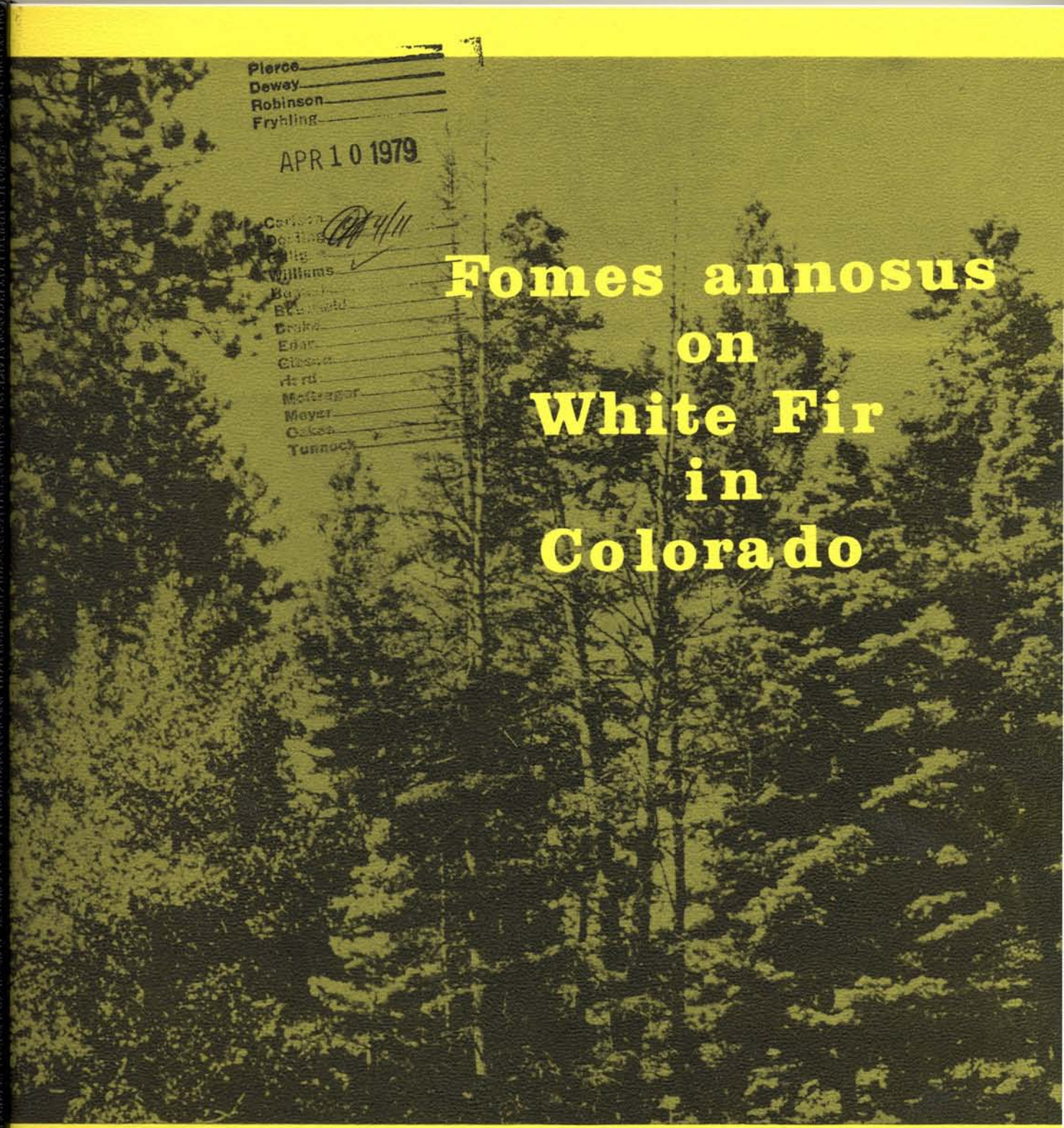

Fomes annosus on White Fir in Colorado

Forest Insect and Disease Management

State and Private Forestry

Rocky Mountain Region

Forest Service U.S.D.A.

