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California Fivespined Ips

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Note: Since leaflet 102 was first issued in 1966, the California fivespined ips was found to be two species: *Ips paraconfusus* Lanier and *Ips confusus* (LeConte). Although these two species closely resemble each other, they differ in hosts and range. The common name California fivespined ips belongs with the new species, *Ips paraconfusus* Lanier.

Before 1945, the California fivespined ips, *Ips paraconfusus* Lanier, was considered an economically insignificant bark beetle. However, increased logging in second-growth ponderosa pine during the late 1940's resulted in large amounts of fresh slash, which became breeding material for the beetle. The outbreaks of the California fivespined ips that followed were larger than any previously recorded.

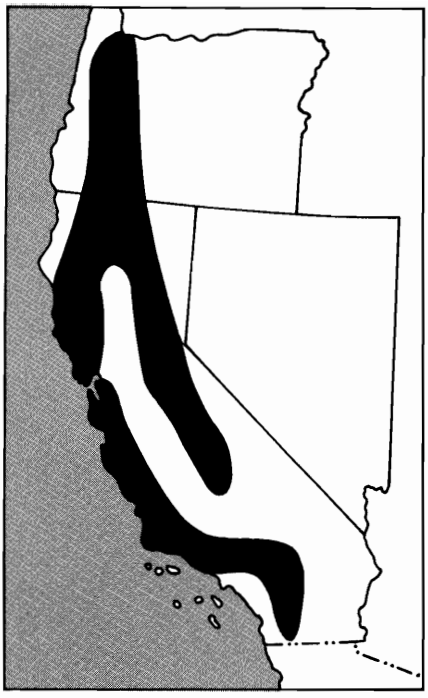

Figure 1—*The range of the California fivespined ips.*

Since then, careful management of slash has generally limited mortality to scattered trees under stress. Even so, during droughts when many trees are under stress, the California fivespined ips causes widespread mortality and top-killing of pines. The loss of even a few trees is becoming increasingly important as forests are managed more intensively and as some forests are urbanized.

Range and Hosts

The California fivespined ips is found west of the crests of the Sierra Nevada and Cascade Mountains from northern Oregon to southern California (fig. 1).

It attacks the following native pines: ponderosa, sugar, Coulter, western white, lodgepole, Jeffrey, Digger, knobcone, Monterey, and bishop pines. It also attacks knobcone X Monterey hybrid pines and probably other pines introduced in-

Figure 2—*Boring dust on slash.*

to its range. It has been particularly damaging to young ponderosa pine managed for timber and to ponderosa and Monterey pines used as shade trees.

Under normal conditions, the California fivespined ips only attacks scattered trees that are suppressed, diseased, or injured. It generally attacks where the bark is 1/8 to 1 inch (0.3 to 2.5 cm) thick, that is, sapling and pole-size pines 1 to 10 inches (2.5 to 25 cm) in diameter at breast height and the thin-bark tops of larger trees. During outbreaks, however, trees up to 26 inches (66 cm) in diameter at breast height are killed.

The beetle also attacks fresh slash of almost any diameter. Overwintering adults, emerging in the early spring, are much more successful breeding in fresh slash than in trees, so large populations can build up if slash is available.

Evidence of Infestation

Most dying pines exhibit some similar signs; in the appropriate hosts and range, the combination of boring dust, lack of pitch tubes (except in Coulter pines), fading foliage, and blue-stain fungus are characteristic of trees infested by California fivespined ips. The most positive means of identification are the presence of the insects themselves and the characteristic Y-shaped gallery patterns.

The first evidence of infestation in living trees is the reddish dust in bark crevices, on branch axils, and on cobwebs. When the beetles attack slash, the boring dust piles up around the entrance holes or on the ground under the slash (fig. 2). This dust can be difficult to find because it is often scattered by wind or washed away by rain. Live Coulter pines attacked by the California fivespined ips commonly produce pitch tubes, which are a mixture of pitch and boring dust. Pitch tubes caused by this beetle are rare on other host trees.

The most obvious sign that a tree has been infested and killed is not boring dust or pitch tubes but needles that fade from green to yellow, then to orange, and finally to reddish brown. In summer, the needles begin to fade within a month after the first attack. The foliage of trees attacked in late fall may not fade completely until the following spring. Adults of the new brood have often emerged by the time the foliage fades.

