DECLINE OF OHIA LEHUA FORESTS IN HAWAII

Robert E. Burgan Robert E. Nelson

On the island of Hawaii, thousands of acres of ohia lehua *(Metrosideros collina)* forests have died, and tree death is progressing rapidly into healthy forests. Ohia trees are the chief victims, but koa *(Acacia koa)* trees are also dying. Covering some 600,000 acres on the island of Hawaii, ohia and koa forests provide a variety of resource values–watershed cover, wildlife habitat, timber, forage, and recreation. Some parts are still relatively undisturbed and, therefore, are of special significance for scientific study. Furthermore, these forests are unique, having evolved in isolation from other forests. Ways to prevent an epidemic situation from spreading further must be given intensive and immediate study. Unless a remedy can be found, ohia forests as known today may become relicts.

Most of the affected area is on State-owned land, but significant acreage of National Park and private lands are also included. The decline of the ohia forests is of concern to a number of agencies:

- The County of Hawaii Department of Water Supply is concerned that one result may be a decline in the quality or quantity of water flowing from mountain watersheds.
- The Volcanoes National Park has reported that most of a 9,000-acre section of the Upper Olaa Forest Reserve is affected. This Reserve was set aside in 1951 because it was such a good example of the original forest and vegetation type on the island.
- The U.S. Fish and Wildlife Service has noted that within the National Park, both the number of bird species and total bird populations are rapidly declining in areas where the ohia forest has died, in contrast to no change or growth in populations where the trees are still healthy.

PACIFIC SOUTHWEST
Forest and Range Experiment Station

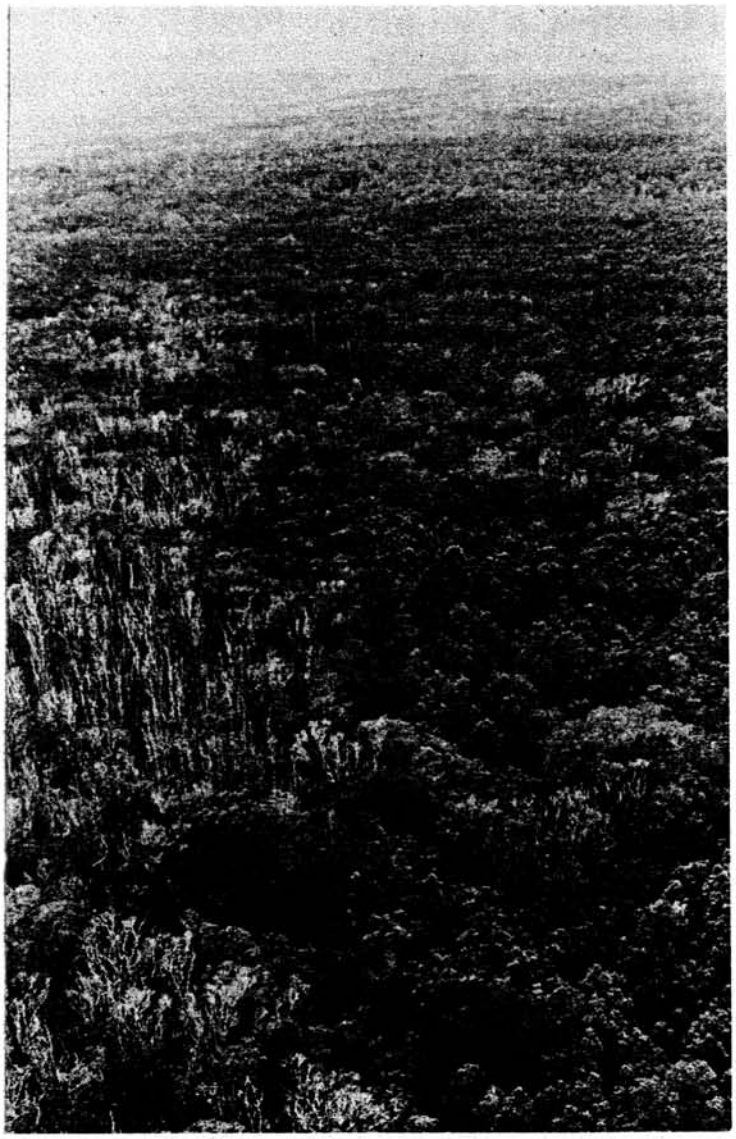
FOREST SERVICE
U.S.DEPARTMENT OF AGRICULTURE
P.O. BOX 245, BERKELEY, CALIFORNIA 94701

