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1971 STUDIES OF THE SPRUCE BUDWORM IN NORTHERN ALBERTA

by

H. F. CEREZKE

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H. F. Cerezke*

ABSTRACT

Ground and aerial surveys of the spruce budworm (*Choristoneura fumiferana* (Clem.)) in 1971 indicated low population levels at several locations in northern Alberta. These levels were similar to those reported in 1970 except along the Chinchaga River west of High Level where an upsurge in budworm numbers was clearly evident. Low populations of the black-headed budworm (*Acleris variana* (Fern.)) were also general throughout most of the northern and west-central portions of Alberta.

A ground cruise of residual blocks of white spruce timber in F2-L5 timber berth adjacent to the Wabasca River indicated no immediate hazard to the spruce budworm was likely in 1972. In sample plots within F2-L5, 17.5% of the trees 10 ins. d.b.h. and over had dead tops from previous budworm outbreaks while 63.2% of trees less than 10 ins. d.b.h. had dead tops. No tree mortality was attributed directly to the spruce budworm and only few signs of current budworm feeding were observed.

Work toward refinement of sampling techniques for spruce budworm larval and adult populations was continued in 1971 and white spruce seedlings were planted on clearcut areas to determine the effects of budworm feeding on young regeneration.

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*Research Scientist, Northern Forest Research Centre, Canadian Forestry Service, Department of the Environment, 5320 - 122 Street, Edmonton 70, Alberta, Canada.

INTRODUCTION

Studies of the spruce budworm, *Choristoneura fumiferana* (Clem.), in 1971 in northern Alberta included several aspects. These are outlined below with a brief explanation of the purpose of each study and a summary of the main findings is also given. Assessment of damage and current spruce budworm populations in white spruce stands along the Wabasca River was of chief concern since past outbreaks of this insect had seriously affected some of the commercial stands. This report deals mainly with the 'Wabasca River study area'.

SURVEYS

1. Ground and Aerial Surveys of the Spruce Budworm

The Forest Insect and Disease Survey monitored spruce budworm populations throughout the region served by the Northern Forest Research Centre. In general, populations remained low in all areas checked in 1971, and were similar to those reported in 1970. Small infestations were reported at Ft. Smith and Little Buffalo Falls, N. W. T., and at Carlson's Landing and Peace Point in northern Alberta. A light infestation persisted along the west side of Athabasca River and extended from Ft. McMurray to nine miles north. In this area, defoliation by the budworm was most severe on intermediate and suppressed trees.

In the Footner Lake Forest a special aerial survey was made by the author over spruce forests between High Level and the Wabasca and Chinchaga Rivers, as well as over main spruce stands along these two rivers. The survey was made during early July when budworm feeding was complete and when color characteristics of damaged foliage were at a maximum for aerial detection. Only faint traces of current defoliation were observed along the Wabasca and Muddy Rivers in Township 98, Ranges 9 and 10, and in Township 99, Range 9 (Fig. 1).

Light* defoliation was observed in Townships 106 and 107,

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*The categories of Light, Moderate and Severe defoliation as used by the Forest Insect and Disease Survey during aerial surveys may be defined as follows: discoloration from current defoliation visible on top 5-feet of tree crowns (Light); visible on top third-half of tree crowns (Moderate); visible on entire crowns (Severe).

