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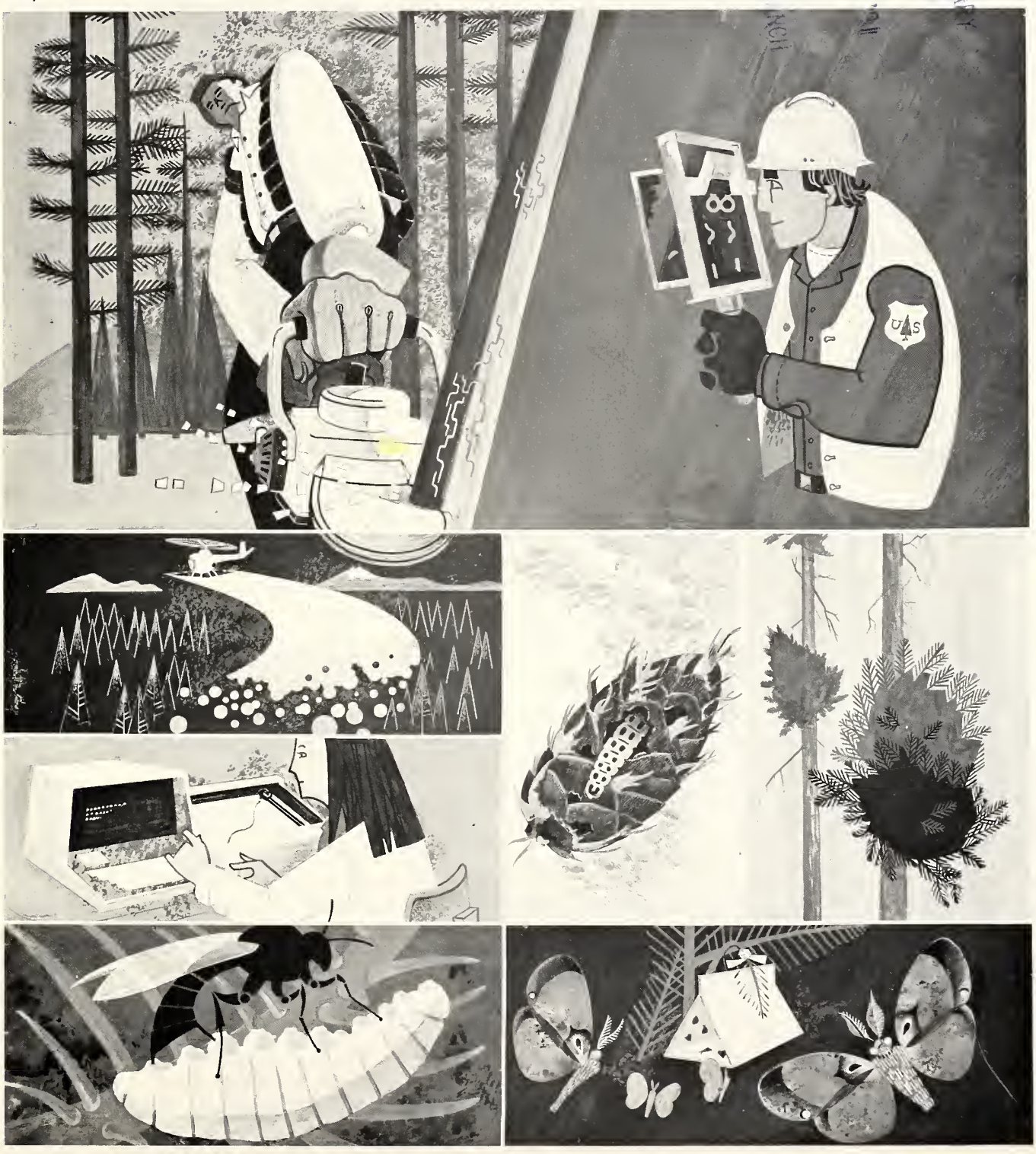
ASSOCIATION OF ARMILLARIA ROOT DISEASE WITH MOUNTAIN PINE BEETLE INFESTATIONS ON THE BLACK HILLS NATIONAL FOREST, SOUTH DAKOTA



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ASSOCIATION OF ARMILLARIA ROOT DISEASE WITH MOUNTAIN PINE BEETLE INFESTATIONS ON THE BLACK HILLS NATIONAL FOREST, SOUTH DAKOTA

by

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ABSTRACT

Examination of a random selection of 63 ponderosa pine stands on the Black Hills National Forest revealed a high incidence of both Armillaria root disease, caused by Armillaria mellea (Vahl. Fr.), and mountain pine beetle, Dendroctonus ponderosae Hopk.,; 89 and 79 percent, respectively. The incidence of mountain pine beetle was the same for the northern and southern Black Hills. The incidence of Armillaria root disease was higher in the northern (93.1 percent) than the southern Black Hills (85.3 percent); however, this difference was not significant. A significant (p=.10) association between mountain pine beetle and Armillaria root disease was found in the northern, but not in the southern Black Hills.

INTRODUCTION

Mountain pine beetle, Dendroctonus ponderosa Hopk., is native to ponderosa pine, Pinus ponderosa Dougl., forests in the Black Hills of South Dakota. Scattered, small groups of trees, usually less than one tree per acre, are attacked and killed under endemic conditions. Under certain conditions mountain pine beetle populations may increase often resulting in catastrophic outbreaks. Numerous stand and tree conditions have been associated with beetle epidemics (Beal 1943; Cahill et al. 1969; Keen 1936; Sartwell et al. 1975; and Lessard 1982). Generally, endemic mountain pine beetle populations are associated with trees damaged by lightning, fire, logging equipment, etc. As populations increase, mountain pine beetles select healthier trees in the 7 to 13 inch (dbh) range. Percent of stand lost to the beetle is normally 30-50 percent higher in even-aged than uneven-aged stands (Lessard 1982).

