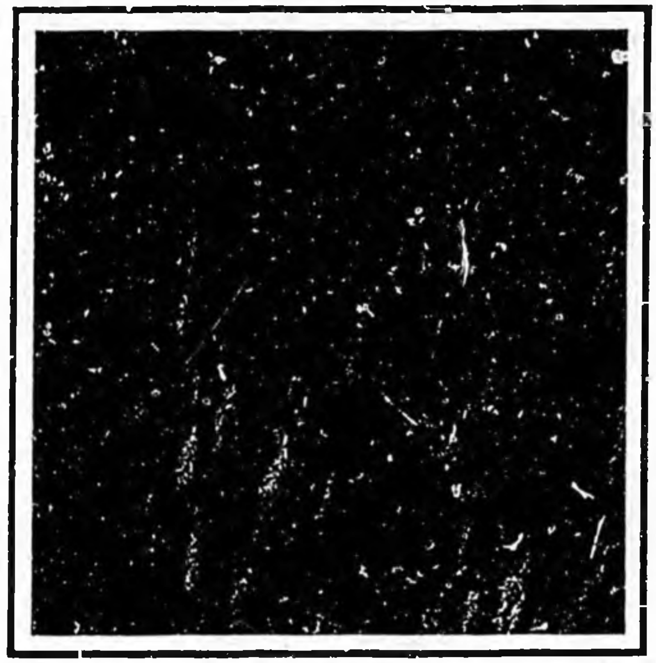
SPRUCE BARK BEETLES

The Spruce Beetle in Alaska Forests



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The Spruce Beetle in Alaska Forests

by Richard A. Werner

The spruce beetle is a bark beetle that attacks white spruce trees in south central and interior Alaska. Bark beetles kill trees by boring through the bark and feeding and breeding in the phloem — the thin layer of soft living tissue directly beneath the bark. The phloem is vital to trees, as it transports food manufactured in the needles down to the roots. If the phloem is girdled, the tree will die.

Small populations of beetles are always present in white spruce forests. Most of the time, the number of beetles is kept low by parasites and predators of the insect. But when conditions are right, the spruce beetles may suddenly increase to epidemic numbers. The right conditions include an abundance of breeding material accompanied by an extremely dry summer. Beetles attack and breed in fresh windthrown trees, felled trees, injured trees, and logging slash. When the beetle population outgrows the supply of dead and injured trees, they move into nearby living trees, particularly mature stands of white spruce.

Of all the insects that affect white spruce in Alaska, the spruce beetle causes the most damage.

Signs that beetles are present

The primary indication that beetles are attacking a tree is reddish-brown dust which accumulates on the bark, in bark crevices, and on the ground beneath the attacked tree.

Globules of resin or pitch tubes at the entrance hole into the bark are another sign of beetle attack. Entrance holes are usually found in the roots (both exposed and underground) and lower part of the trunk. Early detection requires close examination of trees from early June to mid-July. To determine if spruce beetles are present, remove the bark around an entrance hole to locate the adult and larval tunnels.

Resin flow on newly infested trees

Bark removed by woodpeckers searching for beetles

Beetles that attack healthy, vigorous trees are usually trapped in a mass of resin and "pitched out" of the entrance hole. Trees that have been attacked in this way will have patches of resin flowing down the trunk.

Beetle infested trees are often sought out by woodpeckers and pieces of bark removed by pecking activity accumulate on the ground beneath the trees. This is especially noticeable in the winter when the bark accumulates on the snow.

A change in foliage color is another indication of spruce beetle attack. Needles begin to fade from dark green to pale yellowish-green as early as 1 month after an attack and may remain that color until the following summer. In some cases, needle discoloration may not be noticeable until 1 year after the attack and sometimes not until after the beetles have left the tree. By mid-summer, 1 year after initial attack, many needles have dropped and the tree turns reddish-brown. Three to 5 years following attack, the trees appear silvery-gray and remain that way for many years.

Life history

The spruce beetle in south central Alaska has a 1 or 2-year life cycle whereas those in interior Alaska have a 2-year cycle. Adult beetles emerge from infested trees from mid-May to mid-June, and their flight to fresh host materials lasts until mid-July. When the female beetle finds a suitable host, she bores into the bark and constructs an egg gallery in the phloem parallel to the wood grain and usually above the entrance hole. After mating occurs, the female lays whitish-yellow eggs in clusters on either side of the gallery. Eggs hatch into white grub-like larvae which feed in the phloem cross-wise to the egg gallery. Larvae do not enter the wood but may score the outer surface.

Under section of bark showing larval and adult galleries and pupal chambers (one-half normal size)

Adult beetle laying eggs in phloem (twice normal size)

The insects spend the first winter as larvae beneath the bark. In spring they resume development and eventually transform into white pupae for a short time and then to adult beetles. The parent adults may then emerge from the now dead or dying trees (by boring holes through the bark) and move to fresh trees. However, they may remain with the new adults, overwinter in the dead or dying tree, and emerge the following spring.

Guidelines for reducing beetle infestation

Various activities which disturb the environment of white spruce contribute to spruce beetle attack and epidemic outbreaks. These activities include timber harvest; land clearing related to road, seismic line, pipeline, powerline, or building construction; and severe winds which cause windthrown trees.

Spruce beetle attacks may be prevented or reduced by following these guidelines:

Proper Management of Spruce Forests

1. Maintain spruce stands in a healthy and vigorous condition by removing overmature, diseased, and dying trees.

2. Remove damaged or windthrown trees from spruce stands under management.

3. Establish a stand rotation age (harvest age) of less than 150 years.

4. Timber sale size and orientation of cutting areas are important in creating stands that can withstand high winds. Leave strips between clearcut or shelterwood cutting areas should be more than 100 feet wide. Timber sales should not be located along ridgetops where shallow-rooted spruce are highly susceptible to high wind.

Infested spruce trees

Timber Harvest

1. Overmature trees should be removed from forest stands as they are highly susceptible to spruce beetle attack.

2. Windthrown trees, particularly in recently logged areas, should be removed.

3. All logs cut after September should be removed and utilized prior to beetle flight the following May. Logs cut during the summer months should be removed shortly after cutting.

4. All slash and cull logs 4 inches in diameter and larger should be disposed of by burning, burying, chipping, or peeling.

5. Stumps should be cut as low as possible.

6. Whole tree logging will eliminate most of the breeding material usually left in the forest and concentrate it at the logging landing where it can be destroyed.

Rights-Of-Way Construction

1. Timber along rights-of-way for roads, seismic lines, pipelines, and power lines should be cut in the fall and the logs utilized before the next spring. Slash should be treated as described earlier. Trees next to the right-of-way should be examined for beetle attacks in late summer following cutting. If trees are infested, they should be removed.

2. Care should be taken to avoid scarring trunks with mechanical equipment, severing roots, altering drainage patterns, or severly compacting the soil.

Proper slash disposal along a powerline right-of-way

Improper slash disposal along a similar right-of-way

Home Construction

1. Trees removed for home construction should be properly disposed of or utilized. If stockpiled for firewood or used for construction, the bolts or logs should be peeled. Mechanical damage to standing trees should be avoided and damaged areas should be cleaned with a knife and treated with commercial pruning tar.

2. Excess soil should not be placed on top of or removed from the area over the root zone. Trees breathe to some degree through the roots and the addition or removal of soil can cause suffocation.

3. Avoid soil compaction around the base of trees and do not surface these areas with rock, concrete, or asphalt. Sewage drainage fields should be located away from trees because excess water can create stress conditions in adjacent trees.

4. Insecticides can be used to protect live trees from beetle attack. Water solutions of chemicals should be applied with a pressurized sprayer to the trunks of trees before beetle flight and attack from May to July. Your local agricultural extension office can provide additional information.

Additional information can be obtained from the following:

Institute of Northern Forestry
USDA-Forest Service
Fairbanks, Alaska 99701

Forest Insect and Disease Management
State and Private Forestry
USDA-Forest Service
Anchorage, Alaska 99504 and
Juneau, Alaska 99802

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SPRUCE BARK BEETLE ACTIVITY/RESEARCH IN ALASKA

- Areas of past insect activity or high landowner interest are mapped from the air annually. A relatively small portion of the entire State, but a significant portion of the Interior's Commercial Forest is thus covered.
- Mapped areas are always on the conservative side as observations can only reflect where canopy color has already changed.
- In heavily infested stands, over 80 percent of the white spruce trees hvae been killed.
- Due to thick organic mat, loss of seed source and cold soil conditions, natural spruce regeneration is slow or impossible.
- Insect mortality results in rapid loss of product value due to checking (cracking) and blue stain fungus.

Regional Volume Implications:

* Lower Yukon River - Estimated 2.5 billion board feet on 225,000 acres between Galena and Anvik (11MBF/acre). No end is in sight.
* Kuskokwim/Holitna Rivers - Estimated 1.5 billion board feet on 125,000 acres. Intense mortality on Kuskokwim. Infestation continues to spread on Holitna (12 MBF/acre).
* Copper River (Glenallen to Thompson Pass) - Estimated 300 million board feet on 50,000 acres along Richardson Highway, Not much left to kill. Surrounding area not mapped. (6MBF/acre).
* Coastal Alaska - Isolated outbreaks scattered from Prince William Sound to Yakutat show that Sitka spruce not immune to bark beetles.
* Tyonek to Mt. Susitna - Estimated 1.2 billion board feet on 450,000 acres. Beetles have killed most of spruce component in the stand. Insects spreading to north as they run out of food source. (2.7 MBF/acre)
* Upper Susitna/Willow - Estimated 250 million board feet on 100,000 acres. No projection of final potential of this infestation has been done.
(2.5 MBF/acre).
* Matanuska River below Chikaloon - Resident population of beetles is static. No dramatic increase in past five years.
* Kenai Peninsula - Estimated 3 billion board feet on 500,000 acres. Acreage and volumes are probably conservative. Most of upper peninsula has 90% + mortality. Old growth stands near Kachemak Bay have suffered 60% loss and infestation continues to kill trees. New outbreaks located near Clam Gulch and Tustumena Lake. No end of this infestation is in sight as they continue to cycle around the peninsula, hitting stands of spruce as they reach viable size and age - just as (or before) the trees become commercial in size on today's markets. (6MBF/acre).
* Beluga River/Mt. Susitna - Estimated 1.2 billion board feet on 100,000 acres. Intensity of mortality being surveyed this week in coordination with the Mat-Su Borough. Most of damage was done within the last 1 to 4 years. (2.5 MBF/acre).

Efforts to Date

- Field evaluations of mortality, volume loss, fiber degradation are just beginning.
- Demonstration area on silvicultural management options for bark beetle control is being set up by the U.S.F.S. on the Kenai Peninsula.
- U.S.F.S. grant funds provide for 75% of only one Division of Forestry employee with focus on Insect and Disease problems. Federal funding is very unstable.
- Developed a risk rating system for forested areas - which will the beetles most likely attack?
- Developed a vegetation management plan for Russian River Campground where spruce beetles have killed all the spruce over 2 inches in diameter.
- This spring we will be cooperating in lethal trap tree pilot studies - a promising new technology thats baits in and kills the insects without killing the tree on the Kenai Peninsula.
- Field distribution of artificial traps to limit spread of isolated flareups of insects detected at early stages will begin this spring.
- Research to determine the susceptibility of Sitka spruce to beetle attacks is being planned in Southeastern, Gulf of Alaska, Prince William Sound and Kachemak Bay. Studies include insect adaptability to wetter climates.
- "Trap tree" application on State land near Devil's Elbow on the Kuskokwim River will get bark removal and burning this spring.
- Annual survey results have been sent to most Regional and Village Corporations and all of the State D.O.F. Offices.

Limiting Factors

° Division of Forestry has extremely limited capability (one person) that is totally dependent on tenuous Federal funds.

° State land in Southcentral with the most active beetle populations have poor to nonexistent access and low volumes of spruce per acre making salvage impractical at this time.

° Kuskokwim River infestation is heavy on State land with limited existing markets and transportation contraints restricting salvage opportunities.

° Federal/State conservation units where logging to salvage trees or reducing spread potential through forest management is not allowed serve as an ongoing source of beetle attacks on surrounding areas.

° Tanana Chiefs are evaluating the Lower Yukon infestation for salvage options. The solution may involve roading to Norton Sound or special barging to the coast. Most of this infestation is on Native Corporation lands.

° Past State land disposals have put isolated private parcels scattered around most forested State land. These parcel holders (at least the vocal ones) are resistant to harvesting on any but extremely small scales and are against roads into "their wilderness". They do however expect the State to keep their property safe from forest fires such as the ones that burned through the insect killed timber at Yosemite this past summer.

Forest Health Through Silviculture And Integrated Pest Management

A Strategic Plan

United States
Department of
Agriculture

Forest Service

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Executive Summary

Objective

Enhance and maintain the health of the Nation's forests by developing an USDA Forest Service strategic plan to be implemented through Forest Service programs and authorities.

Discussion

The need for this plan was emphasized by the 1987 Congressional Appropriations hearings on the Forest Service budget, by expressions of concern by the public, and by the continuing evidence of pests in the forests.

Forest health is a complex subject with both real and perceived problems which can arouse strong emotions. Such problems justify nationwide concern and Forest Service attention.

For purposes of this report, a desired state of forest health is a condition where biotic and abiotic influences on the forest (i.e. insects, diseases, atmospheric deposition, silvicultural treatments, harvesting practices) do not threaten management objectives for a given forest unit now or in the future.

A healthy forest can be described by many standards, each related to a management objective for the forest. No single standard or definition covers all objectives. This diversity emphasizes the complexity of the problem. Each forest resource manager will have to decide, based on the management objectives for a particular piece of forest, what actions are needed to provide the forest condition and productivity desired.

Many factors impact the health of the forests. These include global warming trends, atmospheric deposition (air pollution and acid rain), meteorological events, soil erosion, volcanos, insects and diseases, and human activities. In preparing the following plan, a detailed analysis of each factor was impractical. Instead, the forest health issue focused upon insects, diseases, and atmospheric deposition effects. These factors have been most frequently mentioned by Congress, Forest Service administrators, and the general public. The effects of forest pests and atmospheric deposition are examined to understand the processes that affect forest health and the actions necessary to mitigate those effects. Forest pests are often symptoms of forest health problems.

It is possible to identify and treat such symptoms with available remedies.

This report focuses on Forest Service responsibilities and programs. The Forest Service has a role in identifying, researching, evaluating, and implementing responses to forest health concerns. This role is best fulfilled by demonstrating the effectiveness and efficiency of selected actions on lands managed by the Forest Service. By developing, testing, transferring and implementing proven technology, the Forest Service redeems its leadership role in maintaining forest productivity now and in the future.

Throughout the United States, forest land is divided among many owners. Each may have different management objectives for their land. Vegetation may be manipulated to achieve particular purposes using a variety of silvicultural treatments. Such treatments can be effectively used to develop stands and forests that are more vigorous and less susceptible to disease and insects. However, not all lands can be treated immediately and not all lands will receive treatment.

Although more than 60 percent of the over 700 million acres of U.S. forest land could receive silvicultural treatments to enhance forest condition, at the current rate of entry it would take almost 50 years to treat all of the treatable acreage (if all areas received only one entry for treatment). Reserved, inaccessible, nonstocked, unproductive, and a large percentage of non-industrial private forest land will not be affected by silvicultural activities to improve forest health. Therefore, Forest Service leadership, advocacy of silvicultural treatments, and resource management actions will not solve all forest health concerns.

Factors such as weather are beyond the influence of the Forest Service. The Forest Service recognizes its air quality responsibility and has implemented programs to determine atmospheric deposition and receptor relationships. Additionally, the Forest Service is developing actions to manage the effects of atmospheric deposition on ecosystems.

For those forest lands where economics and other societal values permit treatment, the emphasis must be on achieving long-term improvements. Properly applied integrated resource management and integrated pest management represent the best practical solutions available for improving forest condition in the long run. However, for the next decade, suppression and mitigation of forest pests are the most relevant responses to forest health concerns.

Eight forest health issues are identified that relate to Forest Service programs and authorities. These issues include planning, public involvement, resource management, pest suppression, environmental analysis, pesticides, pest control technology, and forest health monitoring. Recommendations are developed for dealing with each issue.

Recommendations

The following recommended options for resolving the issues are proposed as a Forest Service strategic plan to enhance and maintain a healthy forest condition. Some of the recommended options require further analysis and the consideration of alternative procedures before they will be ready for implementation.

ISSUE 1- PLANNING

Integrated forest pest management considerations are not adequately incorporated in forest resource management planning processes.

RECOMMENDED OPTIONS

***Develop procedures for including pest impact information in the next planning cycle.**

***Transfer integrated pest management technology to the National Forest system and states.**

*** Require pest specialist input to National Forest system inter-disciplinary teams conducting forest resource management planning.**

ISSUE 2- PUBLIC INVOLVEMENT

Traditional forest management practices frequently conflict with public expectations.

RECOMMENDED OPTIONS

*** Establish a nationwide information program on forestry and the dynamics of the forest ecosystem.**

*** Require a comprehensive public information effort in conjunction with forest pest management activities.**

*** Train federal, state, and county specialists in conducting public information meetings.**

*** Target high-use recreation areas for intensive integrated pest management.**

*** Clarify and apply integrated pest management policy in wilderness areas.**

ISSUE 3- RESOURCE MANAGEMENT

Certain forest management practices may aggravate forest pest problems.

RECOMMENDED OPTIONS

*** Risk-rate all high-value forest analysis areas for pest outbreak potential.**

***Include integrated pest management in forest resource management prescriptions.**

*** Identify imminent pest risks to high-value resources and reschedule management activities to minimize impacts.**

*** Analyze the feasibility of using fuelwood sales to achieve vegetative management objectives.**

*** Determine optimum levels of forest pest management support.**

ISSUE 4- PEST SUPPRESSION

Mechanisms are needed for prompt responses to pest outbreaks.