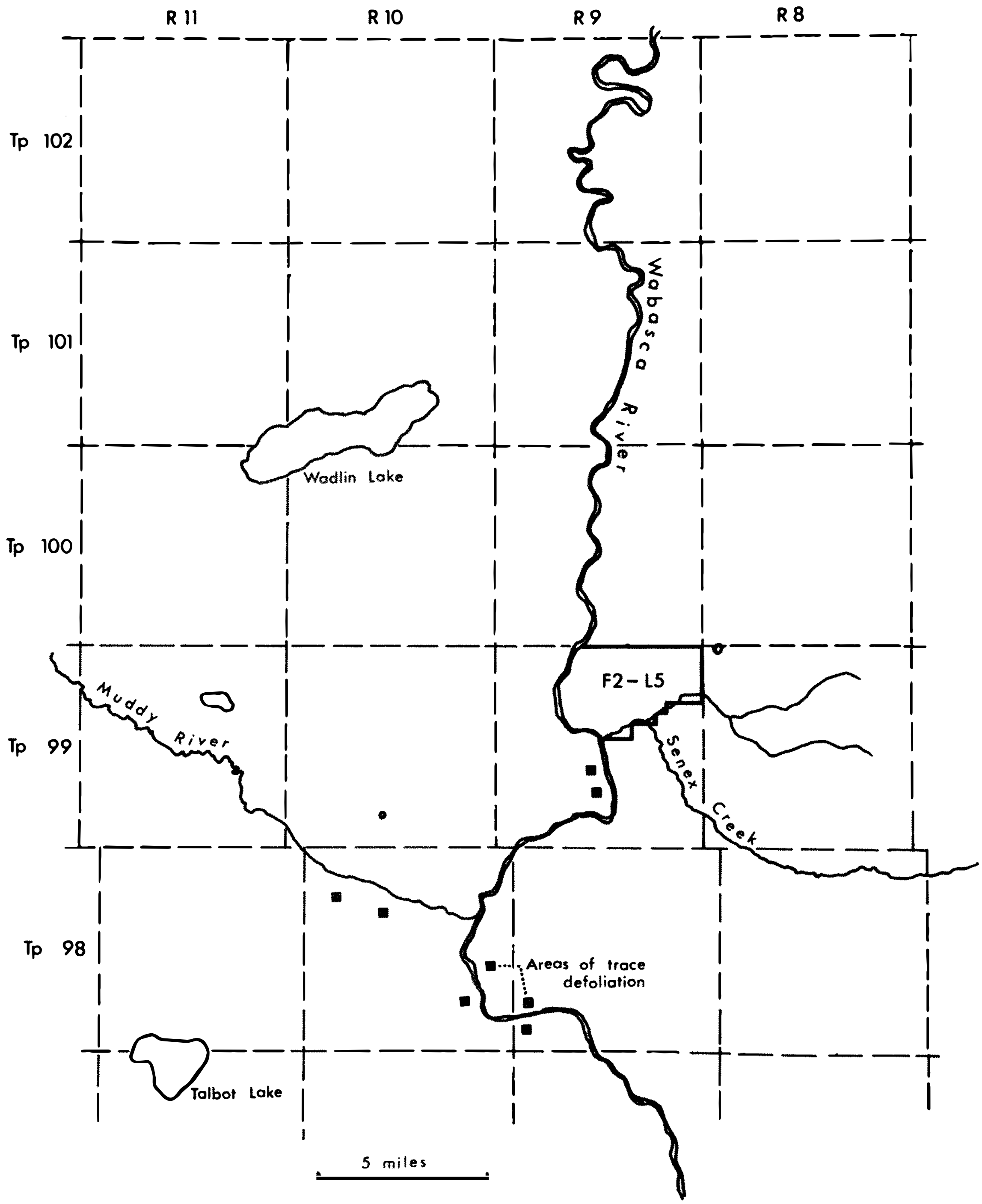

Fig. 1. Map of the 'Wabasca River study area' showing the location and boundary of F2-L5 timber berth and areas of trace defoliation observed in 1971.

Range 1 and in Townships 108, 109 and 110, Ranges 2 and 3 along the Chinchaga River valley. These observations indicated little or no change in budworm population levels from 1970 for the Wabasca and Muddy Rivers area but an upsurge was clearly indicated along the Chinchaga River. Aerial coverage included Watt Mountain on which no current defoliation was evident.

Forest Insect and Disease Survey collections also indicated that low populations of the black-headed budworm, Acleris variana (Fern.) were general throughout the northern and west-central portions of the province.

2. Damage Surveys of the Spruce Budworm

A ground cruise was undertaken at the request of the Alberta Forest Service to examine residual blocks of timber remaining in F2-L5 timber berth (Figs. 1, 2), and to assess these stands for hazards of the spruce budworm. The study included assessments of tree damage caused by previous budworm outbreaks and of the current level of budworm populations, upon which a prediction was made of budworm conditions expected in 1972.

Timber cutting operations in F2-L5 were undertaken during the winter of 1970-71 in alternate clearcut block patterns. The terms of the contract called for removal of timber from about 50% of the berth area but not all of this quota was removed at the time of the budworm cruise in July. The ground cruise consisted of sampling all trees within 9 plots located within similar 3-4Sw timber types in the residual blocks (see Fig. 2 for plot distribution). Each plot was a tenth-acre in area. Data recorded for each tree included diameter (b.h.), total height, condition of the tree crown, and presence or absence of current feeding damage by budworm larvae.

