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AN INSTANCE OF LIGHTNING DAMAGE AND INFESTATION OF PONDEROSA
PINES BY THE PINE ENGRAVER BEETLE IN MONTANA

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ABSTRACT

Lightning damage to a struck ponderosa pine (Pinus ponderosa Laws.), the pattern of infestation in its bole by the pine engraver beetle Ips pini (Say) (Coleoptera: Scolytidae), and the success of the pine engraver infestation of surrounding sapling- and pole-size trees were documented in a western Montana study. The struck tree became infested for its entire length by bark beetles. Seventy-six percent of the immature trees within 80 feet of the struck tree also became infested. Attacks tended to be more successful closer to the struck tree and in trees in relatively moist soil. The possibility exists that the discharge that struck the mature tree may have caused undetected damage to surrounding trees and disposed them to successful attack by the bark beetles.

The pine engraver beetle Ips pini (Say) (Coleoptera: Scolytidae) is an important pest of standing ponderosa pines (Pinus ponderosa Laws.) of sapling and pole size in the northern Rocky Mountains. Most tree killing occurs during hot, dry summers when oleoresin exudation pressure is reduced and the likelihood of successful beetle attack is increased (Vité 1961). Tree killing by this insect fluctuates greatly from year to year. Hundreds of thousands of trees, often in groups of more than a thousand,² may be killed during outbreaks.

During years of limited pine engraver activity, the beetle confines its attacks to slash, tops of mature trees, and small groups of standing sapling- and pole-size trees that often have been damaged by fire or broken off by wind or snow. Observers have long been aware that lightning-struck trees may also trigger infestations (Hopkins

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²Terrell, Tom T. 1964. Oregon pine Ips generations in the Northern Region 1962-1963. Unpub. rep., U.S.D.A. Forest Serv., Northern Region, Missoula, Montana.



Figure 1.--Aerial view of group kill. Light-colored tree (arrow) is the lightning-struck, mature pine surrounded by dead saplings and poles.

1909; Thatcher 1960; McMullen and Atkins 1962), but little has been published about the nature of lightning damage to the struck tree, the pattern of infestation on the bole, and the extent of the beetle attack in surrounding trees as reported here.

On September 12, 1966, we located a mature, lightning-struck ponderosa pine surrounded by a group of dead immature (sapling- and pole-size) ponderosa pines that were infested by the pine engraver (fig. 1). This group of trees was on a narrow ridge oriented NNE-SSW at 5,000 ft. elevation about 6 miles southwest of Missoula, Montana. The drier southeast-facing side of the ridge contained an open stand of ponderosa pine and Douglas-fir (*Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco). The more moist northwest slope supported a denser stand of Douglas-fir and western larch (*Larix occidentalis* Nutt.). The prevailing wind is from the southwest.

LIGHTNING EFFECTS

The struck pine was 79 ft. tall and 24 in. diameter at breast height. The lightning scar on this tree (fig. 2) was typical of those on conifers throughout the northern Rocky Mountains (Taylor 1965). The spiral scar extended from 13 ft. below the tree's tip to the ground. It increased in width from 5 in. at its top to 17 in. at the ground. Except for a few narrow slivers of outermost sapwood, only bark was removed by the discharge from its path along the bole. No fire resulted.

Figure 2.--Mature pine with lightning scar (arrows) and some of the surrounding trees attacked by the pine engraver.



A less commonly observed characteristic of the lightning damage was an excavation in the soil at the base of the lightning scar. Soil loosened but not ejected by the lightning was carefully removed by hand, revealing the 4- by 1- by 1-ft. excavation shown in figure 3. Several lateral roots were severed. The lightning also damaged a Douglas-fir sapling 17 ft. northeast of the struck pine, rupturing its bark and excavating some soil at its base.

The date of the lightning discharge is unknown. However, it was estimated to be about July 10, 1966, from the date of discovery, stage of beetle brood development, differentiation of the current annual ring, and radar records of thunderstorms in the area.