RECOMMENDED OPTIONS

*** Include suppression funding need projections in the budget process.**

*** Establish a funding authority to suppress emergency pest outbreaks.**

*** Provide training in integrated pest management for all foresters in the National Forest system.**

*** Update guidelines setting priorities for funding pest prevention and suppression.**

ISSUE 5- ENVIRONMENTAL ANALYSIS

Programmatic NEPA documents permitting timely intervention against pest outbreaks are not available.

RECOMMENDED OPTIONS

*** Prepare programmatic NEPA documentation for potentially controversial pest management activities.**

*** Prepare programmatic NEPA documentation for pest management in forest nurseries and seed orchards.**

ISSUE 6- PESTICIDES

Alternatives to environmentally unacceptable chemical pesticides are needed for integrated pest management systems.

RECOMMENDED OPTIONS

*** Set priorities and conduct research to meet insecticide/ fungicide needs for integrated forest pest management.**

*** Determine Forest Service response to pesticide development needs for integrated forest pest management.**

ISSUE 7- PEST CONTROL TECHNOLOGY

Effective and economical integrated pest management technology is needed to protect forest resources from pest damage.

RECOMMENDED OPTIONS

*** Strengthen integrated pest management technology for major forest pests.**

*** Improve the development of technology to solve operational problems.**

*** Improve the program to transfer integrated pest management technology.**

ISSUE 8- FOREST HEALTH MONITORING

Standardized indicators for monitoring forest health are needed.

*** Establish a task force to identify standards and procedures for monitoring forest health.**

Although specifically applicable to the Forest Service, the actions listed above represent a positive first step for any forest resource management agency seeking ways to respond to concerns about the health of our Nation's forests.

FOREST HEALTH THROUGH SILVICULTURE AND INTEGRATED PEST MANAGEMENT- A STRATEGIC PLAN

INTRODUCTION

PURPOSE

This report describes recommendations for a USDA Forest Service strategic plan to enhance and maintain the health of the Nation's forests.

This strategic plan represents the Forest Service response to the forest health problem and the concerns emphasized by the Members of Congress during the 1987 Congressional Appropriations hearings on the Forest Service budget.

The recommendations of this report focus on Forest Service programs and responsibilities. The Forest Service has a leadership role in identifying, researching, evaluating and implementing responses to the forest health problem. This role is best fulfilled by demonstrating the effectiveness and efficiency of selected actions on lands managed by the Forest Service.

BACKGROUND

Apparently, a large portion of the public perceives a decline in the health of the Nation's forests. During the appropriation hearings on the 1988 Forest Service budget, Members of Congress expressed specific concerns about forest health. Their concern was partially triggered by ongoing outbreaks of gypsy moth, southern pine beetle, western spruce budworm, and mountain pine beetle. An additional concern was the growing need for information that might not be forthcoming about atmospheric deposition (air pollution and acid rain) and root diseases. Members of Congress questioned whether the proper balance was being maintained between short-term, commodity-oriented pest suppression projects and long-term investments in prevention or research.

Forest pest outbreaks seem to have increased in both frequency and severity during the last twenty years. Prior to the 1980s, gypsy moth defoliation exceeding one million acres in any one year occurred only during major outbreaks. Since 1980, at least one million acres have been defoliated annually. Prior to 1970, southern pine beetle outbreaks occurred at 10-year intervals. Since then, there have been three major outbreaks, two of record-breaking proportions. During the last ten years, the most damaging eastern spruce budworm outbreak ever recorded ended while western spruce budworm defoliation climbed to record levels. The mountain pine beetle also continued to cause substantial tree mortality on 3 to 4 million acres per year. In addition, losses from diseases such as fusiform rust, root diseases, and dwarf mistletoes continue at high levels as does concern about the possible effects of atmospheric deposition on sensitive forest resources.

A variety of standards are used to describe a healthy forest. Each standard is based upon specific management objectives for a given forest. No single standard or definition covers all objectives. This diversity reflects the complexity of the problem and the difficulty in defining forest health. Each forest resource manager must determine which forest characteristics require improvement and protection based on the management objectives for the forest. The actions needed to improve forest condition and enhance productivity will vary accordingly.

Throughout the United States, forested lands have many owners. Their diversity is reflected in numerous management objectives that can range from intensive and extensive management to wilderness and non-management. Silvicultural treatments that manipulate vegetation for given purposes can also vary widely. Such treatments can be an effective method to develop stands and forests that are less susceptible to attack by insects and disease. However, not all lands can be treated at once nor will all lands receive treatments. The National Forests can be used as an example. Less than 30 percent of National Forest lands have been identified in Forest Land Management Plans as suitable for timber management. Thus, silvicultural treatments such as regeneration harvests, commercial thinnings, salvage, planting, release, precommercial thinnings and fertilization occur on less than 2 percent of the total area each year. Some additional vegetation management opportunities do exist for wildlife and range management purposes.

Many factors impact the health of forests, including global warming trends, air pollution, acid rain, meteorological events, soil erosion, volcanos, insects and diseases, and human activities. Preparing an analysis of all factors for use in a Forest Service forest health strategic plan was not practical. To make the task manageable, this report focuses specifically on forest insects and diseases and atmospheric deposition as they affect forest health or condition. These factors were most frequently mentioned by Congress, Forest Service administrators, and the general public.

Sociologists deal with the health of our society by using social indicators such as rate of divorce, suicide, school dropouts, and unemployment. Epidemiologists address public health issues using indicators such as the incidence of cancer and heart attack. Forest managers can also address forest health using indicators such as changes in tree growth rate, trends in tree mortality, frequency and severity of pest outbreaks, production of goods and services, and vulnerability to pests.

The most useful indicators should reflect the many factors influencing forest health. A superficial look at forest health might suppose an overly simple relationship. A forest of vigorously growing trees resulting from proper silviculture, for example, does not assure the absence of forest pest outbreaks. Conversely, forest pest outbreaks do not preclude the availability of plentiful and diverse products, even though visual, recreation, or wildlife resources may be altered or displaced.

By examining forest pests and atmospheric deposition as case studies, the processes affecting forest health, as well as the actions necessary to mitigate those effects, can be better understood.

Until more specific indicators are developed, the desired state of forest health is a condition where biotic and abiotic influences on the forest (i.e. insects, diseases, atmospheric deposition, silvicultural treatments, harvesting practices) do not threaten management objectives for a given forest unit either now or in the future.

METHODOLOGY

The primary sources of information for this report were the background documents on major forest pests, pest complexes and atmospheric deposition prepared by subject matter specialists. These background evaluations are summarized in the following discussion section, and are reproduced as Appendices to this report.

SCOPE

All United States forest land is considered in this analysis. However, since its purpose is to develop a strategic plan for specific implementation by the Forest Service, the proposed actions focus on Forest Service programs and authorities. It is expected that successful

Cedar Creek plantation in 1912 when Douglas-fir seedlings were planted- Mt. Hood National Forest, Oregon.

strategies employed by the Forest Service will be applicable to other forest land ownerships.

DISCUSSION

In 1977, the forests of the United States covered over 31 percent of the almost 2.4 billion acres of land and water areas. By 2030, forest land is expected to decrease by about 24 million acres as other land uses take precedence. Most forest losses will occur in lower elevations where accessible land will be acquired for agricultural, industrial, and urban development. The remaining forests will have to supply a greater proportion of goods and services. To achieve higher levels of production, a greater percentage of forest land will require some form of production management. Lands already managed will receive more intensive management. To save shrinking forests from pests, managers will have to move from reactive to proactive strategies. Necessarily, that will mean greater emphasis on prevention and less dependency on suppression to reduce the impact of forest pests.

FOREST HEALTH ENHANCED THROUGH SILVICULTURE AND INTEGRATED PEST MANAGEMENT

Silvicultural changes are the single most important action that can be taken to mitigate forest pest and atmospheric impact on the condition of the forest. Forest resource managers employ vegetation management practices that will produce a desired mix of goods and services. Achieving the desired level of productivity generally requires that the forest vegetation is alive and healthy. Practices that promote short-term goals but are detrimental to plant health can have a negative impact on long-term productivity.

Cedar Creek plantation after 9 years (1921)- Mt. Hood National Forest, Oregon.

Vigorous growth in Cedar Creek in 1939- Mt. Hood National Forest, Oregon.

Silvicultural practices such as site preparation, planting, prescribed fire, release or precommercial thinning from competing vegetation, and various harvesting practices including regenerative cutting, commercial thinning, and salvage can have beneficial effects on forest vegetation if applied properly and in a timely fashion. In addition, other practices that include genetically-improved seedlings may provide opportunities to grow forests that are more resistent to insects and diseases.

The major factor in the overall health of the forest is the vigor of the trees and other forest vegetation. If the majority of the trees in a given area have reached or exceeded their pathological age, or have densities that result in stagnated stands, then these trees become vulnerable to attack by insects and diseases. Silvicultural treatments that manipulate vegetation in such a way as to maintain the vigor of the forest could play a major role in achieving healthy forests. Sound management practices can greatly reduce a forest's susceptibility to insect and disease.

For example, pest attacks are directly related to the vigor of the plants. Plant vigor is influenced by soil structure and fertility, proper plant selection for the locality, competing vegetation, adequate sunlight and moisture, and judicious cultivation. When plants are stressed, insect and disease attacks become prevalent and unrelenting. To obtain desired production levels requires application of pest controlling materials- most frequently chemical pesticides. If the conditions responsible for causing plant stress are not corrected, these pest outbreaks recur year after year. Where rotation periods are long and plant responses to stress-causing conditions are more subtle, stress factors tend to accumulate. If the stress-causing practices are not corrected, conditions in the forest will also trigger pest outbreaks and the forest resource manager is confronted with the potential loss of production.

Integrated pest management, or IPM, is a much used and poorly understood concept in forest protection. IPM is defined in Forest Service Handbook Chapter 3409.11 as "A decision-making and action process incorporating biological, economic and environmental evaluation of pest-host systems to manage pest populations." Unfortunately, IPM is often erroneously interpreted as being an alternative to chemical insecticides for dealing with forest pests.

Frequently, interest in IPM occurs only after pest populations have reached damaging levels. Resource managers often look for quick, efficient and cost-effective solutions. They may consider a series of options among which is an IPM approach that includes the use of a pesticide to control outbreak populations. The IPM option is selected, pesticide is applied and the pest outbreak subsides. But the remainder of the IPM option is often abandoned. No long-term benefits are achieved because the other IPM components are not implemented.

On Cedar Creek plantation in 1981, the forest resource has been renewed- Mt. Hood National Forest, Oregon.

IPM is a strategy for long-term management of forest pest-host interactions. Situations capable of causing potential pest problems are anticipated and avoided or changed before outbreaks occur. IPM includes intensive surveys to provide early pest detection and delineation information; introduction or augmentation of predators, parasites or pathogens that help keep pest populations at low levels; and intervention with appropriate techniques to prevent or disrupt damage-causing behavior or successful reproduction.

IPM also considers the condition of trees and forests, their tolerance for pest effects, and their resilience in being able to recover from pest outbreaks.

IPM must be included in forest management prescriptions to accomplish the long-term goal of minimizing pest impacts. Integrated resource management (IRM) should include the information provided by IPM because IRM encompasses the interaction of all relevant functions in the implementation of forest plans. Integrated resource management is the framework for interdisciplinary considerations on each project with the goal of achieving the management objectives established in the forest plan.

While IPM as a concept is fairly well established, IPM as a practice in forest management is still evolving. IPM practices have not been adopted for several reasons. In some cases, IPM is focused on the pest rather that the host. Cultural practices that mitigate host plant stress-causing factors are essential components of IPM. The initiative for implementing IPM must come from the specialists responsible for forest cultivation. An equally important reason for the low level of IPM usage is the absence of pest impact and pest management information in the forest planning and resource management decision-making processes. Pest management specialists are not providing technical input in forms compatible with planning and decision-making needs. The technology and skills for solving both of these problems exist or can be developed. However, getting the technical input into the decision-making process will require changes in attitudes, management, organization, and values. The importance placed on improving forest health determines how successfully this change can take place.

Not all forest land will receive integrated resource management treatments to enhance forest health. Of the over 700 million acres of land classified as forest, approximately 38 percent is non-productive, reserved or inaccessible (Table 1). The current rate of management and harvest entry is approximately 8.8 million acres per year (Table 2). At this rate, it will take about 48 years for all treatable land to be treated. Improving unacceptable forest conditions is a long-term undertaking. It will require that the current generation of managers must gain the commitment of their successors to continue forest health initiatives.

TABLE 1. Estimate of opportunities to use Integrated Pest Management specified silvicultural treatments in solving forest pest and forest health problems.

FOREST CLASSIFICATION	FOREST AREA[1]	AREA NOT RECEIVING SILVICULTURAL TREATMENTS	AREA AVAILABLE FOR SILVICULTURAL TREATMENTS
	(thousands of acres)		
NON-PRODUCTIVE FOREST LAND	207,900	207,900[2]	
RESERVED TIMBERLAND	34,916	34,916[3]	
AVAILABLE TIMBERLAND			
FOREST INDUSTRY	70,326		70,326
NON-INDUSTRIAL PRIVATE	274,896		274,896
NON-FEDERAL PUBLIC	39,163		39,163
OTHER FEDERAL	11,429		11,429
NATIONAL FOREST SYSTEM	85,448	29,773	55,675[4]
TOTAL FOREST LAND	724,078	272,589	441,262
PERCENT	100	38	62

[1] Draft RPA 1987 National Data Base.

[2] Noncommercial forest where silviculture is not practiced.

[3] Excluded from many treatments by law.

[4] Identified in National Forest Land Management Plans as suitable for timber management.

TABLE 2. The rate at which forest pest and forest health problems can be improved using the opportunities afforded by current forest management activities.

FOREST CLASSIFICATION	AREA AVAILABLE FOR SILVICULTURAL MANAGEMENT	AREA BEING MANAGED ANNUALLY	AREA MANAGED AS PERCENT OF AVAILABLE [1]
	(thousands of acres)	(thousands of acres)	percent
AVAILABLE TIMBERLAND			
FOREST INDUSTRY	70,326	2,444 [2]	3.5
NON-INDUSTRIAL PRIVATE	274,896	3,456 [3]	1.3
PUBLIC NON-FEDERAL	39,163	1,057	2.7 [4]
OTHER FEDERAL	11,429	309	2.7 [4]
NATIONAL FOREST SYSTEM	55,675 [6]	1,530 [5,6]	2.7
TOTAL	451,489	8,796	1.9

[1] Rate at which the area available for IPM related silvicultural treatments is currently being managed.

[2] Reforestation and TSA in 1986. Source: 1986 U.S. Forest Tree Planting report (tables 4 & 6).

[3] Sum of 667,000 acres reforestation; 282,000 TSI; 506,000 wildlife habitat improvement; 2,001,000 harvested, not reforested (3 times the estimated reforested area). Source: 1986 Report of the Forest Service.

[4] Assumed as same rate as National Forest System.

[5] Sum of 365,000 reforestation; 360,000 TSI,; 155,000 wildlife habitat improvement; 650,000 fuel management. Source: 1986 Report of Forest Service.

[6] The areas where the Forest Service has direct control. The 1,530,000 acres of NFS land are 0.2% of the land with a potential forest health problem.

FOREST CONDITION

Of the more that 737 million acres of land in 1977 with at least 10 percent stocking by forest trees, 29 percent was located within the Pacific Coast states, 19 percent in the Rocky Mountain and Great Plains states, 28 percent in the South, and 24 percent in the North (Forest Resource Report No. 23). Twenty-one states had more than 50 percent forest cover. Of those, 20 states are located in the East and South. The USDA Forest Service administers over 187 million acres, or 25 percent of the forested acreage in the United States.

Approximately 346 million acres of commercial forest land produce 50 cubic feet or more of wood fiber per acre per year. This could mean that as much as half of the forested land in the country may require planned management and protection at some time to maintain its timber productivity. As uses for wildlife habitat, water production, and recreation gain in importance, the remaining 391 million acres may also require management intervention.

The most economically important commercial forest types in the United States are the oak-hickory and oak-pine forests of the East; the loblolly-shortleaf and longleaf-slash pine forests of the South; and the spruce-fir, Douglas-fir-hemlock, ponderosa pine and lodgepole pine forests of the

West. These forests cover a combined total of 422 million acres of which over 219 million acres produce 50+ cubic feet of wood fiber per acre per year.

Tree mortality (primarily unsalvaged mortality) on commercial forest land is one useful indicator of forest health. By examining the relationship between annual mortality of growing stock to inventories of growing stock, national and regional trends in forest condition can be identified and compared. Changes in mortality, calculated by dividing the annual mortality of growing stock by the net volume of the inventory of growing stock, are expressed as a percentage. These data are developed for softwoods and hardwoods for selected years by geographic area (Table 3).

North

In 1952, growing stock mortality as a percentage of growing stock inventory in northern softwood and hardwood forests was 0.78 and 0.62 percent, respectively. The percentage mortality during the intervening years from 1952 to 1976 fluctuated above those figures and returned to approximately the same level by 1987. A 0.04 percentage point increase in softwood growing stock mortality between 1976 and 1987 is attributed to spruce budworm outbreaks in Maine and the Great Lakes States. The downward trend in hardwood mortality observed during this period is not expected to continue due to the spread of the gypsy moth throughout the region and the increased incidence of hardwood dieback, declines, and outbreaks of other hardwood defoliators.

