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Third reported outbreak of hemlock canker along roads of Prince of Wales Island

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Paul Hennon, March 1992

Abstract. Hemlock canker, caused by the combination of environmental factors and the fungus *Xenomeris abietis*, killed western hemlock during 1990 and 1991 along roads of Prince of Wales Island, Alaska. This is at least the third outbreak of the disease in twenty years. Hemlock canker kills understory hemlock and lower branches of larger hemlock trees. More than 37 miles of this disease were mapped, all of which occurred along unpaved roads. The disease was absent along paved roads. Damage by X. abietis extended to an average of 130 feet into forests from roads at four sites where ground transects were conducted. Accounting for damage on both sides of the road where it occurred, an estimated 852 acres have been affected. The disease was confined to old-growth stands during the previous outbreak, but some western hemlock trees in mixed-aged stands and young-growth stands were killed along several miles during the current outbreak. Absence of the disease in areas where roads are now paved and continued high levels of the disease on unpaved roads suggest that road dust may be an important environmental factor in the development of the disease.

INTRODUCTION

Dead and dying western hemlock trees (*Tsuga heterpohylla* (Raf.) Sarg.) have been reported along portions of roads on Prince of Wales Island, Alaska (Fig. 1). This hemlock mortality is caused, at least in part, by the fungus *Xenomeris abietis* Barr. The disease, known as hemlock canker, kills understory trees and the lower branches of overstory hemlock trees. Environmental factors probably contribute to the disease.

This is the third reported outbreak of the disease in southeast Alaska. Small hemlock trees were killed along roads on Kosciusko Island and near Neck Lake on Prince of Wales Island from 1973-1975 (Baker and Laurent 1974; Baker et al. 1975; Hostetler et al. 1976). In 1977, the disease was found on Prince of Wales Island along the road from Thorne Bay to Control Lake. This latter discovery may have occurred near the conclusion of the same outbreak as in 1973-1975. The identity of the causal fungus, *X. abietis*, was determined by Dr. Al Funk of the Canadian Forestry Service.

The second, and perhaps larger outbreak, occurred from 1982 to 1985 (Hennon 1987). A detailed mapping of the distribution of the disease documented its extent on Prince of Wales Island (Hennon 1987). Almost all mortality occurred in western hemlock, but several mountain hemlock (*Tsuga mertensian*a (Bong.) Carr.) were also found dying. Other tree species and vegetation appeared to be unaffected. Mortality was still evident for several years after trees ceased dying. The disease occurred along 30.8 miles of road, all of which was unpaved when the outbreak began. Ground surveys showed that damage was confined to within an average of 130 feet from roads. Viewed from the air, the disease was restricted to a narrow strip adjacent to roads.

Road dust appeared to be involved in the development of the disease. The disease appeared to be most damaging on roads with the greatest traffic. Since some roads had been paved shortly after the onset of the 1982-1987 in areas where the disease was prevalent, the current outbreak provides an opportunity to investigate whether the disease appears along these paved roads where dust would no longer be a contributing factor.

Figure 1. Hemlock canker kills small hemlock trees and the lower branches of larger hemlock trees along roadsides of Prince of Wales Island.

CAUSE OF HEMLOCK CANKER

Symptoms. Hemlock canker causes outright death of hemlock tissue by killing the phloem or cambium or, when it does not completely girdle branches or stems, a dead portion (canker) develops. In the latter case, the tree produces callus tissue and thick resin around the canker. The resin frequently dries on and around the canker creating a crusty white appearance. Many trees have numerous resinous cankers in their branches. The crowns of such trees usually appear thin and yellow when viewed from a distance. Large trees (taller than 65 feet) are apparently not killed by the disease.

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

Environmental factors. Funk (1971) discussed the role of *X. abietis* in the death of Douglas-fir (Pseudotsuga menziesia (Mirb.) Franco) and western hemlock on Vancouver Island in Canada. There, the fungus was associated with environmental stresses such as drought. Funk noted that the fungus was capable of invading and killing phloem tissues of these trees, but emphasized its secondary role to environmental stress in the development of the disease.

The distribution of the disease on Prince of Wales Island suggests that environmental factors are critical to the disease development in Alaska, as well. Outbreaks appear to be sporadic in time (occurs for several years, then cannot be found for several more years), perhaps because it is responding to

different weather patterns (e.g., drought). During outbreak, the disease is most frequent in old-growth stands adjacent to roads, and only damages hemlock tissues within about 65 feet of the ground.