FOMES ANNOSUS ON WHITE FIR IN COLORADO

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ABSTRACT

Fomes annosus is reported for the first time on white fir in Colorado. The pathogen was found in many stands in the southern portion of the State where white fir is a major component of the type. Infection centers often contained dead trees in older age classes and recently killed trees in the younger age classes. Windthrown trees with extensive root and butt decay were common within infection centers. *Fomes annosus* was not restricted to cut-over stands; however, mortality caused by the pathogen was greater in such areas.

INTRODUCTION

Fomes annosus (Fr.) Cke. (= *Fomitopsis annosa* (Fr.) Karst.) is an important pathogen of forest rees and is widely distributed throughout temperate forest regions of the world (8). The fungus causes considerable damage to conifers in North America (14), where it is prevalent in the intensely managed forests of the Southeast (5) and Pacific Northwest (3). However, there have been few reports of *F. annosus* in the Rocky Mountains. Williams (16) described distribution of the pathogen in Montana and northern Idaho. Tegethoff (15) described distribution of the fungus in Nevada, Utah, and southern Idaho. Shope (13) reported *F. annosus* on Engelmann spruce in the Pike National Forest in Colorado.

Conifers infected with *F. annosus* may have thin crowns, slight foliar yellowing, and premature needle senescence (11). Resin often accumulates in and adjacent to wood colonized by the fungus (2, 9).

Air-borne basidiospores are the most important means of *F. annosus* dissemination. They are produced from perennial sporophores (conks) which normally develop near the soil surface and in places protected from dessication. Sporophores usually survive in nature only a few years (11) because of dessication during summer, feeding of insects, and hyperparasitism by other fungi such as *Trichoderma* spp. (10).

Fomes annosus typically causes white-rot decay of wood, with decomposition of both lignin and cellulose. In decayed wood the fungus produces small, elongated, shallow pockets which are whiter than the surrounding bleached wood. Wood with advanced decay is very spongy, white flecked, and often stringy or laminated (9).

Less vigorous trees are generally more susceptible to *F. annosus* than healthy trees (6). Bark beetles often accelerate mortality of trees infected with *F. annosus* (11).

Incidence of *F. annosus* is usually associated with cutting of pine stands where freshly-cut stumps serve as infection courts (12). From infected stumps the fungus colonizes root systems of adjacent trees via contacts and grafts with infected stump roots. After invading the roots, the fungus kills the cambium, and decay proceeds. Mortality centers form as trees around infected stumps die (1).

The *F. annosus* disease cycle in true fir usually differs from that in pine. For example, mortality is often common in uncut stands (4). Advanced decay also precedes cambium killing in fir (3, 8). The fungus probably exists in trees for several years causing root and butt decay with little mortality. When trees eventually die, the pathogen builds up enough inoculum potential to successfully attack root systems of adjacent live trees. Although fir stumps can be infected experimentally with *F. annosus* spores, the actual role of stump infection in disease spread within natural stands is unknown.

METHODS

White fir (*Abies concolor* (Gord. & Glend.) Lindl.) decay and mortality by *F. annosus* was found near Vallecito Reservoir (San Juan National Forest - La Plata County) during routine forest disease surveys. Because of the pthogen's reported significance on white fir in other regions (4, 15), an effort was made to identify areas in Colorado where it is present.

Areas surveyed in 1978 included roadside portions of three national forests (Pike and San Isabel, Rio Grande, and San Juan) in southern Colorado where white fir was a major tree component (7). General walk-through surveys where groups of dying trees were seen were conducted by the authors. Areas of *F. annosus* incited mortality were marked on standard (½" - 1 mile) national forest maps.

Trees displaying symptoms were investigated for signs of *F. annosus* activity. Samples of resin-stained wood were collected from the base of suspect trees and cultured on 2% water agar to confirm presence of the pathogen. Efforts were taken to locate sporophores within stumps, at the base of infected trees, and within broken remnants of older trees. Decay characteristics were also used as a guide for *F. annosus* activity. However, presence of the fungus was never confirmed on the basis of decay alone.