South

The greatest changes in growing stock mortality between 1952 and 1987 occurred in the South. During this period, softwood mortality decreased by the same amount from 0.79 to 0.62 percent. The trend during the intervening years for softwood was generally downward until 1976. From 1976 to 1987, softwood growing stock mortality as a percentage of growing stock inventory jumped 0.25 percentage points. Much of this increase is attributed to southern pine beetle outbreaks during that period. Conversely, while hardwood mortality increased 0.10 percentage points between 1952 and 1962, the trend has been downward ever since. This downward trend may be ending now that the gypsy moth is becoming established throughout the South and oak decline is becoming more prevalent.

Rocky Mountains

Growing stock mortality as a percentage of growing stock inventory in the Rocky Mountains was less in 1987 than it was in 1952 for both softwood and hardwood. The trend for softwood mortality was generally downward during this period while hardwood growing stock mortality increased from 0.88 to 0.94 percent by 1970 before falling to 0.69 percent in 1987. Subsequent inventories are expected to show an increase in softwood mortality due to the extensive damage caused by mountain pine beetle infestations throughout the region. Future trends in hardwood mortality will depend on how extensive and destructive the invading gypsy moth becomes.

TABLE 3. Trends in annual hardwood and softwood mortality form all causes expressed as a percentage of growing stock inventory, by geographic region, from 1952 to 1987. [1,2]

YEAR	UNITED STATES		NORTH		SOUTH		ROCKY MTS.		PACIFIC COAST	
	SOFT-WOOD %	HARD-WOOD %	SOFT-WOOD %	HARD-WOOD %	SOFT-WOOD %	HARD-WOOD %	SOFT-WOOD %	HARD-WOOD %	SOFT-WOOD %	HARD-WOOD %
1952	0.62	0.69	0.78	0.62	0.57	0.79	0.65	0.88	0.60	0.52
1962	0.62	0.75	0.86	0.67	0.56	0.89	0.65	0.87	0.59	0.53
1970	0.55	0.65	0.84	0.71	0.50	0.60	0.58	0.94	0.51	0.47
1976	0.53	0.64	0.74	0.69	0.65	0.58	0.48	0.79	0.46	0.49
1987	0.60	0.59	0.78	0.63	0.86	0.62	0.49	0.69	0.49	0.43

[1] Data source: FRR-23 for 1952 to 1976; draft RPA 1987 National Data Base for 1987. Uses data proposed by FIA of SE Station for South softwood in 1976, and for softwood and hardwood for 1987.

[2] Mortality is determined by dividing total disappearance between mortality and removals based on available observations and other information.

Pacific Coast

Relatively minor fluctuations accompanied the downward trends of softwood and hardwood growing stock mortality on the Pacific Coast from 1952 to 1987. These trends are partially explained on the basis that old growth forests are being replaced by younger, more productive forests. This trend may be ending, however, as Douglas-fir and true fir become the dominant species on sites better suited to pine and other drought-tolerant species. Major outbreaks of western spruce budworm, such as is now occurring in eastern Oregon and Washington, and the Douglas-fir tussock moth could dramatically increase the level of softwood growing stock mortality. The gypsy moth is also a potential threat to Pacific Coast hardwoods but will take several years before it becomes a factor.

National

Modest decreases of 0.02 and 0.10 percentage points in softwood and hardwood growing stock mortality as a percentage of growing stock inventory occurred between 1952 and 1987. Although mortality is increasing, it did not increase as fast as annual growth rate. Net annual growth on commercial forests increased from about 13.9 billion cubic feet in 1952 to 22.3 billion cubic feet in 1987.

From these figures, it is not clear whether or not a national forest health crisis is at hand. However, it is apparent that serious regional and local problems do exist. Where forest ecosystems are continuously subjected to stress-causing influences, their ability to resist or tolerate additional stress loads is diminished.

FACTORS CONTRIBUTING TO PEST OUTBREAKS

Native forest pests are natural components of forest ecosystems. Changes in pest population densities are directly related to vegetation changes within the forest, and how those changes affect the survival of the pest organism. Other factors affecting pest populations include biological, meteorological, cultural, and socio-political events and conditions. In many cases, events within each category interact to mask or accentuate the effect of a single factor. The following is a summary of the more common processes involved in triggering forest pest outbreaks.

Biological

Host condition, predators/parasites/pathogens of the pest, and pest population dynamics may all provide biological triggers for pest outbreaks.

Examples of host-related factors include large diameter trees with thick phloem that maximize conditions for production of large bark beetle broods; mature and overmature trees producing large flower crops that provide an enriched food source for budworms and subsequent larval survival and adult fecundity; and the genetic predisposition of certain clones that serve as reservoirs for pest populations during periods of low pest incidence. Table 4 presents the acreage of susceptible commercial forest by vegetation type and the annual acreage involved in outbreaks of major pests from 1979 to 1983.

The dynamics associated with relationships between a forest insect and the complex of predators, parasites and pathogens that prey on it are usually cyclic in nature. Outbreaks may occur when these biological control organisms are unable to keep pace with increases in pest populations. This is a fairly common condition since most native insects have co-evolved with their predators, parasites and pathogens. A certain amount of inefficiency exists in this relationship; otherwise, extremely efficient predators or parasites would eliminate their prey and cause their own extinction. Predators or parasites that have more than one host are opportunistic and prey on those species that are most plentiful. These situations do not provide a reliable natural mechanism for keeping pest populations from increasing.

Pest populations themselves may also influence outbreak episodes. Pest species that have multiple generations per year have the ability to exploit conditions favorable for population increases. Some individuals in low populations of defoliators may exhibit an aggressive behavior that carries them to a greater number of potential hosts. When an insect invades new areas, the absence of predators, parasites, and pathogens may result in a population explosion producing many times more individuals than the host trees can sustain. A typical example is the gypsy moth introduced into the United States from Europe. The introduced white pine blister rust, Dutch elm disease, and chestnut blight were particularly destructive because the host trees had no resistance to these disease-causing fungi. In general, however, biological factors are subordinate to other causes of pest population outbreaks.

Management

Management activities influencing forest pest outbreaks include activities that, by design or accident, produce forest conditions favorable to the survival or growth of forest pests. There are many examples of management activities on forested lands of the United States that are responsible for some of the more destructive pest outbreaks. Specific examples that frequently occurred in the past include off-site planting; harvest schedules beyond the entomological or pathological rotation for the species or area; planting susceptible varieties (or relying on natural vegetation) in areas of known disease occurrence; increasing stand densities; planting or encouraging the natural establishment of extensive monocultures; failure to remove infested overstory trees during a harvest; and, failure to provide a cultural substitute for the stand mosaic-creating effects of fire. Stand management plans that do not address potential pest problems set up the conditions for serious pest outbreaks.

TABLE 4. Acreage of commercial forests potentially susceptible to outbreaks of major forest pests in the United States and the average annual acreage in outbreak from 1979 to 1983.

FOREST PEST	PRINCIPLE SUSCEPTIBLE HOST TYPES	ACREAGE OF SUSCEPTIBLE HOST TYPES (million)	AVERAGE ANNUAL ACRES IN OUTBREAK (million)
GYPSY MOTH	Oak-hickory; oak-pine; oak-gum-cypress; maple-beech-birch; aspen-birch; western hardwoods.	240.7	5.8
EASTERN SPRUCE BUDWORM	Red spruce-balsam fir; white spruce-balsam fir.	13.8	5.7
SOUTHERN PINE BEETLE	Longleaf-slash pine; oak-pine; loblolly-shortleaf pine.	57.3	9.3
ROOT DISEASES	Southern pine plantations; shortleaf pine; sand pine; Douglas-fir; fir-spruce.	77.1	16.8
WESTERN SPRUCE BUDWORM	Douglas-fir; grand-white fir; western larch; Engelmann spruce.	41.6	6.8
MOUNTAIN PINE BEETLE	Lodgepole pine; ponderosa pine; sugar pine; western white pine.	56.6	4.3
DOUGLAS-FIR TUSSOCK MOTH	Douglas-fir; grand-white fir.	49.2	<0.1
DWARF MISTLETOES	All western pines; true firs; spruces; Douglas-fir; larch; hemlock.	112.3	22.6
FUSIFORM RUST		44.0	15.3

Meteorological

While biological and management factors may predispose forests to pest outbreaks, weather is frequently responsible for actually triggering an outbreak. Droughts or floods can create tree stress and enhance the attack success of bark beetles. Warm, dry weather during periods when defoliator egg hatch occurs increases the survival of the newly-hatched caterpillars. Wind-thrown trees provide breeding sights for borers, engraver beetles, and other bark beetles. High winds may transport large numbers of egg-carrying female spruce budworms into areas with low resident budworm populations. Lightning strikes in southern pine forests create stressed trees that are susceptible to attack and serve as reservoirs for southern pine beetles. Winds may move gypsy moth larvae twenty or more miles beyond generally infested areas into new areas. Conversely, weather conditions adverse to pest populations are the most frequent cause of the collapse of an outbreak.

Atmospheric deposition (air pollution and acid rain) is suspected of influencing forest pest outbreaks but does not fit conveniently into any of the previous categories. Although few specific correlations between forest pests and air pollution or acid rain have been confirmed, research in this country and Europe has established that plants are adversely affected by concentrations of pollutants commonly detected in ambient air samples.

It is difficult to identify a relationship between pollutants and plant stress that trigger pest outbreaks. The task is complicated by the tremendous variation in plant tolerance to different pollutants. Research technology for evaluating atmospheric deposition effects on plants is still evolving. However, scientists continue to suspect that atmospheric deposition contributes to tree stress. The concern is that, as pollution impacts increase, forests will become more susceptible to secondary problems such as insects and disease. If the effects occur over wide areas, the stage is set for potentially catastrophic forest pest population explosions.

Socio-political

A wide variety of social and political factors influence forest management decisions that can have an impact on forest health. These include public opposition to some vegetation management activities such as clear-cutting, herbicide treatments, thinning, forest type conversion, or tree cutting for any purpose; public opposition to road construction in roadless areas; and, budgetary priorities that preclude mitigation of incipient pest outbreaks that, if left untreated, may intensify or accelerate the deterioration of forest condition.

Policies and practices that fail to recognize forests as dynamic systems may create the conditions they are intended to prevent. The apparent perception by a large segment of the public that mature, stately stands of trees will remain unchanged forever if human interference is prohibited can create potential obstacles to the enhancement and maintenance of healthy forests. As Americans increasingly choose to live in urban areas their attitudes about forestry and the natural environment change and tend to favor protection and preservation rather than consumptive uses. The public perception of what forests should be also influences legislators.

Economics frequently influence decisions that affect forest health. A major problem in management planning is the difficulty in quantifying the value of non-commodity forest resources. The majority of management decisions are therefore bases on the quantifiable benefits accruing from commodity-producing activities and resources. Recreation, water, wildlife, and scenic resource values are generally not factored into the process. Management action essential for preventing or suppressing pest outbreaks or improving forest conditions may be withheld because benefits cannot be calculated. Economics will also determine the extent to which forest conditions will be improved in the future.

Summary

Pest populations respond to conditions within the forest environment. Meteorological and other natural episodes such as wildfire may cause acute, localized, generally short-lived increases in pest levels. Conversely, cultural practices that suspend the progress of plant succession over extensive contiguous areas may increase the probability of pest damage. These practices may produce conditions favoring chronically high pest levels that subside only after a majority of susceptible host trees have been eliminated.

PEST STATUS BY GEOGRAPHIC AREA

Since 1973, outbreaks of six major forest insects have occurred in this country. These include the spruce budworm in the North, the southern pine beetle in the South, the gypsy moth in the North and South, the mountain pine beetle, the Douglas-fir tussock moth, and the western spruce budworm in the West. At their peaks, these outbreaks covered a combined total of 87 million acres. Three major forest disease- dwarf mistletoe, root disease, and fusiform rust- continue to cause serious losses on more than 35 million acres. There is also a high level of concern that atmospheric deposition may be adversely affecting sensitive forest resources. Table 5 summarizes average annual forest pest outbreaks that occurred from 1979 through 1983. The following section summarizes the current forest pest activity in the North, South and West.

North

There are three dominant forest health concerns in the North- spruce budworm, gypsy moth, and atmospheric deposition.

The spruce budworm is a normal component of the spruce-fir type in the Northeast and Lake States. Approximately 10 million acres of red spruce and balsam fir in the New England States and 4 million acres of white spruce and balsam fir in the Lake States are the major forest types susceptible to spruce budworm attack. At intervals of 60 to 70 years, outbreaks of spruce budworms defoliate and kill the mature and overmature trees. During the last New England outbreak (1974-1984), an estimated 1.9 million cubic feet of spruce and fir were killed. When the overstory is killed, the spruce and fir in the understory are released. This sets the stage for another spruce-fir forest and eventually, another spruce budworm outbreak.

The gypsy moth is an introduced forest pest that feeds principally on hardwoods such as oak. It also damages some conifers. Feeding by caterpillars defoliates the trees and causes growth loss. Repeated growth loss can result in tree death. The gypsy moth currently infests approximately 48 million acres of hardwood forests in the Northeast, Ohio, Virginia, and Michigan. At the peak of the last major outbreak (1981), the gypsy moth defoliated 13 million acres in 11 states. Initially viewed as a nuisance pest of the Northeast, the moth spread southward through Pennsylvania, Maryland, West Virginia, North Carolina and Virginia. It now threatens the hardwood forests of the South. Studies from Pennsylvania and other generally infested northern states suggest that heavy and repeated gypsy moth defoliation may cause the death of 50 percent or more of the oak component.

Concern about atmospheric deposition impacts on northern forests has triggered extensive surveys to detect and delineate forests that might be affected by environmental pollutants. Ozone and other oxidants appear to be associated with white pine foliar injury and growth reduction. Although the relationship is still considered circumstantial, pollution-related impacts may also be present in the upper elevation spruce-fir forests of New York, Vermont, and New Hampshire. In most other instances where atmos-

Gypsy Moth.

pheric deposition injury is suspected (particularly in sugar maple and low elevation red spruce stands), the damage has been associated with forest declines that historically have occurred in these forest types. Not answered is the question of what effect, if any, atmospheric deposition has on predisposing these forests to the declines.

In addition, there are a number of other forest pests in the North that impact forest health. Included are ash, maple, oak, and spruce declines; the beech bark, sapstreak, trunk rot, and blister rust diseases; and tent caterpillars, leaf tiers, spittlebugs, and borers. The impact of these pests occur on several thousand to several million acres of forest land every year. Few can be cost-effectively controlled. Most can be minimized on actively managed forest land. An increase in silvicultural efforts to prevent outbreaks of major forest pests in the North will also help decrease the relative impacts of most of these pests.

South

Southern pine beetle and fusiform rust have long been problems in southern forests. More recently, the potential threat of gypsy moth and atmospheric deposition is gaining attention.

The southern pine beetle is a native pest of southern yellow pines with loblolly-shortleaf pine type sustaining the greatest impacts. This type occupies 34 million acres of the more than 57 million acres of susceptible forest in 11 southern states. Over 51 million acres are in state and private ownership.

In 1986, at the height of the most recent outbreak, 46 percent of the susceptible forests were impacted by southern pine beetle attacks. This high level of attack is thought to be associated with increases in stocking density and the age of pine forests in the South. Older, densely stocked stands are more susceptible to attack. Also, large diameter trees produce more beetles per square foot of bark surface. The tremendous numbers of beetles produced are able to overcome the defenses of even the healthiest trees. Outbreaks continue until cold weather or some other factor causes a population collapse.

Fusiform rust is a chronic disease problem on about 15 million acres scattered throughout the 43 million acres of loblolly and slash pines. In young trees, damage causes mortality. Older trees suffer stem breakage and product degrade. Most direct mortality occurs before the trees reach ten years of age. For 1983, losses associated with replanting and tree mortality were estimated at $49 million, making fusiform rust the most costly forest disease in the South. The acreage of new infection is increasing at an average rate of over three percent per year.

Although the gypsy moth has been detected frequently in southern forests during the past ten years, it has only recently reached damage-causing numbers. Defoliating populations now exist in parts of Virginia and North Carolina. The potential threat of the gypsy moth to southern hardwood forests cannot be accurately forecast. The levels of oak mortality in Pennsylvania and the importance of the 119 million acres of hardwood forests to the economies of southern communities are reasons for con-

TABLE 5. Forest pest outbreaks and suppression activity from 1979 to 1983 for the major forest pests in the United States.

FOREST PEST	OUTBREAK LOCATION	ACREAGE AFFECTED	VOLUME LOSS	SUPPRES-SION ACRES	SUPPRES-SION COST
	(States)	(Million)	(MMCF)	(Million)	($MM)
GYPSY MOTH	DE,ME,MD,MA,NH,NJ, NY,PA,RI,VT,WV	29.1	176.6	1.8	24.2
EASTERN SPRUCE BUD-WORM	ME,MI,MN,NH,VT,WI	28.4	841.1	6.9	39.8
SOUTHERN PINE BEETLE	AL,AR,GA,LA,MS,NC,SC TN,TX,VA	46.7	614.5	46.7	6.8
ROOT DIS-EASES	23 Southeastern and Western states	16.8	242.6	none*	none*
WESTERN SPRUCE BUD-WORM	AZ,CO,ID,MT,NM,OR, UT,WA,WY	34.2	241.5	1.0	7.4
MOUNTAIN PINE BEETLE	AZ,CA,CO,ID,MT,NM,NV OR,SD,UT,WA,WY	21.6	398.3	0.9	13.9
DOUGLAS-FIR TUSSOCK MOTH	ID,NM,OR	<0.1	minimal	<0.1	<0.1
DWARF MISTLETOES	MI,MN,WI; all Western states except NV	22.6	1,967.5	0.1	4.5
FUSIFORM RUST	AL,AR,FL,GA,LA,MS,NC SC,TX,VA	15.3	[1]	N/A	N/A

[1] Volume is not calculated for fusiform rust since damage is to seedlings and saplings.

