,000
Total acres by ownership	**576,199**	**616,498**	**434,601**	**334,357**	**1,961,655**

[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 acreage affected by island and Ranger District.

STATUS OF INSECTS

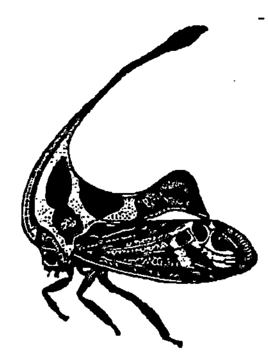
ROLE OF DISTURBANCE IN ECOSYSTEM MANAGEMENT

A key premise of ecosystem management (based on natural variability) is that native species have adapted to, and in part, evolved with natural disturbance events. Species loss and ecosystem change have been observed in areas where "natural" disturbance regimes have been substantially altered. Disturbances, large and small, are responsible for the way current landscapes appear and function today. Disturbances of various kinds and intensities will determine the structure, composition, and function of future landscapes. Alaska ecosystems are shaped/produced by disturbances. Just note the effects of glaciation, earthquakes, tidal waves, fire, flooding, etc. Disturbance events such as fire, insect and disease outbreaks create and maintain a shifting mosaic of landscape patterns. Both fire and flooding are responsible for spruce and birch regeneration in south-central and interior Alaska; large scale windthrow is important in southeast Alaska. Fire burns across the landscape in an irregular and uneven manner. The burned surface may or may not be essentially the same as the pre-burned surface. Succession after fire in Alaskan forest ecosystems is complex and related to site, fire, climate, type and age of the vegetation present before fire, and plant species available for sprouting or invasion after fire. Alaska insect communities, probably one of the largest components of forest ecosystems, are also "creatures" of disturbance as well as agents of disturbance. Arctic/boreal insects are characterized by having few species and large population numbers. These insects are opportunistic in their behaviors. They respond quickly to disturbances in climate, food, and breeding material. The spruce bark beetle for example, responds quickly to large scale blowdown, fire scorched trees, or spruce impacted by flooding. Large beetle populations can be produced by such breeding material, leading to potential outbreaks.

As agents of disturbance, spruce beetles are one of the most important mortality agents of mature spruce stands in Alaska. There are a variety of impacts associated with outbreaks to forest resources, both timber and non-timber. These impacts can be viewed positively or negatively 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 a spruce as sawtimber 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 tree as houselogs, chips, or firewood continues for some time; **(2) Long term stand conversion:** To best regenerate both spruce and birch, a site disturbance (i.e. fire, windthrow, flooding, etc.) is required which results in a seed bed comprised of bare mineral soil with some organic material. If there is adequate seed source, such site disturbances provide excellent sites for regeneration. However, what is occurring on many sites in south-central Alaska after spruce beetles have "opened up" the canopy is a scarcity of regeneration establishing due to minimal ground disturbance. Under such conditions, grass and other competing vegetation quickly invade the site and delay future re-establishment of tree species; **(3) Impacts to wildlife habitat:** Those wildlife species that are dependent on large diameter spruce stands are negatively impacted. Those wildlife species that benefit from early successional stage vegetation, such as willow and aspen, will benefit from spruce beetle infestations as stand composition changes; **(4) Impact to scenic quality:** Recent studies have demonstrated that there is a significant decline in scenic quality of spruce beetle impacted stands and that scenic beauty is an important forest resource. Along scenic corridors such as National Scenic Byways, maintaining or enhancing scenic quality necessitates minimizing impacts from spruce beetle infestations; **(5) Fire hazard:** There is concern that fire hazard of spruce beetle impacted stands will increase over time as dead trees fall and dry grass accumulates, thus increasing fuel loading. Recent Alaska studies have shown that more than 35 tons per acre of large woody debris accumulates on the forest floor 5-10 years after a spruce beetle outbreak. In contrast, approximately 2 tons per acre of large woody debris accumulates in uninfested stands; and **(6) Impact to fisheries:** If salmon spawning streams are bordered by large diameter spruce and if these trees are subsequently killed by spruce beetles, there is a concern as to the long term availability of large woody debris in the streams. A continual supply of large woody debris in spawning streams is a necessary component for spawning habitat integrity.

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. 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.



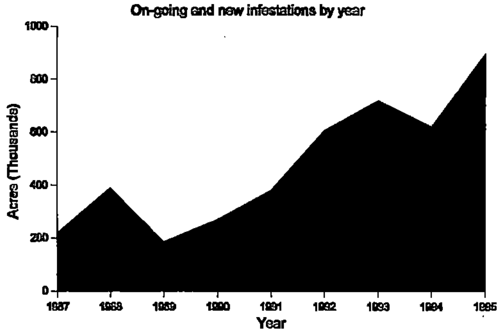
SPRUCE BEETLE

Dendroctonus rufipennis Kirby

Spruce beetles continue to impact vast areas in Alaska. Spruce beetle activity increased by 40% over levels detected last year (Fig. 1). Approximately 892,831 acres of on-going and newly infested areas were detected this year; the highest level of activity on record. The most extensive areas of spruce beetle infestations continue to be in the Copper River Area--170,767 acres and south-central Alaska--683,281

Fig. 1. Alaska Spruce Beetle Activity

On-going and new infestations by year



acres. Southeast Alaska's Sitka spruce forests are being impacted by 16,500 acres of beetle infestations. The white spruce forests of interior Alaska currently have 22,283 acres of on-going infestations.

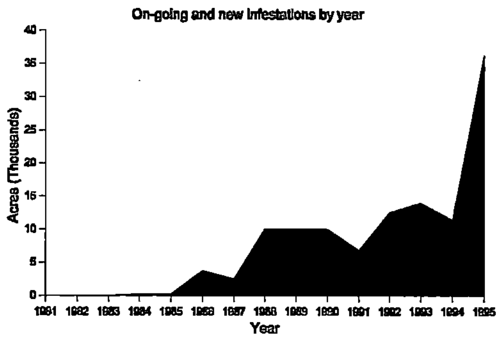
Areas of specific interest include:

South-central and Interior Alaska

<u>Spruce beetle activity on the Chugach National Forest doubled this year</u>--more than 32,433 acres of on-going and newly infested acres were aerially detected vs. 12,715 acres in 1994. Spruce beetle activity in the Turnagain Arm area is increasing: scattered activity (100 ac) in the Girdwood area, 200 acres in the Twenty Mile area, and approximately 850 acres scattered from Sawmill Creek to Ingram Creek, including Seattle Creek. Spruce beetle activity has intensified in the Sixmile River drainage where more than 1,635 acres of beetle-caused spruce mortality are located from the Hope-Y to Sunrise. More than 1,500 acres of on-going infestations occur near Hope from Bear Creek to Palmer Creek. In the Moose Pass area, beetle infestations are occurring on more than 4,500 acres from the north side of Trail Lake to Crown Point. Nearby on Kenai Lake, more than 5,900 acres are infested. Spruce beetle activity is still apparent in the Granite Creek, Summit Lake, Cooper Lake, and Upper Russian lake, and along Resurrection River near Boulder Creek.

<u>On the rest of the Kenai Peninsula south to and including Kachemak Bay, bark beetle activity is intense</u>. From Pt. Possession south to Tustumena Lake, more than 50,000 acres of beetle infested spruce stands were detected; the heaviest beetle activity located between Skilak and Tustumena Lake. From Tustumena Lake south to Homer and including the Fox River drainage, spruce beetle activity is extremely intense and widespread. More than 400,000 acres of spruce are infested with many stands having more than 60% mortality. The southeast portion of Kachemak Bay from Sheep Creek to Seldovia is experiencing a dramatic increase in spruce beetle infestations: more than 36,000 acres of Sitka spruce are currently impacted vs. 11,440 acres detected last year. The Kachemak Bay outbreak had its origins in a blowdown event in 1981. By 1984, approximately 200 acres of infested standing spruce were detected; this rose sharply in 1988 and has increased ever since (Fig. 2). Of interest is the rapid spread of beetle activity southeast along the Bay. More than 12,000 acres are infested (40% mortality) in the China Poot Lake area and 600 acres of scattered beetle kill are appearing near Seldovia with another 700 acres near Port Graham.

Fig. 2. Kachemak Bay Spruce Beetle



<u>A significant increase in spruce beetle activity was noted on the west side of Cook Inlet</u> from Tuxedni Bay up to the McArthur River and the West Forelands where more than 35,000 acres of Sitka and white spruce are infested. Scattered infestations are increasing slightly in the Judd Lake and Hiline Lake areas near the Skwetna River. Further west and inland, the Iliamna Lake spruce beetle outbreak intensified on more than 60,000 acres; a substantial increase over last years levels. Spruce beetle activity is heaviest south of Pile Bay on the west side of the lake. Beetle activity appears to be increasing in the Pedro Bay Area. Beetle activity in the Lake Clark area, from the northeast end of the lake to the Pass has intensified. Almost all of the spruce has been killed on more than 19,000 acres.

<u>Spruce beetle activity more than doubled in the Anchorage Bowl area</u>: more than 8,000 acres of spruce beetle activity were noted. Areas heaviest hit include: Fire Island--3,700 acres; Bear Valley/Rabbit Creek--500 acres; Kincaid Park--800 acres (Fig. 3). North of Anchorage the majority of the spruce stands in the Eagle River (4,671 ac.) and Eklutna River (2,800 ac.) drainages are heavily infested. Further north along the Glenn Highway, spruce beetle activity is apparent and heavy on more than 7,000 acres from Chickaloon to Sheep Mtn. Lodge.

<u>The Copper River Basin area continues to support more than 170,767 acres of on-going spruce beetle infestations.</u> Heavy spruce beetle activity continues around: Klutina Lake (13,500 ac.); Tonsina Lake (7,000 ac.); along the Richardson Highway from Tonsina to Copper Center and down the Copper River to its confluence with the Chitina River. There is also light spruce beetle activity scattered over 3,300 acres from Glennallen north along the Glenn Highway.

<u>White spruce forests of interior Alaska were slightly impacted this year</u>. Approximately 6,695 acres of light infestations continue to occur along the Yukon River south from Koyukuk to Kaltag. Another 4,085 acres of spruce beetle activity were noted east of Delta Junction. Further south along the Kuskokwim River, there are more than

3,000 acres of infested spruce from McGrath downstream to Devil's Elbow. An additional 1,500 acres of infestations were located along the Big River and 4,000 infested acres of spruce up the South Fork of the Kuskokwim River to Farewell Lake.

Southeast Alaska

During 1995 in southeast Alaska, spruce beetle infestations encompassed approximately 16,500 acres. Four areas were impacted substantially, although other scattered areas were affected to a smaller degree.