Table 1 summarizes the incidence of dead tree tops for merchantable-* and non-merchantable-size trees. On merchantable-size trees pooled from all plots the incidence of dead tops was only 17.5% while on non-merchantable-size trees the incidence of dead tops was 63.2%. This suggests that the merchantable trees in the residual non-cut blocks have a lower risk rating or greater chance for survival from immediate budworm attacks than do present non-merchantable trees; i. e., advanced regeneration and younger age classes are more vulnerable to top kill and mortality. Considering the stand structure of all 9 plots combined, the incidence of top kill by the budworm bears an inverse relation with tree height class (Fig. 3). A similar relation between top kill and tree height class was also observed in an 85-year-old spruce stand west of High Level (Fig. 4). Within the plots of F2-L5 the pattern of top kill in relation to tree height likely reflects the downward dispersal of budworm larvae within tree crowns particularly during years of high populations, as well as the suppressed condition of most of the smaller trees. Stand age and density may also be important variables influencing the distribution of budworm larvae within tree crowns and also the pattern of top kill. Further studies are needed to establish how the incidence and pattern of top kill varies in relation to stand density,

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*Merchantable trees included those 10 inches (d.b.h.) and over; non-merchantable included those less than 10 inches (d.b.h.), including regeneration.

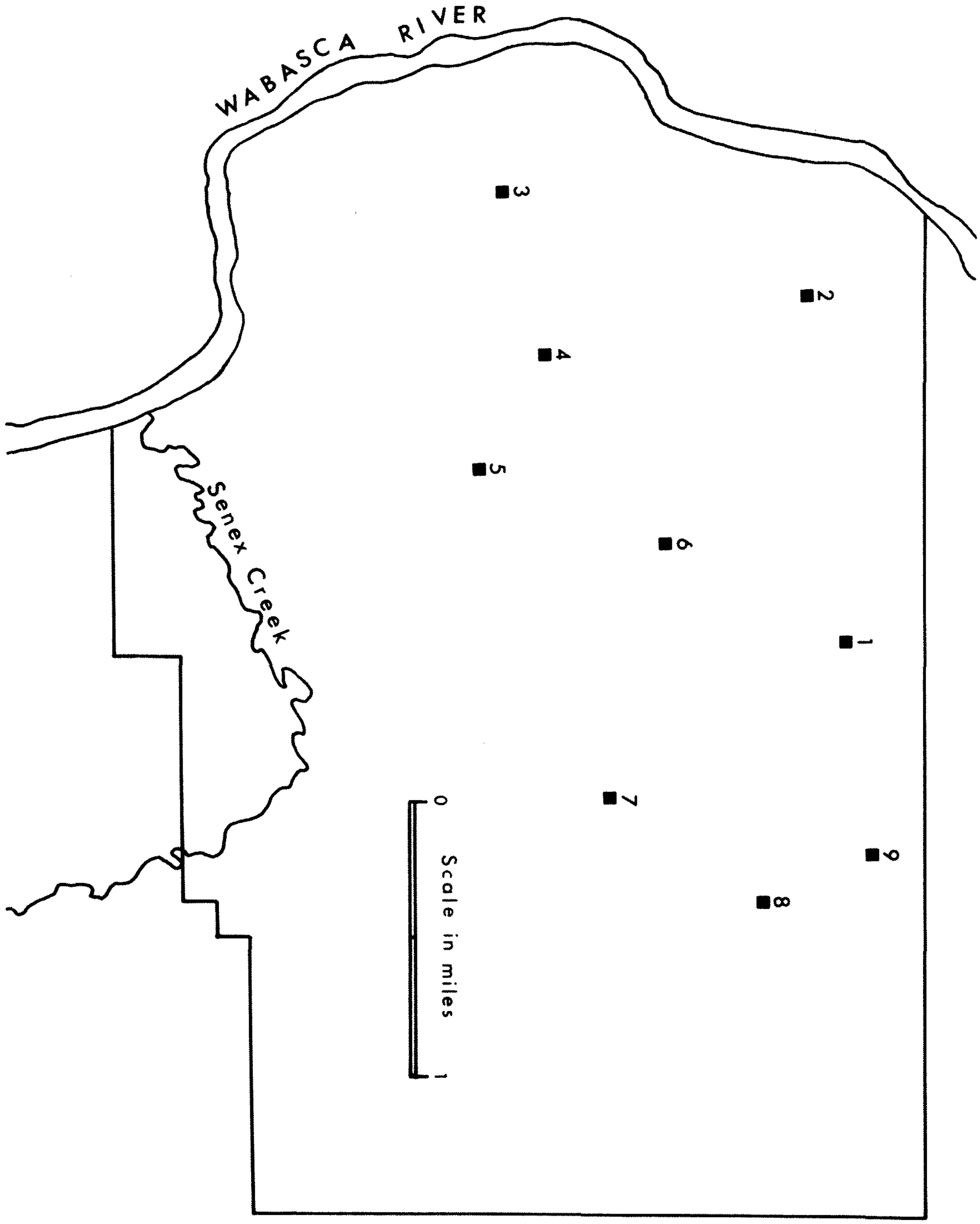

Fig. 2. Enlarged map of F2-L5 timber berth showing the location of tenth-acre size plots sampled within similar 3-4 Sw timber types.

Table 1. Summary of tree top kill by spruce budworm in residual timber blocks in F2-L5, July, 1971

Plot No.	Merchantable trees (10 ins. d.b.h. and over)		Non-merchantable trees (under 10 ins. d.b.h.)		Merch. and non-merch.		
	Living trees	Dead tops	Living trees	Dead tops	Living trees	Dead tops	% dead tops
1	11	3	18	14	29	17	58.6
2	4	1	23	10	27	11	40.7
3	3	2	20	14	23	16	69.6
4	8	0	36	20	44	20	45.5
5	3	1	26	20	29	21	72.4
6	3	0	20	12	23	12	52.2
7	13	2	14	10	27	12	44.4
8	12	1	20	12	32	13	40.6
9	6	1	16	10	22	11	50.0
Totals	63	11	193	122	256	133	
Ave % dead tops	17.5		63.2		52.0		