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Hinds, et al. 1984 showed a significant association between the presence of Armillaria mellea (Vahl.: Fr.) Quel. root disease, bark beetle infestation, and ponderosa pine mortality under endemic conditions. Although the disease is not usually considered to be a primary cause of mortality, it is important to resource managers to know whether endemic beetle populations are maintained in trees weakened by A. mellea. If A. mellea is prevalent, particularly in managed stands, a high incidence of endemic mountain pine beetle populations could be expected in such stands if they are of sufficient age (Sartwell et al. 1975). Silvicultural prescriptions for the management of diseased stands may have to be modified accordingly.

In 1983, an evaluation was conducted to determine the degree of association between mountain pine beetle and root disease in the Black Hills National Forest. Specific objectives were:

1. To determine the incidence of Armillaria root disease in ponderosa pine stands in the Black Hills.

2. To determine the incidence of mountain pine beetle at endemic levels in ponderosa pine stands in the Black Hills.

3. To test the hypothesis that incidence of mountain pine beetle and Armillaria root disease are independent.

METHODS

Twenty-nine ponderosa pine stands on the Nemo Ranger District in the northern Black Hills, and 34 ponderosa pine stands on the Custer Ranger District in the southern Black Hills were sampled in October 1983. Stands in the northern Hills were located on soils derived from limestone parent material and receive 20 or more inches of precipitation annually. Stands in the southern Hills were located on soils derived from crystalline parent material and receive less than 20 inches of precipitation annually. The stands were randomly selected for examination from USDA Forest Service Stage II inventory data. Initially 50 stands were selected from each district; however, due to time and manpower constraints, not all selected stands were sampled. Each stand was examined for the presence of A. mellea and mountain pine beetle infestation. Indicators of A. mellea were dead trees with mycelial fans or rhizomorphs, and windthrown trees with root rot. Indicators of mountain pine beetle infestation were dead or dying trees with pitch tubes, and beetle galleries under the bark.

Contingency tables were constructed to summarize stands which occurred within each of the four possible combinations of A. mellea/mountain pine beetle occurrence (MPB with A. mellea; MPB without A. mellea; A. mellea without MPB; and neither MPB nor A. mellea). These occurrences may have been on different trees within a stand. Stands ranged between 50 and 100 acres. A Pearson chi-square statistic (Sokal et al. 1969) was used to test the hypothesis that the occurrence of these two agents in ponderosa pine stands is

independent. The Yates corrected chi-square test (Sokal et al. 1969) was also used because the occurrence of both agents was high and the number of stands which fell into neither present, or only one present, were small. The study was designed to test independence at the 10 percent level of significance.

RESULTS AND DISCUSSION

The frequency of stands by insect and disease condition for the Nemo and Custer Ranger Districts are displayed in tables 1 and 2, respectively.

Table 1 - Frequency of Stands by Insect and Disease Condition on the Nemo Ranger District - Percents are in Parenthesis

		Mountain Pine Beetle		
		Present	Absent	Total
Armillaria Root Disease	Present	23 (79.3)	4 (13.8)	27 (93.1)
	Absent	0 (0)	2 (6.9)	2 (6.9)
	Total	23 (79.3)	6 (20.7)	29

Table 2 - Frequency of Stands by Insect and Disease Condition on the Custer Ranger District

		Mountain Pine Beetle		
		Present	Absent	Total
Armillaria Root Disease	Present	23 (67.6)	6 (17.7)	29 (85.3)
	Absent	4 (11.8)	1 (2.9)	5 (14.7)
	Total	27 (79.4)	7 (20.6)	34

The incidence of the mountain pine beetle in the northern Black Hills is similar to the southern Black Hills (79.3 and 79.4 percent, respectively). The incidence of Armillaria root disease is higher in the northern (93.1 percent) than the southern (85.3 percent) Black Hills. This difference, however, is not significant. Therefore, the probability of finding mountain pine beetle in a stand in the Black Hills is 0.79 and the probability of finding Armillaria root disease is 0.89. This does not, however, imply that the two are associated.

To test for an association between Armillaria root disease and mountain pine beetle requires rejecting the hypothesis of independence between the two. Both the Nemo Ranger District and Custer Ranger District plots were tested separately (table 3). These results show that the hypothesis of independence is rejected in the northern Black Hills. Therefore, there is a significant association between Armillaria root disease and mountain pine beetle in the northern Black Hills. This hypothesis cannot be rejected for the southern Black Hills and therefore, this same association was not demonstrated.

Table 3 - Test of Hypothesis for Independence of Mountain Pine Beetle and Armillaria

Test	Nemo Ranger District		Custer Ranger District	
	Value	Probability	Value	Probability
Pearson Chi-square	9.88	<0.005	0.01	Not Significant
Yates Corrected Chi-square	3.89	<0.05	0.01	Not Significant

These results are consistent with those of Hinds, et al. 1984. They found 75 percent of the beetle infested trees had Armillaria root disease. This association was significant ($P<.05$). Of the 40 plots surveyed, 32 (80 percent) had Armillaria root disease.

There are several possible explanations for the difference in association of Armillaria root disease and mountain pine beetle in portions of the Black Hills, based on geologic, ecologic, and climatic differences:

1. Armillaria root disease may be less pathogenic in the southern Black Hills.

2. Armillaria root disease may be more difficult to diagnose in the southern Black Hills.

3. Other factors may be more important than Armillaria root disease in predisposing trees to mountain pine beetle attack in the southern Black Hills.

Future evaluations should consider these three items as well as:

1. The incidence of both pests in managed versus unmanaged stands.

2. Vegetation type as an indicator of micro-climate and pest incidence.

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