The spruce beetle outbreak in Glacier Bay National Park has shifted east and up in elevation (1500 ft.), from its historic location in lower Glacier Bay. The new infestation along the west side of the ridge between Gustavus and Excursion Inlet totaled approximately 2,200 acres. A small amount of scattered spruce mortality occurred farther west at Dundas Bay and Berg Bay. The new area affected is nearly five times greater than the 1994 level. The historic outbreak in lower Glacier Bay has impacted more than 30,000 acres, resulting in mortality as high as 75 percent from outbreaks over the past decade and a half. 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.

The Haines area experienced the most substantial spruce beetle pressure in southeast Alaska as the outbreak continues for the sixth consecutive year. Over 8,400 acres along drainages of the Chilkat, Klehini and Kelsall Rivers have new or ongoing infestation, which is up from 3,600 acres in 1994. The majority of this area is located on state lands, but the infestation continues north into Canada. Salvage efforts have been increased in the Haines area by State personnel.

Spruce beetle activity on National Forest and Private land along the Taku River is in its second year and has shown an increase in active infestation, from approximately 75 acres in 1994 to over 3,900 acres in 1995. The beetle activity there follows a large windthrow event that occurred in the fall of 1990. The beetle effects this year were compounded by heavy black-headed budworm defoliation in the same area.

New spruce beetle activity was identified on National Forest land in the region of the Stikine River delta, including Dry Island, Farm Island, Rynda Island and scattered patches up the river. With 2,040 acres impacted, this is the largest new infestation in southeast Alaska. As on the Taku River, the beetle activity was found in association with black-headed budworm. Scattered, small scale spruce beetle activity occurred on Admiralty Island at Whitewater Bay, Gambier bay, Ward Creek and south of Greens Creek. Other minor beetle activity occurred on Baranof at Branch Bay and near Sitka west of Deep Inlet.

ENGRAVERS

Ips perturbatus Eichh.

Engraver activity declined in interior Alaska by 74% in 1995. Aerial detection surveys noted 5,621 acres of white and Sitka spruce mortality throughout the state. The most intense areas of Ips activity and associated tree mortality are along the Christian and Sheenjak Rivers where approximately 2,500 acres of white spruce are currently infested. Engraver activity in the Fairbanks area declined this year; only 300 acres of spruce mortality were noted.

In southeast Alaska Ips infested trees were isolated to several dense, immature stands, from Prince of Whales Island to Haines, totaling approximately 700 acres. The only ongoing activity is on Chilkoot Lake near Haines, but has decreased to approximately 150 acres.

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, then subsiding within a few years.

In southeast Alaska, western hemlock is the 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.

Repeated 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 are also accelerating 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.

Black-headed budworm populations crashed in 1995 among the coastal spruce-hemlock forests of southeast Alaska. The last budworm outbreak of this magnitude occurred from the late 1940's to the mid-1950's. This year's population crash was as dramatic as the onset in 1991 and 1992. The 1995 budworm defoliation only occurred on approximately 13,000 acres, down significantly from the 193,000 acres recorded in 1994. The peak year for budworm defoliation occurred just one year prior, in 1993, totalling 258,000 acres of defoliation. Cool wet weather in early summer months retard growth and development of the budworm and may have resulted in population declines.

The 1995 budworm activity was concentrated in large, mainland river drainages near spruce beetle outbreaks. An area along the Taku River, from boundary Creek to East Twin Glacier, hosted the largest single outbreak for 1995, leaving 7,767 acres heavily defoliated. Down river, two smaller patches of light defoliation existed; 312 acres on the north end of Sunny Cove, and 467 acres on Swede Point. Moderate defoliation of 1,100 acres was also observed along the North Arm of the Stikine River on the mainland side. 1,073 acres of light defoliation occurred on the east side of Excursion Inlet and is in close proximity to current spruce beetle activity over the ridge in lower Glacier Bay. Although, western hemlock is the primary host for black-headed budworm, Sitka spruce were also defoliated to a lighter degree. The weakened spruce will be more susceptible to future spruce beetle attack, also present in these area

Black-headed budworm defoliation was evident on Admiralty Island in only three locations and only to a minor degree. In Seymour Canal, 623 acres of light defoliation occurred near the margins of Swan Cove. Within Young Bay on Mansfield Peninsula, there were 250 acres of light defoliation, and on the west side of the island another 100 acres were defoliated on the north side of Thayer Creek. Since the beginning of this outbreak in 1991, the largest concentration of black-headed budworm defoliation has been on Admiralty Island, until this year.

Light defoliation was present on Chichagof and northern Baranof Islands. On Chichagof approximately 156 acres of light defoliation occurred in Patterson Bay, while another patch of 267 lightly defoliated acres was located east of Tenakee at Cannery Point. On north Baranof Island south of Sitka, 367 acres were defoliated on both sides of Blue Lake near the old pulp mill. Budworm defoliation noted elsewhere included: 156 acres (light) adjacent to Echo Cove, north of Juneau; 312 acres (light) on the outer coast of Glacier Bay in the region of Palma Bay; and 50 acres of light defoliation on Revillagigedo Island north of Neets Bay.

Numbers of black-headed budworm larvae sampled at defoliator plots were down substantially in 1995 due to weather conditions and other factors leading to the budworm crash. From 1992 to 1994 the numbers of larvae sampled were consistently higher north of Frederick Sound, however in 1995 the opposite was true. The defoliator plots south of Frederick Sound produced a significantly greater average budworm per branch then did the areas northward. The greatest numbers of larvae were collected from California Cove and Princess Bay, both on South Revillagigedo Island. Relatively large numbers were also collected on Kuiu Island and Prince of Whales Island. Very few larvae were found on Admiralty Island, where the recent outbreak affected the greatest acreage.

No black-headed budworm activity was detected this year in south-central Alaska or in Prince William Sound. It is expected that budworm populations will continue to decline in 1996.

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.

Unlike the larvae of the black-headed budworm, hemlock sawfly larvae feed in groups, primarily on older hemlock foliage. The two species of insects 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.

In southeast Alaska, sawfly defoliation of western hemlock increased about threefold from 1992 to 1993. However, from 1993 to 1994, sawfly defoliation acreage dropped dramatically, from approximately 19,000 acres to about 3,400 acres, then again in 1995, to about 1,100 acres. The drop in sawfly populations, like that of the budworm, is at least in part related to weather, although other factors (e.g., natural biological controls) may also have been involved.

The 1,100 acres that were defoliated in 1995 were all only to a light degree and most of this area occurred south of Frederick Sound. The only areas defoliated north of Frederick Sound included; 156 acres on the east side of Glass Peninsula, 135 acres east of Washburn Peak on the east side of Glass Peninsula and 41 acres south of the Antler River delta near Berners Bay. Defoliation south of Frederick Sound included: 70 acres on Kadin Island, in the Stikine River delta; 50 acres on Heceta Island south of Chuck Lake; 306 acres along the east fork of Anan creek; while the remaining areas were located on Revillagigedo Island. On Revillagigedo, defoliation was noted west of the George Inlet head (50 acres); at the head of Carroll Inlet (50 acres); in Punchbowl Cove (110 acres); and on the south side of Smeaton Bay (130 acres).

The highest hemlock sawfly larvae counts were from defoliator plots south of Frederick Sound, the highest of these located at Calder Bay on Prince of Whales Island. Although the sawfly larvae were higher than those of the black-headed budworm counts, less visible defoliation was attributed to the sawfly.

SPRUCE NEEDLE APHID
Elatobium abietinum Walker

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. Spruce under stress, 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.

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 with sub-freezing temperatures during January and February. After a slight resurgence of activity in 1994, the 1995 population levels were low; occurring on 36 acres east of Tenakee Springs and on another 32 acres along Phonograph Creek of Lisianski Inlet.

COTTONWOOD DEFOLIATION
***Chrysomela* sp. and *Lyonetia* sp.**

Defoliation of cottonwood by leaf beetles (*Chrysomela* sp.) and leafminers (*Lyonetia* sp.) is common throughout much of the tree's range in Alaska. Defoliation is most pronounced near the tops of affected trees. Defoliation is believed to cause reduced tree growth. The biology and overall ecological significance of leaf beetles (*Chrysomela* sp.) in Alaska is not well known.

In southeast Alaska, cottonwood defoliation consisted of over 1,700 acres mainly on the outer coast of Glacier Bay National Park and Preserve. Other notable defoliation occurred along the Takhini River near Haines and the Gilkey River near Berners Bay for over 300 acres each.

Cottonwood defoliation declined sharply in south-central and interior Alaska in 1995; only 1,000 acres of defoliation were noted along the Susitna River this year vs. more than 4,000 acres in 1994. Cottonwood beetles were prevalent in the urban areas around Anchorage.

SPRUCE BUDMOTH
***Zeiraphera* sp.**

Light to moderate defoliation was detected on Yakutat Foreland, resulting in over 1,243 acres of Sitka spruce defoliation. Of the acreage identified, 396 acres were located down stream from Situk Lake and 847 acres were located near the beach, just north of Dry Bay. The budmoth feeding results in dead buds, typically with the bud scales and dead current year needles remaining on the shoots.

SPRUCE BUDWORM

***Choristoneura* spp.**

Areas of white spruce defoliation attributed to the spruce budworm (*C. fumiferana* and *C. orae*) increased slightly this year. Approximately 279,168 acres of intense defoliation were detected this year. The infestation is spread along the Tanana River and the confluence of the Tanana and Yukon Rivers extending approximately 50 miles upriver and downriver from Tanana. Areas of intense defoliation occur on: 18,681 acres west of Fairbanks; 13,344 acres along Tanana River north to Big Delta; 21,450 acres near Kantishna; and 225,693 acres along the Yukon River from Ruby nearly to Stevens Village. No spruce budworm activity was noted on Sitka spruce in southeast Alaska. One budworm adult was reared from Mugo Pine (a common ornamental) in Eagle River, north of Anchorage. The species determination is not known but appears to be similar to our budworms. This may be an accidental introduction. Ground inspections will be undertaken next season to determine if budworm populations are established on Mugo.

This is the fifth consecutive year of budworm outbreaks in many areas of interior Alaska. Research studies have shown that defoliated trees have been significantly stressed as indicated by: significant decrease in radial growth; significant reduction in the production of new foliage in the upper crowns; and lack of cone production for five consecutive years. Successive heavy defoliation has also caused some top kill and mortality in seedlings and saplings. Since 1993, spruce coneworms; *Dioryctria reniculelloides*, were observed feeding in conjunction with *Choristoneura*. Coneworm populations have increased dramatically and may be responsible for some of the current defoliation attributed to the spruce budworm.

There is increasing concern that endemic engraver beetle populations in budworm impacted areas may take advantage of the stressed trees and explode to outbreak populations. Permanent impact plots established in 1990 in the Fairbanks area have shown a steady increase in engraver caused-tree mortality. Another concern in severely defoliated stands is the impact to some wildlife species. Red squirrels are highly dependent on spruce cones for winter food. As previously mentioned, spruce have not had a cone crop for almost five years in heavily defoliated areas. Alaska State Fish & Game biologists have predicted a large crash in red squirrel populations this winter and for a number of years to come.