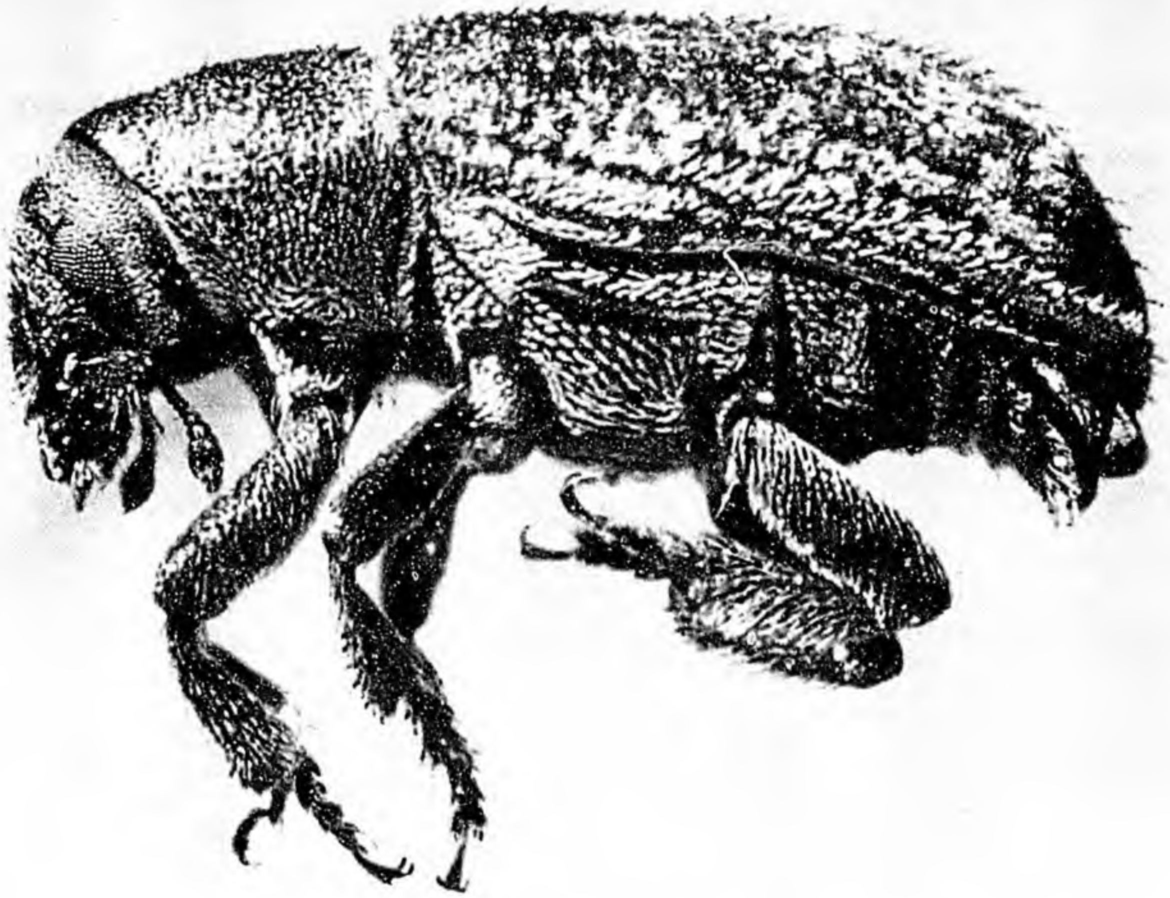
N/A - Not applicable

* No direct suppression.

cern. The southern oak forests are essential to the timber, wildlife, and recreation activities in the region.

Concern in the South for atmospheric deposition generally parallels that in the North. Upper elevation conifer forests in the southern Appalachian mountains show symptoms which may be related to the effects of environmental pollutants. Growth loss in southern pine forests has also been a concern. So far, however, agents other than environmental pollutants have been identified as the most likely and significant contributing factors. This suggests that the effects of atmospheric deposition are mostly indirect, contributing an as yet undetermined level of stress on forest ecosystems. No instance of a southern forest being killed by non-point source environmental pollutants has yet been confirmed. However, recent studies have determined that loblolly pine, cottonwood, and white oak are among those tree species sensitive to ozone. A potential does exist for adverse effects on southern forests from air pollutants.

A condition commonly but mistakenly attributed to the effects of atmospheric deposition is the problem known as "oak decline." Although little information is available about the severity of oak decline in the South, the problem is widely distributed throughout upland hardwood forests. In one sense, oak decline is related to environmental conditions.



Southern Pine Beetle.

Dieback, decline, and mortality generally follow stress-causing episodes of drought, frost, and defoliation.

Southern pest management specialists cite several reasons why oak decline is a potential concern. Oak and hickory mortality averaged 29 percent in decline-affected stands during 1985 and 1986. Oak and hickory stands valuable for timber, recreation, and wildlife habitat are converting to sugar maple, ash and yellow poplar. It is expected that gypsy moth-caused defoliation will place additional stress on the upland hardwood forests.

Root diseases of southern pines represent another problem for the South. Annosus root disease, littleleaf disease, and sand pine root disease potentially threaten over 36 million acres of susceptible loblolly, shortleaf, and sand pine stands. Plantations are particularly vulnerable to these root diseases. Unless cultural practices known to reduce the threat from these diseases are employed within susceptible areas, benefits from tree improvement genetics could be offset by root disease-caused seedling mortality, growth loss, and replanting expenses.

West

Of the major western pests, the mountain pine beetle is the most destructive insect. Unmanaged stands of mature and overmature lodgepole pine and second-growth mature and overmature ponderosa pine, mature and overmature western white and sugar pine, and overmature whitebark and limber pines are all susceptible to attack. Lodgepole pine is the principal host, representing 95 percent of the trees killed during a five-year period (1979-1983). Over 56 million acres of western forests are potentially susceptible to mountain pine beetle attack. Three states- Idaho, Oregon, and Montana- account for over 50 percent of this acreage. As the average age of the susceptible forest type increases, continued destruction from this pest is anticipated.

The western spruce budworm is the most persistent and destructive foliage-feeding insect in the West. A native pest of Douglas-fir, true firs, Engelmann spruce and western larch, the western spruce budworm causes growth and productivity loss and tree mortality. Approximately 41

Dwarf mistletoe in Jeffrey pine, Laguna Campground- Cleveland National Forest, California.

million acres are covered by forests susceptible to this insect. A major outbreak is occurring on over 6 million acres in eastern Oregon and Washington. Outbreaks follow no set pattern and may last up to 20 years. Damage is caused by larvae feeding on buds and needles. Forests most susceptible to western spruce budworm attack are mature, dense stands of shade-tolerant species on dry sites.

Concern about root diseases of western coniferous forests is escalating as the number of unsuccessful efforts to regenerate harvested stands increase and stands previously regenerated become understocked. Although all western forests are affected to some degree by root diseases, Douglas-fir and the spruce-fir types are the most seriously damaged. These two forest types occupy over 50 million acres or 40 percent of the commercial forest land in the West. Tree killing is the most serious consequence of root pathogens. Trees weakened by diseased roots may be predisposed to attacks by other pests such as bark beetles or become vulnerable to windthrow. Root diseases are a management concern on about 15 million acres of western commercial forest land. Five states- California, Idaho, Montana, Oregon, and Washington- account for over 86 percent of this acreage. The incidence of root disease problems is expected to increase due to management activities that favor Douglas-fir and true firs.

Most of the conifer species in the West are parasitized by dwarf mistletoes. Although losses from dwarf mistletoe are not as visible as those caused by insects, the cumulative losses of growth and mortality are considerable over the life of the forest. According to recent estimates, more than 22 million acres of commercial forest land are infested with dwarf mistletoes. Annual losses in growth and mortality exceed 380 million cubic feet. A history of selective harvesting, perpetuation of infected uneven-aged stands, failure to remove infected trees during harvest, restricted size of clearcuts, and lack of attention to dwarf mistletoes in vegetation management planning have served as obstacles to implementing remedies for this problem. As more stands are managed appropriately, dwarf mistletoe losses should be reduced accordingly.

The Douglas-fir tussock moth, a potentially serious pest of Douglas-fir, is found throughout the range of this important tree species. Grand fir and white fir are also damaged by this foliage-feeding insect. These three tree species occur on 49 million acres of commercial forest land throughout the West. No single factor has been identified as responsible for the cyclic pattern of outbreaks that have occurred every 8 to 10 years since the turn of the century. While the outbreak expected during the mid-1980s failed to materialize at the magnitude predicted, the 800,000 acres defoliated in Oregon, Washington, and Idaho during the mid-1970s sustained a loss averaging over $100 per acre.

The best documented evidence of atmospheric deposition injury to forest ecosystems occurred in the San Gabriel, San Bernardino, and Sierra Nevada mountain ranges of California where ozone is the primary pollutant. Ponderosa and Jeffrey pines were seriously affected. Trees with ozone foliar injury symptoms not only have slower growth rates but are predisposed to attack by other organisms. The extent to which air pollution is a factor in the various tree and forest declines remains to be determined. Other damage studies are being focused on areas downwind of the Los Angeles basin, the San Francisco/San Joaquin air basin, and the larger cities in the Pacific Northwest and interior West.

Additional pests identified by pest management specialists in the West include the bark beetle complexes attacking conifers, the aspen defoliator complex, the black-headed budworm in Alaska, white pine blister rust, and cedar decline. During the most recent outbreaks of these pests, a cumulative 9.4 million acres of the 25.3 million acres of susceptible hosts were impacted. These pests may become locally important but rarely attain Region-wide or multi-Regional significance. The importance of such pests is related primarily to impacts on non-timber resources and their contribution to the general deterioration of forest health.

ISSUES AND OPTIONS

Eight issues are identified that relate to forest management activities affecting forest health. These issues include planning, public involvement, resource management, pest suppression, environmental analysis, pesticides, pest control technology, and forest health monitoring.

The issues reflect administrative and technical conditions that require substantive clarification before an appropriate course of action can be recommended. Clarification was obtained by developing rationale statements and presenting various plausible options as solutions to the problems. Options are recommended for resolving the issues. The following options are proposed as a Forest Service strategic plan to enhance and maintain a healthy forest condition. Each option will have further analysis, including the development of alternatives, before they will be ready for implementation.

Options recommended for further analysis and action are set in *bold-face.

ISSUE 1- PLANNING

Integrated forest pest management considerations are not adequately incorporated in forest resource management planning processes.

RATIONALE

- Plans mention but do not provide for practicing integrated pest management.

- Plan analyses projecting productivity rarely make necessary adjustments for potential losses to forest pests.

- Means for predicting some forest pest-caused impacts were not available for the current planning cycle.

- Failure to address forest pest impacts in the plans and stand management prescription could exacerbate existing and potential pest problems

- Priorities for forest management activities rarely consider management of forest pests.

- Economic or biological thresholds triggering pest prevention or suppression activities have not been extensively defined or included in forest plans.

OPTIONS

A. Amend selected National Forest plans to include integrated pest management for high value forest resources.

Regions would identify National Forests having the potential for significant adverse pest impacts on forest plan targets. Using existing technology, an analysis would derive expected impacts. A decision to amend the forest plan would, in part, depend upon the magnitude of predicted pest impacts.

B. * Develop procedures for including pest impact information in the next planning cycle.

Washington Office Forest Pest Management, Forest Insect and Disease Management, and Timber Management would develop or enhance capabilities to predict tree growth loss and mortality for major pests and pest complexes and integrate this information with other information on other forest management outputs to establish potential impacts for use in the forest planning process. For those areas exhibiting sufficient impact, National Forests would involve the public in the process of incorporating integrated pest management strategies and displaying the consequences of unmanaged pest problems.

C. * Transfer integrated pest management technology to the National Forest system and states.

Washington Office Forest Pest Management, Forest Insect and Disease Research, with participation by field specialists, will develop procedures for making IPM technology and information on the consequences of pest activity available to forest resource management planners.

D. * Require pest specialist input to National Forest System inter-disciplinary teams conducting forest resource management planning.

Washington Office Forest Pest Management, Land Management Planning, and Timber Management jointly prepare Forest Service Manual direction to include pest specialist input to interdisciplinary teams involved in forest resource management planning.

ISSUE 2- PUBLIC INVOLVEMENT

Traditional forest management practices frequently conflict with public expectations.

RATIONALE

- Harvesting and silvicultural activities frequently elicit a negative public response.

- Forests most attractive to the public are more open, feature larger trees, have a diversity of age classes and species with little high brush or downed trees.

- A greater number of people from more diverse backgrounds are using the forest, predominantly for recreation.

- The general public does not understand forest ecosystem dynamics or the dynamics of pest outbreaks, and may be further confused by the differing opinions of experts.

- Forest management decisions and practices, appropriate from the perspective of the forester, are often viewed by the public as narrow in purpose and not responsive to broader social goals and values.

- When perceived as a natural phenomenon, extensive areas of dead trees may be accepted by the public for backcountry areas but not for recreation and scenic locations.

- Communications with the public about forest management are not always in terms that the public understands.

- Developed recreation areas are intensively used and a valuable forest resource that can be highly affected by a deterioration in forest condition.

- Forest health is more important to recreational use of the forest than to timber production in specific areas.

- The condition of National Forests surrounding public and private recreation developments is important to the quality of experiences afforded visitors, and to the support of regional economies dependent upon forest-based tourism.

- The impact of recreation use, soil compaction, and tree injury combine with insect and disease to increase frequency and severity of pest outbreaks in recreation areas.

- The public may be skeptical of vegetation management activities for pest control that appear to be conventional commercial timber harvesting operations.

OPTIONS

A. Regions conduct site-specific integrated resource management information programs for high-use areas.

Regions analyze opportunities to target large numbers of National Forest users for educational information about forestry, vegetation management, and pest prevention and implement a site-specific information program.

B. * Establish a nationwide information program on forestry and the dynamics of the forest ecosystem.

The Public Affairs Office, Forest Pest Management, Forest Insect and Disease Research, Timber Management, Timber Management Research, and other Washington Office staffs, as appropriate, develop a National Resource and Environmental Education program module to communicate information on forests as a dynamic system and on management required to produce goods and services to meet public needs; consider use of television and media other than brochures to reach a broader audience.

C. * Require a comprehensive public information effort in conjunction with forest pest management activities.

Forest Pest Management provide Forest Service Manual 3400 direction requiring the regions to establish information programs. Regions would be required to expend a minimum of one percent and no more than two percent of the cost of any prevention or suppression project on education and information materials. Materials could include billboards, posters, editorials, television and radio spots, articles, and brochures. Information materials and programs would explain what is being done, what the objectives are, how project performance will be evaluated, and the contribution of environmental analyses and NEPA to decision-making.

D. * Train federal, state, and county specialists in conducting public information meetings.

Washington Office Forest Pest Management and Public Affairs Office design a training package for use by Regional office staffs in demonstrating how to give technical presentations, organize informational materials, and conduct question and answer sessions at public meetings.

E. * Target high use recreation areas for intensive integrated pest management.

Washington Office Forest Pest Management, Land Management Planning, and Recreation prepare Forest Service Manual direction requiring incorporation of forest pest management considerations in management plans for developed recreation areas and areas surrounding high use sites.

F. * Clarify and apply integrated pest management policy in wilderness.

Washington Office Forest Pest Management and Recreation prepare an analysis of policy needs governing forest pest management activities within wilderness areas consistent with Wilderness Act requirements.

G. Require prevention tactics to reduce human impacts on recreation area vegetation.

Regional Forest Pest Management and Recreation staffs develop regional directives to enhance the protection of vegetation in developed recreation areas from adverse effects of human use and the protection of recreation users from hazardous vegetation.

ISSUE 3- RESOURCE MANAGEMENT

Certain forest management practices may aggravate forest pest problems.

RATIONALE

- Existing forest conditions reflect the management or lack of management of the past 50 to 200 years.

- Successful reduction of wildfire in the forest ecosystems eliminated a natural cause of forest mortality, diversity and change.

- Cultural practices that result in longer rotations for a host species increases the probability of a forest pest outbreak.

- Rotation ages beyond the pathological rotation for a host species increases the probability of a pest outbreak.

- Off-site planting, planting susceptible species in areas having high pest hazard, and type conversions that reduce diversity, increase the probability of a pest problem.

- Practices that cause nutrient depletion, soil degradation, and overcrowding increase tree stress and vulnerability to pests.

- Active forest management, especially well-managed harvesting of wood, reduces the occurrence of forest pest problems.

- Fuelwood is a major product of forest growing stock and the largest outlet for all forest material; removal of fuelwood from National Forests helps eliminate wood material susceptible to pest damage from the forest.

OPTIONS

A. * Risk-rate all high-value forest analysis areas for pest outbreak potential.

Washington Office Forest Pest Management and Timber Management prepare Forest service manual direction requiring risk-rating for all high value forest analysis areas to determine the potential for pest outbreaks. Forests to modify management prescriptions as necessary.

B. * Include integrated pest management in forest resource management prescriptions.

Washington Office Forest Pest Management and Timber Management prepare an analysis to determine the adequacy of pest impact, benefit, and treatment cost considerations in stand management prescriptions and prepare policy direction to correct deficiencies as needed.

C. * Identify imminent pest risks to high value resources and reschedule management activities to minimize impacts.

Regional Forest Pest Management and Timber Management identify potential pest outbreaks likely to occur within the next 5 years and adjust harvesting and stand improvement activity schedules to maximize predicted impacts.

