United States Department of Agriculture
Forest Service
Alaska Region
Forest Pest Management Report
R-10-87-3

HEMLOCK CANKER ON PRINCE OF WALES ISLAND MARCH 1987

Prepared By:

Paul E. Hennon, Plant Pathologist Forest Pest Management
Region 10, Alaska

Approved By:

Ed H. Holsten, Acting Group Leader
Forest Pest Management State & Private Forestry Region 10, Alaska

And

James E. Eggleston, Director
Forest Pest Management State & Private Forestry Region 10, Alaska

Forest Pest Management State & Private Forestry Alaska Region
USDA Forest Service
P.O. Box 21628 Juneau, Alaska 99802

INTRODUCTION

Dead and dying western hemlock trees (*Tsuga heterophyla* (Raf.) Sarg.) have been reported along roads on Prince of Wales Island since 1982. This mortality is apparently caused by a fungus. The disease, known as hemlock canker, kills understory hemlocks and the lower branches of overstory hemlock trees (Fig. 1). Viewed from the air, the disease is confined to a narrow strip adjacent to roads. Apparently, this is at least the second outbreak of this disease; from 1973-1975, small hemlock trees were killed along roads on Kosciusko Island and near Neck Lake on Prince of Wales Island (Baker and Laurent 1974, Baker et al. 1975, Hostetler et al. 1976). In 1977, (C.G. Shaw III, Personal communication) the disease was found on Prince of Wales Island along the road from Thorne Bay to Control Lake.The identity of the causal fungus, *Xenomeris abietis* Barr., was determined by Dr. Al Funk of the Canadian Forestry Service.

The objective of this report is to verify that the cause of the current outbreak is the same fungus, to evaluate the extent of its damage, to predict its future impact, and to provide an historical record of its occurrence.

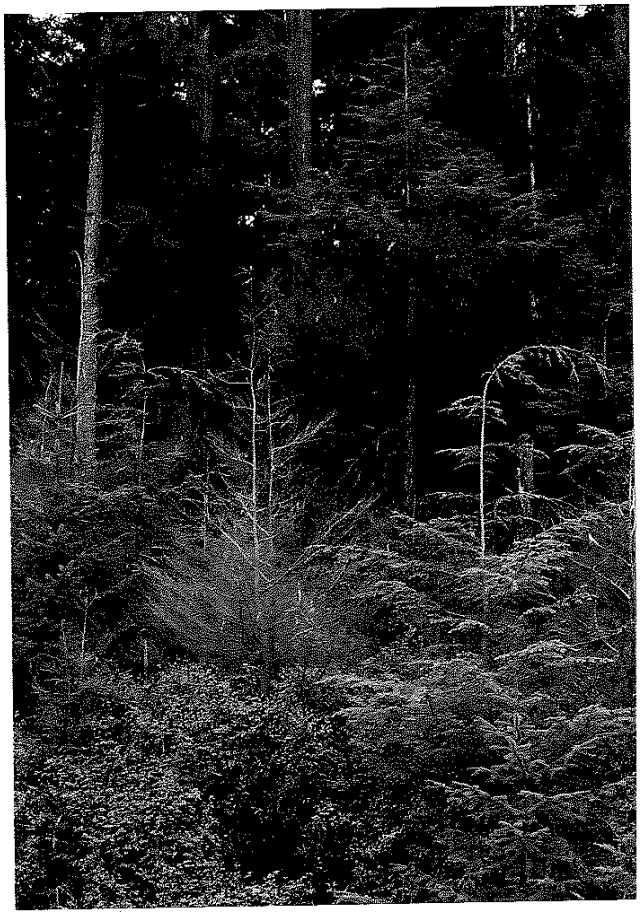

Figure 1. Hemlock canker kills understory hemlock and lower branches of overstory hemlock along roads of Prince of Wales Island.

EXTENT OF DAMAGE

Stands with hemlock canker along roads were mapped during a roadside survey that was conducted in 1985 and 1986 (Fig. 2). The following is a breakdown of the incidence of hemlock canker along portions of the road system on Prince of Wales Island:

Location	Distance of Road Affected (miles)
Klawock-Craig area	10.9
Thorne River-Control Lake area	3.9
Sarkar Lake area	3.4
Neck Lake area	2.2
Red Bay area	4.3
Labouchere Bay area	6.1
TOTAL	30.8

Fifteen transects were established to measure the extent of the disease from the road perpendicular to its perimeter. The perimeter of hemlock canker occurred an average distance of 130 feet from roads, but sometimes extended more than 300 feet from roads. Accounting for cases where disease occurred on both sides of roads, an estimated 668 acres were affected on Prince of Wales Island.

