1945
ANNUAL TECHNICAL REPORT

WINNIPEG LABORATORY
FOREST INSECT INVESTIGATIONS

SUBJECT INDEX

SUBJECT INDEX (CONTINUED)

SUBJECT INDEX (CONTINUED)

SUBJECT INDEX (CONTINUED)

SUBJECT INDEX (CONTINUED)

SUBJECT INDEX (CONTINUED)

I. INTRODUCTION

The year 1945-46 was highlighted by changes and additions to personnel which were inevitably accompanied by a partial reorganization and re-orientation of the research program. The technical staff was limited to four full-time and two part-time workers during the summer, and to four full-time workers during the winter. The original research program for the year, on the jack pine budworm and the European larch sawfly was, on the whole, brought to a successful conclusion despite personnel transfers and continuing difficulties and shortages imposed by post-war conditions.

H. A. Richmond's able leadership of the Winnipeg Laboratory was terminated by his transfer to Victoria, B.C. on August 1, 1945, as Officer-in-Charge of the Forest Insect Laboratory there. He was succeeded in Winnipeg by R. R. Lejeune. W. C. Mc Guffin continued in charge of the ever-expanding work of the Winnipeg Forest Insect Survey. Mrs. W. Barker assisted W. C. Mc Guffin and in addition supervised much of the winter work on the European larch sawfly. R. J. Heron, a seasonal assistant in 1944, has been employed continuously since May 1945, while summer assistance for field projects and the Forest Insect Survey was provided by two University of Manitoba students, W. Black and R. Wong. L. T. White, who was with the Winnipeg Laboratory prior to his enlistment in the R.C.A.F. in 1942, returned to the laboratory from December 1, 1945 to March 2, 1946. Mrs. E. Caplan, stenographer, terminated her work with the Department in August, 1945, and was replaced by Mrs. W. Cherrett.

A notable development was the employment of three Forest Insect Rangers, taken on at various intervals throughout the summer. These men will no doubt greatly augment the scope of the Forest Insect Survey, and have already provided invaluable assistance in the varied work of this laboratory.

The major accomplishments during the year fall into the three following categories: (1) budworm investigations, (2) European larch sawfly studies and (3) Forest Insect Survey.

Budworm investigations were curtailed somewhat, but the main part of the work was successfully continued.

Studies on host transfers and hybridization of the spruce and jack pine budworms, egg, larval and pupal population trends, the effect of pollen, surveys of larval and pupal parasites and sample plot examinations were pursued as usual. Hawk Lake, Ontario, was, as in past years, field headquarters for this work.

Investigations on the parasites of the European larch sawfly were greatly expanded. Mass collections of cocoons were made in strategic areas throughout Manitoba for dissection, rearing and study during the winter. Thousands of coooons have been examined and reared, and the unusual results obtained will no doubt have an important bearing on future work involving the use of parasites against this pest in Manitoba. Cocoon surveys and counts were enlarged to encompass new areas.

The Forest Insect Survey completed its biggest and most successful season to date. This was due in no small measure, to the increased assistance provided by the Insect Rangers. With the greater experience these men have now acquired and with further additions to the Ranger staff, it is anticipated that the value and volume of work of the Survey will be increased manifold. One excellent result already apparent is the more accurate mapping of important forest insects.

Added to these major problems, time was found to resume some studies on the jack pine tortoise scale, and to conduct D.D.T. banding experiments against the fall cankerworm.

Travel was hampered to some extent by transportation difficulties, and the necessity for closer supervision of the work being conducted by new men. For this reason some important inspection trips had to be cancelled. However, as much liaison as possible was maintained between co-operating agencies and this laboratory. Their advice and active assistance throughout the year is hereby gratefully acknowledged.

