U.S. DEPARTMENT OF AGRICULTURE FOREST PEST LEAFLET 60
Forest Service September 1961

Silver Fir Beetles

By Gerard M. Thomas and K. H. Wright [1]

Two species of native bark beetles, collectively called silver fir beetles, are destructive to true firs of the Pacific slope of the United States and Canada. The larger of these two beetles, *Pseudohylesinus granulatus* (Lec.), is known as the fir root bark beetle; the smaller, *P. grandis* Sw., as the silver fir beetle. Their ranges are known to extend from central California, through Oregon and Washington, into British Columbia, and eastward into northern Idaho (fig. 1). They are probably also present in Montana and southern Alaska. Apparently they are most abundant in the hemlock-true fir forests of Oregon and Washington.

The silver fir beetles characteristically attack windthrown, felled, and injured trees. Poles and saplings in dense stands, and understory trees weakened by suppression, also are commonly attacked and killed. Before 1947 these beetles were considered of little importance. In that year, however, they were found killing mature Pacific silver fir in northwestern Washington. At first the outbreak was thought to be local, but it spread rapidly, increasing in size and intensity until it reached a peak in 1954. In 1955, when the outbreak abruptly subsided, primarily due to natural control, more than 528 million board feet of silver fir timber had been killed on over a million acres.

Host Trees

Pacific silver fir has the highest timber value of the trees that are attacked significantly by these beetles. So far, it is the only species to be host to serious epidemics. Both beetles have been recorded on grand fir, California red fir, Douglas-fir, and western hemlock. The fir root bark beetle has been collected from ponderosa pine, and the silver fir beetle from subalpine fir and Sitka spruce.

Evidence of Attack

The small entrance holes that the beetles make in attacking a tree are inconspicuous because they normally occur in bark crevices and under bark scales, mosses, or lichens. However, close inspection will reveal a small amount of reddish boring dust under each entrance hole. When attacks are

[1] Forest entomologists, Pacific Northwest Forest and Range Experiment Station, U.S. Department of Agriculture, Forest Service, Portland, Oreg.

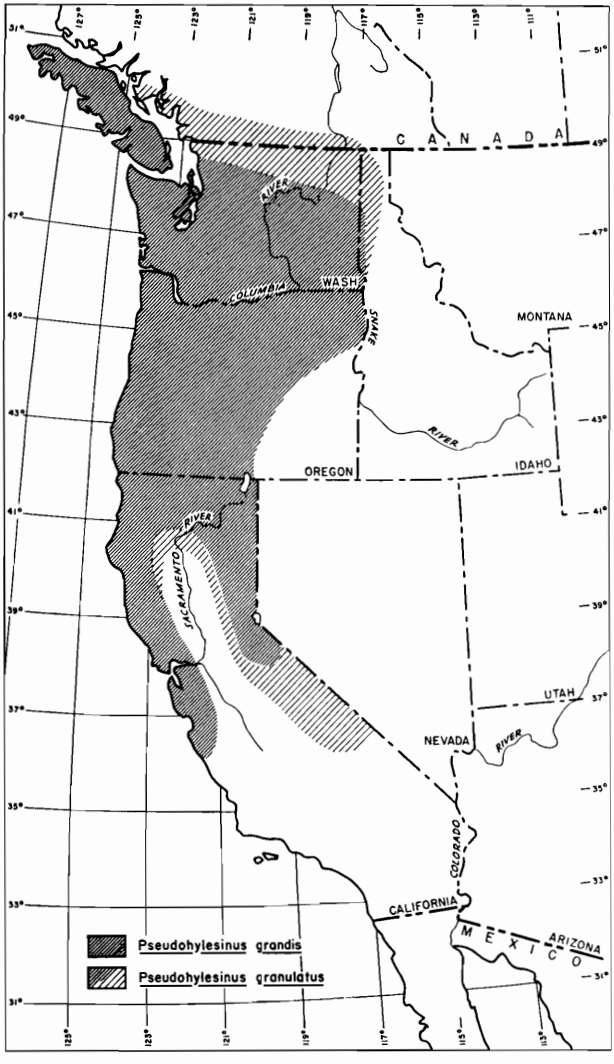

Figure 1.—Distribution of silver fir beetles.

abundant, usually in May and August, the boring dust forms a conspicuous ring about the base of the tree. This ring can be seen from a distance of 10 to 15 feet, but heavy rains may soon wash the dust away.

Adult beetles, boring into the living tissue between the bark and the wood, make two types of attack. In one type they feed or hibernate but do not lay eggs (fig. 2, *A*). In the other type they construct egg galleries and produce brood (fig. 2, *B*). Externally, the two borings appear the same. On attacked trees that have not been killed, the only way to see if brood has been successfully established is to remove a piece of the bark.

A change in foliage color is the most noticeable evidence of kill. In general, the foliage of trees killed by these beetles first turns yellow, then bright red, then gradually fades to brown, remaining on the tree about 2 years after its first change in color. Sometimes, however, in very warm and dry weather the needles die and fall quickly, without appreciably changing color. Yellow and bright-red crowns indicate current mortality. The bright-red phase is usually at its peak in August, the best time for making aerial surveys of damage because red foliage contrasts conspicuously with the surrounding green.