USDA FOREST SERVICE
GENERAL TECHNICAL
REPORT PSW- 3 /1972

Burgan, Robert E., and Robert E. Nelson
1972. **Decline of ohia lehua forests in Hawaii.** Pacific Southwest Forest and Range Exp. Stn., Berkeley, Calif. 4 p., illus. (USDA Forest Serv. Gen. Tech. Rep. PSW-3)

Thousands of acres of ohia lehua *(Metrosideros collina)* forests on the island of Hawaii have died, and tree death is progressing rapidly into healthy forests. Most of the losses are on State-owned lands. All of the "ohia decline" cannot be attributed to the same agent. Some of the earlier decline was attributed to frost and sulphur dioxide. But other factors, including possibly the shoestring root-rot *(Armillaria mellea)*, are responsible for the current losses. Federal and State agencies are seeking to determine the causes of the decline and what control measures are feasible.

Oxford: 48(969) [+ 176.1 *Metrosideros collina* + 176.1 *Acacia koa* + 172.8 *Armillaria mellea*].
Retrieval Terms: Hawaii; ohia decline; forest diseases; epidemics; *Acacia koa: Metrosideros collina; Armillaria mellea.*



The ohia forest at the right appears healthy compared to that at the left. Whether the "disease front" is moving into the healthy forest is not known.

• The U.S. Forest Service and Hawaii Division of Forestry estimate that the ohia and koa forests hold a total volume of about 470 million board feet of timber. At a stumpage value of only $10 per 1,000 board feet, for example, this resource would be worth nearly $5 million on the stump–a base for some $125 million worth of consumer products. Probably 10 percent of the timber has already been killed in the epidemic.

"OHIA DECLINE"

Published reports of the decline of ohia forests date from 1909, when Lyon (1909) told about forests dying on windward Maui. Clifton J. Davis, Entomology Branch Chief, Hawaii Department of Agriculture, referred to the "Ohia Lehua Dieback" near Pauahi and Hiiaka Craters in a 1946 report about insect conditions in Hawaii National Park.[1] But only recently has the "ohia decline" on the island of Hawaii reached epidemic proportions.

All of the "ohia decline" cannot be attributed to the same agent. Several small pockets of ohia above 4,000 feet elevation have been either damaged or killed down to ground line by frost. In areas near volcanoes, some trees have been injured by poisonous fumes, chiefly sulphur dioxide. Most of the current loss, however, is not likely due to either frost or sulphur dioxide.

SHOESTRING ROOT-ROT

An apparent contributing factor is shoestring root-rot *(Armillaria mellea).* This root-destroying fungus has been isolated from affected trees in areas of serious decline where sulphur dioxide and frost are definitely not involved. The fungus was first reported attacking forest trees in Hawaii by Robert V. Bega, of the U.S. Forest Service, who discovered it on silk-oak *(Grevillea robusta)* in 1962. It was subsequently found on koa and ohia by Raabe in 1963 (Raabe and Trujullo 1963).