Several important trips and conferences were attended by officers of the laboratory. Mr. H. A. Richmond was in Ottawa for approximately two months in the spring of 1945, to help in the administrative work of the aircraft spraying program. Various members of the staff attended Entomological

conferences held in Winnipeg during June, and at Morden, Manitoba, in August. In November several sessions of the Entomological Society of Manitoba meetings were held in the Winnipeg Forest Insect Laboratory. R. R. Lejeune attended the western regional meeting of the Ontario Department of Lands and Forests at Kenora, Ontario, in November . R. R. Lejeune and L. T. White were present at the Annual Convention of the Canadian Society of Forest Engineers held in Regina, January 1946.

Despite the many difficulties of the past year, it is believed that the 1945-46 program of work was a success. Investigations on two important phases of the budworm problem were practically completed, and plans have been laid for new projects. A new site for the main field station was tentatively selected in Manitoba, to which it is proposed to transfer all the experimental work presently being carried on at Hawk Lake, Ontario. While not as much progress as was anticipated was made in the preparation of completed studies for publication, a serious effort will be made to do so at the earliest opportunity. It was a source of considerable satisfaction, however, to see the results of investigations on the deterioration of fire-killed white spruce by wood-boring insects in northern Saskatchewan published in the September issue of the Forestry Chronicle. An encouraging note is the definite improvement in the availability of personnel and equipment which augers well for the work of the coming year.

Respectfully submitted,

.R.R.LEJEUNE
Officer-in-Charge

II. ORGANIZATION

H.A. Richmond	SSE 281 - Assistant Entomologist in charge (April 1, 1945, to July 31, 1945).
R.R. Lejeune	SSE 3202 - Agricultural Assistant, Grade 11 (April 1, 1945 to July 31, 1945). in charge (August 1, 1945, to March 31, 1946).
W.C. Mc Guffin	SSE 258M - Agricultural Assistant, Grade 11 (April 1, 1945,to March 31,1946).
L.T. White	SSE 283M - Agricultural Assistant, Grade 11 (December 1, 1945, to February 28, 1946).
R.J. Heron	SSE 3038 - Agricultural Assistant, Grade 6 (May 7, 1945, to March 31,1946).
Mrs. W. Barker	SSE 3167 - Agricultural Assistant, Grade 7 (April 1, 1945, to March 31,1946).
W.F. Black	SSE-3100 - Agricultural Assistant, Grade 5 (May 7, 1945, to September 18,1945).
H.R. Wong	Extra Labour, Laboratory Assistant, (June 1, 1945,to September 29, 1945).
A.E.Anderson	SSE 3175 - Insect Ranger Grade 1, (April 27, 1945, to March 31, 1946).
P.O. Thomas	SSE 3176 - Insect Ranger Grade 1, (May 2, 1945, to March 31, 1946).
W.H. Durnin	SSE 3177 - Insect Ranger Grade 1, (May 21, 1945, to June 19, 1945).
V. Hildahl	SSE 3177 - Insect Ranger Grade 1, (June 30, 1945, to [illegible]
Mrs. E. Caplan	SSE 3147 - Stenographer Grade 2, (April 1, 1945, to August 21, 1945).
Mrs. W. Cherrett	SSE 3147 - Stenographer Grade 2, (August 1, 1945, to March 31, 1946).
C. Gibson	Extra Labour, Caretaker, (April 1, 1945, to March 31, 1946).

III BUDWORM INVESTIGATIONS

A. Status in 1945

1. Jack Pine Budworm

(a) General

The jack pine budworm, in general, continued to subside and has to all intents and purposes practically disappeared in two previous outbreak centres. The main budworm areas during 1945 were confined to the Sandilands Forest Reserve and the Whiteshell Forest Reserve, Manitoba. There is always the possibility of course, that these may be the source of renewed damage and defoliation. Smaller outbreaks were recorded at Seddon's Corner on the Trans-Canada highway, Sasagannigak Lake and south of Gypsumville, all in Manitoba.

(b) According to area.