D. Set national priorities for integrated pest management by forest types.

Forest Pest Management, Timber Management, Land Management Planning, and Resources Program and Assessment identify, by Region, the forest types essential to meeting national targets for forest products and develop priorities for focusing forest pest prevention and suppression resources.

E. * Analyze the feasibility of using fuelwood sales to achieve vegetative management objectives.

Washington Office Timber Management, Policy Analysis, and Wildlife and Fisheries conduct an analysis of the future demand for fuelwood and prepare a report, including policy recommendations, identifying ways to maximize the sale of firewood from National Forest and private lands as a means of achieving stand improvements and reducing stand vulnerability to pest outbreaks.

F. * Determine optimum levels of forest pest management support.

Washington Office Forest Pest Management conduct an analysis of the benefits and costs of national, regional, and state pest management activities to establish the appropriate level of program funding to federal land managers and state cooperators.

ISSUE 4- PEST SUPPRESSION

Mechanisms are needed for prompt responses to pest outbreaks.

RATIONALE

- No mechanism exists for projecting forest pest suppression funding beyond one year.

- Allocations of pest suppression funds are strongly influenced by political considerations.

- A system is needed to forecast occurrence and location of pest problems a minimum of one year, and preferably three years in advance, as well as the estimating costs of controlling these problems.

- A significant number of susceptible forests will continue to exist and to require substantial pest suppression efforts for the foreseeable future even as the threat of pest damage is reduced through preventative management.

- No mechanism exists to rate pest-threatened forests in terms of their value, susceptibility, imminence of pest attack, expected treatment success, and projected treatment costs. This information is needed to develop a long-term strategic plan which could be updated annually.

- Reliable risk rating systems need to be developed and used to indicate where the pest outbreaks might be expected to occur.

OPTIONS

A. * Include suppression funding need projections in the budget process.

Washington Office Forest Pest Management develop Forest Service Manual 3400 direction requiring that Regional Offices identify and summarize by pest the probable high and moderate levels of expected outbreaks and the respective funds needed for suppression during the next three years.

B. * Establish a funding authority to suppress emergency pest outbreaks.

Washington Office Forest Pest Management and Program Development and Budget gain Agriculture Department and Office of Management and Budget support for authority to respond to rapidly expanding or unexpected pest outbreaks for which annual appropriations are insufficient.

C. * Provide training in integrated pest management for all foresters in the National Forest system.

Washington Office Forest Pest Management and Timber Management prepare Forest Service Manual direction requiring training in integrated pest management for National Forest System resource managers, especially silviculturists and others responsible for preparing management prescriptions.

D. * Update guidelines setting priorities for funding pest prevention and suppression.

Washington Office Forest Pest Management and Timber Management, with field unit participation, review existing procedures, guidelines, and criteria for setting prevention and suppression funding priorities, revising Forest Service Manual direction as necessary to improve responsiveness to pest management needs.

ISSUE 5- ENVIRONMENTAL ANALYSIS

Programmatic NEPA documents permitting timely intervention against pest outbreaks are not available.

RATIONALE

- Situations involving pesticides, wilderness, threatened or endangered species make it difficult to respond to pest outbreaks promptly.

- Forest pest suppression activities require supporting environmental analyses.

- The lead time to prepare required NEPA documentation may preclude rapid response (suppression action) against low level, but increasing, populations of a threatening pest.

- Early communications with the public would be facilitated during preparation of these documents.

OPTIONS

A. * Prepare programmatic NEPA documentation for potentially controversial pest management activities.

Washington Office Forest Pest Management, Forest Insect and Disease Research, and Timber Management, with participation by field unit specialists, coordinate preparation of programmatic EIS's for major multi-Regional pests to which site-specific EA's (environmental assessments) can be tiered. Each EIS should include consideration of the potential need to treat wilderness areas and other sensitive special purpose areas, and to protect threatened and endangered species. These analyses can cover a wide range of issues, including risk analysis of pesticide use, efficiency of alternative treatments, long-term impacts, and cumulative effects. This activity should include state cooperators.

B. * Prepare programmatic NEPA documentation for pest management in forest nurseries and seed orchards.

Regions and Area prepare a South-wide, North-wide, and West-wide programmatic EIS, respectively, to which site specific EA's can be tiered for pesticide use in all Forest Service nurseries and seed orchards.

ISSUE 6- PESTICIDES

Alternatives to environmentally unacceptable chemical pesticides are needed for integrated pest management systems.

RATIONALE

- Use of pesticides will continue to be challenged.

- New technology is needed to improve the accuracy of pesticide applications and to enhance the dependability and effectiveness of existing biological pesticides.

- Environmentally acceptable pesticides and behavioral chemicals need to be developed.

- Commercial pesticide development does not address forest protection needs.

OPTIONS

A. Create a research program with the specific responsibility to develop alternatives to the use of chemical pesticides.

Forest Insect and Disease Research and selected Forest Service Research Experiment Stations establish new or re-direct existing projects to develop non-chemical pesticides and the application technology for use against the gypsy moth and spruce budworm.

B. * Set priorities and conduct research to meet insecticide/ fungicide needs for integrated forest pest management.

Washington Office Forest Insect and Disease Research and Forest Pest Management complete a review of Forest Service insecticide/fungicide research and development needs for biological and other environmentally compatible insecticides and propose any needed improvements toward a more responsive program.

C. * Determine Forest Service response to pesticide development needs for integrated forest pest management.

Research and State and Private Forestry review the Forest Service's pesticide research and development activities, including screening, selecting, enhancing, and formulating promising biological pesticides; preparing the required registration documentation, and developing the necessary application technology and propose any needed changes in current policy, organization or delegations to improve Forest Service responsiveness in these areas.

ISSUE 7- PEST CONTROL TECHNOLOGY

Effective and economical integrated pest management technology is needed to protect forest resources from pest damage.

RATIONALE

- New technology is often inadequately field tested before it must be tried operationally.

- Available technology is not used because the technology transfer process is not completed or is not effective.

- A significant time lag exists for movement of new technologies from research into applied areas.

- A long lag often exists in the process of finding solutions to operational problems in forest pest management.

- Better monitoring of the success of pest management activities is needed to document the effectiveness of technology now in use.

OPTIONS

A. * Strengthen integrated pest management technology for major forest pests.

Washington Office Forest Insect and Disease Research and Forest Pest Management review current programs and recommend any needed changes to increase Forest Service's responsiveness to improving integrated pest management technology for gypsy moth, western spruce budworm, fusiform rust, southern pine beetle, mountain pine beetle, eastern spruce budworm and root diseases.

B. * Improve the development of technology to solve operational problems.

Washington Office Forest Pest Management and Forest Insect and Disease Research examine opportunities to strengthen cooperation between research scientists and application specialists to provide for timely solutions to operational problems, including improving operational testing of new technology.

C. * Improve the program to transfer integrated pest management technology.

Washington Office Forest Pest Management, the State and Private Technology Transfer specialist, Forest Insect and Disease Research, with participation by field unit specialists, will identify applied technology needs, new technology available for implementation, and develop a more effective technology transfer program for pest management programs.

ISSUE 8- FOREST HEALTH MONITORING

Standardized indicators for monitoring forest health are needed.

RATIONALE

- Forest health means different things to different people depending on their unique experiences and perspectives.

- Forest health is a moving target and not easily focused.

- Forest health is an impression.

- Forest health can be compared to the health of the nation's population, as distinct from individual health.

- Forest health will be perceived as a widespread, continuing problem until measures or indicators of change in the forest and a standard are established.

OPTIONS

A. * Establish a task force to identify standards and procedures for monitoring forest health.

Washington Office task force involving Timber Management, Cooperative Forestry, Forest Insect and Disease Research, Forest Environment Research, Timber Management Research, Forest Inventory and Economics Research, Recreation, and Land Management planning will, in cooperation with state cooperators:

1. Establish a set of indicators that measure changes in the forest related to forest health;

2. Establish a system for monitoring the forest health indicators;

3. Use the information from Forest Inventory and Analysis, the annual assessment of Forest Insect and Disease Conditions in the United States, the monitoring systems of EPA (Environmental Protection Agency), and other federal, state, and private data systems;

4. Sponsor cooperation among federal, state, and private researchers and encourage the exchange of scientific information on the changes in the productivity and health of the forest ecosystems;

5. Annually compile and evaluate the above data and report on the magnitude of changes in the productivity and health of the forest ecosystems;

6. Coordinate with the Forest Response Program; and,

7. Examine the feasibility of a joint Canada-USA-Mexico coordinated monitoring system.

B. Demonstrate mitigation actions on National Forest system sites where atmospheric deposition impacts have been confirmed.

Washington Office Forest Pest Management lead a task force of Timber Management, Forest Insect and Disease Research, Forest Environment Research, and Recreation to evaluate and employ mitigation measures where atmospheric deposition damage has been confirmed.

CONCLUSION

Forest health is a complex issue involving actual and perceived forest condition problems. The actual problems are the product of events occurring over a long period of time. The perceived problems reflect an incomplete understanding of forest ecosystems, the biological processes operating within them, and alternative views of the purposes to be served by the forest. However, regardless of whether forest health problems are real or perceived, a response must focus on long-term solutions. This proposed strategic plan identifies responses that the Forest Service and other forest resource management agencies can take to enhance and maintain the health of the forests entrusted to them. There are no "silver bullets" or "quick fixes." Correcting misconceptions about forests and forestry or eliminating unwanted conditions in today's forests will require thorough long-range planning, conscientious implementation, and continuous monitoring.

This analysis dealt with forest pests and related atmospheric deposition because their effects on the forest are understood and many of those effects can be remedied by resource management activities. Forest pest and atmospheric deposition damage is commonly cited as evidence that a forest health problem exists. Since the severity of these effects is related to the condition of the forest vegetation, management activities that produce healthy vegetation help minimize pest and atmospheric deposition damage. The challenge is to employ vegetation management practices that achieve production objectives without sacrificing long-term production capability. Those practices also must be economically defensible, technically feasible, and politically acceptable.

Recommendations

The following recommended options for resolving the issues are proposed as a Forest Service strategic plan to enhance and maintain a healthy forest condition. Some of the recommended options require further analysis and the consideration of alternative procedures before they will be ready for implementation.

ISSUE 1- PLANNING

Integrated forest pest management considerations are not adequately incorporated in forest resource management planning processes.

RECOMMENDED OPTIONS

*** Develop procedures for including pest impact information in the next planning cycle.**

*** Transfer integrated pest management technology to the National Forest system and states.**

*** Require pest specialist input to National Forest system inter- disciplinary teams conducting forest resource management planning.**

ISSUE 2- PUBLIC INVOLVEMENT

Traditional forest management practices frequently conflict with public expectations.

RECOMMENDED OPTIONS

*** Establish a nationwide information program on forestry and the dynamics of the forest ecosystem.**

*** Require a comprehensive public information effort in conjunction with forest pest management activities.**

*** Train federal, state, and county specialists in conducting public information meetings.**

*** Target high-use recreation areas for intensive integrated pest management.**

*** Clarify and apply integrated pest management policy in wilderness.**

ISSUE 3- RESOURCE MANAGEMENT

Certain forest management practices may aggravate forest pest problems.

RECOMMENDED OPTIONS

*** Risk-rate all high-value forest analysis areas for pest outbreak potential.**

*** Include integrated pest management in forest resource management prescriptions.**

*** Identify imminent pest risks to high-value resources and reschedule management activities to minimize impacts.**

*** Analyze the feasibility of using fuelwood sales to achieve vegetative management objectives.**

*** Determine optimum levels of forest pest management support.**

ISSUE 4- PEST SUPPRESSION

Mechanisms are needed for prompt responses to pest outbreaks.

RECOMMENDED OPTIONS

*** Include suppression funding need projections in the budget process.**

*** Establish a funding authority to suppress emergency pest outbreaks.**

*** Provide training in integrated pest management for all foresters in the National Forest system.**

*** Update guidelines setting priorities for funding pest prevention and suppression.**

ISSUE 5- ENVIRONMENTAL ANALYSIS

Programmatic NEPA documents permitting timely intervention against pest outbreaks are not available.

RECOMMENDED OPTIONS

*** Prepare programmatic NEPA documentation for potentially controversial pest management activities.**

*** Prepare programmatic NEPA documentation for pest management in forest nurseries and seed orchards.**

ISSUE 6- PESTICIDES

Alternatives to environmentally unacceptable chemical pesticides are needed for integrated pest management systems.

RECOMMENDED OPTIONS

*** Set priorities and conduct research to meet insecticide/ fungicide needs for integrated forest pest management.**

*** Determine Forest Service response to pesticide development needs for integrated forest pest management.**

ISSUE 7- PEST CONTROL TECHNOLOGY

Effective and economical integrated pest management technology is needed to protect forest resources from pest damage.

RECOMMENDED OPTIONS

*** Strengthen integrated pest management technology for major forest pests.**

*** Improve the development of technology to solve operational problems.**

*** Improve the program to transfer integrated pest management technology.**

ISSUE 8- FOREST HEALTH MONITORING

Standardized indicators for monitoring forest health are needed.

*** Establish a task force to identify standards and procedures for monitoring forest health.**

Although specifically applicable to the Forest Service, the actions listed above represent a positive first step for any forest resource management agency seeking ways to respond to concerns about the health of our Nation's forests.

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Opinion

Wednesday, March 15, 1989

Use Interior forests or see them deteriorate

Consider the boreal forest of Interior Alaska. Here are over 22 million acres of accessible timberland covered with some scattered, some dense growth of white spruce, paper birch, aspen, black spruce, cottonwood, poplar, tamarack, alder, willow, and a few other species. Despite relatively small-scale efforts over the years to harvest a portion of Interior timberlands, not much use has been made of the asset. There is a small cut annually of sawlogs, less than one-fourth of what is imported from Canada and the Lower 48 for local use here. A lesser amount is salvaged for firewood. In the early 20th century cordwood was harvested along the Yukon, the Tanana, and lesser streams to fuel the riverboats. For many generations throughout the Interior logs have been used for shelter and a few other purposes.

William R. Wood

Views expressed here do not necessarily represent those of the Daily News-Miner

The boreal timberlands of Interior Alaska remain an idle resource, one of great promise if utilized sensibly. In idleness they con[illegible] recurring cost to the state [illegible] residents—plus the burden of lost opportunity.

In Georgia where modern forest management techniques are practiced there are more trees harvested each year than were on the land when Oglethorpe landed in 1703. Here there are probably about as many trees standing today as were here when the Fort Yukon trading post was established well over a century ago.

In the boreal timberlands of Interior Alaska wildfire has consumed more timber than humankind. Unfortunately, not all of the burned-out acreage manages to regenerate itself. There are self-destructive forces at work in the boreal forest. Overmature stands tend to retard their own growth. White spruce, a splendid tree of many uses, gives way to scrawny black spruce of limited usefulness. Where the black spruce takes over, there is not much food for wildlife. Its attraction as a recreation asset is minimal. Such areas are largely avoided by humankind and most other living things.

Set aside, left alone, the boreal forest as we know it today will deteriorate and likely in large part disappear in a few generations.

This need not happen, for sensible timberland management technology is known. It is possible not only to preserve but to enhance the total boreal forest habitat. State-of-the-art techniques are not static. There is much more to be learned leading to a wide-range of improvements.

Good husbandry of a living asset takes time. There is not much immediate pay-off in prospect, but the long-term outlook is exciting. An appropriate tree-improvement program for Interior Alaska will take at least two generations, but the growth cycle of the white spruce, scientists are confident, can be reduced from 120 years to 80 years or less. The present scattering of wildflowers and berries can be increased manyfold, the entire habitat for wildlife enhanced.

There are ways to learn, to earn, and to enjoy a satisfying way of life that can become a reality by the enhancement and use of the boreal forest of Interior Alaska. There is a choice for us now: just preserve it and lose it or improve it and use it intelligently.

Trees are good. Let's plant a lot more of them of the very best stock. Let's take good care of them. Modern techniques of good stewardship are unfolding. We can augment natural reseeding with selected additional plantings of the very best. Reforestration of cut-over and burnt-over areas is a must. Other areas can be thinned and replanted with better types. The term afforestation is becoming familiar.

The state lawmakers have recognized this, in part at least, and have set aside a portion of annual income from forest products for reforestation purposes. Yet this first step seems stalled for some reason, perhaps the overlapping and duplication of jurisdictions among state and federal administrative agencies as well as by competing special interests in the private sector.

When each of these insists on its own special-interest agenda that would exclude all other interests, not much happens. In fact, the lawmakers' intent to establish a meaningful forest management improvement program in Alaska, it seems, is being ignored.

It is time to straighten out the unnecessary tangle, to thin out the political underbrush and get on with the pleasant task of planting more trees—for the good future for Interior Alaska residents.

William R. Wood is a retired president of the University of Alaska now volunteering his time as executive director of Festival Fairbanks '84.

ELECTIVE DISTRICT 13
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NUNAKA VALLEY
ELMENDORF A.F.B.
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March 2, 1989

COPY

MEMORANDUM

To: House and Senate Resources Committee Members

From: Rep. Terry Martin T.M.

Suject: Spruce bark beetle

As a member of the Resources Committee, you are probably at least acquainted with the problem of spruce bark beetle infestation of Alaska's forests. In light of the upcoming meeting of the House Resources Committee in the Mat-Su area to discuss forest issues, I thought it would be an appropriate time to distribute the attached material on the current status of the beetle problem.

There are three important points to keep in mind in addressing this issue: First, that we need to stop the infestation and save what's left of our spruce forests for the future. Second, by harvesting the dead and dying, beetle-infested trees, we can put people to work during these economic hard times. And third, the potential value to be realized from harvesting the trees, even if it is only for chips, is significant, and would contribute greatly to Alaska's economy.