SPRUCE CONEWORM

Dioryctria reniculelloides Muturra & Munroe

Spruce coneworms are members of the Pyralidae family and usually have one generation per year in Alaska. The larvae are commonly mistaken for spruce budworms. Coneworm larvae attack and feed on developing spruce cones as well as mining and feeding on buds and expanding shoots. Populations of budworms and coneworms are often found on the same tree. As previously mentioned, some of the massive spruce budworm outbreaks in interior Alaska may be due to coneworm feeding. Coneworm defoliation was also quite apparent on ornamental blue spruce throughout the Anchorage area.

LARGE ASPEN TORTRIX

Choristoneura conflictana Wlkr.

Large aspen tortrix defoliation increased by almost 70% over levels noted last year. 1995 aerial detection surveys noted more than 32,300 acres of heavy (> 70%) defoliation throughout interior and south-central Alaska's aspen stands. The largest area of increase in interior Alaska was noted on 7,500 acres east of the Black River and west of little Black River; and on 2,000 acres along David Creek, south of the Porcupine River. Other areas of intense activity were: in the Susitna Valley where 7,000 acres of scattered aspen defoliation were noted; and in the Mat-Su Valley of south-central Alaska (Fig. 4) where more than 13,800 acres of intense defoliation were noted.

Tortrix populations were also scattered on 2,000 acres of the northern Kenai Peninsula. Tortrix populations are expected to increase in 1996. Overall impact to defoliated trees should be minimal as previous studies have shown little or no top-kill or tree mortality associated with consecutive years of heavy defoliation. Local bird populations should benefit with the increased food supply (caterpillars).

WILLOW DEFOLIATION

Beginning in 1991, an outbreak of a willow leaf blotchminer, *Micrurapteryx salicifolliela* (Lepidoptera:Gracillaridae) occurred for hundreds of miles in the Yukon and Kuskokwim River drainages. Larvae of this miner cause blotches that result in a yellow or reddish discoloration of foliage easily visible from the air. The outbreak worsened in 1992 but subsided to a great extent in 1993, however, certain willow species were still severely infested locally. This insect displays profound host specificity; some intermingled willow species are free of it while others may be severely infested.

The downward trend in willow defoliation continued in 1994 with fewer than 10,000 acres of willow defoliation. Willow defoliation once again decreased in 1995; approximately 5,573 acres were detected. Similar to previous years, defoliation occurred in interior Alaska: 5,053 acres along the Porcupine and Black Rivers; and a few hundred acres along the Yukon River near Circle. Of concern though, was what appeared to be large areas of willow mortality along the Yukon River from its confluence with the Porcupine River downstream. This is one of the areas previously defoliated for many consecutive years. Ground inspection of the "mortality" will be undertaken next year. If willow mortality is verified, it may have an adverse impact on local moose populations which are highly dependent upon willow sprouts as a food source.

LARCH SAWFLY
Pristiphora erichsonii (Hartig)

Larch sawfly activity in interior Alaska rose dramatically in 1995. More than 116,000 acres of heavy defoliation was observed this year vs. 311 acres in 1994 and 12,200 acres in 1993. The largest area of defoliation occurred south and east of Fairbanks along the Tanana River where more than 72,900 acres of larch were defoliated. Another 12,000 acres of larch defoliation was observed near Big Delta northward up the Tanana River. A ground check of heavily defoliated areas near Fairbanks noted a re-flushing of new growth later in the growing season. Little or no sawfly caused mortality is expected from this outbreak. However, there is a concern that three consecutive years of defoliation may be followed by a build up of larch beetle (*Dendroctonus simplex*).

Larch sawfly populations occur wherever there is host material; from Maine to Alaska. Sawfly larvae feed on both eastern and western larch. Effects of heavy defoliation normally result in a reduction in growth rate with little or no mortality occurring. Records collected during a 1955 sawfly outbreak in northern Minnesota indicated that 7 years' moderate to heavy defoliation will kill an occasional larch. The life cycle of the sawfly varies from one to two years. In a 1-year cycle, adults emerge in the spring, lay eggs, and larvae develop throughout the summer. Mature larvae spin to the ground in late summer and enter the duff, spin tough, papery brown cocoons in which they winter. Some larvae spend two winters before they pupate and emerge as adults.

GYPSY MOTH
Lymantria dispar (L.)

The European gypsy moth was accidently 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 also 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 Management personnel along with Alaska Cooperative Extension and the USDA Animal and Plant Health Inspection Service have placed pheromone monitoring traps throughout Alaska, especially 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, a much more damaging race of the European gypsy moth, in the Pacific Northwest, the Alaskan pheromone trapping program was expanded last year; more than 200 traps were placed throughout Alaska from Petersburg to Nome, including Dutch Harbor in 1995. No Asian or European gypsy moths were encountered. If the Asian gypsy moth becomes established in the western U.S., including Alaska, the potential impacts to forests and riparian areas could be tremendous. The trapping program will be carried out again next year.

SPEAR-MARKED BLACK MOTH

Rheumaptera hastata (L.)

No black-moth activity was observed in 1995 in contrast to 1993 when 5,500 acres of defoliated birch were detected southeast of Fairbanks. Populations are expected to remain at low levels in 1996.

SITKA SPRUCE WEEVIL

Pissodes strobi Peck

A number of adult specimens of the Sitka spruce weevil were collected this summer in the Anchorage Bowl from nursery stock (*Picea pungens*). This is believed to be the first collection/record of this species in Alaska. A field inspection of the nursery stock showed flagged (dead) leaders and adult exit holes on a number of 6-10' tall blue spruce. The infested nursery stock had been transported to Alaska in the spring/summer of 1994 and outplanted at a local nursery. Sitka spruce weevils have one generation per year in the Pacific Northwest: oviposition occurs in the early spring; larval and pupal development are completed by the following fall. Adult weevils emerge from infested tops and overwinter nearby. The collection of live adults in the spring of 1995 indicated that adult weevils successfully overwintered in the Anchorage Bowl.

The Sitka spruce weevil is one of the most injurious insects to Sitka spruce in the Pacific Northwest, including portions of Vancouver Island. These small weevils attack and kill or seriously deform the terminal shoots of young spruce (Fig. 5). As a result, the planting of Sitka spruce has been drastically reduced in Oregon, Washington, and British Columbia. However, the Sitka spruce weevil has not been found on the Queen Charlotte Islands or in southeast Alaska. It is believed that there are not adequate spring/summer temperatures in Canada and Alaska to allow successful brood development. It is doubtful that the spruce weevil can establish itself in south-central Alaska. Ground checks will be undertaken next summer to verify this. However if established, the Sitka spruce weevil could become a serious pest of ornamental and native spruce in the Anchorage area.

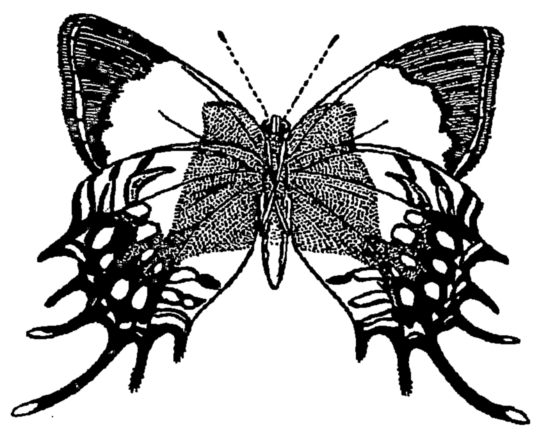
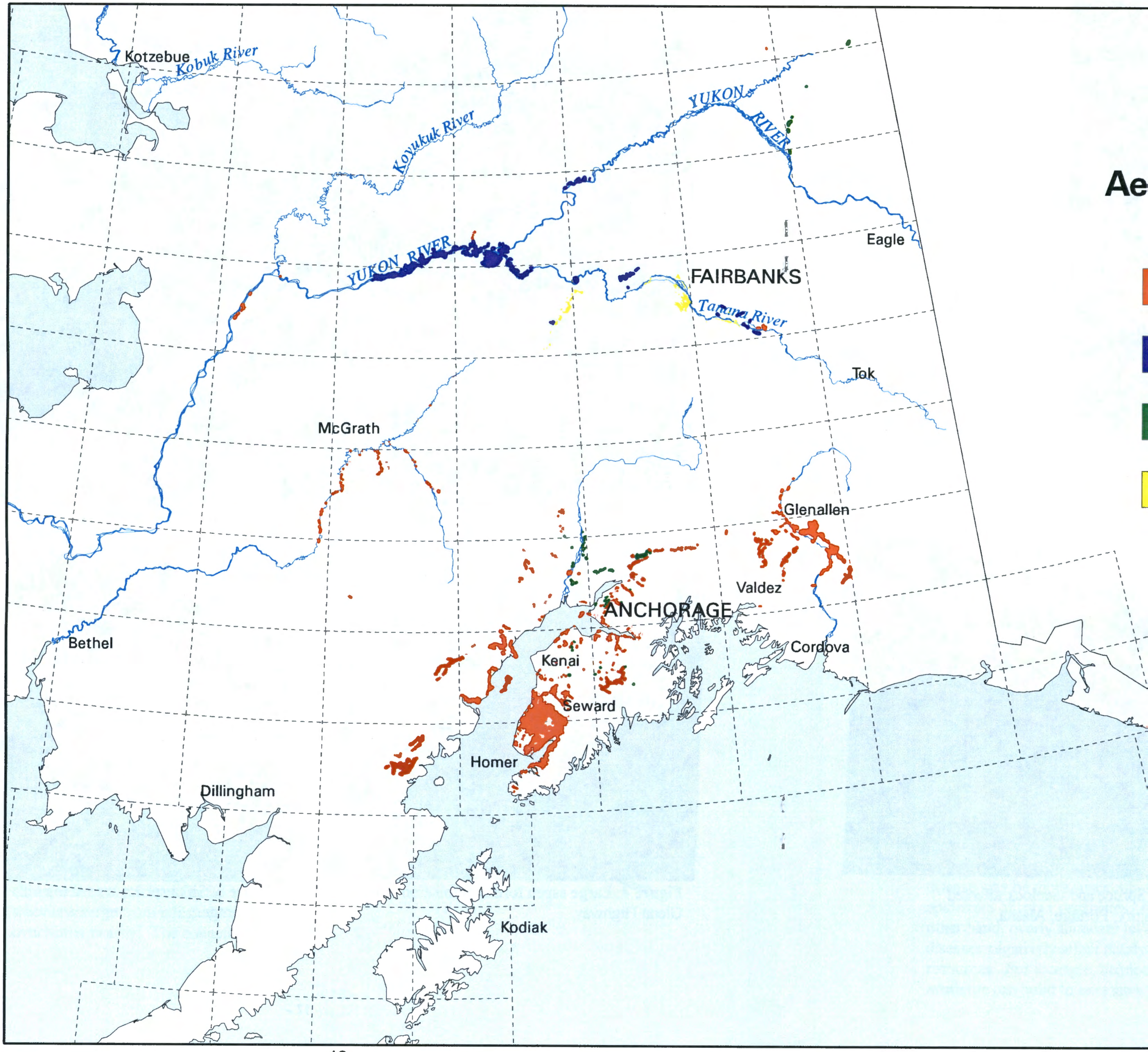


Figure 3. Spruce beetle caused tree mortality, Kincaid Park, Anchorage.