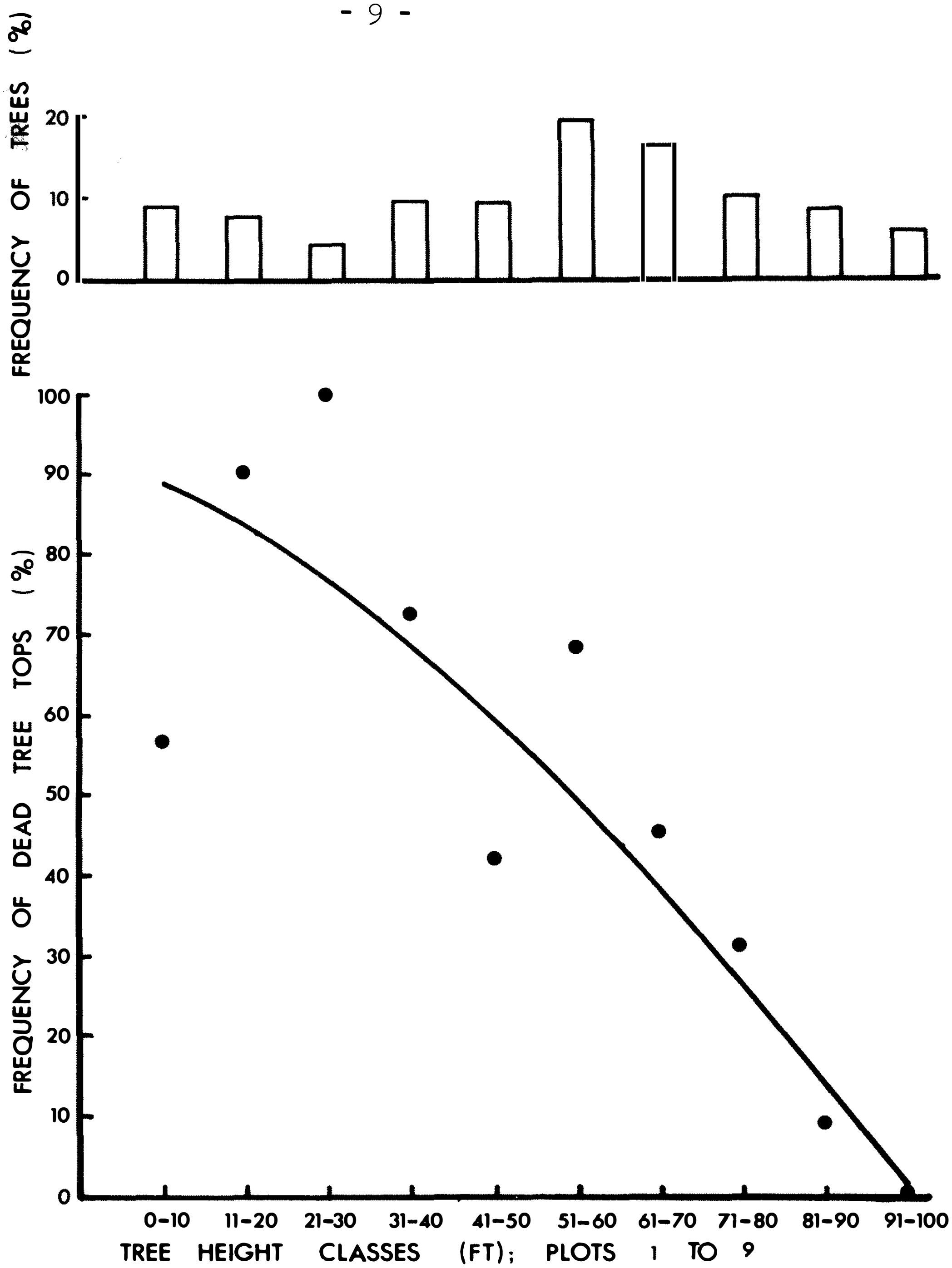

Fig. 3. Frequency histogram of tree height classes (top) and the relation between tree top mortality and height class of trees (bottom) pooled from all nine plots sampled in F2-L5 in the 'Wabasca River study area'.