Examples of sporophores were deposited with the pathology herbarium at the Rocky Mountain Forest and Range Experiment Station in Fort Collins.

RESULTS AND DISCUSSION

Fomes annosus was located within white fir stands on three southern Colorado national forests (Fig. 1 and Table 1). The fungus was most prevalent in southern portions of these forests where white fir was common.

Mortality caused by *F. annosus* commonly occurred in groups (Fig. 2). Infection centers were found in both cut and uncut stands. Centers ranged in size from one or two trees each to many infected trees covering an area of an acre or greater.

Fomes annosus was often associated with trees with green foliage and little cambial necrosis. In such cases the only evidence of the fungus was extensively decayed root systems of windthrown trees (Fig. 3). Extent of the fungus in white fir may have been underestimated because of the common lack of infection symptoms.

Extensive root and butt decay was common on trees within and adjacent to mortality centers (Fig. 4). Evidence indicates the fungus causes decay of infected live trees which become weakened and susceptible to wind breakage. Most such breakage occurred at either the root collar (Fig. 4) or 5 or more feet above ground level.

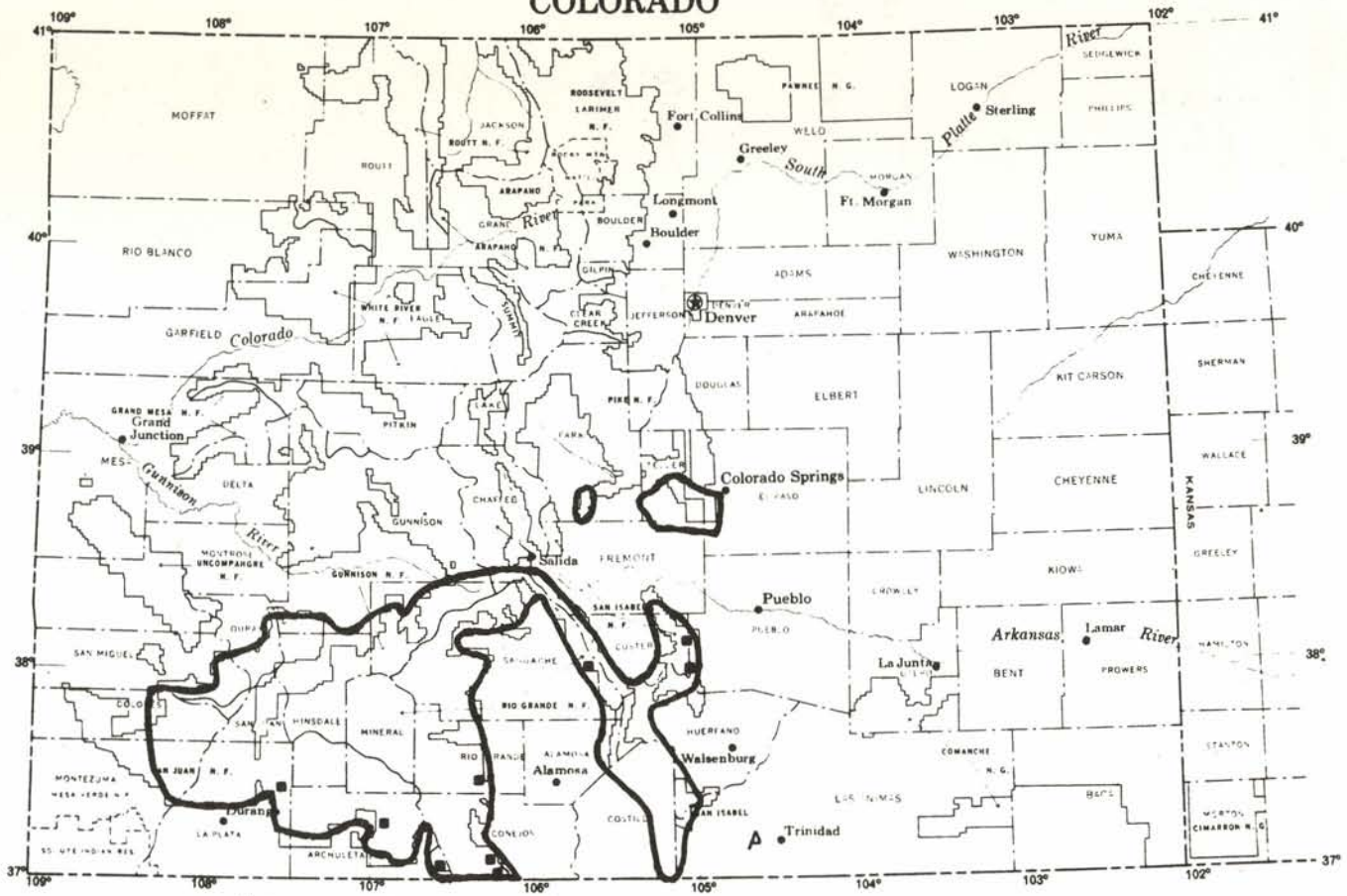
Fomes annosus sporophore production was prolific within mortality centers. Sporophores were commonly found within the base of broken, decayed, old-growth trees (Fig. 5). Decayed stumps provided another source of sporophores. Sporophores were deep within these stumps and/or attached to roots below the ground. Sporophores were also found at the base of recently-killed trees (Fig. 6) attached to the root collar just below the litter layer. Most sporophores were viable, as evidenced by white, fertile, spore-producing layers (Fig. 7). Their shape varied and ranged in size from small buttons to as much as 18 inches (46 cm) across.