Budworm was distributed throughout the Sandilands Forest Reserve with the heaviest defoliation recorded in the southern part in the vicinity of Reserve Headquarters. At the worst, however, damage here could be considered moderate and was generally confined to open growing stands. Nevertheless, severe defoliation is anticipated for 1946, as indicated by the fact that five small pines averaging eleven feet in height, examined in August 1945, yielded 8500 eggs per tree. A second area of less intense defoliation obtained in the Dawson Cabin area in the northern part of the reserve. The main damage here was apparently experienced by the fairly extensive regeneration which prevails in the stands examined. A very light infestation covered the remainder of the reserve. Beyond the reserve boundary, southeast to Sprague, only a trace of budworm was found in stands heavily defoliated during 1944.

Three areas of budworm infestation are known to exist in the Eastern Manitoba region. The main body is of medium intensity and located in the southeastern part of the Whiteshell Forest Reserve. It is roughly bounded on the south by the Trans-Canada highway, on the west by Mud Turtle Lake and on the north by a line running southeast from Redrock Lake through Nora Lake into Ontario. This part of the outbreak appears to be limited in extent by the availability of pure stands of jack pine. A small, isolated, but severe outbreak, which probably stems from the Whiteshell infestation, is still in progress at Seddon's Corner, east of Beausejour. To the north, pine budworm was recorded in relatively small numbers around the shore line of Sasa-

ginnigak Lake. It was impossible to determine the inland boundary accurately, but it was apparently neither extensive nor heavy.

The pine budworm was present in very limited numbers at two other points in Manitoba. In the first, twelve miles south of Gypsumville in the inter-lake area, a few pupae were found on jack pine growing on sand ridges. This particular area was similarly reported in 1944. The second, an extremely light infestation, on reproduction, is situated six and a half miles northwest of Mafeking.

Two previously troublesome outbreaks in Saskatchewan and Manitoba have subsided. In the Fort a la Corne provincial forest, there was evidence of light current defoliation in the area east and west of Twin Lake. Elsewhere in the Forest there appeared to be no budworm activity. Not a trace of budworm was to be found in the comparatively short-lived outbreak in Riding Mountain National Park, Manitoba.

There are still no records of this insect occurring in Alberta.

2. Spruce Budworm

The seven year old outbreak in the Spruce Woods Forest Reserve, Manitoba, continued to spread in 1945, although the intensity of defoliation remained much the same at a medium level. It has now extended its range from the west side of the Epinette swamp north west to Onah and in a southerly direction to the Assiniboine River. In the main, the infestation is spotty with islands of heavy defoliation occurring occasionally. The heaviest current damage was noted in the spruce around Onah. This area was visited and reported on by Mr. C.B. Gill of the Manitoba Forest Service. Despite the age of the infestation, there is no evidence of tree mortality or terminal killing in the Reserve.

While the Spruce Woods outbreak gives cause for concern, a much graver menace may threaten the spruce - balsam forests of Eastern Manitoba in the near future. The spruce budworm, which has caused such widespread destruction in eastern Canada, was discovered in 1945, in epidemic proportions at a point in Ontario, a bare sixty air miles from the Manitoba boundary due east of Lac du Bonnet.

Providing susceptible stands are available, it is reasonable to expect a spruce budworm outbreak to build up in this part of Manitoba during the next few years. It is indeed likely that it is already present in endemic numbers because during 1945 several specimens of spruce budworm larvae from black spruce were received from Sasaginnigak Lake. Co-operators in this area are therefore urged to do their utmost to detect the presence of this insect on spruce and balsam in 1946.

B. Biological Control of *Archips fumiferana* Clem.

1. The Budworm Pupal Survey

(a) Introduction:

In 1945 the collections of budworm pupae continued in about the same quantity as in 1944. In extent the 1945 survey was somewhat restricted. In some Ontario areas, previously sampled, budworm pupae were not found. Other areas in Ontario are now released to the Sault Ste. Marie Laboratory. In Manitoba and Saskatchewan, decreased budworm populations made collections, for the most part, impractical. A fair sampling was received from Sandilands Forest Reserve, but collections from other areas were small or lacking.