In the vicinity of Red Bay (Fig. 2), hemlock canker was also noted along several streams that crossed roads where the disease was present. Along these streams, the disease occurred up to 1/4 mile from any road. I have not observed hemlock canker adjacent to streams that do not drain across roads with adjacent hemlock canker. The forest type and the appearance of the disease along these streams was similar to those infected along roads; understory hemlock and lower branches of large trees were affected in an old growth stand.

Sitka spruce (*Picea sitchensis* (Bong.) Carr.) had no symptoms of disease and was not directly affected. Mountain hemlock (*T. mertensiana* (Bong.) Carr.) was not normally present in diseased stands, but it is susceptible, as several small mountain hemlock trees were attacked along the road between Control Lake and Big Salt Lake.

Small western hemlocks were often killed; other small hemlocks had dead branches or had numerous cankers on their branches or mainstems. In many affected stands, few understory hemlocks escaped attack and nearly every hemlock seedling was dead. The roots of recently killed seedlings often remained alive for some time, indicating that attack by the fungus was only on above-ground portions of the seedlings.

Hemlock trees up to 50 feet in height and 14 inches in diameter were killed. Most trees of this size had only their lower branches killed, however. On large, overstory trees, branches up to 40 feet from the ground were killed.

The current outbreak of hemlock canker was first noted in the summer of 1982 (C.G. Shaw III, Personal communication). The initial infection of these trees probably occurred during the fall or winter of 1981. Small trees and the lower branches of large trees continued to die in 1983 and 1984, but in the spring of 1985, little additional mortality occurred.

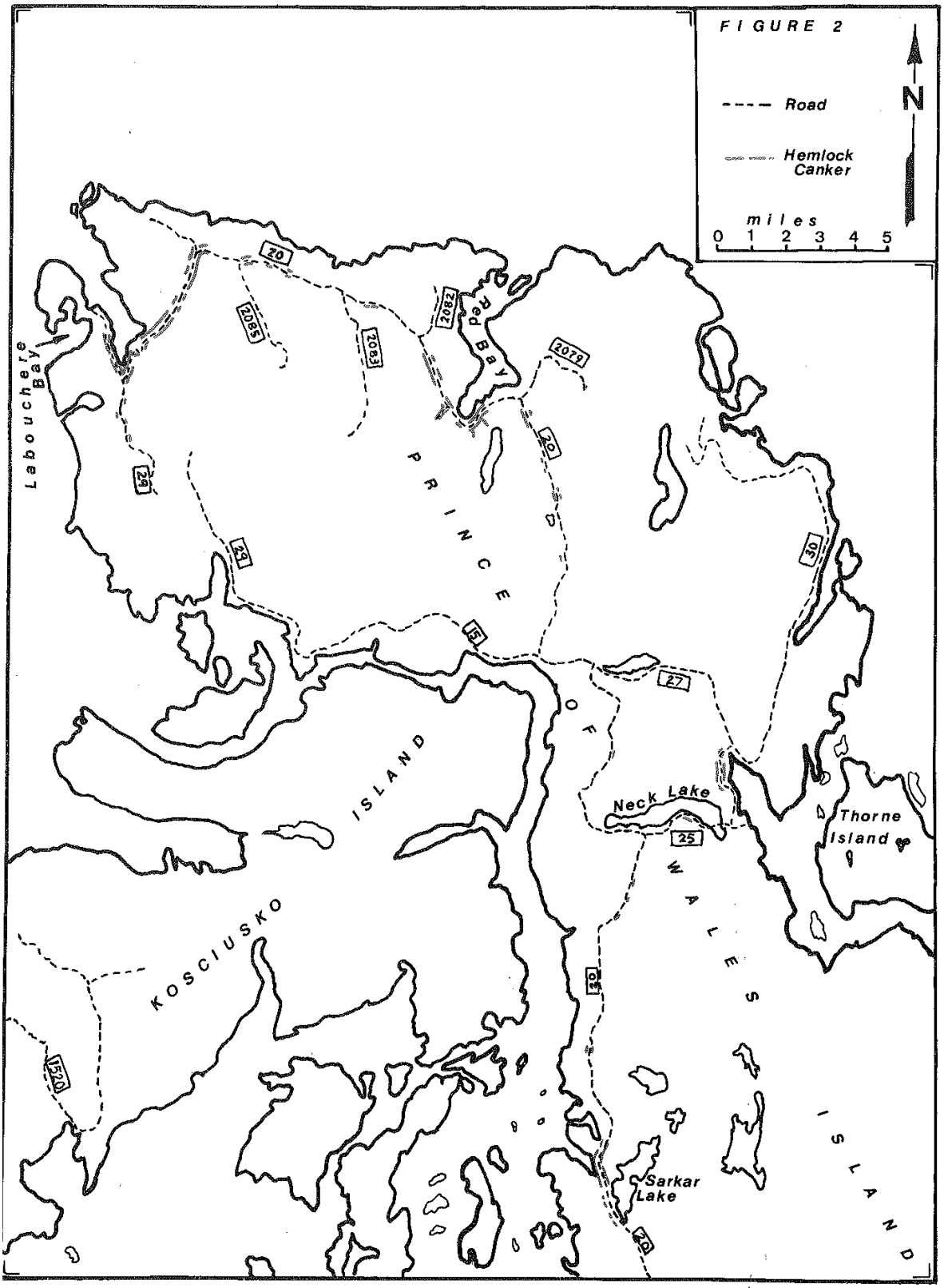
FIGURE 2
Road
Hemlock Canker
N
miles
0 1 2 3 4 5
Laboucherie Bay
Ped Bay
PRINCE OF WALES ISLAND
KOSCIUSKO ISLAND
Neck Lake
Thorne Island
Sarkar Lake
20
2085
2083
2081
2079
29
49
15
27
30
25
10
20
1520