Resin stained wood at the base of recently killed trees was a good indicator of *F. annosus* infection (Fig. 8). Cultures of resin-soaked wood yielded the fungus.

Spongy, white-flecked and stringy decay (Fig. 9) was associated with *F. annosus* activity on white fir. Trees with *F. annosus* decay often had other associated decay-causing fungi. Two of the most common were *Armillariella mellea* (Vahl.) Quel. in the base of trees and the Indian Paint Fungus (*Echinodontium tinctorium* E. & E.) in the mid- and upper portions of the bole.

FIGURE 1 Distribution of *Fomes annosus* on white fir in Colorado.

COLORADO



■ **FOMES ANNOSUS LOCATIONS**

□ DISTRIBUTION OF WHITE FIR

TABLE 1 Locations where *Fomes annosus* was found on white fir in Colorado (1978).

National Forest	Ranger District	County	Legal Descriptions
San Juan	Pine	La Plata	T. 36 N., R. 6 W., Secs. 9, 16 T. 37 N., R. 6 W., Secs. 15, 16, 21
San Juan	Pagosa	Archuleta	T. 35 N., R. 1 W., Sec. 13 T. 35 N., R. 1 E., Secs. 7, 17, 18
Pike and San Isabel	San Carlos	Custer	T. 22 S., R. 69 W., Secs. 15, 16, 22 T. 23 S., R. 68 W., Secs. 28, 29, 30
Rio Grande	Conejos	Conejos	T. 32 N., R. 7 E., Secs. 10, 15, 20 T. 32 N., R. 6 E., Sec. 23 T. 33 W., R. 7 E., Secs. 18, 29, 30 T. 32 N., R. 4 E., Sec. 5
Rio Grande	Alamosa	Conejos	T. 36 N., R. 6 E., Sec. 3
Rio Grande	Saguache	Custer	T. 23 S., R. 12 E., Sec. 28