Description

The two species are very similar in appearance, differing mainly in size. On the average, the fir root bark beetle is about one-fifth to one-fourth inch long, compared with about one-eighth inch for the silver fir beetle. The adults are typical bark beetles: cylindrical, hard shelled, and short legged. When new adult beetles emerge from the tree in which they developed, their upper surfaces are clothed with patches of grey and brown scales, giving them a mottled appearance (fig. 3, *A*, left). The scales are soon rubbed off, leaving a minutely roughened, somewhat shiny, dark reddish-brown to black surface (fig. 3, *A*, right). The females lay oval, pearly-white eggs, about one-fiftieth inch long. Larvae hatched from the eggs mature into creamy-white grubs with light-brown heads (fig. 4, *A*). The larvae transform into pupae (fig. 4, *B*), which in turn transform into adults.

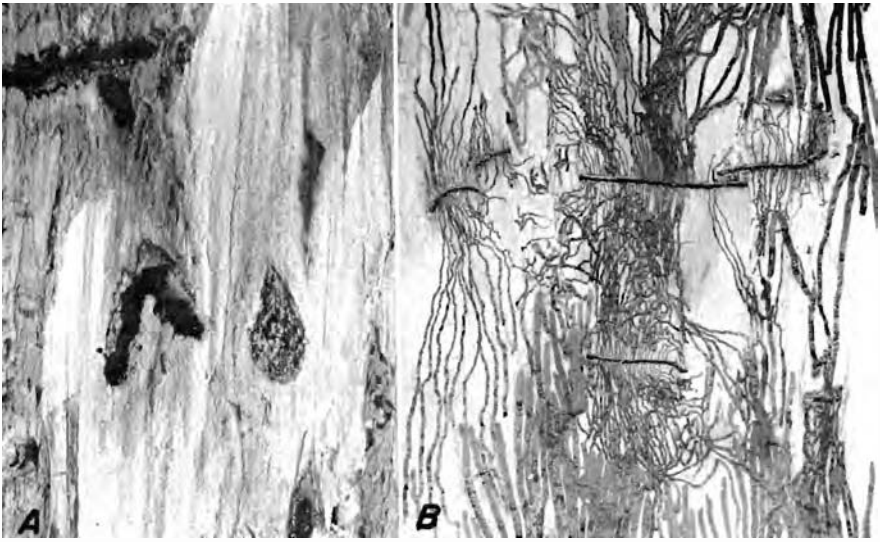

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Figure 2.—Silver fir beetles make two types of attack: *A*, Evidence of feeding attacks on inner bark—no brood produced (X 1.3); *B*, galleries and larval mines resulting from successful attacks—much brood produced and tree killed (X 0.3).

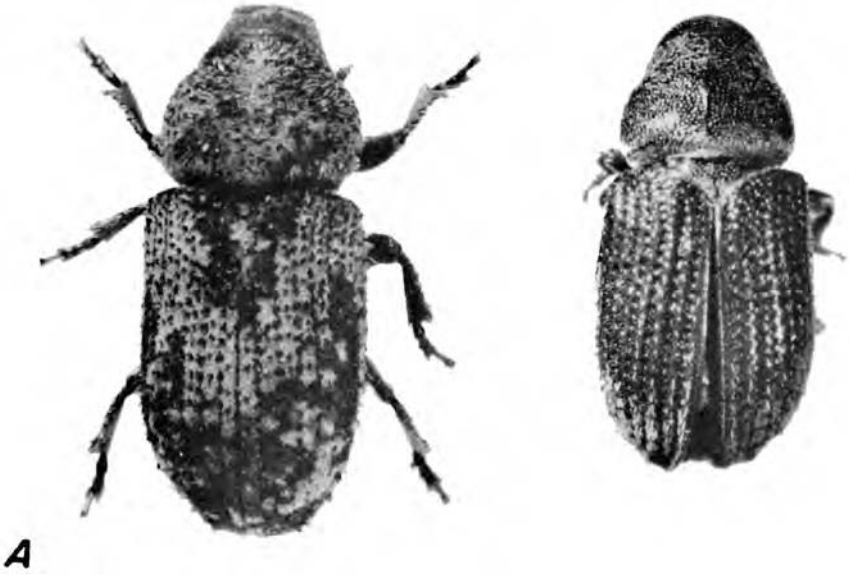

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Figure 3.—The two species of silver fir beetles (× 16): *A, Pseudohylesinus grandis* adult, with scales (left) and without scales (right); *B, P. granulatus* adult.

