White Fir Needle Miner

Richard I. Washburn[1]
and Mark D. McGregor[2]

The white fir needle miner, *Epinotia meritana* Heinrich, is distributed throughout much of the Western United States and extends into Southwestern Canada. Specimens have been collected from such widely distributed areas as Victoria, British Columbia; Hot Springs, Green River, and Pullman, Wash.; San Isabel National Forest, Colo.; South Fork Merced River, Calif.; Bryce Canyon National Park and Widstoe, Utah; and the North Rim of Grand Canyon, Ariz. The type specimen was reared by Herbert T. Peck from "pine needles" collected in Carbon County, Utah. Records indicate that the paratypes from Victoria, B.C., were collected from the trunk of Douglas-fir *(Pseudotsuga menziesii (Mirb.) Franco).*

Host Trees

The principal host in Southwestern United States is white fir, *Abies concolor* (Gord. & Glend.) Lindl. Red fir, *Abies magnifica* A. Murr., is the preferred host in central California, but occasional innocuous infestations have occurred in white fir. Specimens collected in Washington and British Columbia were adults in flight.

Evidence of Infestation

Feeding habits of the white fir needle miner differ by host. On white fir, needle miner activity is evidenced by bleached-yellow mined needles from late spring to early fall. Often, abandoned mined needles are detached from the twig and dangle in bunches from webbing created by larvae as they move to new needles. Larvae prefer 1-year-old needles but will mine 2- and 3-year-old needles under epidemic conditions. Additional indications of white fir needle miner presence are exuviae protruding out of mined needles, and swarms of adult moths around host trees during late June and July. After considerable limb mortality has occurred, the stand or individual trees take on a silvery appearance.

Moderate-to-heavy white fir needle miner populations produce the following symptoms on red fir. Defoliation causes a thinning of crowns. All ages of needles except the current growth are mined. Needles are hollowed, but not bunched together as in white fir; instead, mined needles drop singly. The needle that serves as a pupal chamber is usually mined almost throughout its entire length. A mound of frass just outside the exit hole of mined needles indicates that such needles have served as the pupal chamber. Brownish pupal cases wedged in exit

[1] Principal entomologist, Intermountain Forest and Range Experiment Station, Ogden, Utah 84401; stationed in Moscow, at the Forestry Sciences Laboratory, which is maintained in cooperation with the University of Idaho.
[2] Entomologist, Northern Region, Division of State and Private Forestry, Missoula, Mont.

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holes indicate that the insect is in the moth stage.

History and Impact

Five separate outbreaks of the white fir needle miner have been recorded: three in southern Utah, one in northern Arizona, and one in central California. The outbreaks in southern Utah occurred in or near Bryce Canyon National Park and the adjoining Dixie National Forest. The outbreak periods were 1939–48, 1951–57, and 1960–67. The infestation in Arizona occurred from 1964–68 in portions of Grand Canyon National Park and Kaibab National Forest. The infestation in California was discovered in 1965 on the Sierra National Forest, and Yosemite and Sequoia Kings Canyon National Parks; it continued through 1968.

Needle miner feeding can affect the host trees in a variety of ways. Heavy defoliation of white fir for several consecutive years in Arizona and southern Utah caused widespread tree mortality. Mortality occurred principally in codominant, intermediate, and suppressed trees. Defoliation is often severe enough to cause death to a high proportion of the tree limbs (fig. 1). Heavily defoliated stands decline in vigor and apparently become more susceptible to attack by the fir engraver beetle, *Scolytus ventralis* LeConte. A serious outbreak of this beetle developed within the boundaries of the 1951-57 needle miner infestation in southern Utah. Scenic and recreation values can be seriously impaired by repeated defoliation. This impact is of special concern in National Parks.

Damage in red fir stands of central California appears to be limited to a general reduction of the foliage (fig. 2); defoliation is heaviest in alternate years. The middle and lower crowns are more severely affected than upper crowns in overmature, mature, and larger understory trees. Seedlings and young trees up to 10 feet in height usually are not seriously defoliated. In a recent outbreak in California, there did not

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Figure 1.—White fir defoliated by the white fir needle miner. Bryce Canyon National Park, Utah.

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Figure 2.—Red fir defoliated by the white fir needle miner. Yosemite National Park, California.