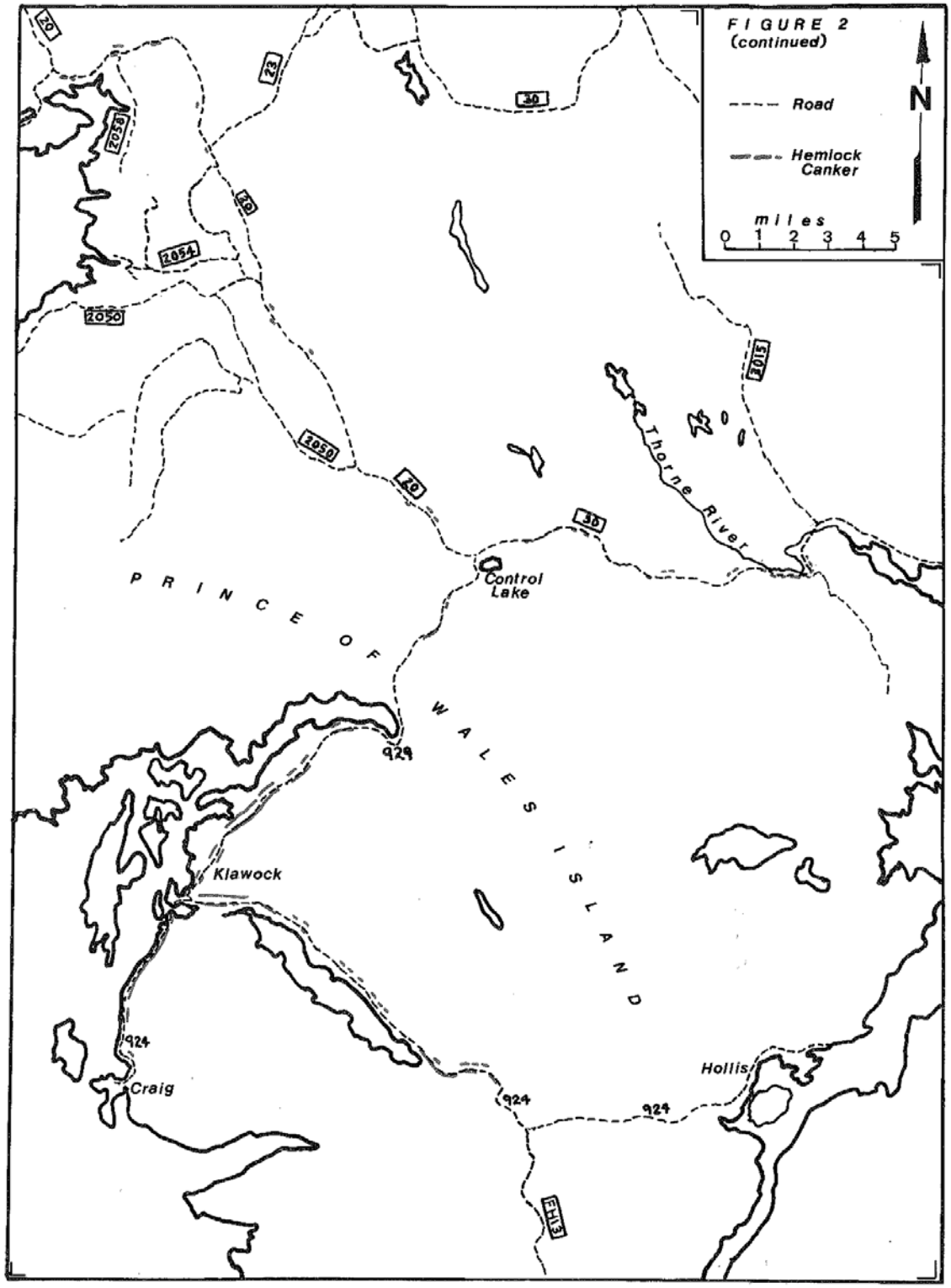
FIGURE 2
(continued)
Road
Hemlock Canker
N
miles
0 1 2 3 4 5
20
73
30
2053
40
2054
2050
2050
20
30
2015
Thorne River
Control Lake
PRINCE OF WALES ISLAND
929
Klawock
924
Craig
924
924
Hollis
6113