Figure 4. Large aspen tortrix defoliation along Glenn Highway.

Figure 5. Sitka spruce weevil top kill, Anchorage.


Kotzebue
Kobuk River
Koyukuk River
YUKON RIVER
YUKON
RIVER
Eagle
FAIRBANKS
Tanana River
Tok
McGrath
Glenallen
Valdez
ANCHORAGE
Cordova
Bethel
Kenai
Seward
Homer
Dillingham
Kodiak
Ae

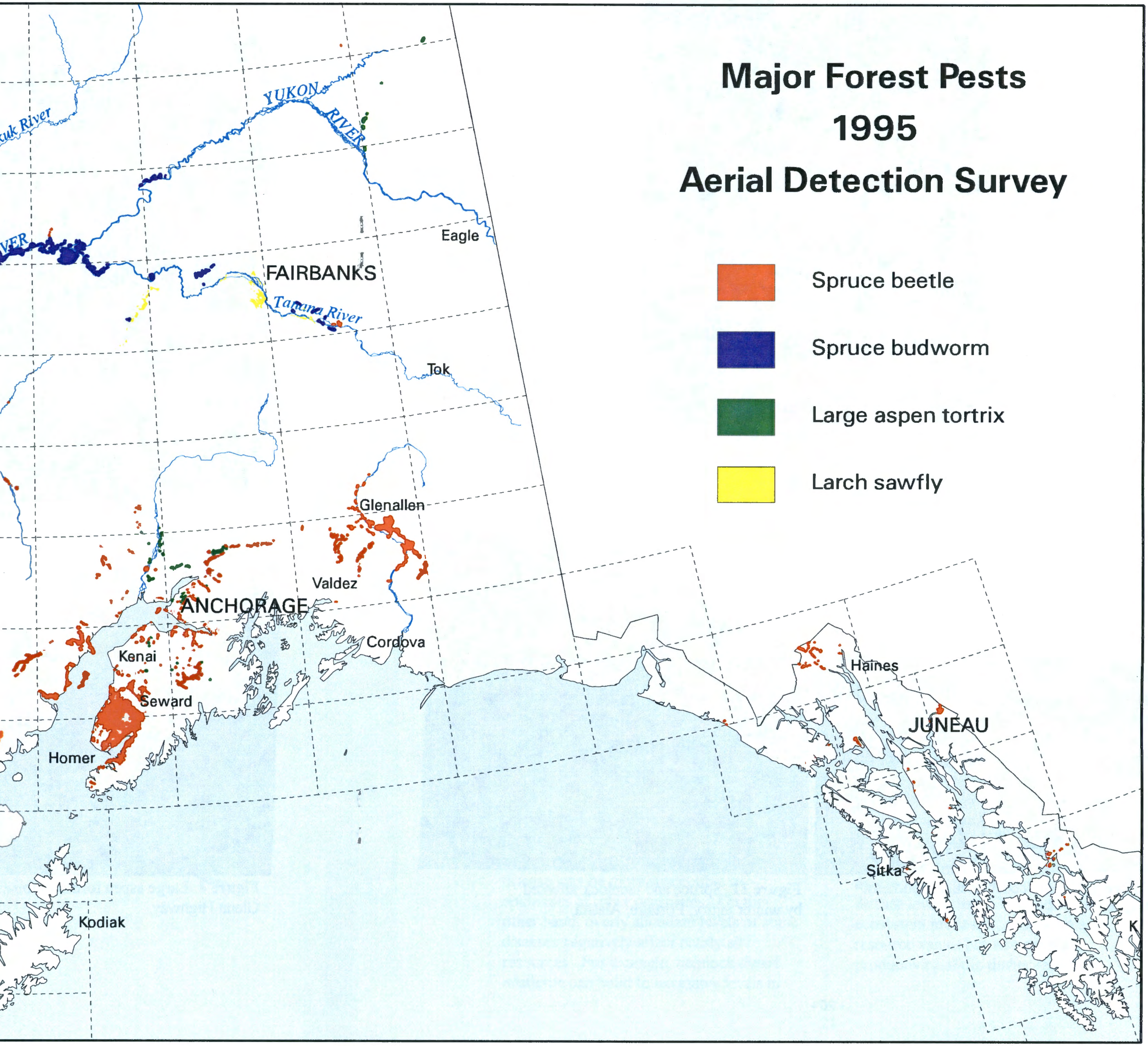

Major Forest Pests
1995
Aerial Detection Survey
Spruce beetle
Spruce budworm
Large aspen tortrix
Larch sawfly
YUKON RIVER
Tanana River
FAIRBANKS
Eagle
Tok
Glenallen
Valdez
ANCHORAGE
Cordova
Kenai
Seward
Homer
Kodiak
Haines
JUNEAU
Sitka

Figure 8. New growth of spruce infected with needle rust, *Chrysomyxa ledicola*.

Figure 9. Yellow-cedar decline, southeast Alaska.

Figure 11. Spruce and hemlock affected by winter injury; Portage, Alaska.

STATUS OF DISEASES

ECOLOGICAL ROLES OF FOREST DISEASES

The economic effects of forest diseases in Alaska have been recognized for some time. The nearly ⅓ cull in old-growth forests of southeast Alaska caused by heart rot fungi, for example, has been viewed as a severe limitation for the availability and cost of harvesting timber. The aim of management was to eliminate or reduce disease to minimal levels. But this perspective ignores the functional ecological roles of disease in Alaska's forest ecosystems. We are learning that several key diseases enhance diversity, provide wildlife habitat, and alter forest structure, composition, and succession. As agents of succession in the western hemlock/Sitka spruce communities, 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, and then appear to be the primary factors that maintain the old-growth phase through canopy-gap level disturbance. Thus, diseases are key ecological factors in Alaskan ecosystems.

To reduce disease to minimal levels in all instances is to diminish the various desirable characteristics that they produce and to alter successional patterns. 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 that lack disturbance, resulting in canopy collapse through a process of retarded height growth of all trees. Thermal cover, and vertical diversity are altered so that even resources such as habitat for most wildlife is reduced.

Two of the principal types of disease that alter forest structure in Alaska, heart rot and dwarf mistletoe, can by 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. Managers need to consider, however, that these organisms can take a long time to recolonize clear cut sites, especially for hemlock dwarf mistletoe. If structural and biological diversity are 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. 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 moderate disease levels that will conserve essential ecosystem processes, enhance many resource values but also maintain productivity of the timber resource.

TABLE 2. 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	+	-	-	+

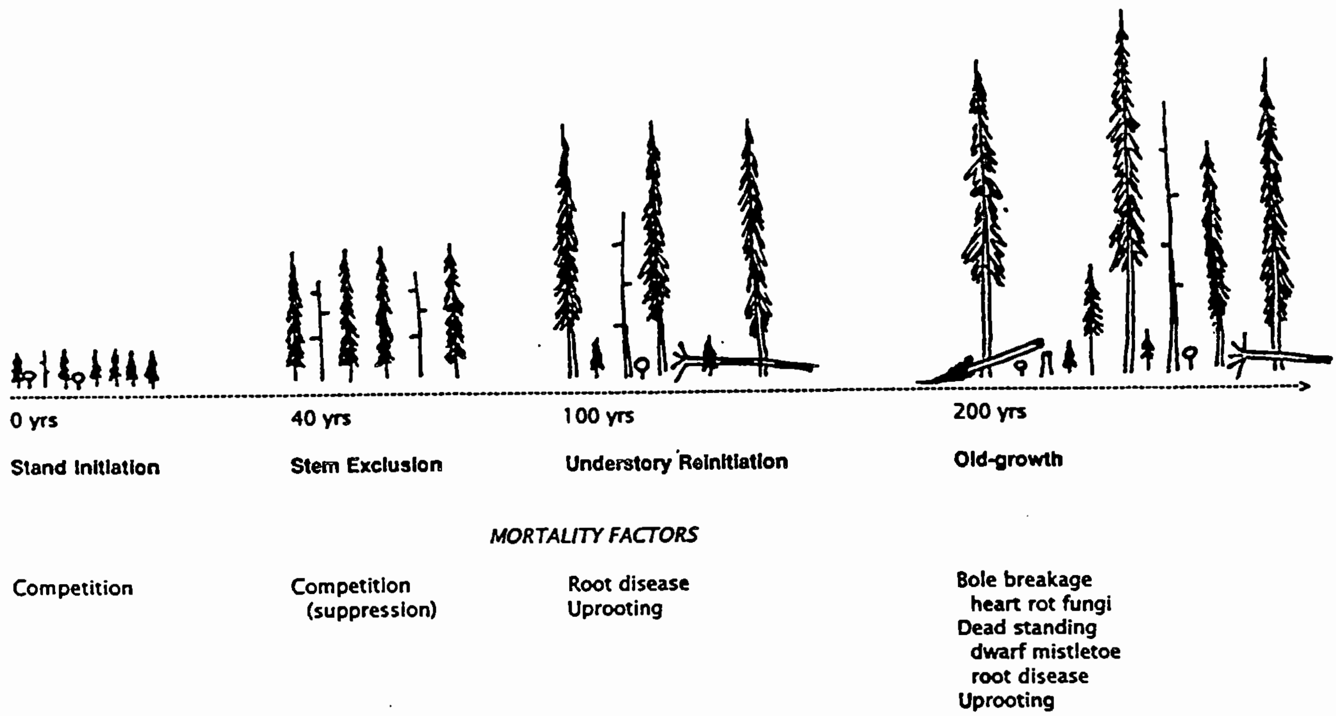


Figure 6. Role of diseases in developmental stages following catastrophic disturbance (e.g., large-scale windthrow, clearcut harvest) in the forests of coastal Alaska. Terms of stand development stages are from Oliver, C. and Larsen, B.C., 1990, Forest Stand Dynamics, McGraw-Hill, New York, 467p. Note 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 be 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 needed to evaluate the above proposed scenario.

STEM DISEASES

HEMLOCK DWARF MISTLETOE

Arceuthobium tsugense (Rosendhal) G.N. Jones

Hemlock dwarf mistletoe is the most important disease of western hemlock in unmanaged, old-growth stands throughout southeast Alaska as far north as Haines. Within the range of western hemlock, dwarf mistletoe is absent from Cross Sound to the northwest along the Gulf of Alaska. The incidence of dwarf mistletoe varies in old-growth hemlock stands in southeast Alaska from stands in which almost every 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 1000 feet. Heavily infected western hemlock trees have branch proliferations (witches-brooms), bole deformities, reduced height and radial growth, less desirable wood characteristics, top-kill, and severely infected trees may die.