Some environmental conditions present in these areas must either be stressing hemlock or favoring development of the pathogenic fungus.

OUTBREAK IN 1990

Survey methods. A roadside survey was conducted in 1990 and completed in 1991 to determine the distribution of the current outbreak. Some 258 roaded miles on Prince of Wales Island were driven and adjacent forest stands were observed for the occurrence of the hemlock canker disease. Portions of the road system that were paved and unpaved were noted. Where hemlock canker was encountered, the forest type along the road was classified as old-growth, young-growth, or a mixture of young and old trees. Occurrence of hemlock canker was marked, as carefully as possible, on 1:64,000 scale topographic maps that showed all roads.

Ground surveys were conducted at four locations to determine the largest trees killed, highest portion of the crown killed in surviving trees, and extent of the disease into forests from roads. Each ground survey was located in an old-growth stand where the fungus was killing hemlocks along roads.

Results. Hemlock canker was found and mapped on a total of 37.2 miles of road as far north and south as roads occur on Prince of Wales Island (Fig. 2). The disease was entirely confined to unpaved roads during this outbreak (Table 1). Of the disease along unpaved roads, most (32.4 miles or 87%) occurred in old-growth stands. By comparison, just 1.5 miles (4%) of the disease were mapped along young-growth stands and 3. 3 miles (9%) in mixed-aged stands.

Hemlock mortality caused by *X. abietis* extended to an average of 132 feet (Table 2) into forests from roads at four sites where ground transects were conducted.

Accounting for disease on both sides of the road where it occurred, an estimated 852 acres have been affected. The size of hemlock trees killed and height into the crown of the disease of surviving large trees are also reported in Table 2.

Table 1. Occurrence of hemlock canker in forests of different ages along roads on Prince of Wales Island, Alaska.

Forest Type	Unpaved Roads	Paved Roads
Old-growth	32.4	0
Young-growth	1.5	0
Mixed (old-and young-growth)	3.3	0
TOTALS	37.2	0

Table 2. Mean distance from road, largest tree killed, and highest portion of crown affected by hemlock canker at four sites along the road system of Prince of Wales Island, Alaska.

Forest Type	Mean	Range
Distance from Road	132ft	50-230ft
Largest tree killed Height (ft) Diameter (in)	47.5ft 9.5in	30-65ft 5-14in
Highest branch killed in surviving tree	52.5ft	40-65ft