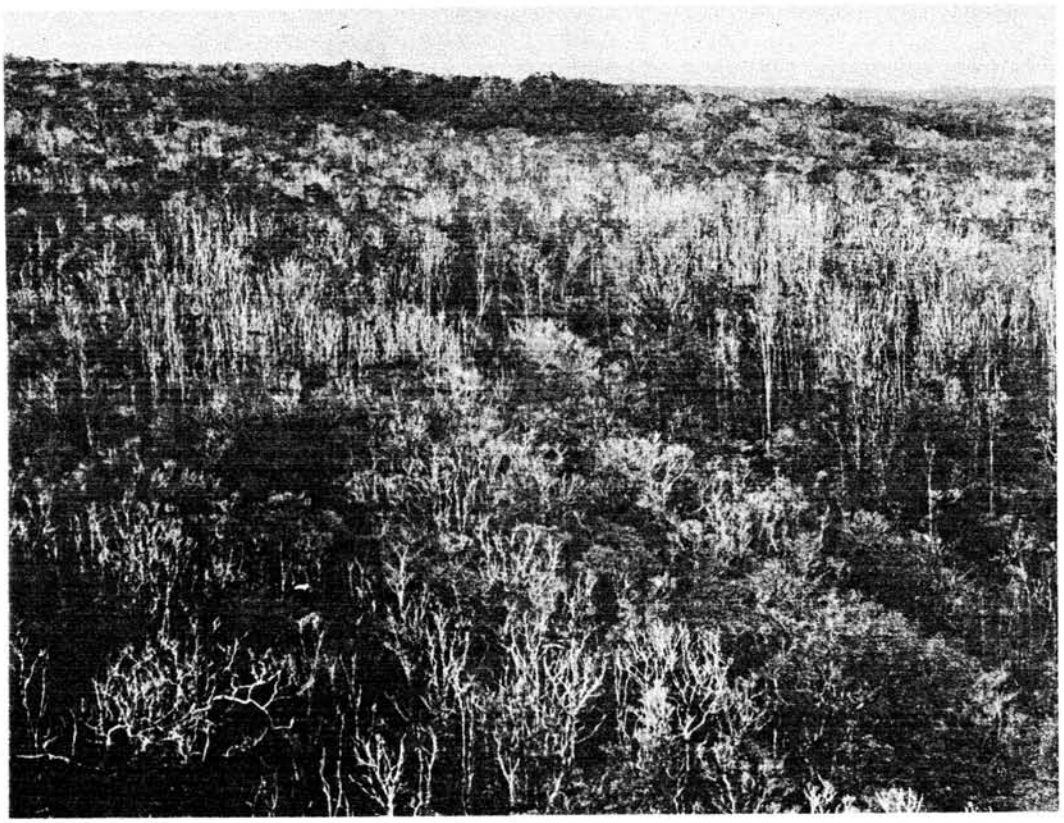
Since then the fungus has been observed by others on these same species. It has also been found on haukuahiwi *(Hibiscadelphus hualalaiensis),* naio *(Myoporum sandwicense),* olupua *(Osmanthus sandwicensis),* kopiko *(Straussia* sp.*),* manono *(Gouldia* spp.*),* pilo *(Coprosma* spp.*),* kolea *(Myrsine* spp.*),* mamaki *(Pipturus albidus),* a'e *(Zanthoxylum dipetalum),* pukiawe *(Styphelia tameiameiae),* and mamani *(Sophora chrysophylla).*[2]

Armillaria mellea may have been introduced into the Hawaiian Islands on fruit tree nursery stock during the early 1900's. Its subsequent spread could have been accelerated by the high populations of introduced rats and wild pigs.

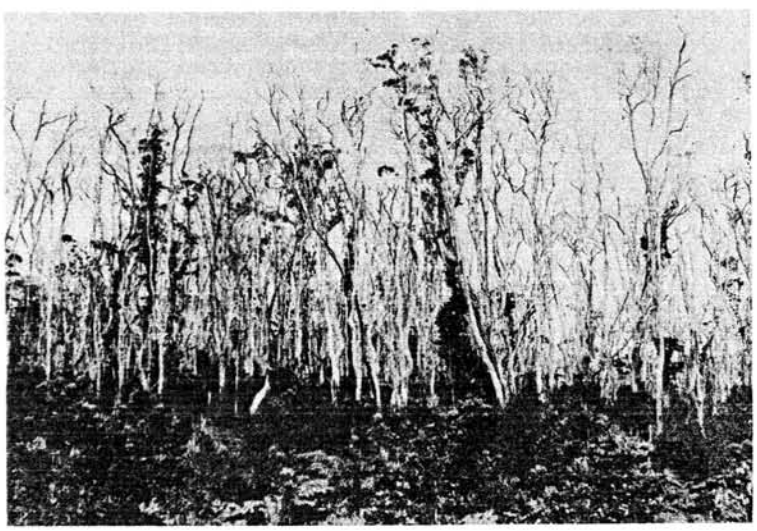
This fungus is propagated in two ways: Its basidiospores are wind-borne and can establish themselves in old stumps or dead trees, but cannot infect healthy

[1] Notes on Forest Insect Conditions, Hawaii National Park for the year 1946. January 6, 1946. (Memorandum on file at the Institute of Pacific Islands Forestry, Honolulu, Hawaii.)