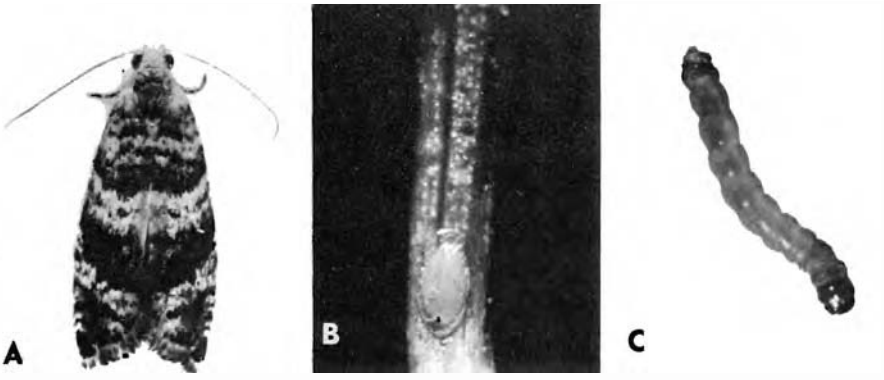

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Figure 3.—Life stages of the white fir needle miner: *A*, Adult; *B*, egg; *C*, larva.

appear to be any permanent damage. However, radial and terminal growth might have been temporarily reduced.

Description

The adults (fig. 3,*A*) are small, dusty gray moths. Forewings are mottled, with patches of cream and black bands. Basal margins of forewings are fringed with long lead-gray scales. The tips of the forewings have copper-colored scales that impart a brownish cast. Their wings range between 10 to 11 mm. in length and their bodies between 4 to 4-1/2 mm. in length.

When deposited, eggs (fig. 3,*B*) are flat, oval, greenish gray to lemon yellow, nearly transparent, and are about 0.1 mm. wide by 1.1 mm.long. They are difficult to detect without magnification.

Newly-hatched larvae average 1.4 mm. long and are cream to yellow; their brownish-to-black heads are about 0.2 mm. wide. Mature larvae (fig. 3,*C*) are about 8.0 mm. long; they have a nearly black hard shield on the dorsal surface of the first body segment. Head, thorax, and abdomen sometimes are naked or sparsely covered by thin, nearly transparent short setae.

Pupae are orange to dark brown, and average 5.5 mm. long. Pupae are shorter than mature larvae but slightly longer than adults. The black-tipped folded wings, eyes, antennae, and other adult characteristics are visible on pupae.

Life History and Habits

Life history and habits of the white fir needle miner differ by host attacked.

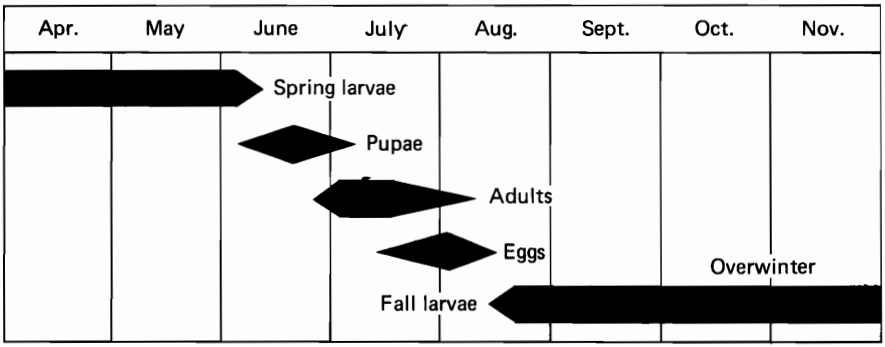

Figure 4.—Seasonal history of white fir needle miner in Utah and northern Arizona.

In white fir stands of Utah and northern Arizona, the needle miners undergo one generation each year (fig. 4). First and second larval instars overwinter in short mines constructed along the outer edge of the needle. Feeding begins with the onset of warm weather. The exact number of instars is not known. Each larva mines five to seven 1-year-old needles. Under epidemic conditions, 2- and 3-year-old needles are also mined. Two to six mined needles are webbed together and usually remain on a tree throughout the summer. The pupal chamber is constructed in the last mined needle. The larva clears the needle of frass and reverses its position to orient its head toward the entrance hole and pupates. Pupation occurs in June and early July. The pupal case is wedged tightly in the entrance hole. When the moth emerges 10 to 14 days after pupation, the case remains with the needle (fig. 5).

First adults appear in late June; peak emergence occurs about mid-July. Female emergence lags 3 to 5 days behind males. Adults mate 2 to 3 days after emergence and soon oviposit. Eggs are usually deposited singly; they are cemented to needles with a clear-to-greenish secretion. Moths oviposit without preference to location on individual needles. One egg is usually laid per needle but as many as seven were observed at the peak of the outbreaks in southern Utah. Eggs hatch in August and September. Young larvae bore immediately into the needle at the point of egg attachment where they overwinter.