The California fivespined ips also introduces blue-stain fungus, which kills the tissues around the entrance holes, thus preventing a tree from repelling the beetles with heavy resin flows. If beetle attacks are numerous enough to girdle a tree with fungus-killed tissues, the crown becomes water stressed and quickly dies. The fungus is colorless when introduced, but as a tree dies, the sapwood develops a characteristic blue stain.

Development and Life Stages

The beetle's life cycle is affected by differences in climate that occur over its range, which spans almost 1,000 miles (1,610 km) from north to south and elevations from sea level to timberline. In the cooler parts of its range, the California fivespined ips generally has two spring/summer generations plus one overwintering generation. In the warmer parts, the beetle can have up

Figure 3—*A typical egg gallery with its three branches.*

Figure 5—*Larvae in mines radiating from an egg gallery.*

Figure 4—*Eggs in niches along a gallery.*

to five spring/summer generations in addition to the overwintering one. Seasonal variations in temperature can also cause one generation more or less than average for a locality.

Each generation consists of four stages: egg, larva, pupa, and adult. The length of each stage of the life cycle varies enough that generations tend to overlap, rather than appearing in waves.

Adults are reddish-brown to black beetles about 3.0 to 5.5 mm long (cover photo). Their wing covers are concave at the rear and have five toothlike spines on each side. In the warmer parts of the beetle's range, adults attack continuously from mid-March to mid-November.

The male attacks first. It bores a nuptial chamber several times its size in the inner bark, or phloem, and emits a pheromone that attracts other male and female beetles. If enough adults are attracted, they may kill a small group of trees.

Within a day or two, several females enter the nuptial chamber. After mating, each female bores an egg gallery. Since there are usually three females, the typical gallery resembles an inverted "Y" with the branches parallel to the wood grain (fig. 3). Each egg gallery extends 4 to 6 inches (10 to 15 cm) from the nuptial chamber and lightly grooves the sapwood. Beetles keep the galleries open by pushing boring dust out the entrance hole.

Often more than 50 percent of the attacking adults re-emerge about 20 days after they enter a tree. These adults reattack fresh host material and produce a second brood.

Females deposit eggs, about 1 mm long, in niches cut along the sides of the galleries (fig. 4). The eggs hatch in 5 to 14 days.

During the next 2 to 5 weeks, the larvae mine their own tunnels within the inner phloem (fig. 5). When they finish feeding, the larvae transform into pupae (fig. 6) and then into adults. During the summer, the pupal stage lasts 1 to 2 weeks.

Near the center of its range, at an elevation of 3,000 feet (910 m), one summer generation takes from 45 to 60 days to complete.

Late summer or fall attacks produce a partial generation that overwinters under the bark of trees or slash as mature larvae, pupae, or adults (fig. 7).

Figure 6—*Pupa of California fivespined ips.*

Figure 7—*Under the bark: larvae, pupae, and adults in a Y-shaped egg gallery.*

Associated Insects

Boles of pines top-killed by California fivespined ips are often attacked and killed by the western pine beetle, *Dendroctonus brevicomis* LeConte; the mountain pine beetle, *D. ponderosae* Hopkins; or the California flatheaded borer, *Melanophila californica* Van Dyke.

Figure 8—*Ponderosa pine killed by California fivespined ips population that built up in the slash piles in the foreground.*

Factors Affecting Outbreaks

Outbreaks of the California fivespined ips are sporadic and seldom last more than a year. Although no one can predict when outbreaks will subside, their onset is associated with increased numbers of beetles or weakened trees or both. For example, during a dry spring, loggers may begin work earlier in the season, creating fresh slash in which populations can build up. The adults that emerge from the slash attack trees already weakened by the drought.

The following factors affect the size of populations:

Slash—Although fresh pine slash—created by logging, land clearing, or storm breakage—may be infested whenever adults are active, the effect of slash on population buildups is most pronounced in spring and early summer. At that time, the populations are small, having been reduced by natural control agents and turbulent spring weather. Moreover, living trees—drawing on abundant soil moisture from winter precipitation—are generally resistant to attack. Therefore, fresh slash available between March and June provides host material and, thus, enhances population growth. Broods develop most successfully in shaded slash or on the underside of logs. These broods emerge by midsummer—and may kill nearby trees beginning to experience moisture stress (fig. 8).