BEEBLE INFESTATION

The age and vigor of the struck tree, as determined by the Ponderosa Pine Tree Classification (Keen 1943) was 3B (mature tree, crown vigor fair to poor) and was risk class 2 (moderate risk of beetle attack) as defined by Salman and Bongberg (1942). The upper two-thirds of the struck pine was infested by the pine engraver except for a small area of mountain pine beetle (Dendroctonus ponderosae Hopk.) at 50 ft. The lower 20 ft. of the bole was infested primarily by the western pine beetle (Dendroctonus brevicomis Lec.) but also showed evidence of attack by the pine engraver. Lack of



Figure 3.--Soil excavation at base of struck ponderosa pine, showing severed lateral roots (arrows). Rule is 6 in. long.

pitch tubes, abundance of emergence holes, and condition of galleries in the inner bark indicated a high rate of survival of the pine engraver. While most of the pine engraver broods had emerged from the tree at time of examination, a few callow adults and some associated insects were still present.

The extent and degree of infestation are evident from figure 4, which shows the positions of all trees 1.0 in. d.b.h. and greater, growing within an 80-ft. radius of the lightning-struck pine. No attacked trees were found beyond the 80-ft. radius. The 96 immature ponderosa pines within the 80-ft. radius were examined for presence and success of attack by the pine engraver beetle, and classified on the following basis: Successfully attacked trees showed evidence of larval development in the phloem, while unsuccessfully attacked trees lacked larval mines, though they may have contained egg galleries; unattacked trees had no sign of bark beetle entry. Results of the classification are shown in table 1 and figure 4.

Figure 4.--Map showing all trees 1.0 in. d.b.h. and greater within 80 ft. of mature, lightning-damaged ponderosa pine.

