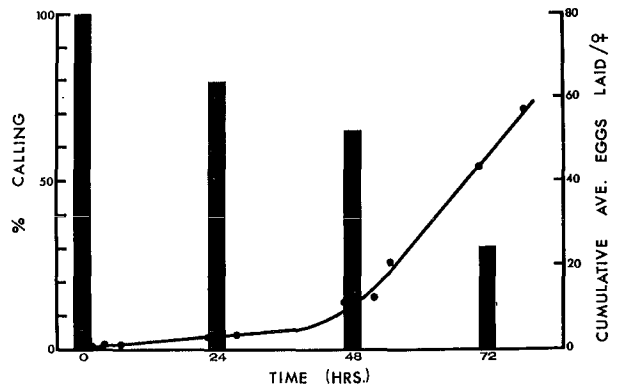

Figure 1. Comparison of calling behavior and egg deposition of 23 virgin *O. leucostigma* females over a 3 1/2-day period. Vertical bars represent female calling and continuous line represents oviposition.

usually ovipositing and only rarely were behaviorally inactive. This relationship between calling and oviposition is not surprising because in moths these behaviors are mutually exclusive although some pheromone may be released during oviposition (Grant, 1975).

Figure 1 also demonstrates that by the time females are more than 2 days old they have deposited a considerable number of unfertilized eggs. As a consequence these females are noticeably smaller than newly emerged females. Undoubtedly this accounts for the smaller masses of fertilized eggs laid by older females.

Thus the consequences of aging for whitemarked tussock moth females are reduced fecundity because of spewing and a decreased frequency of calling behavior which ultimately reduces the chances of mating. Concomitantly, pheromone production declines further decreasing the attractiveness of females. Clearly it is advantageous for whitemarked females to mate as soon as possible after eclosion. In field populations, the emergence of males before females may be one mechanism to ensure such early mating, but other mechanisms, perhaps related to pheromones and mating behavior, should also be looked for.—G. G. Grant and L. McCarty, Insect Pathology Research Institute, Sault Ste. Marie, Ont.

Weather and Outbreaks of the Eastern Hemlock Looper in Newfoundland.—The eastern hemlock looper, *Lambdina fiscellaria fiscellaria* (Guen.), is a native pest of the coniferous forests of eastern North America, and periodic outbreaks, at 5-7-year intervals, have been reported from Newfoundland Island since 1912. The outbreaks usually lasted from 4 to 6 years but individual infestations collapsed in about 2 years (Otvos *et al.*, Inf. Rep. N-X-68, 1971).

Weather is generally believed to be a major factor affecting fluctuations of insect populations. This paper examines the population changes of the eastern hemlock looper in Newfoundland in relation to temperature and precipitation during the period of 1947-1971 with the utlimate goal of using this relationship to facilitate forecasting the course of future outbreaks.

Information on looper population levels on balsam fir, *Abies balsamea* (L.) Mill., black spruce, *Picea mariana* (Mill.) B. S. P. and white spruce, *P. glauca* (Moench) Voss, was obtained from Island wide surveys conducted annually by the Forest Insect and Disease Survey. The average number of larvae per tree was calculated for the Island and plotted for each year from 1951 to 1971. Earlier records on insect numbers were incomplete and were not included in the analysis.

Temperature and precipitation data during the larval and pupal stages of the looper (May-August) recorded at three weather stations across the Island (St. John's, Gander and Stephenville) were obtained from the Monthly Record (Atmospheric Environment Service, Environment Canada). The average difference from the 30-year (1941-1970) normal for temperature and precipitation during May to August was computed and plotted for each year.

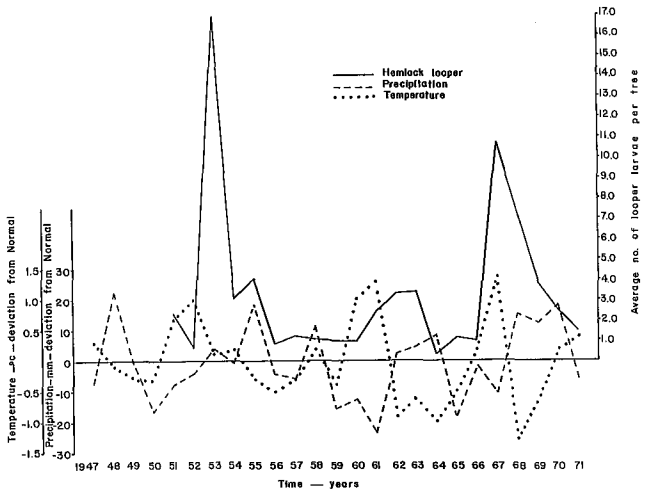

Figure 1. Average number of hemlock looper larvae per tree and deviations of temperature and precipitation from their 30-year normals (1941-1970).

Three peaks in looper numbers shown in Figure 1 represent the outbreaks during the period of 1951 to 1971: the first from 1947 to 1954 (Carroll, Can. Ent. 88:587-599, 1956) and the second and third from 1959 to 1963 and from 1966 to 1971, respectively (Otvos *et al.*, Inf. Rep. N-X-68, 1971). The increase in looper numbers to epidemic levels was preceded by about 2 years of warmer than normal temperatures for two of the three outbreaks and above-normal temperatures occurred for 2 years during the third outbreak. Precipitation generally was less than normal during the three outbreaks. Similarly a number of spruce budworm epidemics in different parts of Canada were preceded by a period of 3 to 4 years of warm, dry weather (Wellington *et al.*, Can. J. Res. (D) 28: 308-111, 1950; Ives, Inf. Rep. NOR-X-118, 1974; and Pilon and Blais, Can. Ent. 93: 118-123, 1961). Thomson (Bi-mon. Progr. Rep. 8(3):3, 1952) working on the western hemlock looper in British Columbia reported that weather was usually extremely dry in September (when mating of this insect occurs in B.C.) for 3 years prior to a major increase in adult numbers.

In Newfoundland, the decline of the eastern hemlock looper numbers was generally preceded by a period of lower than normal temperatures. Precipitation usually was above the normal during the decreasing phase of the outbreaks. Silver (Can. Ent. 95:58-61, 1963) reported that epidemic blackheaded budworm populations decreased or collapsed during or following periods of above average precipitation.

The results of this preliminary investigation suggest that deviation of temperature and precipitation from the normal was correlated with fluctuations of looper population levels. These and possibly other weather parameters affect looper populations, in part directly, by influencing larval development and in part indirectly, through their affect on biotic control factors such as parasites and diseases. A more detailed analysis of the patterns between weather and looper population levels will be conducted to develop a system for forecasting the development and decline of hemlock looper outbreaks.—Imre S. Otvos, Newfoundland Forest Research Centre, St. John's, Nfld.

Mortality of Overwintering Eggs of the Eastern Hemlock Looper in Newfoundland.—The eastern hemlock looper, *Lambdina fiscellaria fiscellaria* (Guen.) is an important pest of balsam fir, *Abies balsamea* (L.) Mill., forests. The eggs of the looper are about 1 mm in length and are laid from late August to October, usually singly or in groups of two or three on a variety of substrates including bark and lichens on trees and moss on the forest floor (Otvos, Clark and Clarke, Nfld. For. Res. Centre, Inf. Rep. N-X-68, 1971). The insect overwinters in the egg stage and hatches in June of the following year (Carroll, Can. Ent. 88: 587-599, 1956). This note presents data on the mortality of overwintering looper eggs in four generations.