INSECT PROBLEMS

Pine Needle

D. L. DAHLSTEN

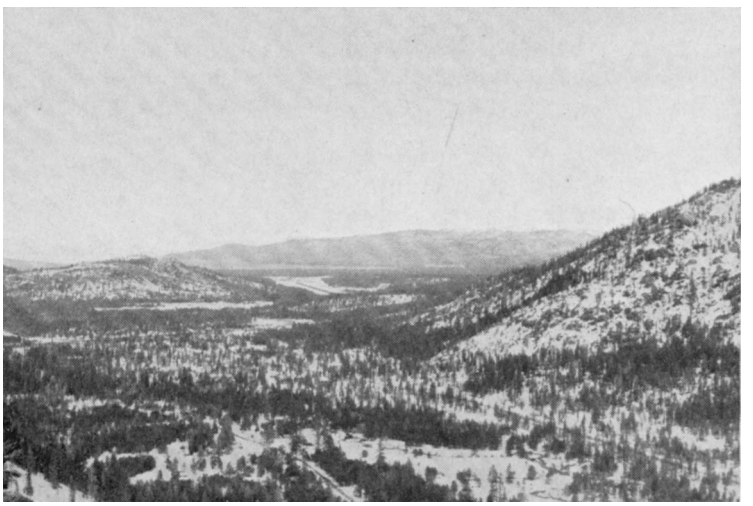
Lodgepole pine foliage heavily infested with the pine needle scale, Phenacaspis pinifoliae (Fitch).

MAN'S EXPLOITATION of his surroundings with disregard for nature's interrelationships has led to serious environmental problems including pollution of the air, water, and land. All of man's activities influence his environment in one way or another. The problem is to find ways to minimize this influence and make sure that these activities disrupt the environment as little as possible.

In the summer of 1968, a small scale insect, *Phenacaspis pinifoliae* (see photo), was discovered in extremely high densities on the foliage of lodgepole and Jeffrey pines in the city of South Lake Tahoe. Preliminary observations indicate that this insect outbreak may be another result of the adverse influence of man on his environment.

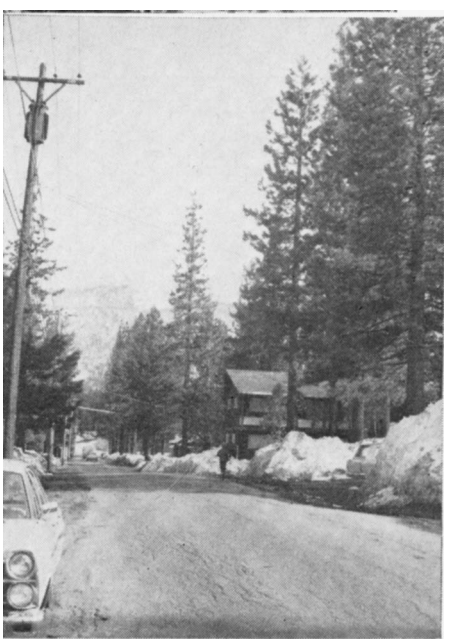
Cooperation

The University's Division of Biological Control, in cooperation with the State Division of Forestry and the State Bureau of Vector Control and Solid Waste Management, has initiated a project to study the insect pests in mountain recreation areas. California's tremendous population growth coupled with the growing demand for summer and winter recreation facilities will pose additional problems in future years. The Tahoe Basin (see photos) is a large recreation area and is probably typical of a number of areas that will be developed in the forests of California in the future.



Picture of the Tahoe Basin looking toward the community of South Lake Tahoe.

A number of insects have become more abundant as a result of urbanization; the housefly and German cockroach are good examples. In addition, as new urban areas develop in previously undisturbed areas, man frequently moves into closer contact with arthropods that had been of only minor importance to him in the past.



A typical street in the mountain recreational area of South Lake Tahoe.

In South Lake Tahoe during the spring, the snow pool *Aedes* mosquitoes are a particular nuisance, and as the year progresses and temperatures rise, other

IN FOREST RECREATION AREAS

Scale . . . Mosquitoes

R. GARCIA J. E. PRINE R. HUNT

mosquito species appear. As the land area developed, a mosquito control program was established. Certain aspects of this program—in particular the attempt to control adult mosquitoes with malathion fog—may have been partly responsible for the outbreak of the pine needle scale.