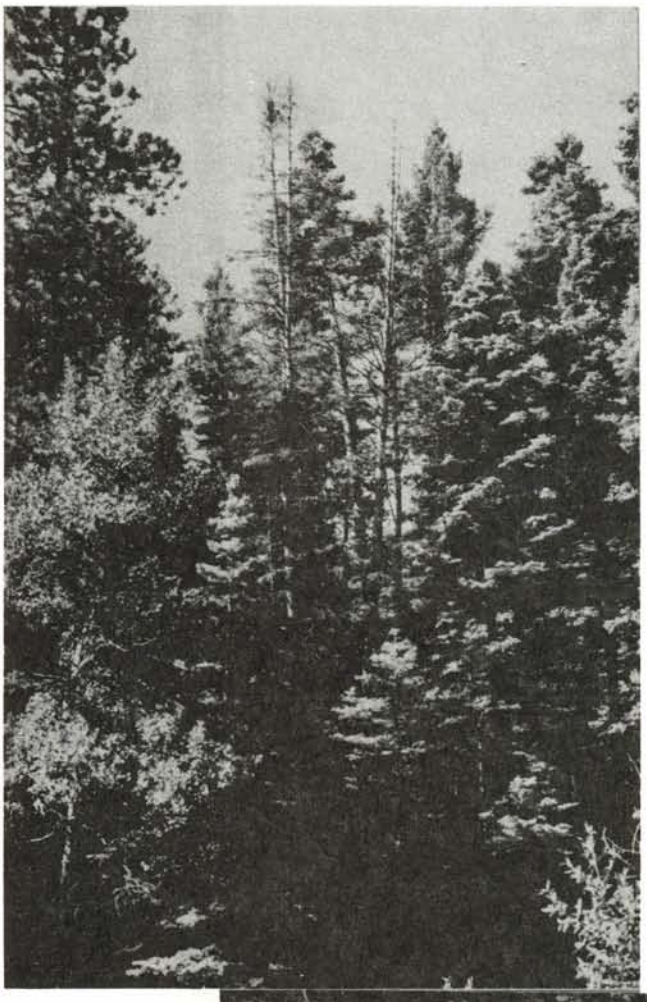


FIGURE 2

White fir mortality caused by *Fomes annosus* in the Pike and San Isabel National Forests of Colorado. Infected trees usually die in groups because of fungus spread through root systems.

FIGURE 3 Windthrown tree with *Fomes annosus* root decay. This tree is near an old growth tree that probably served as a source of infection.

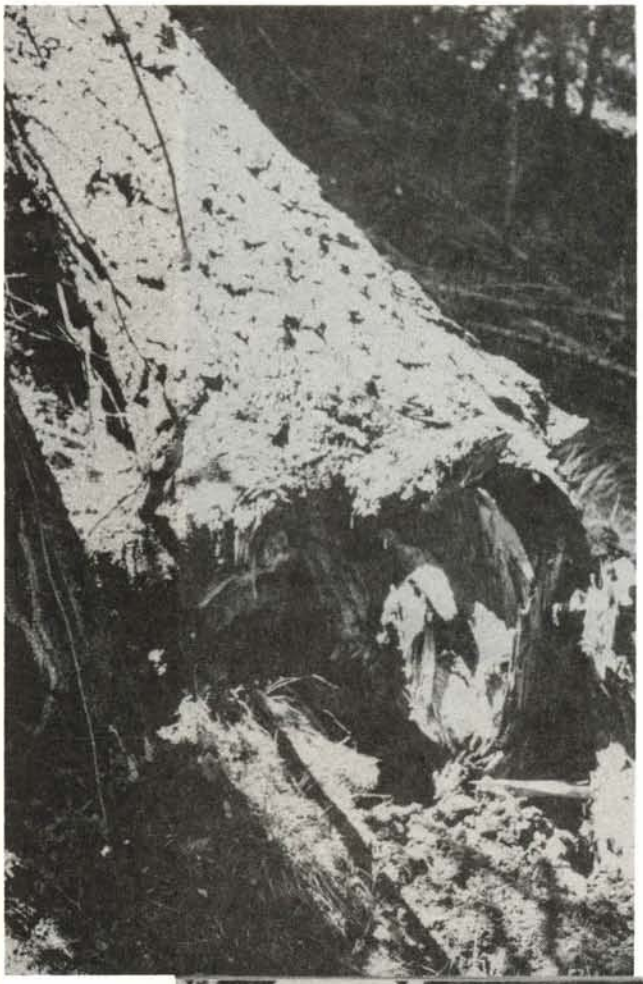


FIGURE 4

Extensive root and butt decay by *Fomes annosus* at the base of old-growth white fir. This tree was alive prior to windthrow.

