Control Methods

Western Hemlock Looper. *(Prepared by M. Furniss from the appended references).* The first known record of extensive tree-killing by a forest insect in the western United States involved the western hemlock looper, *Lambdina fiscellaria lugubrosa* (Hulst). It killed a vast amount of western hemlock, *Tsuga heterophylla*, in Tillamook and Clatsop Counties, Oregon, about 1889-1891 (Keen 1938). A subsequent outbreak killed 200 million board feet (bd ft) of hemlock in Pacific and Grays Counties, Washington from 1929-1932. Losses in Pacific County were reduced in 1931 through the first airplane dusting experiment attempted against a forest defoliator in the western United States (Keen 1932). Keen was involved with the operation and voiced his concern in a letter to Craighead (13 July 1931) regarding toxicity of the calcium arsenate contained in the dust:

> *In connection with the airplane dusting project, we are naturally experiencing some criticism from people who object to having poison scattered around in wholesale lots for fear of killing off the wildlife and even domestic animals. I have tried to get some information from the local Boards of Health as to what constitutes lethal doses of calcium arsenate for birds, mammals and humans but with very little success...*

Results of the project were reported periodically by Keen and seemed to vary with time. Craighead wrote, 2 September 1931:

> *I was much interested in your report... covering ... the dusting results on the hemlock looper. I am not surprised that the effects of the dust at this time did not look so encouraging as they did a couple of months ago... Obviously what is needed is a dust that has good adherence.*

And later (21 December 1931):

> *As I interpret your presentation the dusting project has turned out like most all experiments over forested areas. The results are inconclusive and therefore more negative than encouraging... I am convinced that we do not yet have satisfactory flying equipment for applying the dust.*

Nonetheless, the Chief noted:

> *"... it is evident that you made marked progress in your knowledge of this species (hemlock looper) and I agree with your suggestion that you prepare your observations for publication." [see Keen (1932) that, however, dealt with project details, not biology].*

In 1945, the hemlock looper again became destructive, this time in Clatsop County, Oregon. Part of this infestation was dusted with DDT by airplane, marking the first such use of this insecticide in a west-coast forest. Stewart Holbrook, a well known Portland author, described the result (Portland Oregonian, 26 August 1945) under the heading: "DDT: Atomic bomb for parasites of the forest. Miracle chemical spells sudden death for insects, knocks the hemlock looper for a loop in dusting of Oregon's woods".

He noted that the extent of the infestation had been surveyed by Robert L. Furniss: *In this tall forest, its ground a jungle, a hundred men on foot could not learn the damaged area in a year's time ... So Furniss got into a plane and for the next few weeks ... (looked) for the brown (infested) areas, and mapped the infestation.*

Holbrook recounted further:

> *... I saw the incredible thing with my own eyes ... We got a brief sight of the plane and its tail-spray going over an opening in the tree tops ... Twenty minutes passed while all of us kept our eyes on the muslin; and then they began to fall, looper after looper ... and lay very still ... On this single 2 x 3 - foot (muslin) screen we counted 360 loopers ... The ... dead ... calculated from counts of 60 screens ... ran to 4,300,000 loopers to the acre.*

References

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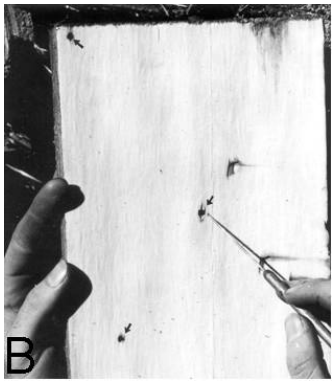
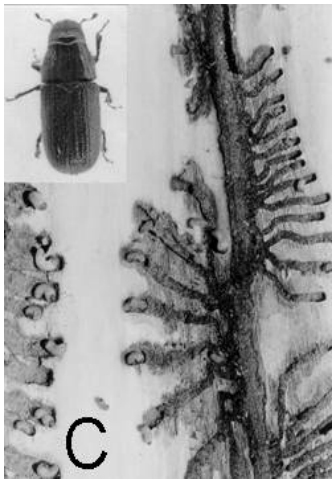


During 1956-1963, I conducted varied research on the Douglas-fir beetle on the South Fork of the Salmon R., Idaho. During 1959-1960, LeRoy Kline was my summer assistant. His MS thesis involved the temporal and spatial distribution of the beetle's natural enemies in infested trees. Another study that he assisted with was testing a 2% DDT spray for preventing infestation of downed trees by the DFB. In the NW USA, outbreaks occur when the beetle population is released in storm-damaged trees.



