Six-Spined Engraver Beetle

William M. Ciesla [1]

Ips calligraphus (Germar) is one of the largest beetles of the genus *Ips* native to North America. It is easily recognized because it is the only species found in the United States and Canada with six spines on the outer declining margins of each wing cover. All other species have fewer than six spines. This insect has no universally applied common name but has been referred to as the "six-spined engraver" or "coarse-writing engraver." In the southeastern United States, where it is the largest of three indigenous species of *Ips*, it is simply known as "big Ips."

This insect is normally a secondary invader that breeds in fresh logging slash or trees that have been windthrown, struck by lightning, or attacked by more aggressive species such as the southern pine bettle, *Dendroctonus frontalis* Zimmerman. However, *Ips calligraphus* can become an aggressive tree killer when fresh slash from logging and thinning operations or natural disasters provides an abundance of breeding sites where the beetle can build up to epidemic proportions and subsequently attack and kill apparently healthy trees (fig. 1). Flooding, prolonged dry periods, wildfire, and occasionally, insect defoliation can predispose trees to attack (fig. 2). An outbreak of a pine looper, *Phaeoura mexicanaria* (Grote) caused severe defoliation of ponderosa pine forests in southeastern Montana in 1969 and 1970. The pine engraver *Ips pini* (Say) and *Ips calligraphus* invaded these weakened trees and killed an average of 63 trees of above 5 inches in diameter per acre.

Distribution and Hosts

Two subspecies of *I. calligraphus* are recognized—*I. calligraphus calligraphus*, which is widely distributed in the eastern United States and Canada, and the larger *I. calligraphus ponderosae*, which is found in portions of Arizona, Colorado, Montana, Nebraska, New Mexico, South Dakota, Utah, and Wyoming (fig. 3). An isolated population of *I. calligraphus calligraphus* in California is apparently a result of accidental introduction.

In the northeastern United States and adjacent Canada, east-

[1] Entomologist, Division of State and Private Forestry, Northern Region, Forest Service, U.S. Department of Agriculture, Missoula, Mont.

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Figure 1.—Windthrown longleaf pines provide host material for population buildup and subsequent invasion of standing trees by *Ips calligraphus*.

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Figure 2.—Heavy defoliation of ponderosa pine by a looper, *Phaeoura mexicanaria*, weakens trees and increases their susceptibility to *Ips* attack.

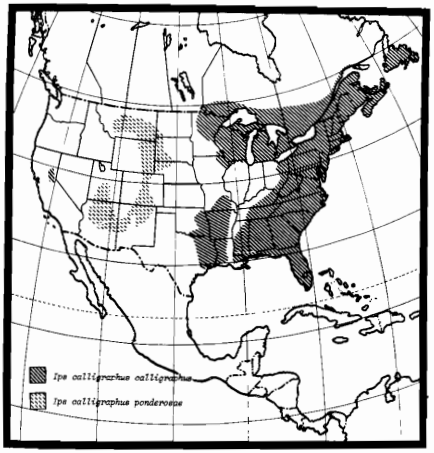

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Figure 3.—Approximate distribution of *Ips calligraphus* in North America.

ern white pine (*Pinus strobus* L.), red pine (*P. resinosa Ait.*), and pitch pine (*P. rigida Mill.*) are attacked by *Ips calligraphus*. Virginia pine (*P. virginiana* Mill.), shortleaf pine (*P. echinata* Mill.), loblolly pine (*P. taeda* L.), longleaf pine (*P. palustris* Mill.), slash pine (*P. elliottii* Engelm.), and spruce pine (*P. glabra* Walt.) are hosts in the middle Atlantic and southeastern United States. In the West, ponderosa pine (*P. ponderosa* Laws), limber pine (*P. flexilis* Laws), and Digger pine (*P. sabiniana* Dougl.) serve as hosts.

Evidence of Infestation

The presence of reddish-brown boring dust in bark crevices of fresh slash or standing trees is usually the most reliable outward indicator of attack. Boring dust is usually found in distinct piles marking the location of individual attacks on logging slash or windthrow. Occasionally yellowish to reddish-brown pitch tubes may be found on standing trees. Trees that are successfully attacked are inoculated with blue-staining fungi and ultimately die. Under normal conditions infestations can be readily detected by aerial or ground surveys as the foliage begins to change from green to red. Fading foliage is not a reliable indicator of infestation, however, when prior foliage damage such as insect defoliation or wind damage has occurred.

Description of Stages

Ips calligraphus passes through four distinct stages in its life history: egg, larva, pupa, and adult. Eggs are ovoid and pearly white in color. These hatch into yellowish-white legless larvae with amber-colored head capsules. Larvae transform into white pupae and subsequently into adults. Adults range in length from 4 to 6 mm.; they are light brown or tan in color at first, but darken as they mature. The most distinguishing feature of the adult is the presence of six spines on the elytral declivity (fig. 4). Males have a somewhat coarser sculpturing on the body and greater development of spines than do females.