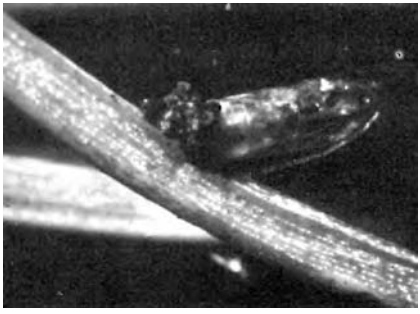

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Figure 5.—Pupal case in emergence hole.

The white fir needle miner requires 2 years to complete a generation on red fir. Two broods occur simultaneously, one maturing each year (fig. 6). Larvae spend the first winter, spring, and most of the summer in a single needle. In late summer, they move to a second needle 1

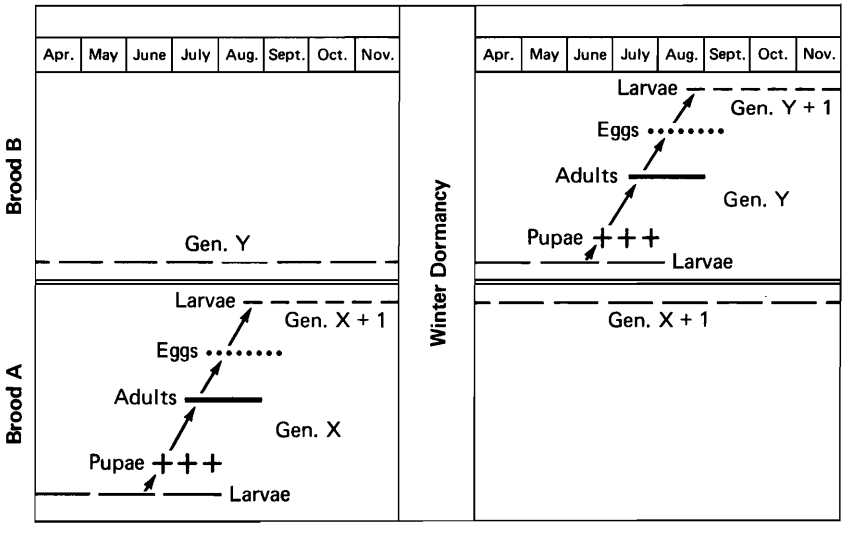

Figure 6.—Seasonal history of the white fir needle miner in California.

or more years old. Some tunnels extend the full length of the needle by the second winter dormancy. Each larva enters two more needles the second spring, mining two-thirds of the needle before it pupates in June. Larvae, pupae, and adult emergence behavior on red fir is similar to that which occurs on white fir. Adult emergence occurs throughout most of July. In July and early August, eggs are laid closely appressed against the incurved needle surface near the attachment to the twig. Rarely is more than one egg deposited per needle. Larvae begin feeding soon after eclosion in late summer or fall. They enter near the apex of needles 1 or more years old, one larva per needle. Early-instar larval tunnels are 4 to 8 mm. long; they are barely visible 8 to 9 months after the larva has entered the needle. This calendar of events is similar for each of the staggered broods; however, it contrasts with the 1-year life cycle that occurs on white fir in Utah and Arizona.

Natural Control

Climatic factors appear to exert little natural control over white fir needle miner populations. Overwintering larvae withstand severe low winter temperatures without noticeable mortality. Heavy rains could conceivably drown some moths during flight.

Twenty species of parasites are known to attack white fir needle miners. Parasites of mature larvae and pupae are usually more abundant than parasites of eggs or small larvae. A Braconid wasp, *Apanteles californicus* Mues., was the most prevalent parasite found in southern Utah. A Eulophid wasp, *Achrysocharis* sp., was the most abundant parasite found in California.

Effectiveness of these parasites in reducing epidemic populations of the white fir needle miner has not been determined.

Applied Control

Several unsuccessful attempts were made between 1948 and 1950 to control the fir needle miner in Bryce Canyon National Park by direct application of insecticide. As a result, small-scale screening tests were conducted from 1955 to 1957 to determine the relative effectiveness of several insecticides. Some materials showed promise; but as of this date none are registered for use against this pest. Check with a forest entomologist, or county extension agent, to learn whether direct control measures have been developed and registered.

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