(b) Areas contributing:

Six study areas were included in the 1945 collections. Collections were continued from Sandilands Forest Reserve, Spruce Woods Forest Reserve, East Hawk Lake and Hudson, Ont. Additional samples were collected at West Hawk Lake and Seddon's Corner, Manitoba. Pupae from Hudson, Ont., were collected from an area not sprayed with DDT.

The source and number of pupae received during 1945 is indicated in the following table:

Table I

SOURCE AND NUMBER OF PUPAE RECEIVED IN THE 1945 BUDWORM PARASITE SURVEY

Locality	Collector	Service or Company	No. of Collections	No.of Pupae.
MANITOBA				
Sandilands F.R.	P.O.Thomas	Forest Insect Inv.	4	765
Spruce Woods F.R. *	H.A.Richmond, W.C. McGuffin, P.O.Thomas, V. Hildahl.	Forest Insect Inv.	1	2091
Seddon's Corner	R.R.Lejeune	Forest Insect Inv.	1	249
W.Hawk Lake	R.R.Lejeune	Forest Insect Inv.	1	91
ONTARIO				
E.Hawk Lake	V. Hildahl	Forest Insect Inv.	4	983
Hudson *	S. Luknuk; R.R. Lejeune W. Black	Ontario Dept. of Lands & Forest, and Forest Insect Investigations	1	1220
TOTALS			12	5339

* Spruce Budworm

(c) Organization:

The revised "Directions for Budworm Pupal Parasite Survey" as included in the 1944 Annual Report were followed in 1945.

(d) Analysis of Data:

(1) Parasites reared: The following parasites were reared from Budworm pupae in 1945. Species are listed in order of abundance:

Hymenoptera:

Itoplectis conquisitor (Say.)
Phaeogenes hariolus Cress.
Amblymerus verditer Nort.
Psychophagus tortricis Br.
Tetrastichus sp., near caeruleus Ashm.
Theronia atalantae (Poda)
Labrorychus sp.

Diptera:

Zenillia caesar, Aldrich.
Phryxe pecosensis (Townsend)
Nemorilla pyste Walker
Gymnophthalma interrupta (Curran)
Madremyia saundersii (Williston)
Phorocera erecta Coq.

One specimen of Theronia atalantae (Poda) from Hudson, Ont. and one specimen of Labrorychus sp. from Seddon's Corner, Manitoba, were reared.

A list of the species of Diptera (parasites of budworm) which have been identified is given below. The areas in which each species occurred is indicated. This list does not include all species recovered, as one specimen from Hudson, Ont. and one specimen from Spruce Woods Forest Reserve are not yet identified.

	Sandilands Forest Reserve	Spruce Woods Forest Reserve	Seddon's Corner Man.	West Hawk Lake, Man.	East Hawk Lake, Ont.	Hudson, Ont.
Zenillia Caesar (Aldrich)		x			x	x
Phryxe pecosensis (Tns.)		x			x	x
Nemorilla pyste Wlk.					x	
Gmnophthalma interrupta(Cn)	x	x				
Phorocera erecta Coq.					x	
Madremyia saundersii(Will.)		x				

(ii) Pupal parasitism for 1945: The degree of parasitism for all areas sampled during 1945 is set down in Table 2, which follows. Here mortality caused by parasites is considered as distinct from total mortality; and the total number of pupae minus those dead from other causes is taken as 100%. Methods used for determining degree of parasitism and other mortality follow those used in 1942, and set forth in the 1942 Annual Report, page 26.

TABLE NO. 2.

