forest management note

Note No. 11 Northern Forest Research Centre Edmonton, Alberta

WEATHER AND FOREST INSECT POPULATION TRENDS

A recently completed study of Forest Insect and Disease Survey (Canadian Forestry Service) data collected in Manitoba and Saskatchewan from 1945 to 1969 has shown that weather influences the population trends of 21 forest insect defoliators (Ives 1981). This note summarizes some results of interest to forest managers.

In the study, the accessible forests of the two provinces were divided into seven areas: southeastern, Interlake and Westlake, Riding and Duck mountains, and northwestern in Manitoba; and Hudson Bay, Prince Albert, and Meadow Lake in Saskatchewan. Annual population trends for each of the 21 species in each area were then placed in one of four categories: insect absent, insect present but no trend evident or trend unknown, insect population increasing, and insect population decreasing.

Weather data were taken from records collected at a weather station in each of the seven areas and were expressed as total precipitation, heat units above 4.5°C, heat units below -18°C, and water deficits (assuming a soil storage capacity of 100 mm). For each area each variable was summed by 3-month periods (Table 1) and then was expressed as a percentage of the range (the largest value was equated to 100% and the smallest to 0). This procedure eliminated most of the differences between areas and made comparisons easier.

The weather variables were further sorted according to the four population trend categories, and the effect of each variable was determined by assessing the differences between increasing and decreasing populations. Differences of five or more in the numerical means of the variable were arbitrarily considered to be important.

The results are summarized in Table 1. It should be emphasized that this shows trends only, and individual outcomes may not always follow expectations for a number of reasons. In the first place, meteorological stations provide only an index of microclimatic conditions in the insects' environment. There is no way of knowing, without detailed study, just how reliable these indices are for each species of insect. Secondly, other factors often have marked influences upon insect population trends, but these have not been considered in the Table 1 results. Detailed studies have shown, for example, that over 90% of forest tent caterpillar pupae and larch sawfly larvae in cocoons have been destroyed by parasites on a number of occasions. Other studies have shown that small mammals occasionally destroy over 90% of larch sawfly cocoons in the fall. Birds, invertebrate predators, and diseases may also affect insect abundance.

Only five of the insects studied are normally considered to be major pests (Table 2). Three of these—the forest tent caterpillar, the spruce budworm, and the jack pine budworm—are favored by warm weather during May to July and August to October. There is, therefore, a danger that all three may reach outbreak proportions at the same time. The two other major pests—the large aspen tortrix and the larch sawfly—are favored by cool weather during May to July. Consequently, a run of warm summers will tend to lead to outbreaks of the first three insects, while a run of cool summers may lead to outbreaks of the last two. The forest manager should also be aware that some of the species not normally considered to be pests may cause damage if environmental conditions are favorable for a number of consecutive years. As an example, the Bruce spanworm, *Operophtera bruceata* (Hulst), was

Table 1. Weather conditions that are favorable or unfavorable for 21 species of forest insect defoliators

