

THE INFLUENCE OF GEOTHERMAL TEMPERATURE
GRADIENTS UPON VEGETATION PATTERNS IN
YELLOWSTONE NATIONAL PARKJohn Selwyn SHEPPARD, Ph.D.
Colorado State University, 1971

This study was designed to verify observations which indicated that distinct zones of vegetation existed in areas of anomalous geothermal flux. Four sites of steaming ground were selected in Yellowstone National Park for this investigation: two in meadow vegetation and two on sites under a *Pinus contorta latifolia* forest. These sites showed varying degrees of zonation in their vegetation. Factors included in the study were: soil temperature, soil pH, soil texture and profile descriptions and vegetation analysis. Vegetation data was ordinated along distinct thermal gradients which, in many cases, paralleled the soil pH gradients. Where soil pH did not follow any gradient, it was constant over that site.

The phenology of several species was observed. Plants growing on the warmer sites would flower and set seed up to 1 month before those on cooler sites. Several species were restricted to these warm sites. These species flowered and grew during the spring, in one case, as early as January.

Several distinct zones of vegetation segregated out on all sites. Mosses dominated on the hotter, more acid sites. These were predominately *Racomitrium canescens*, *Bryum pseudotriquetrum* and *Ceratodon purpureus* on the finer soils, with *Pohlia nutans* and *Dicranum muehlenbeckii* on the coarse soils in a steam zone and species of *Polytrichum* on dry coarse soils. This zone was dominant at temperatures over 50°C (at 10 cm depth). At temperatures from about 30°C to 50°C, there was a grass zone which included *Puccinellia airoides*, *Panicum thermale*, *Danthonia spicata thermale*, *Agrostis scabra*, *Bromus tectorum* and *Poa* spp. Species present at each of the sites again depended on varying edaphic factors. Some sites ranging from about 23°C to 37°C had a herbaceous zone dominated by *Chrysopsis villosa*. This zone merged into a mixed meadow vegetation where soil temperatures were below 27°C to 30°C, or into a *Pinus contorta latifolia* forest. This study indicated that the boundary between the background vegetation and the zones described above occurred where the geothermal flux approximated 300-600 $\mu\text{cal cm}^{-2} \text{sec}^{-1}$.

From these studies it was concluded that the use of vegetation zones as an estimate of geothermal flux was valid. Until further information is available on the effects of soil chemistry, nutrient status and texture, the estimates of geothermal flux can only be considered as an indication of the true rates of flux.

Order No. 71-23,088, 165 pages.

EFFECTS OF THE BALSAM WOOLLY APHID (ADELGES
PICEAE (RATZBURG)) ON THE CAMBIAL ACTIVITY OF
GRAND FIR (ABIES GRANDIS (DOUGL.) LINDL.) AND SUB-
ALPINE FIR (ABIES LASIOCARPA (HOOK.) NUTT.)Warren Elmer SISSON JR., Ph.D.
Oregon State University, 1971

Major Professor: Dr. Frank H. Smith

Cambial activity was studied in trees infested by the balsam woolly aphid and in non-infested trees of grand and subalpine fir. Infested and non-infested samples of grand fir were collected near Corvallis during 1968 and 1969. Samples of subalpine fir, non-infested and infested, were collected near Odell Lake, at approximately 5,000 ft. elevation, during 1969. Light infestations of the aphid were observed in both species.

No differences within species between infested and non-in-

festated trees were noted in the number of overwintering immature (precocious) sieve cells or in the dates for reactivation and cessation of mitotic activity in the cambial zone, or in the number of cambial zone cells per radial file. The relative amounts of xylem and phloem present at any given time during the growing season were the same regardless of the presence or absence of aphids.

Significant differences were noted in the lengths of the fusiform initials in the infested samples when compared to non-infested samples in both species. Xylem production in grand fir, and phloem production in both species was significantly greater in infested samples. A greater number of phloem parenchyma strands were observed in infested samples of grand fir than in non-infested samples.

The rate of cell division, as indicated by the mitotic indices, showed no significant differences between samples of infested and non-infested trees of either species. Differences in xylem and phloem production between infested and non-infested trees could not be attributed to either an increased rate of cell division or an increase in the number of cambial zone cells per radial file in infested samples for either species.

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INVESTIGATIONS OF THE PROCESSES OF DISCOLORATION
AND DECAY OF SUGAR MAPLE, ACER SACCHARUM, AS-
SOCIATED WITH FOMES CONNATUSTerry Alan TATTAR, Ph.D.
University of New Hampshire, 1971

Discoloration and decay of sugar maple, *Acer saccharum*, associated with *Fomes connatus* cause severe damage resulting in economic loss. The purpose of this study was to better understand these processes in living trees. Separate investigations were conducted and the results of this research were presented as three manuscripts.

Discolored and decayed tissue associated with *F. connatus* in sugar maple showed a pattern of physical changes and microbial successions. The lignin to cellulose ratio was approximately the same in clear, discolored, and decayed tissue. No quantitative change occurred in the amount of total extractives in all tissues. The pH and ash concentration increased and total phenolic compounds decreased as tissues discolored and decayed. Microorganisms were in discolored tissue that showed qualitatively altered extractives and increases in pH. *F. connatus* was in a narrow zone of discolored tissue at the border of discolored and decayed tissue. Microorganisms were in decayed tissue that showed qualitative changes in extractives, increases in pH, and substantial decreases in amount of lignin and cellulose.

The ability of *Phialophora melinii* and *F. connatus* to tolerate and to utilize certain phenolic compounds was studied *in vitro* to help explain successional patterns of fungi in living trees. *P. melinii*, which is often isolated in advance of *F. connatus* in columns of discolored and decayed tissue in sugar maple, tolerated and utilized phenolic compounds which were toxic to *F. connatus*. The capacity of *P. melinii* to alter phenolic compounds, and thereby permit growth of *F. connatus*, was indicated. The effects of pH, manganese concentration, nitrogen source, amount of glucose present, and means of sterilization on the growth of these fungi in media containing phenolic compounds were also investigated.

Isolates of *F. connatus*, *P. melinii*, *Acrostaphylus* sp., from discolored tissue, and *Trichoderma viride* and *Mortierella* sp. from decayed tissue of sugar maple were grown in liquid culture media containing sources of carbon and nitrogen found in the tissue of sugar maple. These compounds included the carbohydrates of wood and their component monosaccharides,

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