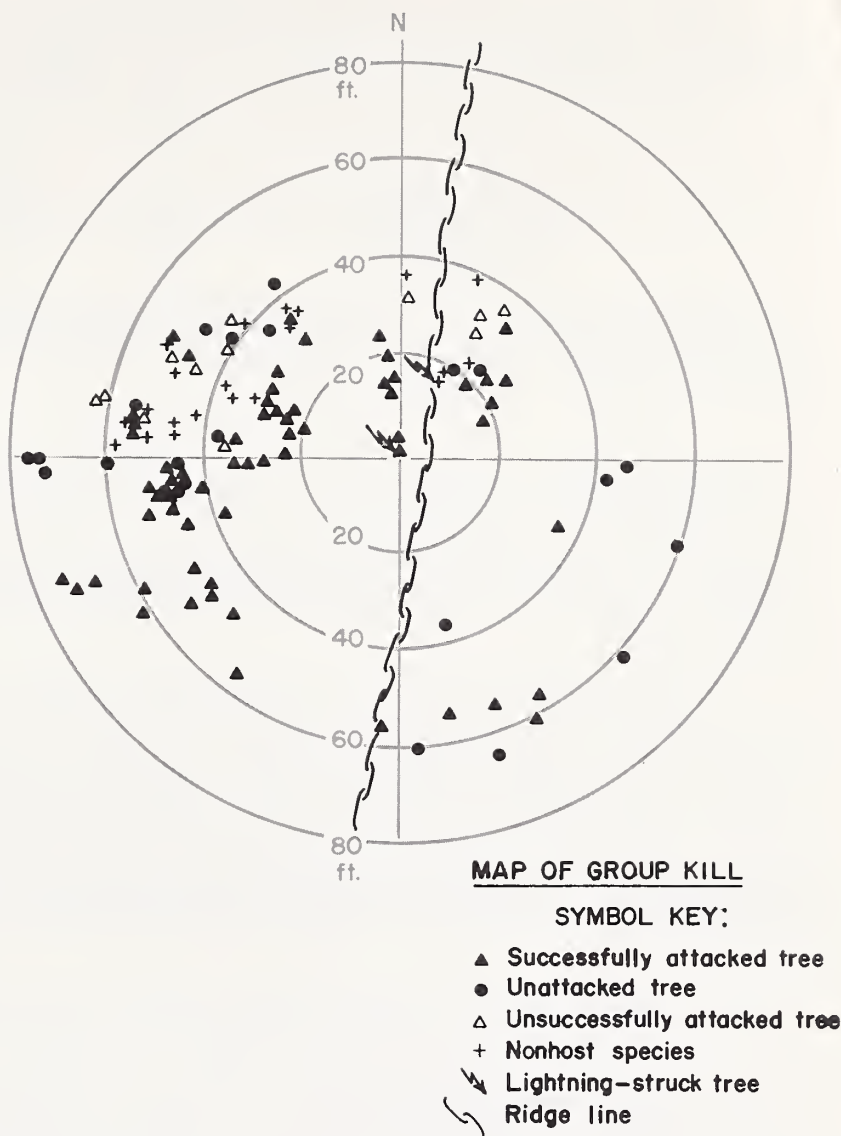


Table 1.--Rate and success of attack by the pine engraver in 96 immature ponderosa pines in relation to distance from a mature, lightning-struck pine

Distance from struck pine (feet)	Total trees	Trees attacked	Attacks successful	Percent of total trees attacked	Percent of attacks successful
0-20	9	8	8	89	100
21-40	31	27	22	87	81
41-60	42	31	26	74	84
61-80	14	7	5	50	71
Total	96	73	61	76	84

Some differences with regard to aspect were evident. The pine engraver beetle successfully attacked 18 percent more of the pine trees growing on the moist northwest-facing slope than on the drier southeast-facing slope:

	<u>NW</u>	<u>SE</u>
Total number trees	72	24
Percent attacked	80	62
Successfully	68	50
Unsuccessfully	12	12

Forty-three percent of the successfully attacked trees on the moist slope showed resistance to beetle attack in the form of pitch tubes, compared with 52 percent of those successfully attacked on the dry slope.

DISCUSSION

We lack positive knowledge of the dates of lightning damage and initial attack by bark beetles in the mature tree and the immature trees surrounding it. However, the evidence leaves little doubt that the bark beetles followed the lightning damage. This sequence of events fits that reported by Dixon and Osgood (1961), Johnson (1966), and Anderson and Anderson (1968), who cite the attractiveness of lightning-damaged pines to bark beetles.

A more interesting question is whether the attacks in the surrounding immature trees resulted from their being disposed by unseen lightning damage to their roots (Komarek 1964), or whether they were attacked after and as a result of a mass attraction created by successful infestation of the larger tree (Miller and Keen 1960; McMullen and Atkins 1962). Quite possibly, both of these mechanisms were involved. However, reports of group tree mortality around lightning-struck trees in the apparent absence of insect activity (Stevens 1918; Shipley 1946; Murray 1958; Minko 1966) reinforce the hypothesis that the trees surrounding the struck tree suffered lightning damage to their roots.

The conditions described here suggest three questions:

1. Infestation by the pine engraver of the entire stem contrasts with the infestation pattern reported by Johnson (1967) for ponderosa pines not struck by lightning. Is this difference typical?
2. Rate of successful attack diminished with distance from the lightning-struck tree. Is it likely that lightning damaged the roots of the nearby trees, lowering oleoresin exudation pressure and thereby disposing the trees to successful attack?
3. A slightly higher rate of successful attack occurred on the more moist side of the ridge, where it might be expected to be lower, owing to higher resistance of trees to beetle attack. Did lightning lessen such resistance?

Only further study can supply answers to these questions. Such study would require prompt detection of lightning damage so that subsequent events could be properly documented. Equally important, actual physical damage or physiological change prior to attack would need to be demonstrated in trees surrounding each struck tree.

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