Discussion Group B — What can we learn from Historical Records?

The Historical Record and its Value in Developing Chronologies for Western Spruce Budworms

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Only short-term records of population density fluctuations of western spruce budworms have been compiled to date. Analyses which depend on extended longitudinal records are therefore impossible. Analyses of records compiled from data collected in several locations for short periods are unlikely to be helpful in illuminating long-term population behavior. Consequently, other sources of data, such as population indexes (*sensu* Morris 1955), must be sought.

In the Pacific states, the earliest record of what became known as the western spruce budworm (*Choristoneura occidentalis* Freeman) is a 1914 rearing from Douglas-fir at Ashland, Oregon (Lindsten et al. 1949, quoted by Dolph 1980). Minor outbreaks were recorded in 1929 and 1931, but it was not until 1943 that large-scale outbreaks were first recorded (Dolph 1980). An exhaustive listing of observations and summaries of defoliation caused by western spruce budworm from 1922 to 1971 in the northern Rocky Mountain states has also been compiled (Johnson and Denton 1975). Detailed defoliation maps of this area have been compiled since 1948. Together these records cover at least two widespread outbreaks of the western spruce budworm and the modoc budworm (*Choristoneura retiniana* Walsingham). Although these records do not provide an exact record of population change, this information may be used to estimate parameters associated with outbreak characteristics in a region (Kemp 1983).

Defoliation records also form the basis for calibrating tree ring records to generate proxy data on population fluctuations of the two budworm species in the United States. Defoliation signatures have been described for western spruce budworm in growth rings of its three principal hosts (Williams 1967), for volume losses on grand fir (Ferrell and Scharpf 1982) in the Intermountain region, and for modoc budworm on white fir (Ferrell 1980). Swetnam is also working on defoliation signatures in northern New Mexico. Before regional budworm chronologies can by synthesized, however, techniques to distinguish budworm-caused depressions in tree growth from all other agents causing similar changes must be developed. Variations in the intensity of outbreaks and reports on the activities of other inimical agents in these areas may be exploited for this purpose. Stem analyses may also be combined with this data to estimate growth losses (Thomson and Van Sickle 1980; Ferrell and Scharpf 1982).

The meteorological instrumental record covers the entire region and period covered by the defoliation record. Kemp (1983) coupled these records to identify meteorological variables associated with regional outbreak frequencies.

The historical record is inadequate to evaluate long-term trends and validate models of outbreak behavior. By extending this record in certain strategic locations, it may be possible to test the effect of climatic changes and other geological processes on the initiation, maintenance, and collapse of budworm outbreaks. The large, long-lived trees and varied environments occupied by western forests (cf. Fowells 1965) must contain rich tree ring records. With crossdating, these records may be extended beyond the histories represented in living host trees. Together with the detailed climatic reconstructions developed by the Laboratory of Tree Ring Research for the West (Fritts 1976), these chronologies would provide an unparalleled opportunity to analyze the effects of climatic change on budworm population change.

Living host trees may be as old as 500 years, thus as a minimum, the record would extend to the beginning of "The Little Ice Age" and cover the period of recovery to a more benign climate (cf. Ford 1982). Should we be successful in discovering such a series, answers to such questions whether the frequency and extent of outbreaks are increasing could be provided with a measure of reliability. Contrasts with eastern chronologies developed by Blais (1983) may allow formulation of a general theory for the causes of North American spruce budworm outbreaks. By dissecting budworm defoliation time series with the use of methods described by Rust and Kirk (1978), it may be feasible to isolate effects of trends in climatic change from those of climatic cycles driven by astronomical events. The understanding derived from these studies would allow us to model budworm population behavior under future environments. These might include budworm responses to: different fire management policies, elevated temperatures due to the greenhouse effect caused by increasing atmospheric carbon dioxide concentrations, a colder climate resulting from increased atmospheric particulate densities.

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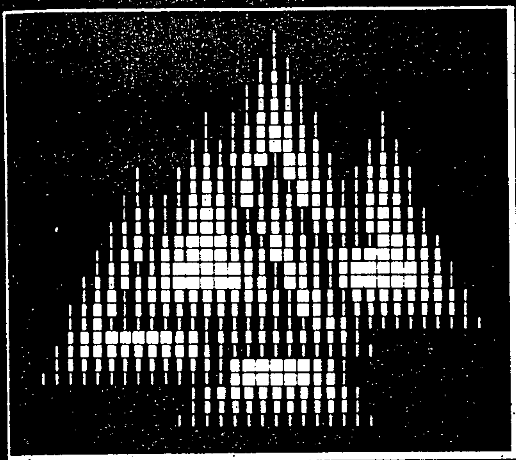

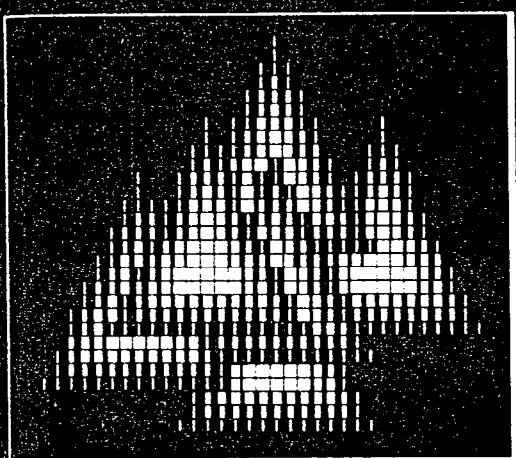

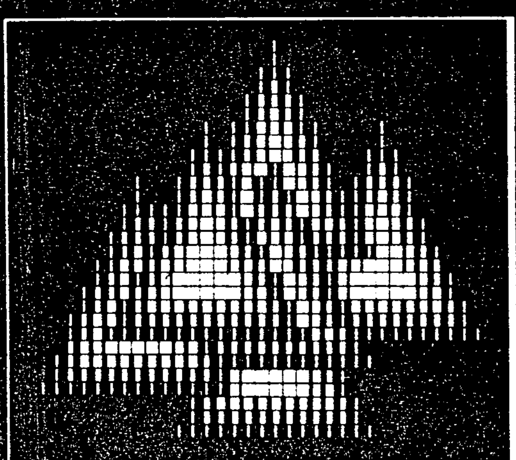

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