Pine needle scale

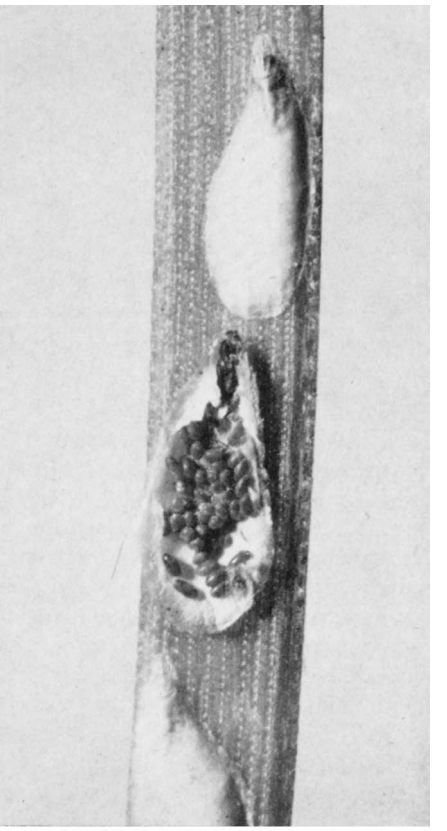
The pine needle scale is widespread throughout the United States and southern Canada. Its hosts include most of the pines, fir, spruce, Douglas fir, California nutmeg, and incense cedar. There has been some concern over infestations of this insect in ornamental and shelter-belt plantings. In California, the pine needle scale is not ordinarily a serious pest, although it can easily be found in most of the forested regions in the state. Heavily infested trees appear white, and the feeding of the scale causes a chlorosis or yellowing of the needles. Feeding may hinder the growth of young trees or cause premature needle drop; if feeding is extensive, branches, seedlings, or older trees may be killed. Seriously weakened trees are also susceptible to attack by other insects, particularly bark beetles. Tree mortality is not a major problem, however. Probably the greatest concern about this insect is in mountain residential areas where the forest is considered ornamental and where whitish trees are unsightly.

Armored scales, insects in the family Diaspididae, as well as other insects and mites, commonly occur in large numbers in ecologically disturbed areas such as beside dirt roads or in places where there have been chemical spray programs directed at other insect pest species. In such areas the balance or the natural control factors of the insect have been disrupted so that the pest population is allowed to grow, temporarily unchecked by its natural enemies. The road dust interferes with natural enemies of the host insects and permits the hosts to escape; insecticides from pest control programs often kill the parasitoids and predators directly. In forested regions, the pine needle scale is known to occur in large numbers along dirt roads. The ecological disturbances at South Lake Tahoe may have been caused by the weekly mosquito adulticide fogging program. Ironically, malathion, the insecticide used for mosquitoes, is also recommended for control of pine needle scale in some texts.

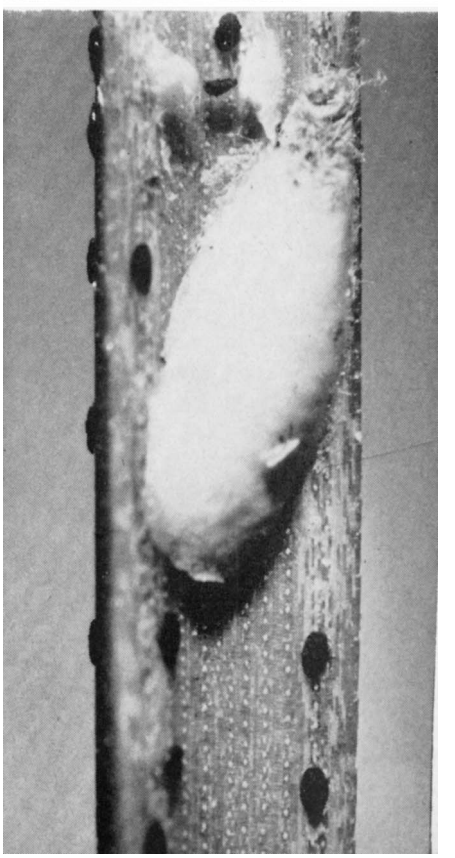
Other insects

Several other insects and mites that are quite abundant at South Lake Tahoe may also be so numerous because of an ecological disruption. Two species of mites, *Oligonychus* sp. and *Brevipalpus* sp.; an aphid, *Schizolachnus* sp.; and several species of scale, *Nuculaspis californica*, *Pineus* sp., *Physokermes* sp., and *Matsucoccus* sp., have been collected from the study area.

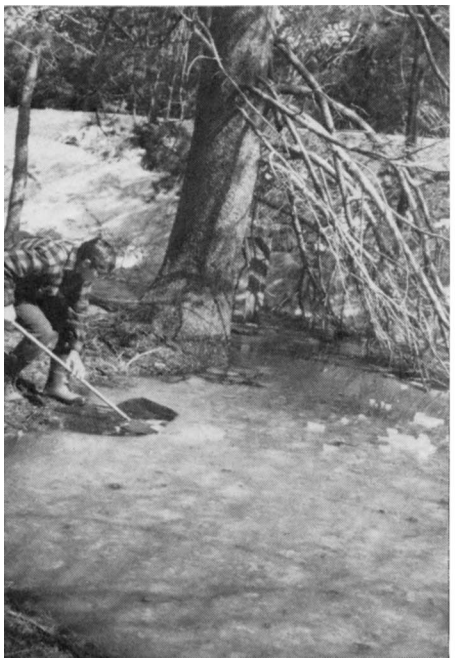
The pine needle scale usually has one generation per year at South Lake Tahoe, although two generations have been reported in certain areas in the United States. Females produce eggs in the fall and the eggs overwinter under the waxy secretion, or scale, of the dead



Adult female scale covering of Phenacaspis lifted to show the overwintering eggs.