[2] Communication with Franklin Laemmlen, Plant Pathologist, University of Hawaii, and observations of the U.S. Forest Service and Hawaii Division of Forestry Survey Team.



This heavily diseased portion of an ohia forest is typical of thousands of acres of forest decline on the island of Hawaii.



Only the skeletal stems of trees remain in what was once a luxuriant ohia rain forest on the island of Hawaii.

trees. Healthy trees are infected by the brown or black cordlike rhizomorphs or "shoestrings" which grow out from infected roots. On meeting a healthy root, the rhizomorph penetrates it and grows up the cambial layer to the root crown, which it girdles. The leaves become dwarfed, turn yellow or fall prematurely; on small trees all foliage may die simultaneously.

The parent lava type, soil structure, moisture stresses, insects, and other ecological factors may also be involved in the decline.

HILO FOREST RESERVE

The condition of the ohia forest within the boundaries of the 120,000-acre Hilo Forest Reserve, has been evaluated on a sampling basis from black and

white aerial photographs taken in 1954 and 1965. The area in each of four condition classes was estimated. The four classes were: (1) healthy forest—no trees dead; (2) slight decline—less than 20 percent of trees dead; (3) moderate decline—20 to 60 percent of the trees dead; (4) severe decline—more than 60 percent of the trees dead.

The area of healthy forest decreased from 53,000 acres in 1954 to 43,000 acres in 1965. The acreage of slight and moderate decline remained about the same. But the area of severe decline nearly tripled—from 5,000 acres in 1954 to 14,000 acres in 1965.

Observations indicate that the present decline condition is even more serious. Large areas of forests observed as healthy in 1967 are now heavily affected as the decline has spread rapidly south from the Saddle Road.

What can be done about this situation? The U.S. Forest Service, Hawaii Division of Forestry, University of Hawaii, Hawaii Department of Agriculture, and U.S. National Park Service have joined forces in seeking answers to such questions as: What is the present location, extent, and rate of spread of the epidemic? What are the subsequent effects on the composition of the forests? What are the major causes of death of the ohia and koa trees? What are the factors (host-pathogen-environment complexes) contributing to the recent acceleration of this decline? Can feasible control measures be developed and if not, what are the alternatives? Deciding on alternates if practical control measures are not possible may well be the most challenging task in this coordinated effort.

LITERATURE CITED

Lyon, Harold L.
1909. **The forest disease on Maui.** Hawaiian Planters' Record 1:92-95; 151-159.

Raabe, R. D., and E. E. Trujillo.
1963. *Armillaria mellea* **in Hawaii.** Plant Disease Rep. 47: 776.

The Authors

ROBERT E. BURGAN is working on forest growth and yield studies, with headquarters at the Station's Institute of Pacific Islands Forestry, Honolulu, Hawaii. From 1963 to 1969, he served on the timber sales staff of the Union and later Bear-Sleds Ranger Districts, in Oregon. He earned bachelor's and master's degrees in forestry at the University of Montana. **ROBERT E. NELSON** heads the Station's Institute of Pacific Islands Forestry, headquartered in Honolulu, Hawaii. He joined the Forest Service in 1941, after earning a forestry degree at the University of California. He became field supervisor of the California State Cooperative Soil-Vegetation Survey in 1949. Since 1957, he has been in charge of the Station's Hawaii office.

U.S. Forest Service research in Hawaii
is conducted in cooperation with
Division of Forestry
Hawaii Department of Land and Natural Resources

EDITOR'S NOTE: *General Technical Report* is a new series of Forest Service research publications that complements the three existing series: *Research Paper, Research Note,* and *Resource Bulletin.* The General Technical Report series serves as an outlet for information of a technical nature but not necessarily the product of a specific piece of original research or resource survey.