Drought—Pines in weakened or disturbed condition are more susceptible to attack than healthy trees, so extensive mortality can occur in stands stressed by drought. Although above-normal levels of tree mortality and top-killing occur during the summer and fall following a winter drought, the mortality rate usually declines the next year. Logging or construction during droughts further weakens trees,

Slash Disposal:
How to Prevent *Ips* Buildup

- Plan logging or land clearing from mid-July to January only. Fresh slash available between March and June enhances survival of the *Ips* brood.
- Use freshly cut pine to the smallest diameter practical to reduce the quantity of host material.
- Lop and scatter limbs to expose the bole to the sun. Sunlight makes slash too hot and dry for brood production.
- Chip fresh slash or break it into small pieces with logging or construction machinery. Small pieces of slash produce limited broods.
- Plan to burn slash piles before broods emerge. If fire regulations will prevent timely burning, avoid piling green slash.
- Pile slash in sunny locations and cover the piles tightly with clear plastic. The greenhouse effect created makes the slash too hot for brood production. This technique works best in the warmest parts of the beetle's range.
- Keep fresh slash, logs, and firewood at least several yards away from living trees. If enough beetles are attracted, they may kill nearby trees.

making them even more susceptible to attack.

Widespread outbreaks of the beetle occurred in California during the droughts of 1929–32, 1959–61, and 1975–77.

Stress—Besides being stressed by drought, pines can be stressed by other conditions, including storm damage, fire, lightning, flooding, stand overstocking, root diseases, dwarf mistletoe infections, and injuries from logging or construction. These conditions usually result in attacks on single trees or small groups rather than widespread mortality.

Biological Controls—About 20 native species of parasitic and predaceous insects attack the California fivespined ips. In addition, insects such as bark beetles and wood borers compete with *Ips* larvae for food, destroying much of the phloem before the brood reaches maturity. Other organisms that limit the populations of California fivespined ips include predaceous mites, internal parasitic nematodes, woodpeckers, and fungi that deteriorate the phloem. These native organisms reduce population levels but not quickly enough to prevent outbreaks.

Management

Outbreaks in healthy trees are sporadic, brief, and usually detected *after* the trees have been killed or top-killed. Direct control programs have never been proven effective in reducing mortality caused by this beetle in forest stands.

However, control programs may sometimes achieve a small reduction in mortality among high-value trees such as those in recreation and residential areas. Infested trees can be removed by salvage-logging, or they can be burned or treated with insecticide to kill the brood before it emerges. Such efforts are costly, but these programs may reduce mortality rates somewhat if infested trees are detected early.

Preventing the California fivespined ips from building up in slash will do more to prevent mortality than the application of control measures. Slash treatments are particularly important during a dry spring.

It is also important to avoid stressing trees, which makes them more susceptible to attack:

- Postpone logging, thinning, and land clearing during periods of drought when trees are already stressed.
- Restrict felling, skidding, and construction activities near trees to avoid crown and stem injuries.
- Keep vehicles and heavy equipment away from trees to avoid soil compaction and root injury.
- Minimize excavating, filling, and paving near root zones, which can stress trees by altering water and air movement to the roots.

Ornamental pines can be kept healthy by methods that would be impractical in forest stands. For example, homeowners or recreation area managers can water and fertilize to keep trees healthy during droughts. They can also use insecticides to protect trees recently stressed by fire, drought, flood, transplant shock, or construction. For such trees, homeowners may want to hire a professional tree care service, which can treat the entire stem and use certain insecticides that are available only to certified applicators.

Insecticides can be injurious if not handled or applied properly. Use them selectively and carefully; follow recommended practices. Note that registrations are reviewed by the U.S. Environmental Protection Agency and some States also have restrictions on the use of certain insecticides.

Assistance

Information about identifying, preventing, and controlling the California fivespined ips and its associated organisms is available through County Agriculture Commissioners, County Extension Agents, and State Forestry Departments. Federal land managers should contact the U.S. Department of Agriculture, Forest Service, Forest Pest Management.

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