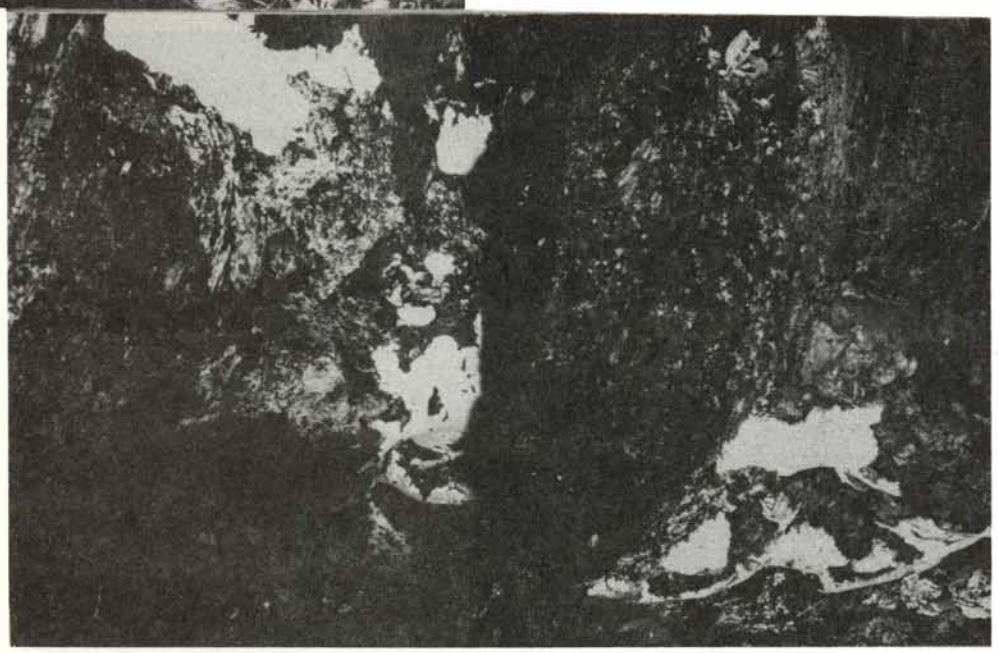


FIGURE 5 *Fomes annosus* sporophore arrangement within a white fir tree that had become extensively decayed. This tree had broken at about ten feet above ground level because of decay.

FIGURE 6 *Fomes annosus* sporophore production at base of infected white fir tree. Note the location below the litter layer.