Life History and Habits

The life cycles of the two beetles are very similar. In northwestern Washington each requires approximately 24 months. New adults emerge in August and make feeding attacks, boring holes through the bark of host trees. At this time they don't construct galleries or lay eggs. From late September until the end of October the beetles concentrate their boring and feeding at tree bases, where they hibernate through the winter. In late May and early June the overwintered adults emerge and soon make egg-laying attacks. In late July or early August some of these over-

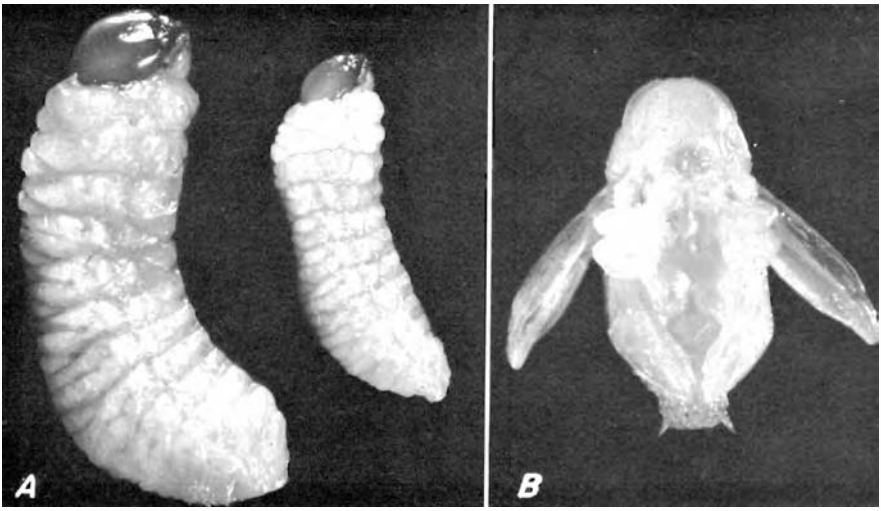

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Figure 4.—*A*, Larvae of *Pseudohylesinus granulatus* (left) and *P. grandis* (right), showing comparative size; *B*, pupa of *P. grandis*. All × 13.

wintered adults reemerge, construct more galleries, and lay a second batch of eggs.

The egg galleries of both species cut across the grain of the wood (fig. 2, *B*). In successful attacks, the length of galleries ranges from one-half inch to 5 inches and averages about 1 inch. As gallery construction proceeds, eggs are laid in niches along the sides. After 10 to 14 days, small larvae hatch from the eggs.

The larval stage lasts from 12 to 14 months, depending upon when the eggs are laid. The young larvae mine at right angles to the egg gallery, usually following the grain of the wood. At first the larval mines parallel each other. As the larvae grow, however, their paths wander and the gallery pattern becomes confused, especially when the population is dense. The larvae develop until cold weather halts feeding for the season. During winter, due to overlapping of generations, both the larvae of one generation and the hibernating adults of another are present. In spring, with the advent of warm weather, the larvae resume their feeding and developing. In July, when the larvae have matured, they construct pupal cells in the inner bark. If the bark is thin, the cells extend into the wood.

In late July the larvae transform into pupae. From 2 to 3 weeks later the pupae change to adults. For about 2 weeks these new adults remain in the pupal cells. When they emerge in August the life cycle is completed.

Each of the two species attacks a different part of a tree. The fir root bark beetle characteristically

attacks the basal part. Its galleries have been observed from a few inches below the ground line to a height of about 15 feet. Their distribution seems to depend on bark thickness. The silver fir beetle attacks all along the bole, but mainly in the upper part and in the branches. It has been found attacking branches only 1 inch in diameter.

Usually more than 1 year is required for a mature tree to be killed by silver fir beetles of either species. The broods often develop in patchlike fashion, killing the cambium in patches, but not extending the attacked area enough to girdle the tree in a single year. In some cases, deadened patches may heal over completely. More often, recurrent attacks over a period of years will finally overcome the tree.

Infection by fungi often accompanies the beetles' attack. The attacked areas of a tree are often severely infected with two species of brown-stain fungi. These fungi, carried by the beetles, evidently help them to overcome the tree's resistance. In addition, four root-

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Figure 5.—White mats of fungus (*Armillaria mellea*) and galleries of *Pseudohylesinus grandis* under bark of a dying Pacific silver fir.

rotting fungi are often associated with attacks of silver fir beetles. Of these, *Armillaria mellea* is most frequently found (fig. 5). Occurring less frequently are *Fomes annosus*, *Poria weirii*, and *Poria subacida*. These root-rotting fungi also evidently aid the beetles in overcoming a tree, and the beetles are suspected of opening wounds through which the rots enter.

Control

Normally, silver fir beetles are held in check by such natural factors as resistance of the host tree, climate, parasitic and predaceous insects, diseases, and woodpeckers. Host resistance—the ability of the tree to ward off attacks by the beetles—is believed to be very important, since young, vigorous trees are seldom killed. This indicates that preventive control may be possible through forest-management practices that keep true fir stands young and vigorous.

The usual methods of controlling bark beetles—felling infested trees and spraying them with chemicals, or felling and burning—would be of limited effectiveness against silver fir beetles, which commonly produce brood without killing the host tree. Furthermore, hibernating adults could be widely dispersed in the forest. Thus it would be likely that more living trees than dead trees would be harboring beetles, especially in winter.

Some control can be accomplished by logging; its effectiveness depends upon the extent and timing of operations. Logging infested stands during the fall, winter, and spring can reduce the beetle population by removing the infested trees and the susceptible trees that could sustain an outbreak.

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U.S. GOVERNMENT PRINTING OFFICE: 1961

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