I appreciate that the Resources Committees are willing to take a look at a problem that has been with us for some time, and hope you will support an effective, realistic solution. I would also hope you will consider forming a joint oversight committee to monitor this issue.

Thank you.

THE SPRUCE BARK BEETLE -

"A DISASTER IN THE MAKING, AN OPPORTUNITY FOR ALASKA"

by Rep. Terry Martin

As many of you may know, this year marks the 25th anniversary of the Beatle invasion from England - in fact, just recently was the anniversary of the night they appeared on the Ed Sullivan Show, and opened a new chapter in the history of American pop music.

We here in Alaska, regardless of our individual likes and dislikes in music, are in the midst of another beetle invasion, or more accurately, a beetle infestation. These, of course, are nothing like the mop-topped, "fab four" of 1964, but they are still having a significant impact on Alaskans.

I am referring to our own spruce bark beetle, a prolific little bug that is chewing its way through our forests and turning one of Alaska's greatest - and greenest - assets into a dead and dying tinderbox.

I've been interested in the activities of this pest for sometime now, and have recently obtained a copy of a two-page summary of its activities and our efforts to combat it. I would like to share a few of the highlights of this report with you, if I may.

The spruce bark beetle has been around for awhile in Alaska, and while he doesn't eat the whole spruce tree, his activities efficiently kills it by girdling the cambium layer - where the tree's life-giving juices flow. Normally, the beetle lives on downed, mature spruce, or on slash or wind-felled trees. In a heavy infestation, as we are seeing in some parts of the interior, the beetle moves from trees on the ground to live, standing trees. In some particularly heavy infestations, the pests have even attacked black spruce, while it normally would stick to its preferred white spruce or Sitka spruce.

What is the magnitude of our beetle infestation? The two page activity summary conservatively estimates that more than 10 billion board feet is effected, from Kachemak Bay, to the upper Kenai Peninsula, to Willow, Chickaloon, Tyonek and Mt. Susitna, the Copper River, the Kuskokwim and Holitna Rivers, to the Lower Yukon around Galena and Anvik. Glacier Bay has had an ongoing problem with the spruce bark beetle, and in some stands, as much as 70% of the spruce have been killed. In heavily infested stands in the Interior and on the Kenai, more than 80% of the white spruce have been killed. These little bugs get around, and no variety of spruce has been immune to their munching.

Total acreage of devastated forest through 1986 adds up to ~~937,016~~ at least 1,450,000 acres throughout Alaska. That's ~~194,872~~ 775,000 acres of state lands, ~~111,812~~ 275,000 acres of Native lands, ~~[illegible]~~ 100,000 acres of National Forest, and ~~174,133~~ 300,000 acres of other Federal lands.

Aside from the detriment to aesthetics of turning a green forest brown, the economic loss on the forest is very high. The dead trees quickly lose their value, due to checking and cracking as they dry out, and they become susceptible to a fungus that turns the wood blue. As the trees die and fall over, the already thick organic mat on the floor of the forest becomes heavier, making it even more difficult for new seedlings to gain a roothold. Regeneration is slow or not possible at all, and so the spruce bark beetle eliminates not only this generation of trees, but stops the next as well unless fire or some other factor disturbs the site.

Of course, the likelihood that a forest of dead trees will catch on fire and burn up is quite a bit higher than if the trees were still alive. Given the volume of timber dead or dying from the spruce bark beetle, we are looking at a potentially disasterous fire. It has been estimated that on the

Kenai Peninsula alone - based upon the $23 million it took to suppress the last major fire there in the late 70s - we could expect to spend anywhere from $50 million to $100 million to contain a fire in beetle infested areas.

However, I believe there is hope in all this. Alaska should encourage the responsible development of its natural resources as our Constitution clearly dictates. If we have the willpower to do so, we can start a new revenue enhancement program, save the virgin forests from the spruce bark beetle, avoid the fire danger and the expense of fire suppression - and create substantial economic activity to private markets by harvesting the infected trees. We can also put youth to work through conservation programs of reforestation, starting the next generation of trees immediately.

Some professional foresters state the answer to this problem is to harvest these trees and remove them from the forest. Most of them can be chipped and sold to pulp mills. The potential economic activity that could be generated from this approach to solving this problem is tremendous: At $~~500~~ 650 per thousand board feet for finished pulp, ~~chips~~, our 10 billion b/f of infested timber is worth a ~~minimum~~ of 6.5 ~~[illegible]~~ billion dollars. The state sold the beetle-infested trees at Tyonek in the mid-70s at a salvage ~~giveaway stumpage~~ rate of $1 per thousand - however, the total economic impact of that sale was in excess of 100 million dollars. ~~even at this low rate the state could bring in $10 million to support state services, including the reforestation programs of the division of forestry which have never been funded.~~

Granted, not all the infested timber is accessible. Some of it is even located in state and federal conservation units where harvesting - for any reason - is not allowed. But remember, these estimates are conservative.

I believe that if we put into operation a policy of this type, we would be able to harvest a significant portion of the beetle-killed timber, stimulate Alaska's economy, and PUT PEOPLE TO WORK.

I have talked with several members of the Resources Committee concerning this problem and they have expressed an interest in having the Division of Forestry present an overview. I hope that can be scheduled in the very near future. I have also advocated that a special legislative oversight committee be appointed that would provide direction to the administration consistent with the policy-solutions we adopt here in the legislature.

You may recall that, early last year, we passed the so-called "Jobs Bill", with the intent of putting $75 million in construction projects on the street last summer. While I won't speak to the effectiveness of that particular effort, I would point out that we have been given an opportunity - through the gnawing of the spruce bark beetle - to create hundreds of jobs and millions of dollars of economic activity.

Of course, we are not the first people in America to face a "plague of locusts." I'm reminded that in 1874, Nebraska had quite a few more trees than it has now. But in that year, clouds of grasshoppers a hundred miles wide by 150 miles long appeared and ate up everything in sight. The sounds of grasshoppers chewing up the crops and treetops inspired one farmer to compose the song "Starving to Death on My Government Claim."

I would leave you with the lesson from another folksong - "The Boll Weavil" - who went lookin' for a home. While this little bug ate up half the economic viability of the poor sharecropper, he also presented the opportunity of figuring out a way to overcome him. This opportunity was met, and the boll weavil now has a monument erected to his memory in Lousiana.

Miles W. Dean
P.O. Box 201341
Anchorage, Alaska 99520

March 16, 1989

Mr. Bob Dick, State Forester
Division of Forestry
Department of Natural Resources
400 Willoughby Avenue
Juneau, Alaska 99801

RE: Proposed Tyonek II Sale & West Cook Inlet Area

Dear Mr. Dick:

An introduction is necessary at this time to fully acquaint you with my interest in development at West Cook Inlet Resources.

After three and one-half years of studies, engineering, permit process and many other related matters, I am preparing to build an all-purpose dock and bulk handling facility at Beluga, Alaska, more commonly known as Ladd Landing.

The last several months I gathered information on timber reserves in that area. Our findings indicate Tyonek II Sale has amiable timber along with other state timber lands.

Further investigation dictates markets are available for the timber resources; some have specialty uses while others need saw logs, chip logs and pulps.

For whatever uses, timber is in demand from a marketability standpoint. Other reasons are disclosed in memorandum of March 2, 1989 from Mr. Terry Martin, Alaska House of Representative (see enclosed).

I am especially interested in purchasing all timber at West Cook Inlet and surrounding area which would add benefits to the dock facility for identified markets in hand. I would like full support of the State Forestry Division to further develop our resources and which in turn would create more employment and badly needed funds for the State Treasury. In addition, it should address the memorandum from Mr. Terry Martin for that area.

I am prepared to move on the timber issue as quickly as the State.

Sincerely,

Miles W. Dean

cc: Rep. Terry Martin
P.O. Box V
State Capital Building
Juneau, Alaska 99811

Mrs Lennie Gorsuch
Commissioner of Natural Resources
State of Alaska, DNR
3601 "C" Street, Suite 1210
P. O. Box 107005
Anchorage, Alaska 99510-7005

Honorable Governor Steve Cowper
3601 "C" Street, Suite 758
Anchorage, Alaska 99503

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FORESTRY

TIMBER SALE PROSPECTUS
(Preliminary Draft)

SC-781 TYONEK NUMBER 2 ADL 210965

This prospectus covers the sale named above and should not be used as a comparison to other timber sales or timber management projects on adjacent lands. This document is intended to supplement the sample contract which has been prepared for this sale, so that prospective bidders or other concerned parties may have more details as to bidding requirements, logging conditions, description of timber, access, and numerous other considerations.

Location

The sale area lies approximately 38 miles west of Anchorage near the village of Tyonek. The entire sale area lies between the two major drainages of the Beluga River on the north and the Chuitna River on the south. The village of Tyonek is approximately four miles to the southeast of the nearest portion of the sale area.

Sale Area Description

The sale area is located on the following legally described lands:

T13N, R10W, S.M. That portion of the Township south of the Beluga River in Sections 7-9, 16-21 and 28-33.

T13N, R11W, S.M. That portion of Township South of Beluga River in Sections 4-10 and 14-36, excluding USS 3964.

T13N, R12W, S.M. Sections 32-36.

T12N, R11W, S.M. That portion of township north of Chuitna River in Sections 3-10, 15-22, 27-29, excluding USS 4547.

T12N, R12W, S.M. That portion of the township north of the Chuitna River in Sections 1-15, 23 and 24.

There are approximately 9456 acres of merchantable timber designated for cutting. The sale area, roads and cutting units are shown on page ___ of this prospectus.

Description of Timber

The timber on this sale is an uneven aged stand of white spruce (52%), birch (36%), and cottonwood (12%). Trees of all species larger than six inches D.B.H. are designated for harvesting and utilization.

The timber stands are generally considered to be mature with minor stem damage and some mortality in the white spruce due to bark beetle activity. Stand characteristics for the average acre are listed in the table below:

Species	Trees/ Acre	Average DBH	Average Total Height	Average % Sound
White Spruce	63	10.0"	56'	96
White Birch	63	11.0"	53'	83
Black Cottonwood	3	21.3"	70'	93
Total	129			

Tyonek II Sale Summary

	Acres	Net MBF Spruce	Net MBF Birch	Net MBF Cottonwood	Net MBF All Spec.
Sale Area Excluding Mental Health *	7,061	20,368.1	14,150.1	5,960.4	40,478.6
Mental Health Lands	2,395	7,446.5	5,226.6	325.1	12,998.2
Sale Area Including Mental Health	9,456	27,863.7	19,245.6	6,555.0	53,664.3
Average Acre Net Bd. Ft.		2,947	2,035	693	5,675

* The volumes are computed from a separate cruise excluding plots on Mental Health lands. Because of this, adding the first 2 lines will not give the volume for the sale area including Mental Health land.

METHOD OF VOLUME DETERMINATION

The timber on this sale was cruised by Division of Forestry personnel. The sale area was cruised between August 1981 and March 1982 using variable plot sampling techniques with a 10 factor prism. One hundred forty three (143) measure plots were taken and the DBH, total height, and defect class of each tally tree was recorded. For more accurate volume determination the sale area was divided into 7 operable types. A 6% sampling error was achieved for the combined types.

Volume and Minimum Price

Species	Estimated Volumes	Appraised Unit Price	Total Value
Spruce	27,860 MBF		
Birch	19,250 MBF		
Cottonwood	6,550 MBF		
		Total =	

Access

Access to the sale area is provided by dedicated public easement on constructed all-weather gravel road. The Purchaser may need to construct a log storage and transfer site, camp, and log processing facility. Any requirements for permits will be the responsibility of the Purchaser.

Roads and Airstrips

The Purchaser is required to construct about 33 miles of summer mainline road, 23 miles of summer spur road, upgrade about 12 miles of mainline road, and construct about 27 miles of winter road. One existing airstrip is to be rehabilitated and graded, another airstrip is to be new construction.

Further information is included in the Forest Management Sale Report and in the sample Timber Sale Contract.

Maintenance

The Purchaser may be required to sign joint road use and maintenance agreements with several parties having operations or interests within the vicinity of the sale area. Other maintenance requirements are specified in the contact.

Logging Conditions

Most units and strips are ideally suited for highly mechanized feller-buncher-delimber operations. Use of rubber-tired grapple skidders and mobile chipping units are highly practicable for most areas of the sale.

Areas designated for summer logging may be harvested any season of the year. Areas designated for winter logging, however, will only be harvested during periods when the ground is fully frozen.

Method of Payment

No timber shall be cut or removed until payment has been made in accordance with the following:

(a) Stumpage Deposit An initial stumpage deposit shall be deposited with the STATE at least 30 days prior to the initial commencement of timber harvesting under this contract. The PURCHASER shall furnish the deposit in the form of cash, certified check, money order, surety bond acceptable to the STATE, or any combination of these, to guarantee payments for timber. The total stumpage deposit shall be $10,000 for the duration of the contract. The STATE may apply a portion or all of the stumpage deposit to cover stumpage payments which are more that 15 calendar days past due.

(b) THe PURCHASER shall pay within 15 days of the first of each month for all timber scaled during the previous month.

(c) All payments and deposits shall be made payable to the Alaska Department of Revenue and shall be submitted to the Department of Natural Resources, Division of Forestry, Southcentral Region.

Performance Bond

A performance bond in the amount of 10 percent of the sale value is required. It must be submitted to the STATE with the signed contract within the thirty (30) day period allowed following receipt of the contract by the PURCHASER.

Release of the bond is conditioned upon faithful compliance with all contract provisions.

Authority

The sale of timber is offered under the authority of the Alaska Statutes, Sections 38.05.020 through 38.05.120 and the Alaska Administrative Code, Sections 11 AAC 71.005 through 11 AAC 71.350 and Sections 11 AAC 71.900 through 11 AAC 71.910 referred to as the "Timber and Material Sales Regulations".

Contract Requirements and Stipulations

A sample contract is available and should be reviewed.

Primary Manufacture

Primary manufacture is not required.

Period of Contract and Timber Removal Schedule

The contract period is ___ years. A minimum of five million board feet of timber must be paid for and removed from the sale area not later than three years following the effective date of the contract.

Sale Procedure - Bid Deposit Requirements

The sale of timber will be by oral outcry auction. As qualifications for bidding, all bidders must submit a bid deposit of five percent of the total appraised price either in cash, certified check, cashier's check, or money order, in favor of the Alaska Department of Revenue. The bid deposit shall be submitted to the selling agent between 1:00 p.m. and 2:00 p.m., prevailing time, on __________, 1985, at the Frontier building conference Room, Suite 336, 3601 "C" Street, Anchorage, Alaska.

A bid deposit will not constitute a bid; all bids will be by oral outcry. A minimum increase of twenty-five cents (25¢) per MBF will be required. A two minute time period between bids will be observed. Bids will be accepted on any species. The total bid value of all species will be the basis for determining the highest bid. Bids for less than the appraised value will not be accepted.

The Division will reject any bid containing or submitted with a condition, qualification or alteration of the terms as specified in the Notice of Sale, this Prospectus, or the contract, or which is otherwise not in accordance with law.

The successful bidder's deposit may be credited to the total amount due to the State for the Stumpage Deposit. The apparent successful bidder may be required to furnish a sworn financial statement showing ability to fulfill the terms of the contract. The deposit furnished by the apparent successful bidder shall be retained as liquidated damages if the successful bidder does not execute the contract and furnish satisfactory bonds within 30 days of receipt of contract. The deposits furnished by unsuccessful bidders will be returned at the end of the auction.

The State reserves the right to reject the highest bid and to award the timber for the amount of the next high bid to the next highest bidder, if the Director considers the highest bidder unqualified to fulfill the requirements of the contract or if the contract is not executed by the highest bidder. The State also reserves te right to waive minor technical defects in this prospectus. The timber sale contract is the binding document.

Qualification of Bidder

At the time of bidding, if bidding as an agent for another individual, a partnership, corporation, or other legally established firm, the bidder shall submit to the selling agent a notarized letter attesting to that fact or a power of attorney. A person, in order to qualify for bidding must be financially and legally competent to enter into and carry out the provisions of the sales contract. The Director may request conclusive evidence of any bidder's qualifications.

General

Further information can be obtained concerning the timber and conditions of this sale from the Alaska Division of Forestry at: Southcentral Regional Office, Pouch 7-005, Anchorage, Alaska 99510, telephone 276-2653; Southeast Regional Office, Pouch M, Juneau, Alaska 99801, telephone 465-2433; State Forester's Office, Pouch 7-005, Anchorage, Alaska 99510, telephone 276-2653; or Northcentral Regional Office, 4420 Airport Way, Fairbanks, Alaska 99701, telephone 479-2243. Alaska's area code is 907.

United States
Department of
Agriculture

Forest Service

Alaska
Region

Forest Pest Management Report

R10-88-C-1

FOREST INSECT AND DISEASE CONDITIONS IN ALASKA - 1988

December 1988

DAVID W. ORR
INSECT AND DISEASE FORESTER

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FORESTRY

P.O. BOX 7005
ANCHORAGE, ALASKA 99510
(907) 762-2127

FOREST INSECT AND DISEASE CONDITIONS IN ALASKA, 1988

CONTENTS

FOREST PEST CONDITIONS IN ALASKA - 1988

CONDITIONS IN BRIEF

Spruce bark beetle activity increased in 1988 throughout Alaska. Aerial detection surveys noted 387,120 acres of white, Lutz, and Sitka spruce mortality. Areas of increased spruce beetle activity were most apparent in interior Alaska's white spruce stands. *Ips* populations decreased for the third year in interior Alaska. Approximately 1,500 acres of spruce mortality was apparent near timber harvest units in the Bonanza Creek Experimental Forest near Fairbanks.