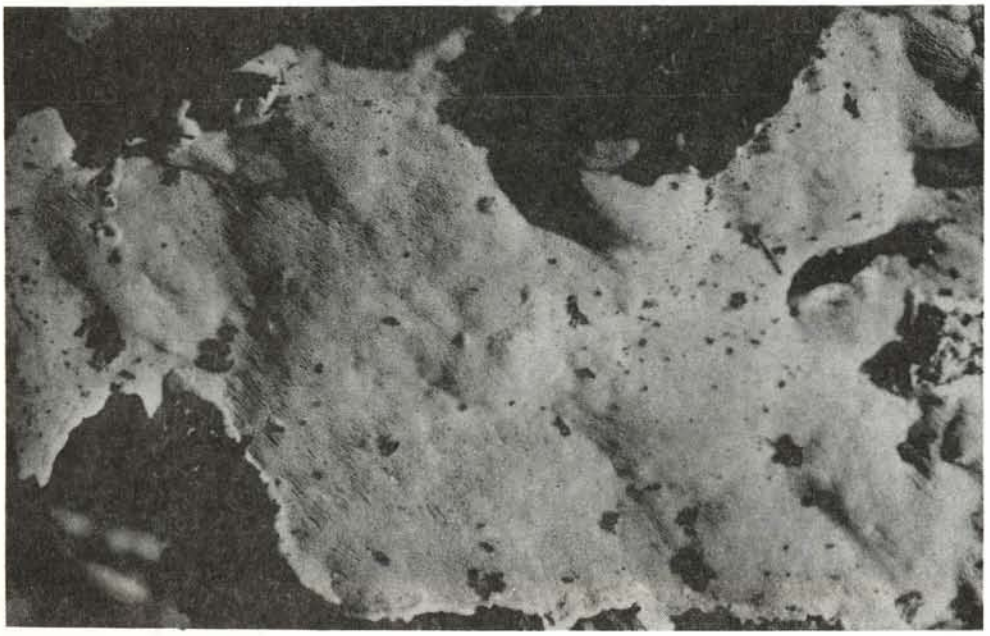


FIGURE 7 Spore-producing layer (hymenium) of *Fomes annosus* sporophore from infected white fir.

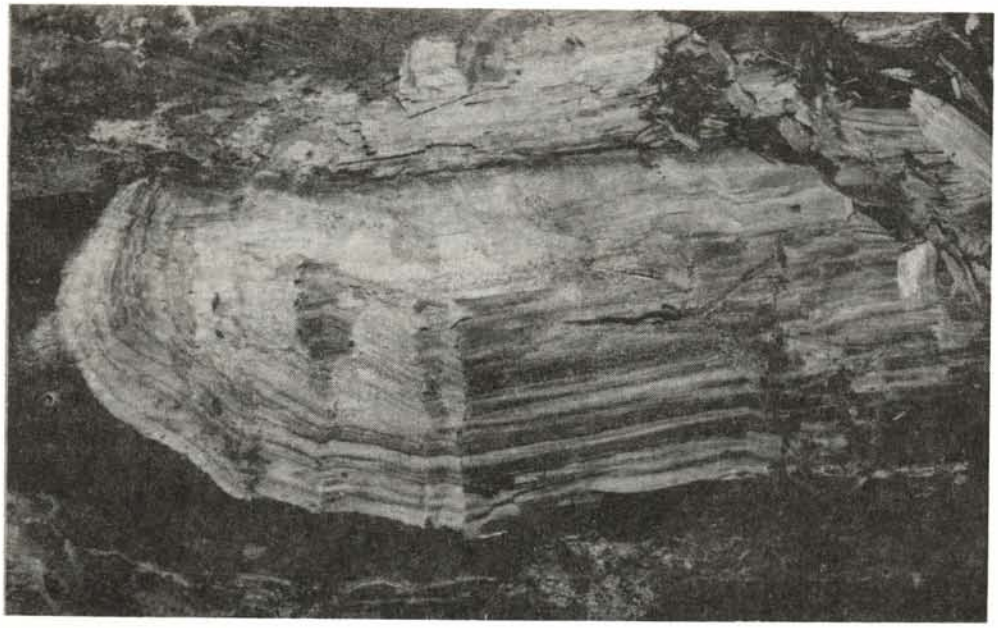


FIGURE 8 Resin staining at base of white fir tree infected by *Fomes annosus*. The fungus is present in and adjacent to stained areas.

FIGURE 9 Advanced decay of white fir caused by *Fomes annosus*. Decayed wood is spongy, white flecked, and often stringy or laminated.

Fomes annosus is apparently not causing important losses of white fir in Colorado. In natural, uncut stands host resistance may limit mortality to only a few weakened trees. However, in cutover stands greater mortality of residual young trees may occur. Build-up of inoculum within infected stumps may be sufficient to overcome normal tree resistance so that greater mortality results.

As more intensive management is applied to white fir stands, i.e. more intermediate and harvest cuttings, mortality due to *F. annosus* can be expected to increase. Forest managers should be aware of this potential threat and identify stands where the risk is high.

Fomes annosus infection centers at various locations will be monitored over a number of years. New mortality and symptom development will be documented to permit a better understanding of disease progression.

Fomes annosus has been detected on white fir and Engelmann spruce in Colorado. Future surveys should be conducted to determine presence of the fungus in other susceptible tree species such as ponderosa pine and subalpine fir.

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