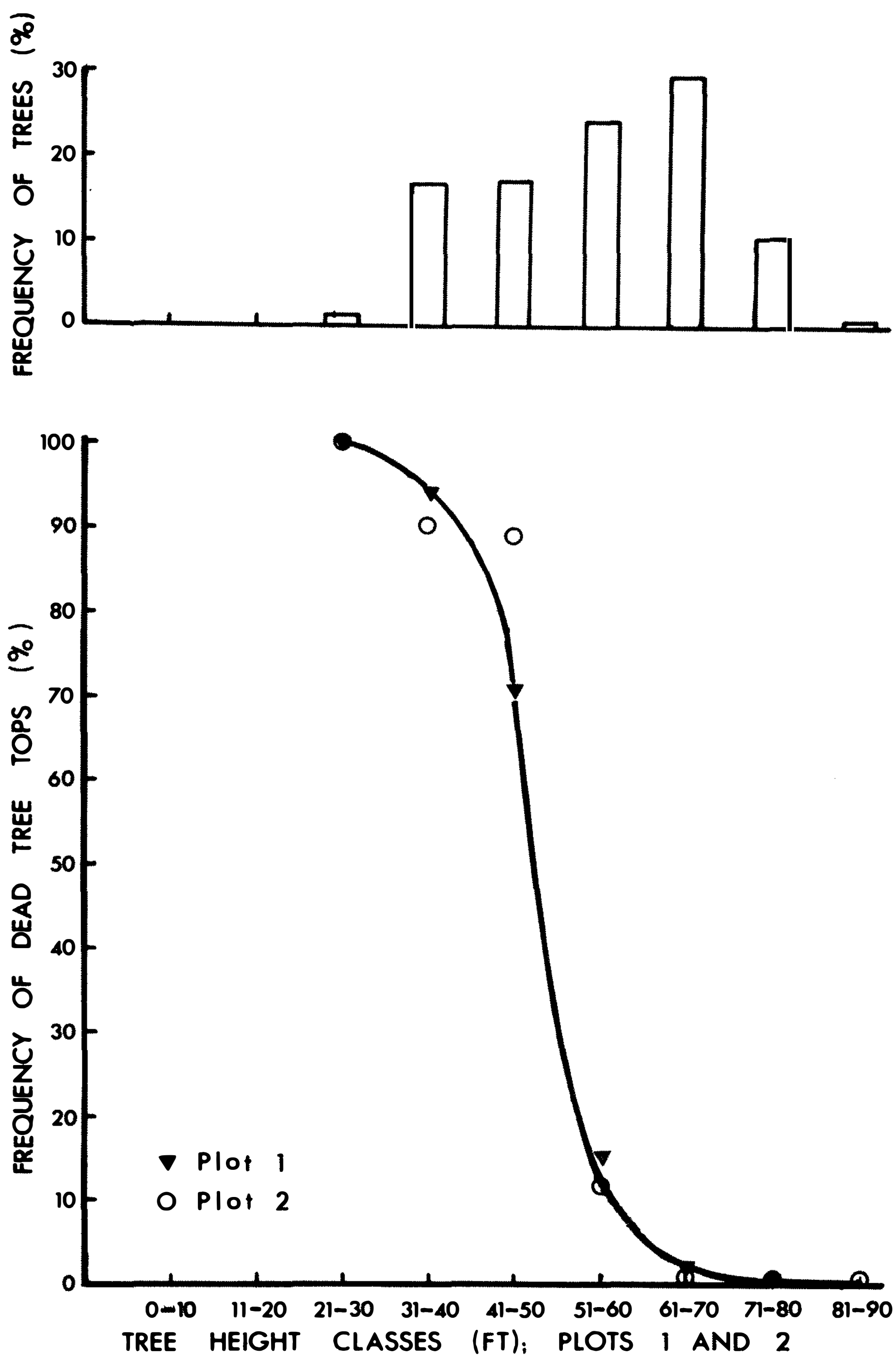

Fig. 4. Frequency histogram of tree height classes (top) and the relation between tree top mortality and height class of trees (bottom) from two fifth-acre plots sampled in an 85-year-old spruce stand 28 miles west of High Level.

age, composition and site. An understanding of these relationships in the northern spruce forests would be useful in formulating silvicultural control treatments and management policy.

Spruce stands in areas of persistent outbreaks of the budworm such as at the confluence of the Wabasca and Muddy Rivers, are in an advanced stage of decadence which was greatly hastened by budworm feeding. Here the relation between incidence of dead tops and tree height class may be further complicated by the high incidence of tree mortality already present. While some tree mortality was observed in plots 1 to 9, none could be attributed directly to the spruce budworm. Few signs of current budworm feeding were observed in any of the plots. It may be concluded from this study that there will not be a hazard by budworm to the residual timber in F2-L5 during 1972.

FIELD TESTS AND STUDIES

1. Field Tests of Synthetic Attractants of the Spruce Budworm

Two chemicals supplied by Dr. C. Sanders of the Canadian Forestry Service at Sault Ste. Marie, Ontario, were field-tested for attraction to male moths of the spruce budworm during July, 1971. Prior to mating and egg laying behaviour of the adult moths, the female emits a chemical substance (pheromone) which is attractive only to male spruce budworms, and thus serves to facilitate mate finding and successful mating. One of the chemicals synthesized above has since been shown to have attractant properties similar to that of the naturally occurring substance produced by the female.

The field tests of the two chemicals were carried out near Ft. McMurray where a light infestation of the spruce budworm was located in an accessible spruce stand. The results of the tests (Table 4) suggest that one of the chemicals (compound "A") competes favourably with the natural attractant. While the synthesis and identification of this compound cannot be regarded as a major breakthrough toward control of the spruce budworm, it has wide application as a field sampling tool to facilitate estimating abundance of moth populations. Further field tests of the synthetic attractant are planned in 1972.

Table 4. Spruce budworm attraction study July 6-28, 1971:

Ft. McMurray, Alberta

Attractant used in traps	No. of male moths captured	
	Plot 1	Plot 2
Compound "A"	149	173
Compound "B"	3	2
Virgin female moths	113	162
Control, no attractant	1	5

2. Field Studies of Budworm Damage to Spruce Regeneration

In the spring of 1971, 2000 white spruce seedlings (3-0 stock) were obtained from the Provincial Nursery at Oliver and planted on recently cutover sites, 28 miles west of High Level. Two plots were established, each with seedlings planted at 8-10 foot spacings. The study is part of an overall plan to investigate the survival and damage potential of the spruce budworm in regeneration spruce, particularly on clearcut areas which border on residual undisturbed stands of white spruce.