Hardwood defoliator activity in interior Alaska decreased for the third consecutive year. Large aspen tortrix larvae defoliated 118,391 acres of aspen. River bottom willow was heavily defoliated (4,313 acres) for the third consecutive year along the Mulchatna and Yukon Rivers. Western tent caterpillar activity was noted on recently planted landscape material in downtown Anchorage. This is the first recorded incidence of this pest in Alaska. Tent caterpillar egg masses were apparently brought into the State on nursery stock.

Black-headed budworm defoliation levels in Prince William Sound were high; 145,000 acres of defoliated western hemlock and Sitka spruce were aerially detected. Cottonwood defoliation (leaf beetles and blotch-miners) occurred on 11,000 acres near Valdez and Kings Bay.

Forest insect problems were relatively minor in southeast Alaska in 1988. The cottonwood leaf beetle defoliated black cottonwoods and willows on 4800 acres along river bottoms near Haines and in urban areas near Juneau. Low-level spruce beetle activity was detected in Glacier Bay National Park and in the Yakutat Forelands. Defoliators of western hemlock remained at very low levels, producing no visible defoliation in 1988. About 3000 acres of previously undetected hemlock top-kill and mortality were mapped in 1988. This brings the total area severely affected during the hemlock sawfly infestation in the mid-1980's to 14,000 acres. Spruce needle aphids were active near the communities of Juneau, Sitka, Petersburg, Craig and Klawock.

Hemlock dwarf mistletoe, wood decays, and decline of Alaska-yellow cedar persist as the most important forest diseases of Alaska. Some 340,000 acres of cedar decline have now been detected, primarily on the Tongass National Forest. Spruce needle cast was present at the highest infection level in recent memory in young spruce trees growing on cutover land and in urban areas througout southeast Alaska. Most other diseases were at low, endemic levels this year. Porcupines continued to damage spruce and hemlock in valuable young-growth stands in southeast Alaska.

STATUS OF INSECTS

SPRUCE BEETLE, *Dendroctonus rufipennis* (Kirby)

Alaska spruce beetle populations increased in 1988 by more than 100,000 acres; on-going as well as new infestations now cover approximately 387,120 acres throughout south-central and interior Alaska's spruce forests. Increased spruce beetle activity was most apparent in interior Alaska along the Yukon and Kuskokwim River drainages.

White, Lutz, and Sitka spruce mortality continues on approximately 36,413 acres of the Chugach National Forest; an increase over the area infested in 1987 (29,586 acres). Spruce beetle activity is most apparent near Summit Lake, Cooper Landing, and the Russian River Campground area. Spruce beetle pressure was extremely high in the Cooper Creek and Russian River Campgrounds where more than 90% of all spruce greater than 5" in diameter has been killed. A reflection of the extremely high beetle pressure was the occurrence of black spruce mortality; trees as small as 3" in diameter were successfully attacked. Black spruce is rarely attacked by the spruce beetle, but when populations are extremely high and preferred hosts (white and Lutz spruce) have been previously killed, beetles have little choice but to attack black spruce. New spruce beetle activity was noted at Upper Trail Lake near the Johnson Pass trail.

Spruce beetle activity continues to increase on the Kenai National Wildlife Refuge where approximately 80,000 acres are currently infested; the majority of the infested forested lands occur in the Mystery Hills and Skilak Lake areas. Scattered spruce beetle activity has been apparent for 2-3 years on 41,000 acres southwest of Tustumena Lake. Spruce beetle populations continue to decline along the Fox River Drainaige near Homer: no spruce beetle activity was detected in 1988. However, across Kachemak Bay from Homer, spruce beetle populations are increasing in the Sitka spruce stands of Kachemak Bay State Park where more than 10,000 acres are lightly infested: approximately 1,000 acres are infested in the Halibut Cove Lagoon area; 800 acres near Mallard Bay, and 9,000 infested acres are apparent from Aurora spit to Battle Creek. The spruce beetle is spreading in a northeasterly direction. Spruce beetle activity is static on approximately 300 acres near Seldovia. Infested trees are most apparent in stands bordering recent subdivision roads north of Seldovia.

Spruce beetle activity on the west side of Cook Inlet continues to decrease; approximately 26,000 acres of scattered beetle activity was detected near Beluga Mountain; a 50% decrease over 1986 levels. Future declines are expected as the beetles have attacked and killed the majority of the susceptible host material in this area.

Spruce beetle activity in the Anchorage Bowl and Chugiak-Eagle River areas continues to decrease. Scattered mortality is still evident throughout the spruce-hardwood type on Fort Richardson Military lands and in the spruce stands along upper Ship Creek. Further up the Mat-Su Valley, 14,000 acres of scattered spruce beetle activity are apparent south of the Matanuska River near Kings Mountain. An additional 19,000 acres of beetle activity was aerially detected for the third year between Willow Creek and Little Willow Creek.

Lutz spruce killed by spruce beetles
which emerged from firewood

The Tiekel River outbreak along the Richardson Highway has decreased by 9,000 acres and now encompasses 14,733 acres. Areas most heavily infested continue to occur along the Tiekel River and along the Richardson Highway from Stuart Creek to Pump Station 12. Infestations will continue to decrease in intensity as the spruce beetle has killed the majority of the susceptible host type after more than eight years of activity. Spruce beetle activity however, is increasing in other localities in south-central and interior Alaska. A large spruce beetle outbreak was detected along the Yukon River south of Nulato in 1986. This was the first recorded spruce beetle outbreak north of the Alaska Range. The outbreak continued to expand in 1987 and by 1988, beetles have infested approximately 140,000 acres. Infestations are scattered throughout the white spruce stands bordering the Yukon River from Anvik to Nulato with some spot activity occurring near Galena. Infestations are expected to intensify and spread along the Yukon in an easterly direction during the next few years. New spruce beetle activity was detected on 14,000 scattered acres north of the Wood-Tikchik State Park approximately 30 miles southwest of the Taylor Mountains. Scattered spruce beetle activity also continues along the Kuskokwim River on 10,000 acres between Sleetmute, Devil's Elbow and McGrath.

1988 spruce beetle infestations throughout south-central and interior Alaska by ownership are as follows: National Forest Land--36,413 acres; State and Private--139,613 acres, and other Federal lands (e.g. Kenai National Wildlife Refuge, National Parks, etc.)--211,094 acres.

In southeast Alaska, spruce beetle activity was low in 1988. Light additional spruce mortality occurred in Glacier Bay National Park, but the total affected acreage did not expand appreciably from the previous year. Slightly over 18,000 acres have been affected in the Park, with mortality ranging from 5 to 75% of the trees in nearly pure stands of Sitka spruce. Small patches of older spruce mortality are evident along the outer coast of Glacier Bay National Park from Dundas Bay to Palma Bay. These patches total less than 500 acres, and do not appear to be expanding.

Nearly 2000 acres of spruce in the Yakutat Forelands have been infested by the spruce beetle. The level of mortality in these areas is low, averaging 10-20% of the stand, and only 3-5% of the trees in these stands are presently infested. The mortality is concentrated around two large salvage sale units on either side of the Situk River.

No current spruce beetle activity was noted elsewhere in southeast Alaska.

ENGRAVERS, *Ips perturbatus* (Eichh.)

Engraver infestations were detected on approximately 1,500 acres, similar to acreages infested in 1987. The areas most heavily impacted occur within the Bonanza Creek Experimental Forest in spruce stands bordering logging roads and recent timber harvest areas.

SPRUCE BUDWORM, *Choristoneura* sp.

No spruce budworm activity was detected in Alaska's spruce stands in 1988. However, visible defoliation is expected near Copper Center and Palmer in south-central Alaska in 1989. Historically, budworm (*C. orae*) defoliation is prevalent every two years, a reflection of the prolonged budworm life cycle.

LARGE ASPEN TORTRIX, *Choristoneura conflictana* (Wlkr.)

Tortrix populations in interior Alaska declined for the second consecutive year. Defoliation was aerially detected on 118,391 acres of aspen; a decrease of almost 50,000 acres from 1987 defoliation levels. Major areas of defoliation occurred near Fairbanks, Delta Junction and Denali National Park. Defoliation levels are expected to decline in 1989. Minimal tree mortality is expected as a result of this outbreak.

SPEAR-MARKED BLACK MOTH, *Rheumaptera hastata* (L.)

Black moth populations significantly declined in 1988. Only 234 acres of birch defoliation were aerially detected in interior Alaska this year versus 25,707 acres in 1987. We can expect little or no black moth activity for the next few years.

GYPSY MOTH, *Lymantria dispar* (L.)

One adult male gypsy moth was trapped in Centennial Park Campground on the outskirts of Anchorage in 1987. A thorough ground check of the campground as well as an expanded pheromone trapping program was carried out this year. No gypsy moth larvae were found in the Campground and no male adult gypsy moths were captured in the traps. State-wide pheromone trapping will continue next year.

Tent caterpillar larvae and webbing

TENT CATERPILLAR, *Malacosoma* sp.

Last summer, tent caterpillars were common on a variety of recently planted landscape materials along the newly completed A Street renovation in downtown Anchorage. This is the first time that tent caterpillars have been reported in Alaska. At this time, the species has yet to be identified but is believed to be the Western Tent Caterpillar (*M. californicum*). Caterpillars and their associated tents were prevalent last June on mountain-ash and Canadian red cherry. All nests and larvae were subsequently treated with insecticide in the latter part of June. The infested area will be thoroughly inspected next season for signs of larval feeding and treated if necessary. The introduction of this insect pest may prove extremely damaging to Anchorage's urban trees if not exterminated. Tent caterpillar feeding can result in reduced tree growth, damage to browse plants, and reduction of aesthetic values. Final identification of the species in question will be available this winter.

HEMLOCK SAWFLY, *Neodiprion tsugae* (Middleton)

Populations of the hemlock sawfly were at low levels throughout southeast Alaska in 1988. No visible defoliation was noted, whereas nearly 2000 acres were defoliated in 1987. Previously undetected top-kill and mortality of western hemlock were mapped on nearly 3000 acres. This damage was the result of heavy sawfly infestations from 1983 to 1985. Most of this additional top-kill was in the southern part of the Tongass National Forest, including Prince of Wales Island, Cleveland Peninsula, and Revillagigedo Island. In total, the sawfly infestation of the mid-1980's produced top-kill and mortality of hemlock on more than 14,000 acres throughout southeast Alaska.

Although sawfly defoliation was not evident from the air, the total larval counts from the 1988 defoliator survey were similar to the numbers in 1987. The highest sawfly populations were recorded on Thorne Island, where defoliation was noted in 1986 and 1987. Other areas where larval numbers increased in 1988 were Tuxekan, Stevenson Island, and Calder Bay, all around the northern part of Prince of Wales Island. Larval numbers also increased in Moira Sound (S. Prince of Wales Island). Sawfly numbers declined on most plots in the southern half of Prince of Wales Island, including Cholmondeley Sound, Skowl Arm (McKenzie Inlet and Polk Inlet), Karta Bay, Thorne Bay, and Kendrick Bay. Other areas with substantial declines in sawfly numbers included Smeaton Bay (Behm Canal), Edna Bay (Kosciusko Island), Kadake Bay (Kuiu Island), Todd (Chichagof Island), and Hood Bay (Admiralty Island).

WESTERN BLACK-HEADED BUDWORM, *Acleris gloverana* (Walsingham)

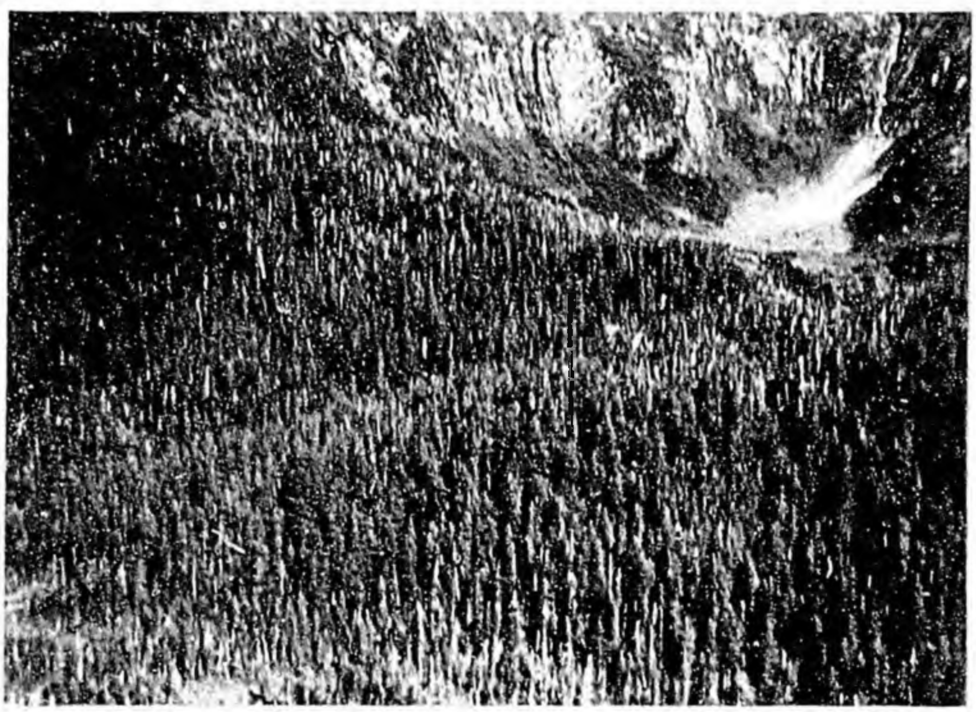
The most recent western black-headed budworm infestation in Prince William Sound occurred in 1983 in the Port Gravina and Fildago areas where 13,000 acres of western hemlock and Sitka spruce were defoliated. This outbreak declined by 50% the following year and by 1985, was not apparent during annual aerial surveys. In 1988, budworm populations dramatically increased and defoliation was detected on approximately 145,000 acres. Areas most heavily impacted include: Port Fildago and Gravina areas; sw end of Hawkins Island; nw and sw side of Montague Island; all of Green, Knight and Perry Islands; portions of Latouche, Ekington, Evans, Chenega, Naked, Glacier and Culross Islands. This outbreak is surprising with respect to its intensity and magnitude. Budworm defoliation was not detected in 1987. The present outbreak is not expected to last more than three years followed by an equally impressive population decrease. Some scattered tree mortality and top kill are expected.

For the most part, black-headed budworm epidemics are rare in Prince William Sound due to the normally unfavorable climatic conditions for population build-up. This year's large infestation is probably a result of the unseasonably warm August and September weather the previous year (1987). This is the dispersal and oviposition period of the budworm.

Western black-headed budworm populations were at very low levels in southeast Alaska in 1988. No defoliation was noted, and larval numbers declined sharply from 1987 levels. The most substantial decreases in budworm larvae were noted in the southern part of the Forest, including Coning Inlet (Long Island), Grace Harbor (Dall Island), S. Prince of Wales Island (Dora Bay, Moira Sound, Thorne Bay), and Princess Bay (S. Revillagigedo Island). The only area where black-headed budworm numbers increased was in Tuxekan, near the northern part of Prince of Wales Island.

SPRUCE NEEDLE APHID, *Elatobium abietinum* (Walker)

Due to a relatively mild winter, spruce needle aphid populations rose in 1988. Damage to Sitka spruce was noted around several communities including Juneau, Sitka, Petersburg, Craig and Klawock.



Black-headed budworm defoliation in Prince William Sound

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

Approximately 11,000 acres of cottonwood were defoliated in Prince William Sound. The majority of the damage occurred near the town of Valdez. 2,500 acres of cottonwood defoliation also occurred at the head of Kings Bay in the Port Nellie Juan area. The causal agents were identified as the cottonwood leaf beetle (*Chrysomela* sp.) and a leaf blotch miner (*Lyonetia* sp.).

The occurrence of both defoliators on cottonwood resulted in widespread, heavy defoliation which may result in limited growth reduction and top kill. Populations are expected to remain high for a few more years followed by a rapid decline.

Populations of the cottonwood leaf beetle remained high in 1988 in southeast Alaska. Willows and black cottonwoods were heavily defoliated in several areas including the Whiting River (800 acres) and the Takhin and Chilkat River drainages near Haines, where defoliation totalled nearly 4000 acres. Homeowners in the Mendenhall Valley near Juneau also reported heavy defoliation of willows and cottonwoods for the fourth consecutive year.

WILLOW LEAFBLOTCH MINER, *Lithocolletis* sp.

For the second consecutive year, willow discoloration was noted along a four-mile stretch of highway from Peterson Creek to Eagle Beach north of Juneau. The discoloration is believed to be caused by *Lithocolletis* sp., the willow leafblotch miner.

WILLOW DEFOLIATION, Tortricidae

After two consecutive years of increases in levels of willow defoliation, 1988 aerial surveys detected only 4,318 acres of defoliated willow versus 18,000 acres of willow damage in 1987. The causal agent has yet to be identified but is believed to be a tortricid larva. The most heavily impacted areas continue to occur near the confluence of the Mulchatna and Nushagak Rivers and along the Yukon River near the town of Galena. Although larval numbers are high in these areas, damage appears to be minimal.

Cottonwood leaf damaged by *Lyonetia* sp.

STATUS OF DISEASES

HEMLOCK DWARF MISTLETOE,
Arceuthobium tsugense (Rosendhal) G.N. Jones

Dwarf mistletoe is a destructive disease of western hemlock throughout southeast Alaska as far north as Haines. Within the range of western hemlock, dwarf mistletoe is absent further west along the coastal area of the Gulf of Alaska. In southeast Alaska, old-growth hemlock stands vary in their level of infestation; dwarf mistletoe is absent in some stands but in other stands almost every hemlock is infected. Sitka spruce and mountain hemlock are only rarely infected by this parasite. Heavily infected western hemlock trees have branch proliferations (witches-brooms), bole deformities, slowed radial growth, or may die.