This year (1987) the dead hemlocks are still evident, but the outbreak is now apparently over. The actual damage to the commercial forest is minimal, as death of understory hemlock seedlings and saplings in an old-growth forest is not construed as a loss. The death of lower branches of large, overstory hemlock trees may also be insignificant to productivity, where foliage on these lower branches probably contributes little photosynthate to the trees' growth rate.

CAUSE OF HEMLOCK CANKER

Hemlock canker is caused by the fungus *Xenomeris abietis*. Fruiting bodies are small (150-200um in diameter), black, clustered perithecia on small black stroma that emerge from dead hemlock bark (Barr 1968, Funk 1981). Such fruiting bodies were found on the dead hemlock tissues and on some of the resinous cankers.

Xenomeris causes outright death of hemlock tissue, or when it is unable to completely girdle branches or stems, it causes a dead portion. In the latter case, the tree produces callus tissue and resin around the wound, resulting in resinous cankers. Cankers become more obvious with time due to the white color of dried resin. Large trees with thick bark are apparently resistant to attack; trees over 50 feet tall are not killed.

Funk and Shoemaker (1971) discussed the role of *Xenomeris* in the death of Douglas-fir and western hemlock on Vancouver Island in Canada. The fungus has been associated with sporadic outbreaks that are triggered by environmental stresses such as drought. They noted that the fungus was capable of invading and killing phloem tissues of these trees, but emphasized its secondary role in producing disease.

Because this disease is 1) sporadic in time (occurs for several years, then cannot be found for several more years), 2) is associated with a particular microsite (within about 40 feet of the ground) in a particular forest type (old-growth), and 3) is found only within 300 feet of roads, specific environmental factors must be important in allowing this fungus to make its attack.

It is fortunate that the disease is confined to the understory of old-growth stands only. Factors that allow the disease to establish in old-growth stands, but not in young-growth stands, are not understood. Perhaps the humid microenvironment of the forest floor of these stands favors some aspect of the biology of this fungus (e.g., sporulation, spore germination, or infection).

Tree-vigor could be an important factor governing disease; vigorous young-growth hemlock may, in some way, be more disease-resistance than heavily-shaded understory hemlock.

Dust from roads is a factor that, hypothetically, could allow *Xenomeris* to attack hemlocks near roads (Holsten et al. 1986). It is conceivable that dust covering branches or twigs aids the fungus by either 1) stressing these hemlock tissues by reducing gaseous exchange, or 2) contributing necessary nutrients for *Xenomeris* to make a successful infection of these tissues. If dust is an important contributing factor for disease, then perhaps hemlock canker does not occur in young-growth stands because dust is frequently washed from the foliage and branches of these young hemlock trees; but, in old-growth stands, foliage and branches of understory hemlocks is not as thoroughly rinsed because much rain is intercepted by the overstory (R. Hauver, Personal communication). Hemlock canker is now visible along some roads that are paved; therefore, these roads should have little associated dust. However, the paving of these roads (e.g., Craig to Klawock) was not completed until the disease already began to develop in the

winter of 1981. It will be interesting to compare the incidence of future outbreaks of this disease, if they occur, along roads that are paved and unpaved. Such a comparison should indicate whether or not dust contributes significantly to the disease.

PREDICTIONS FOR FUTURE DAMAGE

Although the outbreak of hemlock canker appears to be over for now, we can probably expect it to reappear at some future date. As long as the disease does not become established in our young-growth stands, it will not be viewed as damaging. Hemlock trees in such young stands (now typically up to 30 years old), even along roads, were not affected by this disease during its recent outbreak.

As these young-growth stands age and canopies close, however, environmental conditions somewhat similar to those of old-growth stands will develop. At the same time, the young, pole-sized hemlock trees may not be large enough, nor have bark thick enough, to resist attack from *Xenomeris*. The disease could then become damaging. For this reason, we will closely monitor this disease in the future.

SUMMARY

The fungus *Xenomeris abietis* killed small hemlocks and the lower crowns (up to 40 feet from the ground) of larger hemlocks along some 30.8 miles of roads on Prince of Wales Island in southeast Alaska. Infection results in death of the cambium or, when branchlets and branches are not girdled, resinous cankers develop. Unless this disease begins to seriously affect mature hemlock trees or to infect hemlock in young-growth stands, it will not cause significant damage. The disease will be closely monitored in case it becomes damaging in later stages of the rotation of young-growth stands.

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