These are all potential problems in stands managed for wood production. Growth loss in heavily infested stands can reach 40%. 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 habitat 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. Heavily infected hemlock stands can begin to decline and collapse to the extent that diversity and animal habitat are diminished, however. 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" is 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 perimeters of cut-over areas, and 3) infected advanced reproduction. Residual trees may play the most important role in the initial spread to 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.

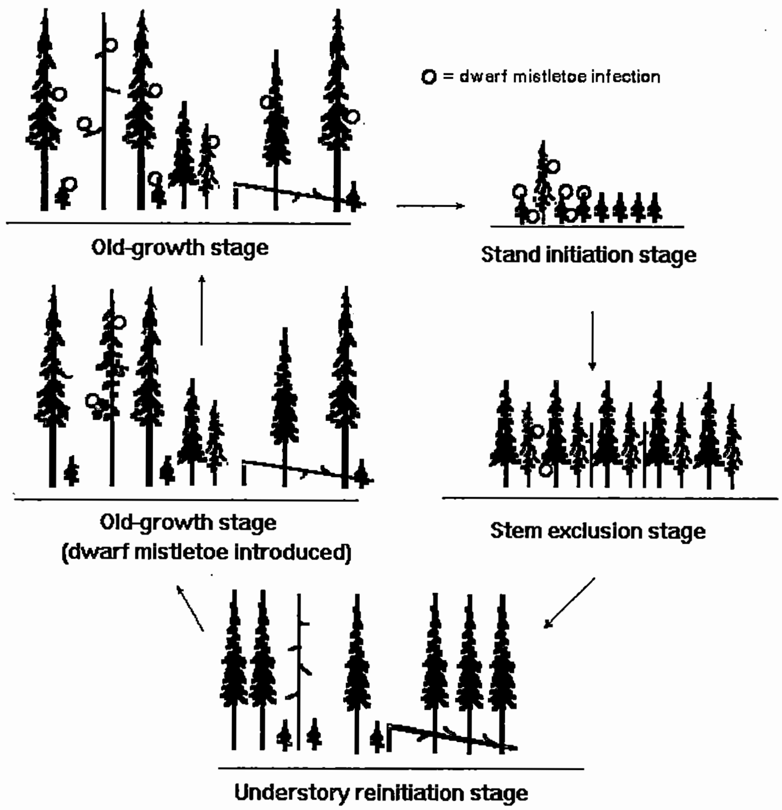


Figure 7. Effects of major disturbance (e.g., catastrophic wind damage or clearcutting) on hemlock dwarf mistletoe in southeast Alaska. Dwarf mistletoe is largely eliminated in the early stages of even-aged stands through shading and the inability of the parasite to spread vertically as fast as hemlocks grow in height. Through this process of stand development, dwarf mistletoe may be eradicated from the site for a very long time (e.g., many centuries) until it is reintroduced by birds. Once established in old-growth, dwarf mistletoe flourishes because its efficient mechanism for short distance spread, explosively discharged seeds, is favored by the pattern of small canopy-gap disturbance.

It is becoming clear that selective harvesting techniques will be the method for maintaining desirable levels of this disease if management will emphasize structural and biological diversity along with timber production.

HEMLOCK CANKER

Xenomeris abietis Barr. and other fungi

Hemlock canker, which occurred at outbreak levels during the early 1990's, subsided in 1994 and 1995. 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. It was also observed in several unroaded areas. Infection of new trees was infrequent in 1995 and affected areas now have the grey appearance of recently-killed hemlocks in the lower and mid canopy levels.

The causal agent has not been conclusively determined. The fungus *Xenomeris abietis* is sometimes associated with dead hemlock, but another unidentified imperfect fungus has been more frequently isolated from cankered tissues. The role of road dust in the disease is also now questioned as hemlock canker was found well away from roads. It is still conceivable that dust is a contributing factor in the disease, although not absolutely necessary for its development.

Ecologically, 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). The disease is abundant only wherever spruce grows near the alternate host, bearberry or kinnikinnik (*Arctostaphylus uva-ursi*) in Alaska. The fungus cannot complete its life cycle unless both host types (spruce and bearberry) are present.

Infections by the rust fungus result in dense clusters of branches (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.

The disease may cause slowed growth on spruce, although this has not been determined by research. The dense clusters of branches and needles (brooms) are known to provide nesting and hiding habitat for some birds and perhaps for small mammals.

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 1995. Infected pine tissues are swollen but are not always killed by the rust fungus. Another fungus, *Nectria macrospora*, colonized and killed many of the pine branches with these galls this year. The combination of the rust fungus and *N. macrospora* frequently caused top-kill. Even though very abundant, the disease does not appear to have major ecological effect in Alaskan forests.

HEART ROTS OF CONIFERS

Heart rot decay cause enormous loss of wood volume in Alaskan forests. For example, roughly ⅓ of the old-growth timber volume in southeast Alaska is defective 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 disturbing factors that cause small-scale canopy gaps. All major tree species in southeast Alaska have been found killed in this manner.

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.

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 wood debris input). Artificially wounding trees on the side of the bole that faces the stream can increase the likelihood of tree fall in that direction. 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:

Sitka spruce

Fomitopsis pinicola
Phellinus pini
Armillaria sp.
Phaeolus schweinitzii
Laetiporus sulphureus

Western redcedar

Poria albipellucida
Phellinus weirii

Western hemlock

Fomitopsis pinicola
Armillaria sp.
Heterobasidion annosum
Laetiporus sulphureus
Phaeolus schweinitzii
Phellinus hartigii
Phellinus pini

With the exception of *Armillaria* sp., all decay fungi important on Sitka spruce are also important in the decay of white spruce in south-central and interior Alaska and on Lutz spruce on the Kenai Peninsula. In addition, significant volume loss occurs in white and Lutz spruce from butt rot caused by *Coniophora puteana* and *Pholiota alnicola*.

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 bark beetles. Large amounts of potentially recoverable timber volume are currently being lost annually on the Kenai Peninsula, where salvage logging has not kept pace with tree mortality from the continuing spruce beetle epidemic. Significant volume loss from sap rot and heart rot appears to begin about 4-5 years following tree death. Several species of sap rot fungi are associated with spruce beetle-caused mortality with *Fomitopsis pinicola* being the most common.

HEART ROTS OF HARDWOODS

Heart rots are the most important cause of volume loss in Alaskan hardwood species. Incidence of heart rot in hardwood species of interior and south-central Alaska is generally high by the time a stand has reached maturity (about 50 years old). Substantial volume loss can be expected in stands 80 years old or older. Decay fungi will limit rotation ages if these hardwood forests are ever managed for wood production. Detailed data on volume losses by stand age class and forest type are currently lacking; studies are needed to better characterize these relationships.

Pleurotus sp. and *Pholiota* sp., which produce annual sporophores (conks), commonly occur on trembling aspen, black cottonwood, and paper birch, but are not as common as heart rot fungi. *Phellinus igniarius* (L. ex Fr.) Quel. and *Fomes fomentarius* (Fr.) Kichx. account for the majority of decay in paper birch, with the former stem decay fungus being the most important in terms of both incidence and decay volume. *Phellinus tremulae* (Bord.) Bond & Boriss. accounts for the majority of stem decay in both trembling aspen and birch. A number of fungi cause heart rot in balsam poplar, 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 this year. Sitka spruce and mountain hemlock are sometimes also attacked. 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 substantial infection and shoot blight by the fungus *Apostrasseria* sp. in southeast Alaska in 1995 as it does every year. The disease does not affect mature cedar trees, however. 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 0.5 m 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.

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 1995 it occurred at moderate levels. It was most common on young Sitka spruce and the lower crowns of larger trees throughout coastal Alaska. *Lophodermium picea* was present at low infection levels in 1995. This disease is more typical of larger, older trees of all spruce species in Alaska. *Rhizosphaera pini* returned to endemic levels after occurring at damaging levels in coastal Alaska the two previous years. It had been killing the lower, inner crown of Sitka spruce in several areas around Juneau. 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 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 and high levels in 1995 throughout southeast Alaska. The disease was abundant on numerous poorly drained sites in many areas. A notable outbreak of over 2,800 acres was visible from the air at Logan Beach and Mountain Lake on the large peninsula by Russell Fjord near Yakutat. The disease occurred at low levels on white and Lutz spruce in interior and south-central Alaska and was found in scattered pockets on the Kenai Peninsula in 1995.

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 from this disease even in years of intense infection (Fig. 8).

On Sitka spruce, the primary ecological consequence of the disease may be to reduce tree vigor of a species already poorly adapted to boggy sites. Repeated infection of spruce may alter forest composition by favoring other tree species.

In spring of 1995, the fungus *C. weirii* was found sporulating on Sitka spruce in Juneau and other areas of southeast Alaska. It did not occur at the high levels found in 1994, however. *C. weirii* produces fruiting bodies on one-year old needles of Sitka spruce in early spring. Its spores infect Sitka spruce needles and, 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

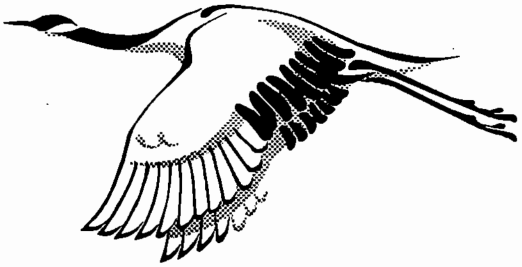
Pucciniastrum vaccinii (Rab.) Joerst.

Hemlock needle rust was present at low, endemic levels on needles of western hemlock in 1995. The disease has not been found at outbreak levels since the late 1970's. Reasons for low infections are not known given the great abundance of both hosts in southeast Alaska, western hemlock and Vaccinium spp. Infection levels are rarely significant enough to cause any 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 severely defoliated nor death of cedar trees. Neither disease has major ecological effects.



DECLINES AND ABIOTIC FACTORS

YELLOW-CEDAR DECLINE

Decline and mortality of yellow-cedar persists as one of the most spectacular forest problems in Alaska (Fig. 9). About 595,000 acres of decline have been mapped during aerial detection surveys. Concentrated mortality occurs in a wide band from western Chichagof and Baranof Islands to the Ketchikan Area. Of the three administrative areas of the Tongass National Forest, the Stikine Area has the greatest concentration of cedar decline at 243,000 acres.

All research suggests that no contagious organism is 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 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 snowpacks in the last century. These hypotheses are developed in some detail (Hennon and Shaw 1994). Whatever the primary cause of this mysterious decline, it is probably a naturally-occurring phenomenon.

A list of acreage affected by Alaska-yellow cedar decline has been determined by mapping dead and dying cedar during annual aerial detection surveys conducted over previous years. 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.