During outbreaks of the spruce budworm, the more mature stands of white spruce tend to be preferred for egg laying and usually suffer more severe damage than young stands. However, during the life cycle development of the budworm, three stages are known when dispersion takes place, namely first and second larval instars and as adult moths. The larvae descend on silken threads from the upper tree crown and may be wind-blown for considerable distances. The adults may also be wind-blown as well, or disperse by flight. Thus considerable tree damage and mortality may occur as result of dispersion into regeneration at times when budworm populations are hight.

Close watch will be maintained of spruce budworm population build-up within and along the edges of the residual mature timber and of insect-caused damage to the seedlings. A tally of the planted seedlings in August, 1971, indicated 50% survival in one plot and 62% survival in the other. Dry soil conditions at the time of planting and some mould development on the roots of seedlings are believed to be part of the cause of the relatively poor survival.

POPULATION SAMPLING

Studies were continued in early June, 1971 toward development of reliable sampling techniques for estimating spruce budworm abundance and to verify the distribution pattern of larvae within spruce tree crowns. Trees of similar size in two areas were chosen for study, one group at mile 28, the other group at mile 46 west of High Level. The live crown of each selected tree was divided into four equal height levels (designated as A, B, C and D; A being the uppermost level) and four branches were removed from each of the four levels for examination. Only the distal 18-inches of each branch was used and was designated the basic sample unit. All live buds were counted on each branch sample and then examined for budworm larvae and damage. Table 2 summarizes the characteristics of the 9 trees sampled while Table 3 gives mean totals of bud counts and mean percentages of live buds damaged per crown level. Total number of buds within the four crown levels were similar for the two areas.

The average number of live buds damaged per 18-inch branch tended to decrease down the crown from level A to level D. However, the incidence of bud damage expressed as a percentage of total live buds remained fairly constant between 8 and 15%. The mean percentage of damaged buds per tree crown was 11.35 at mile 28 and 10.24 at mile 46. Most of the bud damage at these two locations however, was not caused by the spruce budworm but by another defoliator species, probably black-headed budworm. The sampling data may therefore apply mainly

Table 2. Characteristics of white spruce trees sampled for spruce budworm populations west of High Level, June, 1971

Location	No. tree crowns sampled	Ave. d.b.h. (ins.)	Ave. total ht. (ft)	Ave. height live crown (ft)	Ave. age
Mile 28	5	7.9	65	31.6	83
Mile 46	4	8.3	69	29.5	103

Table 3. Summary of total live buds and incidence of damaged buds on 18-inch long branch samples from four levels of white spruce crowns west of High Level, June, 1971

Crown Level	Location: mile 46			Location: mile 28		
	Ave. no. live buds per 18-inch branch	Ave. no. damaged buds per branch	% live buds damaged per branch	Ave. no. live buds per 18-inch branch	Ave. no. damaged buds per branch	% live buds damaged per branch
A	81.0 ± 16.8*	8.81	10.9	87.1 ± 11.3	9.20	10.6
B	52.2 ± 8.8	5.31	10.2	65.4 ± 14.4	9.75	14.9
C	26.3 ± 3.5	3.19	12.1	44.7 ± 10.7	4.90	11.0
D	12.1 ± 5.5	.94	7.8	12.3 ± 6.0	1.10	8.9
Mean per tree crown			10.24%			11.35%

*Mean ± one standard error

to this species. Further work is necessary to separate damage of *C. fumiferana* from *A. variana* during early instar larvae. Larvae of *A. variana* were also observed in F2-L5, indicating its likely widespread occurrence in 1971. This study also pointed out a need to verify by ground checks those observations recorded as spruce budworm from aircraft.

ACKNOWLEDGEMENTS

Infestations of the spruce budworm in Alberta were monitored by J. Petty and R. M. Caltrell of the Forest Insect and Disease Survey. D. M. Kusch and F. J. Emond assisted in the collection and analyses of field data. The cooperation of the Alberta Forest Service in providing 2000 spruce seedlings, tools and assistance for planting, and a fixed-wing aircraft for aerial surveys in the Footner Lake Forest is kindly appreciated. Special thanks are extended to C. E. Geale, L. A. Glade, J. Molnar, and C. Grub, personnel with Alberta Forest Service who helped make arrangements for planting and aerial surveys.