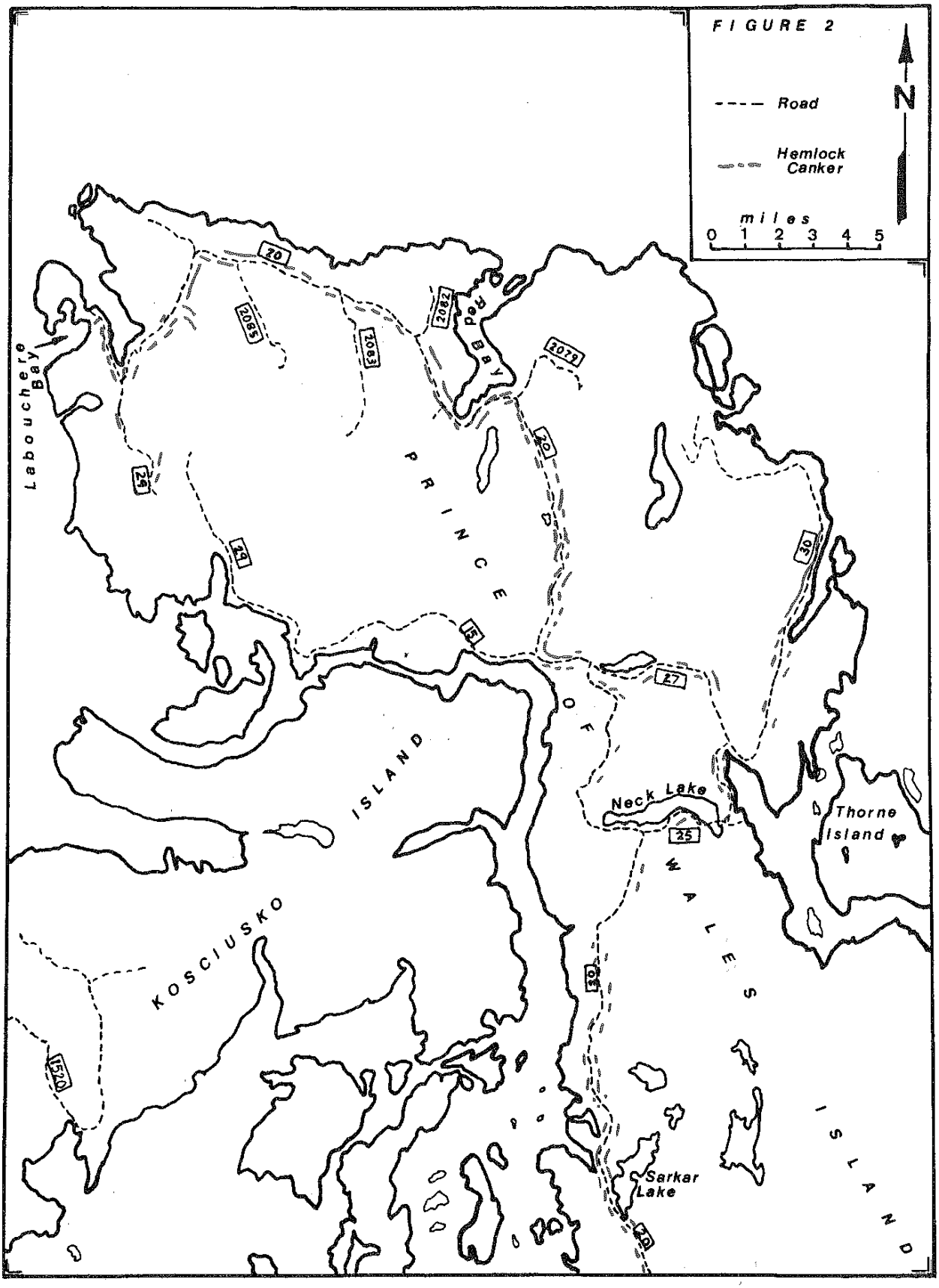
FIGURE 2
Road
Hemlock Canker
N
miles
0 1 2 3 4 5
Labouchere Bay
Red Bay
PRINCE OF WALES ISLAND
KOSCIUSKO ISLAND
Neck Lake
Thorne Island
Sarkar Lake
20
2085
2083
2082
2079
29
19
15
27
25
30
1520

DISCUSSION

The current outbreak of hemlock canker had generally similar characteristics and distribution as the previous outbreak. Once again, the disease was confined to roadsides and killed small trees and the lower crown of large trees. Also, western hemlock was the principal tree killed and mountain hemlock was occasionally killed. The distance from roads that the disease affected hemlock (about 130 feet) and the size of hemlocks killed (from seedlings up to 14 inch diameter trees) were the same during outbreaks. In the current outbreak, however, the disease was found higher in the crowns of surviving trees than was found previously (65 and 40 feet high, respectively).

Comparing the distribution of the present outbreak with that of the previous outbreak, the disease is currently more prevalent in the following areas: south of Red Bay, North of Sarkar Lake, near Exchange Cove, around Control Lake, and along the road to Hydaburg. The only locations of the disease not shown in Figure 2 are areas near Hydaburg. In the previous outbreak, the disease was serious along the roads from Craig to Klawock and along Klawock Lake, but it appears to be absent in these areas now. Interestingly, the roads in these two latter areas were unpaved at the beginning of the previous outbreak and are now paved. Thus, the only general areas where the disease was previously conspicuous and is now absent is along roads that have been paved.

The close proximity of the disease to roads and its restriction to unpaved roads suggest that road dust may be a factory in triggering the disease. Perhaps the disease will no longer be evident along paved portions of the road system of Prince of Wales Island in future outbreaks of the fungus.

A notable difference of the current outbreak is the appearance of the disease in young- growth stands. In the previous outbreak, the disease appeared unsightly along roads, but no real damage had occurred to resources. The disease was not viewed as a problem because it was not killing large trees in old stands and did not kill young trees in intensively managed stands. The present occurrence of hemlock canker in young, managed stands should be viewed with some concern. Currently, the disease is so restricted to roads, and concentration of effected trees in young stands so light, that the disease is not overly threatening. The spread away from roads and intensification in young-growth stands should be monitored closely to determine if the disease will cause more widespread loss in managed stands.

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