First instar nymphs or crawlers of the pine needle scale.



Determining mosquito abundance in a typical snow pool breeding site.

Investigating potential of fingerling rainbow trout for control of snow mosquito larvae.

female (see photo). Crawlers emerge in the spring (photo); and the primary means of dispersal during this stage is the wind. However, the transport of nursery stock can be responsible for spread at any life stage of the scale. The crawlers are brownish-pink and, as feeding proceeds, they change to a pale yellow. The nymphs settle in a few days and it is at this time that they change color. The nymphs insert their mouth parts into the pine needles, then they molt to the second instar stage and begin to form scales after several days. The adult males—small winged insects—emerge approximately two weeks after the beginning of scale formation. Females are wingless and remain beneath the scale for the remainder of their lives.

Counts

Preliminary counts show the percentage of males to be generally low, but from 40 to 54 per cent males have been recorded, depending on the host. It has also been noted that males prefer the older foliage, but a check on the distribution of female scale on lodgepole pine showed them to be most abundant on the three-year-old foliage (35 per cent). Few scales were found on the current growth as leaf buds had not opened at the time of crawler emergence in the spring.

There are 12 known parasitoids and three known predators of this scale. The rate of parasitoidism at South Lake Tahoe is less than 1 per cent. To date, only one parasitoid species, *Physcus* sp., has been reared from *Phenacaspis* at South Lake Tahoe. Efforts are being made in the laboratory to screen the primary parasitoids of *Phenacaspis* from the secondaries or hyperparasitoids as well as from those parasitoids that may be emerging from the other scale insect species on the foliage.

Mosquitoes

There are 15 species of mosquitoes in the South Lake Tahoe area. The snow mosquitoes, *Aedes* (*cataphylla, communis, cinereus, fitchii, hexodontus, increpitus,* and *schizopinax*), appear as larvae from eggs overwintering in the melting snow pools of early spring. During the spring and early summer several of these species attack man viciously. Fortunately, none of these species has been implicated in the transmission of human disease. The most important species of the midsummer months is *Culex tarsalis* which occurs in large numbers in swamp and marsh areas. This species is a proven vector of western equine encephalomyelitis in the western United States; however, no cases of mosquito-borne encephalitis have been recorded in the South Lake Tahoe area.

The mosquito control program for this area was organized in 1963 and has been based on the use of chemical toxicants. These agents have either been dispersed as mists (fogging) for control of adult mosquitoes, or as liquid or granular formulations applied directly to the water sources for control of larvae. As stated previously, the malathion fogging may have been responsible for a disruptive effect which resulted in an insurgence of scale in the pines.

Research approach

An ecological approach is being taken to this complex entomological problem with the study of solutions that will be the least disruptive to an environment already drastically altered by urbanization. A detailed study of the population dynamics of the pine needle scale has already been initiated. Many scale-infested tips have been collected and the primary parasitoids are being reared and colonized at the laboratories of the U.C. Division of Biological Control, Albany. Small potted pine trees supplied by the California Division of Forestry have been infested with scale, and an attempt will be made to produce small hymenopterous parasitoids in large numbers on these scales. To alleviate the scale infestation, these small wasps will be released at selected locations at South Lake Tahoe to augment the natural control of *Phenacaspis*. It has been recommended that the mosquito fogging be stopped during the summer of 1969 to prevent further disruption of the natural controls of the needle scale.

Natural control

An investigation of the natural controls of the mosquito species has also been initiated. Small fingerling trout obtained from the State Fish and Game Department are being released into ponds infested with mosquito larvae. These fish have voracious appetites at cold temperatures and are capable of reducing the snow mosquito population considerably. The fish will be transplanted from the ponds into the local fishing areas later in the year. During the summer, the mosquito fish, *Gambusia affinis*, will be released in the ponds so their control effect on *Culex tarsalis* larvae can be studied.

D. L. Dahlsten is Associate Professor of Entomology and Associate Entomologist, and R. Garcia is Lecturer and Assistant Research Entomologist in the Agricultural Experiment Station, Division of Biological Control, University of California, Berkeley; J. E. Prine is Assistant Vector Control Specialist, Bureau of Vector Control and Solid Waste Management, State Department of Public Health, Sacramento; and R. Hunt is Forest Entomologist, State Division of Forestry, Sacramento.