Main host tree and insect species	Favorable weather								Unfavorable weather							
	Aug.-Oct.		Nov.-Jan.		Feb.-April		May-July		Aug.-Oct.		Nov.-Jan.		Feb.-April		May-July	
	Precip.	Temp.	Precip.	Temp.	Precip.	Temp.	Precip.	Temp.	Precip.	Temp.	Precip.	Temp.	Precip.	Temp.	Precip.	Temp.
Trembling aspen																
Forest tent caterpillar *Malacosoma disstria* Hbn.	Dry	Warm	—[1]	Mild	—	Mild	Dry	Warm	—	—	—	Cold	—	Cold	Wet	—
Large aspen tortrix *Choristoneura conflictana* Wlk.	—	—	Heavy	Cold	Light	Mild	—	Cool	—	—	—	—	—	—	—	Hot
Aspen leaf beetle *Chrysomela crotchi* Brown	Dry	Cool	Heavy	—	—	—	Wet	Warm	—	—	—	—	—	—	—	—
American aspen beetle *Gonioctena americana* (Schaeff.)	—	—	Light	—	Light	Mild	—	—	—	—	—	—	—	—	—	—
A green fruitworm *Orthosia hibisci* Guen.	Dry	Cool	Light	Mild	Light	Mild	—	—	—	—	—	—	—	Cold	—	Hot
A looper *Campaea perlata* Guen.	—	—	—	Mild	—	Cool	—	—	—	—	Heavy	—	—	—	Dry	Hot
A leaf roller *Pseudexentera oregonana* Wlshm.	Dry	Warm	Light	Mild	Heavy	Mild	Dry	Warm	—	—	—	—	—	—	—	—
Aspen leaftier *Sciaphila duplex* Wlshm.	—	Warm	—	Mild	Heavy	Cold	—	Warm	Dry	—	—	—	—	—	—	—
A noctuid *Enargia decolor* (Wlk.)	—	Cool	Light	—	Light	Mild	Dry	Cool	—	—	—	—	—	Cold	—	Hot
Jack pine																
Jack pine budworm *Choristoneura pinus pinus* Free.	—	Warm	—	Mild	Heavy	Cold	—	Hot	—	—	—	—	—	—	—	—
Red pine sawfly *Neodiprion nanulus nanulus* Schedl	—	—	Heavy	Mild	—	Cool	Dry	Warm	—	—	—	—	—	Warm	Wet	—
Red-headed jack pine sawfly *Neodiprion virginianus* complex	—	—	—	Cold	—	Mild	Dry	—	—	—	—	—	—	Cold	—	—
A looper *Semiothisa bicolorata* F.	Wet	Cool	—	Mild	Light	—	Wet	Cool	Dry	Warm	—	—	—	Cold	Dry	Warm
An owlet moth *Zale duplicata largera* Smith	—	Cool	Light	Mild	—	—	—	—	—	—	—	—	—	—	—	—

White spruce																	
Spruce budworm *Choristoneura fumiferana* (Clem.)	Dry	Warm	Heavy	Cold	Heavy	Cool	——	Warm	——	——	——	——	——	——	——	——	
Balsam fir sawfly *Neodiprion abietis* complex	Dry	Cool	——	Mild	——	Mild	——	——	——	——	——	——	——	Cold	——	——	
Eastern black-headed budworm *Acleris variana* (Fern.)	Wet	Warm	Light	——	Light	Mild	Wet	Warm	——	——	——	——	——	Cold	——	——	
Tamarack																	
Larch sawfly *Pristiphora erichsonii* (Htg.)	——	Cool	Heavy	Cold	——	Cold	Wet	Cool	——	Warm	——	——	——	——	——	——	
Green larch looper *Semiothisa sexmaculata* Pack.	Wet	Cool	Light	——	Light	Mild	Dry	——	——	——	——	——	——	——	Wet	——	
A sawfly *Anoplonyx canadensis* Harr.	Wet	Cool	Heavy	Cold	Light	Mild	Wet	Cool	——	——	——	——	——	——	Dry	Hot	
A sawfly *Anoplonyx luteipes* (Cress.)	——	——	Heavy	Mild	Heavy	——	Dry	Warm	——	——	——	——	——	——	——	——	

[1] Blanks indicate that no trends were evident.

Table 2. Relative importance of 21 species[1] of forest insect defoliators in Manitoba and Saskatchewan

Major pests	Minor pests	Usually unimportant
Forest tent caterpillar	Aspen leaf beetle	A green fruitworm, *Orthosia hibisci*
Large aspen tortrix	American aspen beetle	Loopers, *Campaea perlata* and *Semiothisa bicolorata*
Jack pine budworm	Aspen leaftier	A leaf roller, *Pseudexentera oregonana*
Spruce budworm	A noctuid, *Enargia decolor*	An owlet moth, *Zale duplicata largera*
Larch sawfly	Red pine sawfly	Eastern black-headed budworm
	Red-headed jack pine sawfly	Green larch looper
	Balsam fir sawfly	Sawflies, *Anoplonyx canadensis* and *Anoplonyx luteipes*

[1] Scientific names are given in Table 1.

not abundant enough in Manitoba and Saskatchewan to be included in this study yet is currently in outbreak proportions on trembling aspen in parts of Alberta.

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REFERENCE

Ives, W.G.H. 1981. Environmental factors affecting 21 forest insect defoliators in Manitoba and Saskatchewan, 1945-69. Environ. Can., Can. For. Serv., North. For. Res. Cent. Edmonton, Alberta. Inf. Rep. NOR-X-233.

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