Ground surveys indicate 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 appears 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, 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 not particularly beneficial to cavity-using animals because yellow-cedar wood is less susceptible and slow to decay. 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. Studies were initiated in 1995 to determine mill-recovery and wood properties of snags of yellow-cedar that have been dead for varying lengths of time.

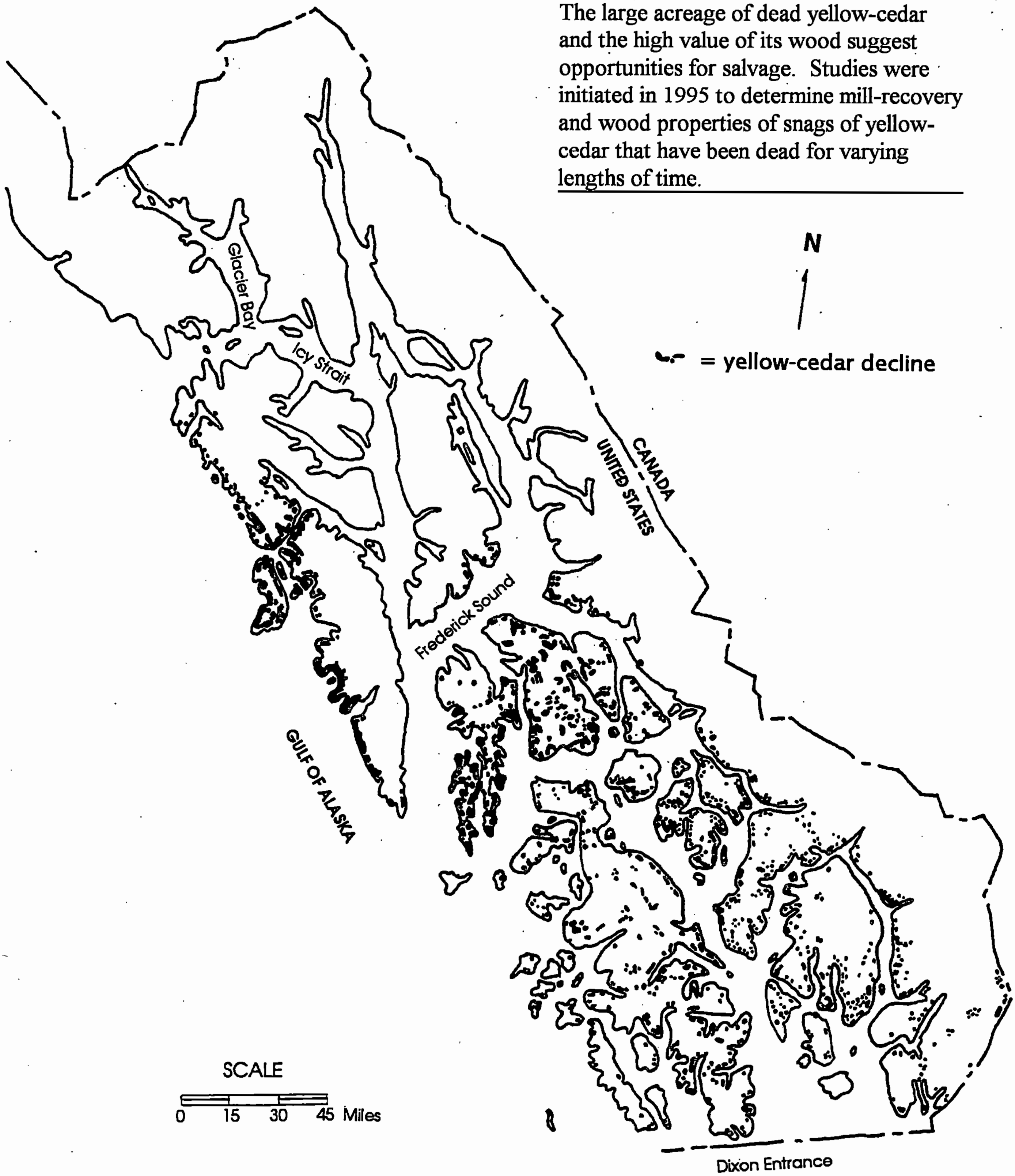


Figure 10. Distribution of yellow-cedar decline in southeast Alaska.

Table 3. Acreage affected by yellow-cedar decline in southeast Alaska in 1995.

	Acres
NATIONAL FOREST LAND	564,001
Chatham Area	136,169
Juneau Ranger District	1,634
Hoonah Ranger District	2,490
Sitka Ranger District	
Chichagof I	38,298
Baranof I	58,719
Kruzof I	27,971
Total	124,988
Admiralty Island Nat'l Mon. Wilderness	7,057
Stikine Area	243,359
Petersburg Ranger District	
Kupreanof I	81,937
Kuiu I	68,826
Mitkof I	8,913
Woewodski I	2,258
Mainland	9,108
Total	171,042
Wrangell Ranger District	
Etolin I	26,700
Wrangell I	17,270
Zarembo I	9,807
Woronofski I	622
Mainland	17,918
Total	72,317
Ketchikan Area	184,473
Thorne Bay Ranger District	
Prince of Wales I	29,826
Kosciusko I	16,541
Heceta I	1,463
Total	46,830

	Acres
Ketchikan Area (continued)	
Craig Ranger District	
Prince of Wales I	44,421
Dall I. and Long I	1,790
Total	46,211
Ketchikan Ranger District	
Revillagigedo I	25,765
Gravina I	6,780
Mainland	22,183
Total	54,728
Misty Fjords Nat'l Mon. Wilderness	
Revillagigedo I	13,623
Mainland	23,081
Total	36,704
NATIVE LAND	18,912
Prince of Wales I	10,196
Kupreanof I	312
Sukkwan I	156
Ketchikan area	6,303
Annette I	1,945
STATE AND PRIVATE LAND	12,141
Sitka area	1,246
Mitkof I	1,517
Kupreanof I	389
Prince of Wales I	1,410
Wrangell area	1,245
Pelican area	156
Ketchikan area	2,131
Gravina I	2,958
Kosciusko I	1089
TOTAL LAND AFFECTED	**595,054**

HEMLOCK FLUTING

Deeply incised grooves and ridges extending vertically along boles of western hemlock characterize hemlock fluting. 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.

WATER DAMAGE

More than 4,700 acres of flood damaged spruce were observed in 1995 in interior Alaska. The largest impacted area, 2,024 acres, was noted south of Farewell Lake Lodge. This is an expansion of the same area affected by high water in 1994.

Flooding damage to conifer stands occurred in scatter locations in southeast Alaska totalling more than 2,400 acres. The largest affected area included more than 600 acres in Yakutat Forelands. Some small areas of high water damage to conifers were the result of beaver dams.

WINTER INJURY

A considerable number of "diseased" Sitka spruce and Mountain hemlock were observed in the spring of 1995 near the Begich-Boggs Visitor Center located south of Anchorage in Portage Valley (Fig. 11). A field check determined that the injury was not caused by insects or disease, but probably warm winter winds. Sudden warm winds (chinooks) that occur during the winter may cause a sudden increase in transpiration (evaporation from the needles). If the soil is frozen when this occurs, water is not available to replace that which is transpired. Under these circumstances, the tree reacts as it would in a period of drought. Although the previous years' growth was dead, closer examination showed the new years' growth had flushed. Affected trees are usually not permanently damaged.

Winter injury to yellow-cedar regeneration was common throughout southeast Alaska in 1995. Early fall or late spring frosts were likely responsible for the shoot and branch dieback that was frequently observed in spring.

STATUS OF ANIMAL DAMAGE

PORCUPINE
Erethizon dorsatum

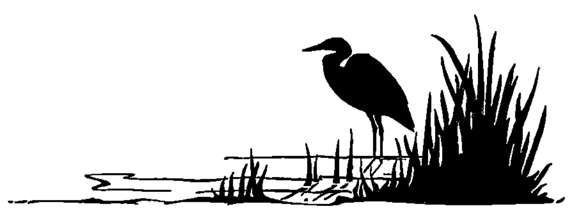
Porcupines cause severe damage to Sitka spruce and western hemlock in numerous local areas of southeast Alaska. An extensive survey documents the level of porcupine damage in young-growth stands. Feeding injuries to trees are confined to the known distribution of porcupine; thus, trees are not damaged where the porcupine is absent such as Prince of Wales, Kuiu, Baranof, Chichagof, and Admiralty Islands. 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. Shore pine near Haines has been damaged the last few years. 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, porcupines climb fewer trees and 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: (i) to provide greater diversity of structure and vegetation in young, even-aged conifer stands through mortality and (ii) 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.

BROWN BEAR
Ursus arctos

Yellow-cedar trees were wounded in the spring by brown bears on Baranof and Chichagof Islands. Brown bears rip the bark away from the lower boles of these trees, apparently to lick the sweet cambium. Other tree species are unaffected. Trees with old scars have associated columns of wood decay that will limit the value of their butt logs. Ecologically, this interaction of bears and trees may benefit the bears directly by providing nourishment. In addition, stand structure may be altered by greater heart rot levels due to bole wounding.



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:

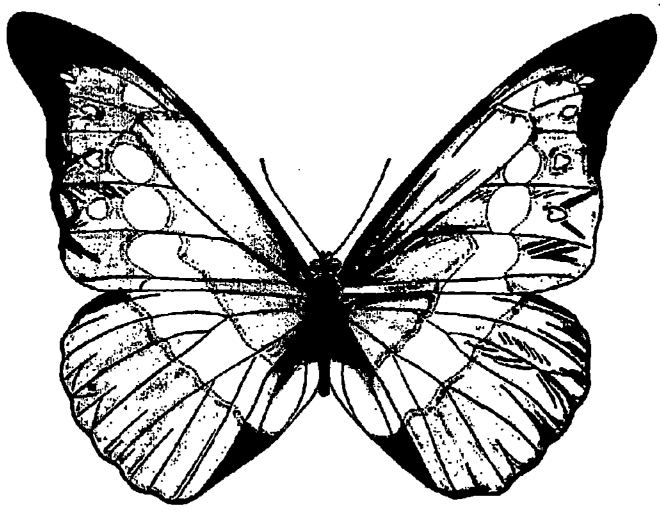
(1) Participation in a cooperative effort with the Alaska Cooperative Extension (ACE) to provide pest management information to Alaska residents. The program, which includes education, research and survey activities, also provides integrated pest management information concerning urban forestry as well 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. IPM Technicians were located in Anchorage, Palmer, Soldotna, Fairbanks, Delta Junction, Juneau, Ketchikan, and Kodiak. 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 IPM Technician for the season. The total recorded client contacts reached well over 5,000 which was more than 50% of all contacts made by the Cooperative Extension Service. The 1995 Technicians conducted 37 workshops and had 72 media contacts. 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. Four issues of "The IPM Scout" were produced and distributed without charge to more than 2,500 subscribers. In addition each IPM Technician submitted four monthly area reports and one feature article during the course of the season.