A (top). LeRoy applying spray to a freshly felled stem section. B (top left). Bark sample showing "point attacks" on the inner phloem of a treated log. Attacking females died before constructing a gallery. C (bottom left). Normal galleries and larval mines in an untreated stem. The effectiveness of DDT was astounding but its adverse environmental effects on other life were coming to attention and use of this insecticide in the U.S. was banned in 1972.

Following the surrender of Japan "bark beetles" were believed to be responsible for extensive mortality of pines on the island of Honshu. Robert L. Furniss (1908 -1980), of the Portland Forest Insect Laboratory was assigned there in 1948 and 1950 "To analyze the forest insect infestation problem in Japan and make recommendations for improved practical control measures."

This poster informed private landowners about the cause of dying pine trees and instructed them to fell infested trees and to burn the infested bark. The characters across the top read: "Let's control bark beetles!" In the circle, at left, is "Pine eater", at right is "White spotted pine elephant bug (referring to the trunk-like snouts of weevils)." Above the circle reads "They suck nutrition from underneath the bark." On trunk, left of the chopper: "To control bark beetles it is important to detect them at the early stage." Above chopper: "Pines die! Detect sick trees and cut them." On trunk at right: "Too late to control (as indicated by dead foliage)." Above person at right: "Cut pine trees must be peeled and burned. Pine wood can't be moved" (in red). At bottom right: "Hyogo-ken (Prefecture)." Translation provided by Takuji Noma. Furniss 2006, Fig. 4 A.

Ford Trimotor spraying DDT to control the Douglas-fir tussock moth on grand fir and Douglas-fir in Latah Co., Idaho, 1947. This was the largest aerial spraying project in western United States at the time and its success led to spraying millions of acres of spruce budworm infestations in northwestern states. The Trimotor flew at 90 mph and carried 400 gals of spray. (Furniss 2004, un-numbered figure; Furniss 2007, Fig. 23A).

Ford Trimotor, sometimes called the "Tin Goose," owned by Johnson Flying Service, Missoula, MT. Two hundred of this aircraft were manufactured by Henry Ford from 1925-1933. It was covered with corrugated aluminum and the tail controls were external. This particular plane was still in use in Idaho to spray DDT to control the tussock moth (1947) and the spruce budworm (1955). I (M. Furniss) was the Project Entomologist on the 1955 project, which treated 1 million acres on the Boise N.F. and surrounding areas (with an assortment of kinds of aircraft). It is still the largest such spray project in Idaho; silviculture and forest management have replaced pesticides for managing this defoliator. (Furniss 2004, un-numbered Figure).

Packing orthodichlorobenzene insecticide for spraying Engelmann spruce infested with the spruce beetle, Arapaho National Forest, CO, August 1950. One million trees were treated. At first, the spray was diluted in fuel oil; subsequently, an emulsion formulation was developed so that only the concentrate needed to be packed into the forest where water from streams was available. The outbreak collapsed in the following winter due to all-time low temperatures. (Furniss 2007A, Fig. 12).

For many years, the Fell-Peel-Burn method was used to destroy bark beetle broods such as the western pine beetle in ponderosa pine in California and Oregon. Control work was done in fall and winter before beetle broods would have emerged in the following spring and when fire danger was low. Blacks Mountain Experimental Forest, Lassen Co., California, October 1934. (Furniss & Wickman 1998, Figure 4A and 4B). Photo no. 8427 b,d by K. A. Salmon, from WFIWC archives.

Figure A (left, upper). Trees were felled with axe and cross-cut saw before power saws became available about mid-century.

Figure B (left, lower). Infested bark was peeled and placed along-side of the tree and burned.

F. P. Keen developed this country's first system of classifying pine trees by their susceptibility to bark beetles. Beetle-caused loss was prevented by silvicultural removal of the relatively small susceptible component. His classification consisted of 16 classes combining age and vigor. Subsequently, Salmon & Bongberg developed the California Risk classification composed of only 4 classes. The class of a tree was determined primarily by visually rating its crown condition. The resultant conflict between these parties and the two classifications was resolved by considering "susceptibility" to be long-term and "Risk" to be short-term. When Bongberg transferred from Berkeley to the new Albuquerque Lab in 1952, M. Furniss assumed the assignment of maintaining risk plots at Blacks Mountain Experimental Forest, Lassen Co., California, and teaching foresters to apply the method. These photos were used in a study of the rate of change of risk of a tree. Upper left photo: Low risk tree exhibiting normal crown characteristics (photo no. 15693 by M. M. Furniss, 1953), and high risk tree (lower left photo) with severely deteriorated crown (photo no. 11441 by C. B. Eaton, 1940) WFIWC archives. (Furniss & Wickman 1998, Fig.5).