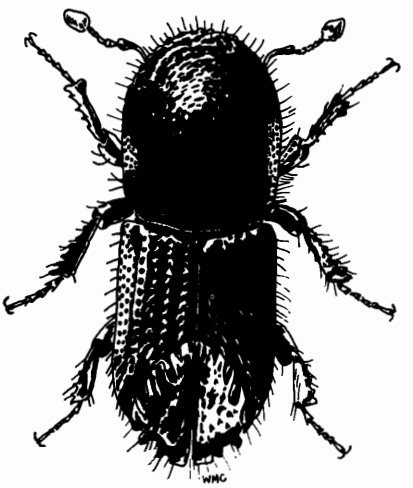

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Figure 4.—*Ips calligraphus* adult.

Life History and Habits

Males initiate attacks in suitable host material and construct a large nuptial chamber in the cambium layer. The male is joined by three to six females and mating takes place in the nuptial chamber. Each female then constructs her own egg gallery and deposits eggs on either side of the gallery, often resulting in a "Y" or "H" shaped gallery pattern (fig. 5). Egg galleries range from 25 to 38 cm. in length and deeply score the xylem tissue. A single female may lay up to 100 eggs.

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Figure 5.—Galleries of *Ips calligraphus* in ponderosa pine.

Eggs hatch in several days and larvae begin construction of individual feeding galleries perpendicular to the egg gallery. The larvae pass through three distinct growth phases called "instars." The advent of each instar results in a distinct widening of the larval feeding gallery. Upon completion of feeding the larvae enlarge the feeding gallery to form chambers where they pupate and transform into adults.

Time required to complete a generation varies throughout the range of the insect and with the time of year. In the southeastern United States, in summer, 25 days on the average are required to complete a generation; in the mountains of California approximately 40 days are required. The number of generations per year also varies with location. Six or more generations can occur annually in the southeastern United States. Four generations have been reported for California, and two to three generations per year are believed to occur in the Rocky Mountains. Larvae, pupae, and adults overwinter under the bark of infested trees or logs.

Ips calligraphus prefers the thicker barked, deeply fissured, larger stems. On small trees it usually confines its attack to the lower bole. However, it will attack the entire bole and occasionally the limbs of large trees. It is frequently associated with other bark beetles, some of which attack trees or fresh logs simultaneously. In the southeastern United States, it is associated with two other species of *Ips*—*I. avulsus* (Eich.) and *I. grandicollis* (Eich.)—the southern pine beetle, *Dendroctonus frontalis* Zimmerman, and the black turpentine beetle, *Dendroctonus terebrans* (Oliver). The pine engraver beetle, *Ips pini* (Say); mountain pine beetle, *D. ponderosae* Hopk.; and red turpentine beetle, *D. valens* LeConte, are common associates of this beetle in the Northern Rocky Mountains. In California its galleries are often intermixed with those of the western pine beetle, *D. brevicomis* LeConte; the California five-spined engraver, *Ips paraconfusus* Lanier; *I. latidens* LeConte; and the California flatheaded borer, *Melanophila californica* Van Dyke.

Natural Control

Parasitic wasps and predaceous beetles and flies undoubtedly exert some influence on the population dynamics of *Ips calligraphus*. Woodpeckers frequently remove portions of infested bark in search of larvae, pupae, and callow adults particularly during the winter months. Fungi are occasionally found in egg and larval galleries and pupal cells and may cause some brood mortality.

Lack of suitable host material is the most significant factor regulating population levels of *Ips calligraphus*. Return to normal moisture conditions following prolonged drought restores tree vigor and increases resistance to attacks. Gradual deterioration of logging slash or windthrow makes it unsuitable for brood production.

Prevention

Good sound cultural practices can minimize the amount of material suitable for attack and brood production. Some suggested preventative measures are:

1. Scatter logging slash to permit rapid drying following thinnings or other intermediate cutting operations. Avoid piling fresh slash adjacent to standing trees.

2. Railroad sidings and other storage areas for pine sawlogs and pulpwood often serve as focal points for infestations. Avoid prolonged storage of this material in or near wooded area, particularly during the hot summer months when the life cycle of this insect is shortened.

3. Destroy bark slabs by burning or chipping at sawmill sites. This is especially important for portable sawmills which often operate within forested areas. If debarking equipment is available and prolonged storage in the mill yard is anticipated, debark logs prior to storage. Continuous water sprays are also effective in preventing attacks in decked logs or pulpwood.

4. Do not stack green pine firewood in forested areas. This serves as an immediate source of infestation.

5. Avoid trimming along power lines and other rights-of-way, running logging equipment over root systems of residual trees, or other practices which may injure trees during periods of hot dry weather. Resin exudations from fresh wounds may serve as attractant sources for attack.

Direct Controls

Infestations resulting from natural disasters, prolonged drought, or defoliation may occur in spite of sound forest management. Removal of infested and damaged trees by commercial timber sales is an economical and effective means of minimizing losses to the forest. When extensive damage, such as that caused by hurricanes, occurs over thousands of acres of timberlands, salvage programs with State Forestry agencies, the USDA Forest Service, private industry, and forest landowners participating are essential to recover losses and reduce amount of material favorable for invasion by *Ips calligraphus* and other bark beetles.

Chemical control of infestations is impractical because of the relatively short life cycle of *Ips calligraphus* and the difficulty of detecting infestations in forested areas.

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