In an effort to expand the outreach program, ACE and Forest Health Management initiated the Alaska Forestry IPM Technician regional position in 1995. The Forestry IPM position was a full time position and allowed us to meet the needs of Alaskans with more specific forest pest and woodlot management issues and concerns. The Forestry Technician activities included: answering 215 phone calls concerning forest health issues; 123 site visits; 25 media contacts; 5 radio interviews; and 2 television appearances. We are looking closely at increasing our support for this excellent program in FY 96.

(2) Ground applications of methylcyclohexenone (MCH) for the prevention of spruce beetle attacks and population build-up in standing spruce were once again undertaken in the spring of 1995. MCH is the naturally occurring anti-aggregating pheromone of the spruce beetle. That is, it functions as a repellent. The objective of the study was to see if the application of MCH in a bubble-cap formulation would significantly reduce the number of spruce beetle attacks on large diameter standing spruce. Previous studies have shown that the use of MCH bubble caps appears feasible as an operational use strategy for protecting high value stands of spruce where spruce beetle populations are low, but increasing. Bubble caps were applied to 1/2-acre square and circular plots. An equal number of untreated plots served as checks. The best treatment (MCH applied to round plots) resulted in 25% new attacks vs. 43% new attacks in the untreated plots. FY 96 studies will test the round plot treatment design but expand plot size to 2 1/2 acres.

There are also studies underway to develop and validate a plume model to determine the horizontal, vertical, and crosswind movement of MCH in a stand atmosphere. The development of this model will allow us to place specific amounts of pheromones in a forest environment based on specific stand conditions (open vs. closed canopies). Likewise, studies were initiated to determine the optimal amounts of natural MCH needed to repel further beetle attacks. The minimum atmospheric concentration of MCH that repels attacking spruce beetles can then be computed for stands of Lutz spruce. This minimum atmospheric concentration of MCH will be used to fine-tune the plume model.

(3) Environmental fate studies of four commonly used forest herbicides in Alaska (triclopyr, imazapyr, hexazinone, and glyphosate) were recently completed by Oregon State University scientists. Two study sites were used: a maritime Sitka spruce site and a river bottom forested site near Fairbanks. Herbicides were applied to competing vegetation with a hand-held boom sprayer. Soil, water, and vegetation were collected before treatment and after treatment (DAT) up to 465 days. Soil and water residues in the subarctic dissipate quickly; less than 2-3% of the total remain at 465 DAT. Rate of loss did not vary with climate or slope. Vegetation residues dissipated very rapidly for imazapyr, hexazinone, and glyphosate; triclopyr had degraded to less than 6% of initial residues by 120 DAT. Residues in the subarctic appear to follow trends observed in temperate climates except during winter.



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."

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

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Institute of Social and Economic Research | University of Alaska Anchorage

Research Summary

R.S. No. 51 | October 1991

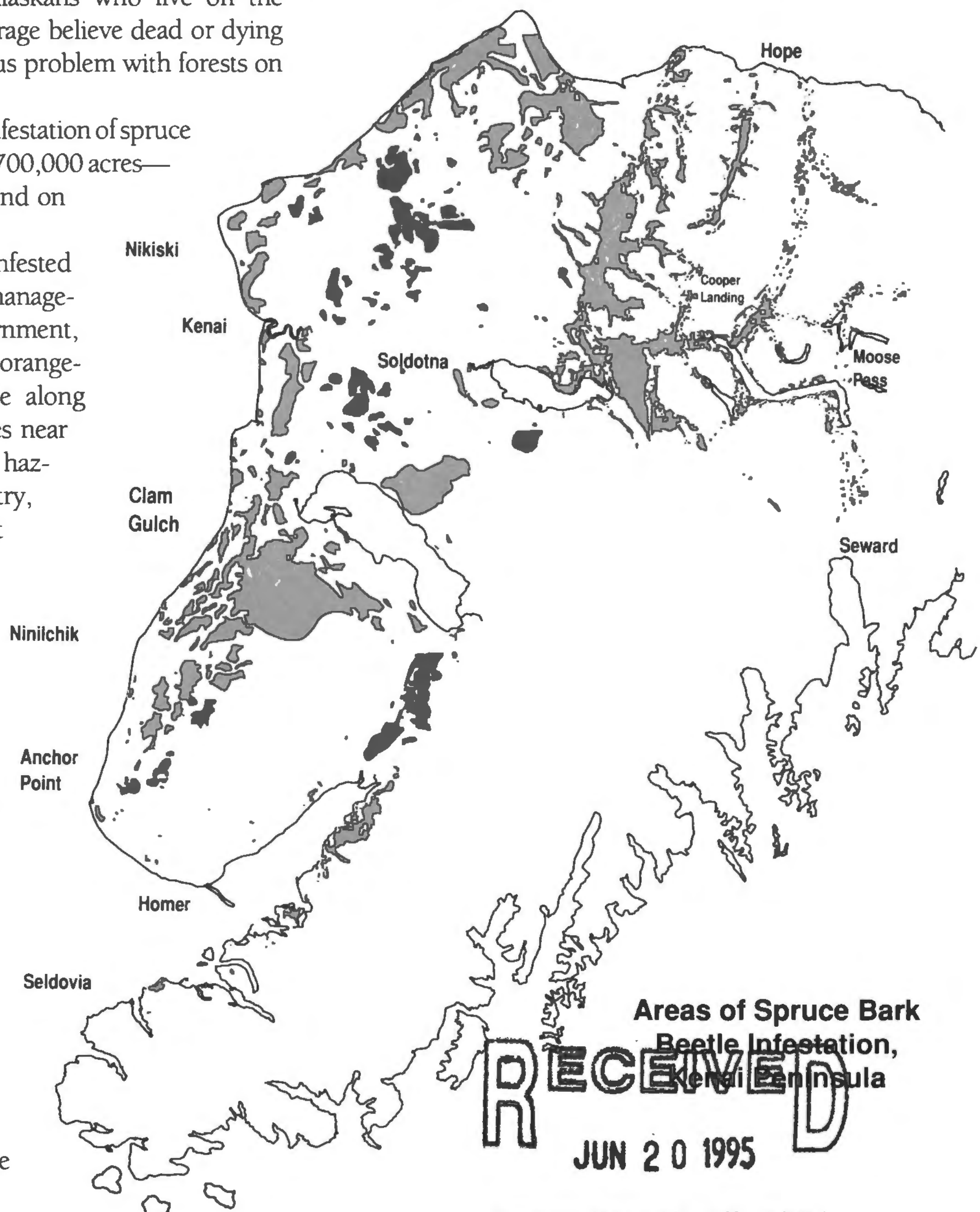
Managing Beetle-Killed Spruce on the Kenai Peninsula

Nearly 90 percent of Alaskans who live on the Kenai Peninsula and in Anchorage believe dead or dying spruce trees are the most serious problem with forests on the Kenai Peninsula.

Since 1970, a spreading infestation of spruce bark beetles has killed trees on 700,000 acres—about 35 percent of forested land on the peninsula.

What to do about the infested trees has become a prominent management issue for the state government, partly because areas of dead, orange-brown spruce are very visible along peninsula highways. Dead trees near communities can also be a fire hazard. The state Division of Forestry, which is part of the Department of Natural Resources, asked ISER to find out how residents of southcentral Alaska want the state to manage areas affected by the spruce bark beetles. The division manages about eight percent of forested land on the Kenai Peninsula.

In March and April 1991 ISER conducted a telephone survey of 400 peninsula households and 100 Anchorage households. ISER also created maps documenting the location and extent of the beetle infestation, using data collected by the U.S. Forest Service over the past 20 years.



Areas of Spruce Bark Beetle Infestation, Kenai Peninsula

*This Research Summary is based on **Developing A Public Consensus on the Management of Spruce Bark Beetles on the Kenai Peninsula**, by Jack Kruse and Robert Pelz. The report is available from ISER at a cost of $5.00. This publication is on recycled paper.*

Below we summarize the report findings. We surveyed three groups of southcentral residents: (1) affected homeowners (Kenai Peninsula residents who reported dead or dying spruce on their own or adjoining properties); (2) other Kenai Peninsula households; and (3) Anchorage households.

We asked southcentral residents whether the state should remove or leave beetle-killed trees; whether it should protect healthy trees near infested ones; and whether and how the state should speed re-forestation in affected areas. Affected areas are near homes, along highways, in campgrounds, and in backcountry.

Bear in mind that the state owns just a part of the beetle-infested lands. Areas of the Chugach National Forest and the Kenai National Wildlife Refuge are also affected, as well as borough and private lands. So whatever the state decides to do about the infestation on its own lands, federal, borough, and private landowners will make their own decisions about large areas of the peninsula.

How Big is the Problem?

Press coverage of the beetle infestation, and the growing swaths of dead trees, have made Alaskans very aware of the spruce beetle infestation. More than half of Anchorage residents and three-quarters of Kenai Peninsula residents have read about the beetle infestation, and half of all southcentral residents say they have seen dead trees along peninsula highways.

What are the problems created when beetles kill spruce trees? Figure 1 shows percentages of affected peninsula homeowners, other peninsula residents, and Anchorage residents who cited various kinds of problems created by the spruce bark beetle. Southcentral residents think the chief problems resulting from beetle-killed spruce are (1) less attractive views, (2) fire threat, and (3) loss of privacy. Other problems cited include large areas affected, loss of timber, and declining property values.

In researching the problem ISER found:

- Of the total 700,000 acres affected by beetles since 1970, 150,000 acres were infested within the past five years. Some areas that were first infested between 1970 and 1975 were re-infested between 1985 and 1990.
- The estimated value of buildings on or adjacent to properties with beetle-killed spruce is $686 million. That does not mean all these buildings are at risk in the event of fires, or that all these property owners have lost privacy. The figure simply establishes that a substantial number of homes and other buildings are in areas affected by the spruce bark beetle.
- About 33,000 acres infested by beetles are in the most populated areas of the peninsula, including the communities of Cooper Landing, Nikiski, Kenai, and Soldotna.
- About 5,000 Kenai Peninsula homeowners, or 51 percent of peninsula households, report beetle-killed spruce on their own or adjoining properties.

Dead Trees Near Homes

Figure 2 shows how residents of Anchorage and the Kenai Peninsula want the state to manage beetle-infested trees near homes:

- About three out of four residents of south-central Alaska want the state to cut down and remove dead trees near homes.
- More than half of southcentral residents want the state to plant new trees near homes and either scrape the ground or place mats around the new trees to discourage grasses that can choke seedling trees.
- Fewer than one-quarter of southcentral residents support the use of chemicals near homes to dry or kill grasses that could choke newly planted trees.