Infected, non-merchantable hemlock trees are sometimes left standing in cut-over areas. The spread of dwarf mistletoe from these infected residuals is probably the principle form of infestation of young hemlock stands. A demonstration area near Thorne Bay on Prince of Wales Island, Alaska was developed to provide information on the recognition, biology, impact, and recommended silvicultural techniques for managing hemlock dwarf mistletoe in young-growth stands. The killing of infected residual hemlocks (by girdling or felling) during precommercial thinning and the care in laying out cutting boundaries to avoid infected old-growth hemlock on clearcut perimeters can help reduce the initial spread to young stands.

SPRUCE NEEDLE CAST,
Lirula macrospora (Hartig) Darker

One-year old needles of Sitka spruce had symptoms of severe attack by *Lirula* in many areas of southeast Alaska this year. Young spruce trees growing in cutover areas or in urban areas were the most severely affected. Research conducted during the last two years demonstrated that most infectious spores are produced by the fungus in early spring when spruce buds are breaking and young needles are emerging. *Lirula* spores are most likely spread by splashing rain water. Once infected, these young needles do not exhibit symptoms until the following spring. These infected, reddish-brown one year old needles were the most noticeable symptom this year. Next year, when these needles are two years old, characteristic *Lirula* fruiting bodies and spores will be produced. Thus, we also expect high infection levels next year.

SIROCOCCUS SHOOT BLIGHT,
Sirococcus strobilinus Pruess.

The incidence of *Sirococcus* remained at fairly low infection levels this year, although this fungus is still causing damage in some young-growth stands in southeast Alaska. *Sirococcus* attacks the shoots of western hemlock and, to a lesser degree, the shoots of Sitka spruce. Young hemlocks in thinned stands have fewer infections than in unthinned stands. Most infections are concentrated in the lower portions of the live crown where they have less effect on tree growth and do not distort the terminal leader.

SHOOT BLIGHT OF ALASKA-YELLOW CEDAR,
Apostrasseria sp.

The incidence of shoot blight on Alaska-yellow cedar (*Chamaecyparis nootkatensis*) has not changed appreciably over the past several years. Terminal and lateral shoots are killed back 10 cm or so on seedlings and saplings during winter or early spring. Growth rates of affected cedars are probably not significantly reduced unless trees are severely attacked or unless the terminal leader is killed. Mature trees were found to be uninfected by this fungus in an intensive survey of diseases of Alaska-yellow cedar.

SPRUCE NEEDLE RUST,
Chrysomyxa ledicola Lagerh.

Spruce needle rust was somewhat less abundant than in previous years throughout Alaska. The spores that infect spruce needles are produced on the alternate host, Labrador-tea (*Ledum* spp.), a plant that is common in boggy, poorly drained areas. Therefore, the disease on spruce is usually confined to areas near large muskegs or bogs. Spruce trees rarely, if ever, die from this disease even in years of intense infection.

SPRUCE BROOM RUST,
Chrysomyxa arctostaphyli Diet.

Spruce broom rust is a perennial disease of white, Lutz spruce, Sitka, and black spruce; its incidence changes little from year to year. It is common wherever spruce grows near the alternate host, bearberry or kinnikinnik (*Arctostaphylus uva-ursi*). The disease is common in interior and south-central Alaska, where scattered individual trees are infected, but only occurs in localized areas of southeast Alaska. The rust fungus causes perennial infections that result in large, dense clusters of branches. Top kill or mortality sometimes occur.

HEMLOCK NEEDLE RUST,
Pucciniastrum vaccinii (Rab.) Joerst.

Hemlock needle rust occurred at somewhat higher-than-usual levels on needles of western hemlock for the second consecutive year. The alternate host for this rust fungus is blueberry (*Vaccinium alaskensis* How.), a very common component of understory vegetation in hemlock-spruce forests.

WESTERN GALL RUST,
Endocronartium harknessii (J.P. Moore) Hirat.

This rust fungus continues to cause spherical galls on branches and main boles of shore pine. *Endocronartium* is common throughout the distribution of pine in Alaska. This year, another fungus, *Nectria macrospora*, colonized and killed many of the pine branches with these galls. In cases where galls were located on the main bole, *Nectria* commonly caused top-kill.

FOLIAGE DISEASES OF CEDARS,
Gymnosporangium nootkatense Arth. and
Didymascella thujina (Durand) Maire

Two fungi that occur on the foliage of cedar, *Gymnosporangium* on Alaska-yellow cedar and *Didymascella* on western redcedar, occurred at low, endemic levels this year. They neither severely defoliated nor killed cedar trees.

HEMLOCK CANKER, *Xenomeris abietis* Barr.

Damage by *Xenomeris*, which was restricted to hemlock adjacent to roads on Prince of Wales Island in recent years, has subsided. Old damage from several years ago is still evident.

ALASKA-YELLOW CEDAR DECLINE

Decline and mortality of Alaska-yellow cedar persists as one of the most spectacular and important forest diseases in southeast Alaska. Some 340,000 acres of decline have been mapped during aerial detection surveys. Cedar trees have probably died throughout southeast Alaska every year since the onset of the problem about 100 years ago. This year, dying discolored trees were particularly concentrated on the southern half of Kuiu Island and the northeast portion of Slocum Arm on Chichagof Island. The patterns of tree death and apparent absence of a pathogen as the primary cause suggest that some form of environmental stress may be the cause of the problem.

An hypothesis is now suggested to explain cedar decline. The general climatic warming that has occurred in Alaska for about the past 100 years coincides with the onset of decline in about 1880. Although winter daily temperatures may have increased by only several degrees than before 1880, many more winter days have had temperatures just above freezing rather than just below freezing. Considerably more precipitation would have occurred as rain and less as snow. Thus, snow pack at lower elevations would be expected to much reduced during the 20th Century. Our recent research has demonstrated that fine root death is one of the earliest symptoms in a declining cedar tree. Also, decline occurs on wet, poorly drained sites and is particularly severe at lower elevations. It seems conceivable that the primary cause of cedar decline is freezing damage to fine roots during winter cold spells. Because of the anaerobic nature of boggy soils, fine roots of cedars growing in poorly drained sites are very shallow--where they may be susceptible to freezing in these exposed open canopy forests. Also, water-saturated soils are poor insulators against cold. In contrast, cedars growing on sites with better drainage, where decline does not occur, have fine roots that are deeper and better insulated from freezing by the drier soils. We have located some wet sites dominated by cedar but where decline does not occur. These sites are above 500 ft elevation where cedar fine roots are presumably protected from from freezing damage by snow during most winter months. This explanation for the cause of cedar decline is currently hypothetical and research is needed to aid in its acceptance or rejection.

The following list of acreage of land affected by Alaska-yellow cedar decline has been determined from a composite map developed by mapping dead and dying cedar during annual aerial detection surveys conducted over the previous 20 years. Recent research suggests that the total acreage of cedar decline increases very slowly because there is no site-to-site spread of decline. The slow increase in area of cedar decline is a result of encroachment (i.e., <1m/yr) of decline to adjacent stands. Contained within most declining stands are trees that died up to 100 years ago, more recently killed cedars, dying cedars (with red or thin crowns), healthy cedars, and other tree species.

STANDS OF DEAD AND DYING ALASKA-YELLOW CEDAR IN SOUTHEAST ALASKA

	Acres
NATIONAL FOREST LAND	333,037
Chatham Area	107,992
Juneau Ranger District	1,011
Hoonah Ranger District	1,556
Sitka Ranger District	
Chichagof I	32,071
Baronof I	52,804
Kruzof I	15,205
Total	100,080
Admiralty Island Nat'l Monument Wilderness	5,345
Stikine Area	137,961
Petersburg Ranger District	
Kupreanof I	56,561
Kuiu I	36,897
Mitkof I	4,710
Woewodski I	2,258
Mainland	5,060
Total	105,486
Wrangell Ranger District	
Etolin I	12,533
Wrangell I	8,874
Zarembo I	5,760
Woronofski I	311
Mainland	4,997
Total	32,475
Ketchikan Area	87,084
Thorne Bay Ranger District	
Prince of Wales I	18,150
Kosciusko I	2,997
Heceta I	529
Total	21,676
Craig Ranger District	
Prince of Wales I	17,021
Dall I. and Long I	856
Total	17,877
Ketchikan Ranger District	
Revillagigedo I	13,622
Gravina I	1,955
Mainland	11,753
Total	27,330
Misty Fjords Nat'l Mon. Wilderness	
Revillagigedo I	7,084
Mainland	13,117
Total	20,201
OTHER FEDERAL LAND	233
Annette I	233
NATIVE LAND	6,537
Prince of Wales I	3,658
Kupreanof I	312
Ketchikan area	2,567
STATE LAND	3,969
Sitka area	1,090
Mitkof I	1,206
Kupreanof I	156
Prince of Wales I	476
Ketchikan area	1,041
TOTAL LAND AFFECTED	343,776

Decline of Alaska-yellow cedar at Slocum Arm on Chichagof Island, Alaska.

HEMLOCK FLUTING

Fluting on the boles of western hemlock continues to be a problem throughout southeast Alaska. Hemlocks with fluting have deeply incised grooves and ridges extending vertically along their boles; a condition that 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 researchers have recently explored reasons for this bole deformation and have documented its presence in young hemlock stands.

UNIDENTIFIED MORTALITY

Mortality of Sitka spruce located near Petrof Glacier on the southeast portion of Kenai Peninsula was reported to Forest Pest Management personnel this fall. Approximately 25% of the mature trees in the area examined showed signs of mechanical or animal damage at the root collar. Patches of bark had been completely removed from the upper surface of at least some of the primary structural roots for a distance of 20-50 cm back from the root collar. Examination of sapwood samples from these trees revealed the consistent presence of a stain visible as faint black streaks. Identification of the fungal isolates will be undertaken this winter.

DECAYS

Heartrot fungi cause substantial loss of wood volume in Alaskan forests. The problem is particularly serious in Alaska where long-lived trees in old-growth forests are still predominant and the slow-growing decay fungi have ample time to cause significant losses. In southeast Alaska, the following fungi are the most important causes of wood decay:

Sitka spruce-
- *Fomitopsis pinicola* (Schwartz:Fr.) Karst.
- *Phellinus pini* (Thore:Fr.) Pilat
- *Armillaria* sp.
- *Phaeolus schweinitzii* (Fr.) Pat.
- *Laetiporus sulphureus* (Bull. ex Fr.) Bond. et Sing.

Western hemlock-
- *Fomitopsis pinicola*
- *Armillaria* sp.
- *Heterobasidion annosum* (Fr.) Bref.
- *Laetiporus sulphureus*
- *Phaeolus schweinitzii*
- *Phellinus robustus* (Karst.) Bourd & Galz.
- *Phellinus pini*

Western redcedar-
- *Poria albipellucida* Baxt.
- *Phellinus weirii* (Murr.) Gilbn.

High incidences of heartrot fungi was reported from the Kenai Peninsula, based on the presence of sporophores. Species with perennial sporophores have been most notable (e.g., *Phellinus tremulae* on aspen, and *P. igniarius* and *Fomes fomentarius* on birch). The frequency of species with annual sporophores (e.g., *Pleurotus ostreatus* and *Pholiota adiposa*, both on birch and aspen) is much less certain, since this has been a relatively dry summer and fruiting may have been reduced.

Heartrots are quite common in mature stands of mountain hemlock, with sporophores of *Phellinus pini* being encountered most commonly. Sporophore incidence frequently exceeds 10%. Decay losses to this pathogen are no doubt considerably greater, however. Sporophores of *Echinodontium tinctorum* have been observed much less frequently.

P. pini is also relatively common in spruce stands (white, Sitka, and Lutz), but not to the extent observed in hemlock. In addition, at least 20% of trees attacked by spruce beetles 5-10 years ago contain advanced decay caused by *Fomitopsis pinicola*. The actual percentage may be considerably higher.

Survey of the incidence of root and butt rots of conifers on the Kenai Peninsula also was initiated this year. Since most identifications are based upon isolation and fungal growth in culture, a tabulation of incidence by pathogen species will not be available until late fall '88. However, total incidence by stand appears to typically be about 10-20%.

STATUS OF ANIMAL DAMAGE

PORCUPINE, *Erethizon dorsatum*

Porcupine damage was noted in a regenerated stand along the East Fork of the Bradfield River in central southeast Alaska. Porcupines continue to cause damage in precommercially thinned conifer stands on Mitkof Island.

BROWN BEAR, *Ursus arctos*

Brown bears wound the lower boles of Alaska-yellow cedar trees every year on Baranof and Chichagof Islands, particularly in the Peril Strait and Slocum Arm areas. Approximately one-half of the cedars in some stands have at least one scar. Other tree species are unaffected. Fresh scars on cedar are produced in spring and have teeth marks in exposed wood. Trees with old scars have associated columns of wood decay that will limit the value of butt logs from scarred trees.

1988 FOREST INSECT AND DISEASE INFESTATION IN ALASKA BY LAND OWNERSHIP AND PEST IN ACRES

PEST	NATIONAL FOREST	OTHER FEDERAL	NATIVE	STATE & PRIVATE
Spruce Beetle *Dendroctonus rufipennis*	37,191	144,392	48,095	92,764
Engravers *Ips perturbatus*		20		1,270
Large Aspen Tortrix *Choristoneura conflictana*		27,354	11,734	79,303
Spear-Marked Black Moth *Rheumaptera hastata*				234
Hemlock Sawfly *Neodiprion tsugae*	2,960		156	
Black-headed budworm *Acleris gloverana*	102,457		43,910	
Cottonwood Defoliation	778	254		15,096
Willow Leafblotch Miner *Lithocolletis* sp.	20			
Willow Defoliation		2,180	502	1,636
Alaska-yellow cedar Decline	333,037	233	6,537	3,969
High Water Damage	856		78	
Totals:	**477,299**	**174,433**	**111,012**	**194,272**

State Total (Insects and Disease)*: 957,016

*These values 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.

INTEGRATED PEST MANAGEMENT ACTIVITIES

Integrated pest management has been described as a "systems approach to reducing pest damage to tolerable levels through a variety of techniques, including predators and parasites, genetically resistant hosts, natural environmental modifications and, when necessary and appropriate, chemical pesticides." Considering the broad parameters offered by this definition a listing a Region 10 IPM acitivities conducted by FPM is as follows:

(1) Participation in a cooperative effort with Alaska Agricultural Research Station and the Cooperative Extension Service to provide pest management information to Alaska residents. The program which includes education, research and survey activities, provides integrated pest management information concerning urban forestry and garden and greenhouse pests. This program includes a Teletip recorded message service as well as an IPM Newsletter which is published monthly throughout the summer.

There were five full-time and three half-time pest scouts employed from May until the end of September in Fairbanks, Delta Junction, Palmer, Anchorage, and Soldotna. Two additional half-time pest scouts were also hired; one in Juneau and one in Sitka. In addition, there are four Extension Agents working with the program. It is anticipated that an additional half-time pest scout will be placed in Kodiak next summer.

(2) A selective cut and fertilization study was initiated this fall on a 9 acre island directly across from the Granite Creek Campground (Chugach National Forest) which had been set aside for research purposes. Two and one-half acres of mature spruce forest were thinned and all thinned material removed with a Zig-zag monocable yarder. The remaining plots will be thinned and fertilized next fall. The purpose of the thinning and fertilization is to determine which treatments or combination of treatments will increase the vigor of the residual spruce thereby reducing their susceptibility to spruce beetle attack.

(3) The testing of systemic insecticide implants for the prevention of spruce bark beetle attacks as well as the use of these implants as a remedial treatment for attacked spruce was initiated in May of 1987 and terminated this fall. Treatment efficacy indicated little or no affect of these treatments in preventing spruce beetle attack or killing established spruce beetle brood.

(4) Testing of trap tree[illegible]eated with silvicides (MSMA and Cacodylic acid) was continued on the Kenai Peninsula [illegible] the [illegible]okwim River, and at Fairbanks. The objective of the testing was to determine which tre[illegible]nificantly reduced spruce and engraver (*Ips*) beetle progeny production compared to un[illegible]ated trap trees. Treatment efficacy will not be known until later this year.

(5) The testing of diesel with and without carbaryl as a remedial spray for the reduction of spruce beetle brood [illegible] infested spruce was undertaken this summer on the Kenai Peninsula. Although efficacy data have not yet been analyzed, preliminary findings indicate that both carbaryl with diesel and diesel alone were effective in killing late instar and new adult spruce beetles. This study will be continued next year with treatments aimed at the reduction (mortality) of early instar larvae.

(6) A two year study comparing bucking length of infested spruce bolts on spruce beetle survival was finished this summer. Although analysis of the data has not yet been completed, preliminary data suggest that, although fewer spruce beetles survived in the smaller bolts, the reduction was not significant to realistically affect population numbers.

(7) A cooperative (PSW/INF/FPM) standing lethal trap tree study was initiated this summer and will terminate at the end of the 1988 field season. The objective of this study is to determine the efficacy of using carbaryl treated uninfested spruce baited with synthetic aggregating pheromone as lethal traps to suppress spruce beetle populations.

SUBMITTING INSECTS AND DISEASES FOR IDENTIFICATION

People interested in obtaining identification of insect and disease specimens should submit samples to specialists. The following procedures for the collection and shipment of specimens should be used:

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. General description of area (eg, old or young forest, bog, urban); unusual conditions (e.g., frost, poor soil drainage, mis-application of fertilizers/ 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."

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