Figure 1. Six Most Commonly Cited Problems
(In Percentages of Respondents)

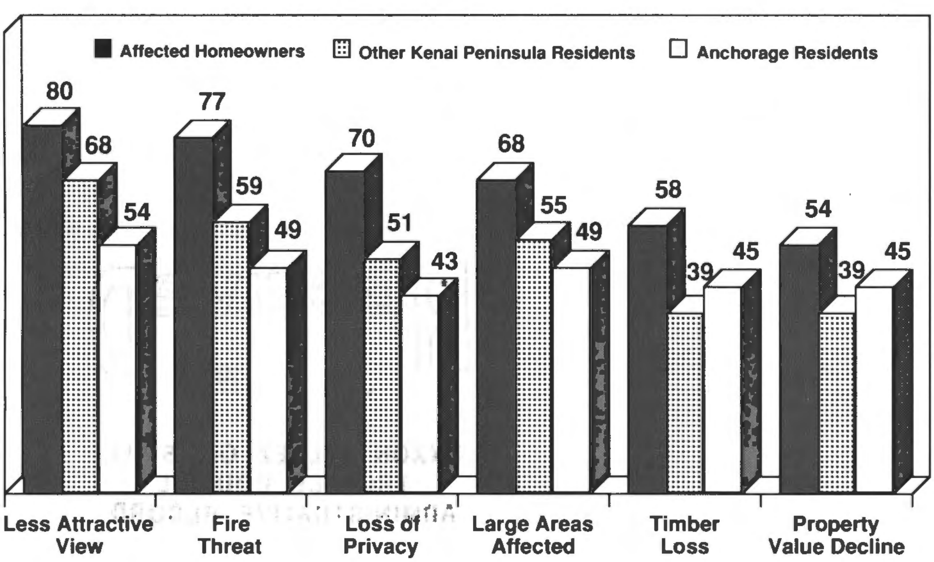


Figure 2. Public Support for Managing Infested Trees Near Homes
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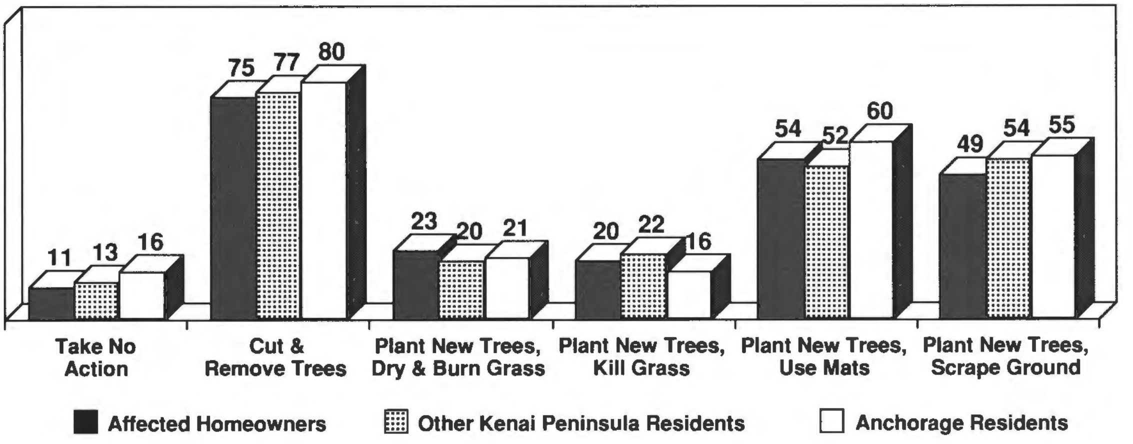


Figure 3. Public Support for Managing Infested Trees Along Highways
(In Percentages of Respondents)

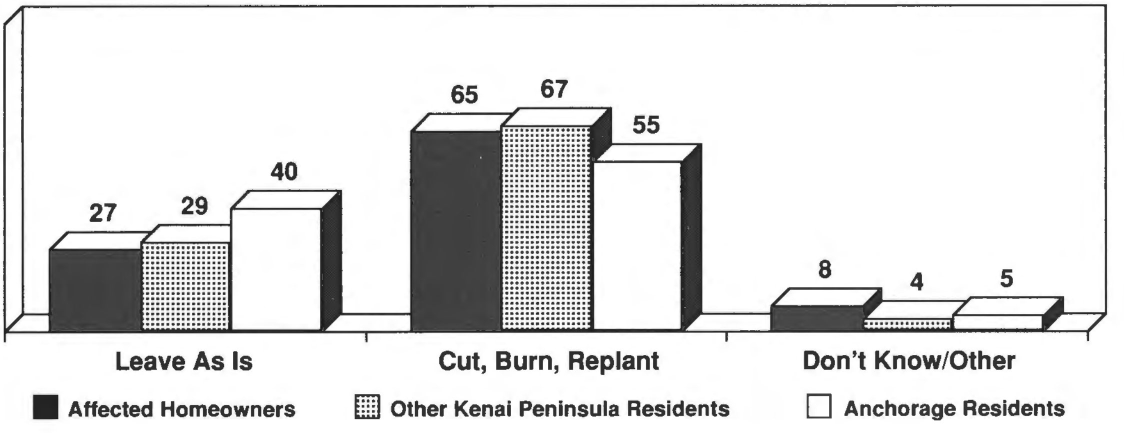
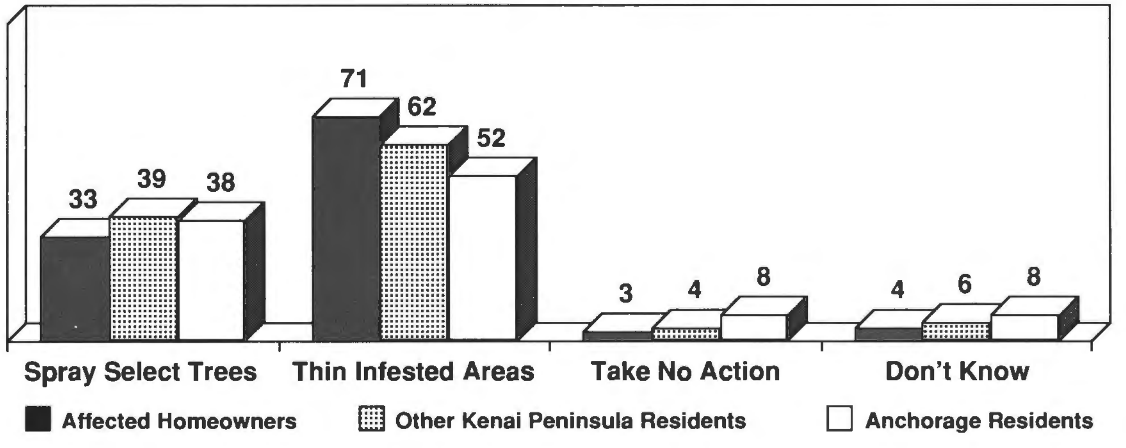


Figure 4. Public Support for Managing Spruce Beetles Near Campgrounds
(In Percentages of Respondents)



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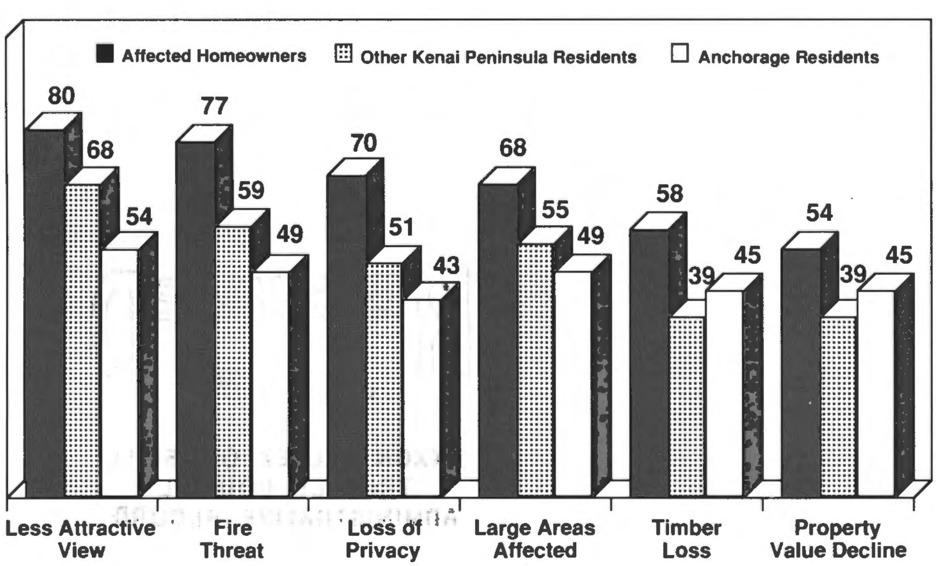


Dead Trees Along Highways

Figure 3 shows how southcentral residents want the state to manage beetle-infested trees along highways:

• Two-thirds of peninsula residents and more than half of Anchorage residents want the state to cut and burn beetle-killed trees along the highways and plant new trees.

• A substantial minority of southcentral residents—40 percent in Anchorage and nearly 30 percent on the peninsula—think the state should do nothing about beetle-killed trees along highways.

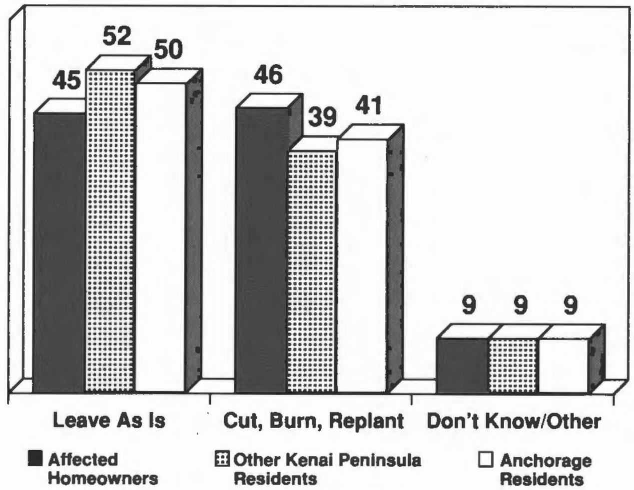
Dead Trees in Campgrounds and Backcountry

Figures 4 and 5 show how southcentral Alaskans want the state to manage beetle-infested trees in campgrounds and in backcountry:

• Most (71 percent) of peninsula residents whose own properties have been affected by the spruce bark beetle want the state to thin out infested trees in campgrounds. More than half of other southcentral residents also support thinning infested trees in campgrounds.

• Sizable minorities (nearly 40 percent) of Anchorage and Kenai Peninsula residents favor protecting selected trees in campgrounds by spraying them with insecticides.

Figure 5. Public Support for Managing Spruce Beetles in Backcountry
(In Percentages of Respondents)



• Southcentral residents are almost evenly split in their opinions about what the state should do about beetle-killed trees in backcountry: roughly half say the state should do nothing, and almost half want the state to cut and burn dead trees and plant new ones.

Research Summary (No. 51)
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