PERCENTAGE MORTALITY OF PUPAE FROM THE 1945 BUDWORM SURVEY

Area	Diptera	Itoplectis Conquisitor	Phaeogenes Hariolus	Chalcids	Miscell. Hymenoptera	TOTAL
MANITOBA						
Sandilands Forest Reserve	3.02	3.88	11.92	8.91	0.00	27.73
Spruce Woods For.Reserve*	5.30	12.23	0.87	0.22	0.00	18.62
Seddon's Corner **	2.18	2.62	29.69	2.62	0.44	37.55
W. Hawk Lake ***	2.38	5.95	19.05	1.19	0.00	28.57
ONTARIO						
E. Hawk Lake	2.30	6.13	13.91	0.66	0.11	23.11
Hudson *	10.80	28.74	0.10	0.10	0.10	39.84

* Spruce Budworm
** Small Collection - 249 pupae
*** Small Collection - 91 pupae

Table 2 depicts the number of pupae parasitised by Chalcids, but not the actual numbers of Chalcids emerging from the pupae. These figures are given in Table 3:

TABLE III

CHALCIDS REARED FROM 1945 BUDWORM PUPAL COLLECTIONS

Species Area	No. of Chalcids	Average no. per pupa
Amblymerus verditer Nort.		
Sandilands Forest Reserve	759	13
Spruce Woods Forest Reserve	22	11
Seddon's Corner, Manitoba	41	7
West Hawk Lake, Manitoba	18	18
East Hawk Lake, Ontario	122	14
Hudson, Ontario.	2	2
Psychophagus tortricis Br.		
Spruce Woods Forest Reserve	82	41
Tetrastrichus sp.		
Sandilands Forest Reserve	20	10

(III) Natural mortality of pupae: The percentage of pupae which died from causes other than parasitism is listed in Table 4.

TABLE 4

NATURAL MORTALITY OF PUPAE RECEIVED IN 1945

Area	% Natural Dead
Sandilands Forest Reserve	9.02
Spruce Woods Forest Reserve	12.43
Seddon's Corner	8.03
West Hawk Lake	7.69
East Hawk Lake, Ontario	7.12
Hudson, Ontario (non DDT area)	17.30

Examination of the pupae tabulated above was carried out again in an effort to determine the cause of their death. The methods used in 1944 were repeated. The condition of the pupae from which no emergences were found is recorded in Table 5, which follows. In this table "injured" refers to pupae showing mechanical injury; "containing moths" refers to pupae containing fully formed moths which failed to emerge; "shrivelled pupae" were small and dessicated, "diseased" pupae showed definite signs of fungus or bacteria; "others" included pupae which could not be classified. Here were recorded pupae which appeared normal in size and shape, but were hollow and without indication of the cause of death. As in 1944, the percentages included in this table are based on small samples, and because of this and the difficulty in correctly classifying the dried pupae, are subject to a large error. A further error may be found in the allocation of pupae to the category "diseased". A large sample of residual pupae from Sandilands Forest Reserve, Manitoba, was examined in 1938 by Dr. Brodie of the University of Manitoba. Main fungi groups found were Alternaria & Cladosporium. These are mainly saprophytic. No definitely parasitic fungi were isolated. Dr. Brodie further reported that his examination failed to reveal any bacteria which could be classed as parasitic and responsible for the death of the pupae.

TABLE V

CONDITION OF ALL UNEMERGED PUPAE

	No. of Pupae in Sample	No. of Unemerged Pupae	% Unemerged Pupae	Percentage Parasitised by Hymenoptera	by Diptera	TOTAL	% Injured	% Containing Moths	% Shrivelled	% Diseased	% Others
MANITOBA:											
Sandilands F. R.	765	69	9.02	14.49	1.45	15.94	2.89	20.29	17.29	2.89	40.58
Spruce Woods F. R.	2091	260	12.43	1.92	2.31	4.23	7.69	29.23	16.92	10.38	31.54
Seddon's Corner	249	20	8.03	15.00	10.00	25.00	5.00	20.00	25.00	10.00	15.00
West Hawk Lake	91	7	7.69	14.29	0.00	14.29	14.29	0.00	28.57	0.00	42.86
ONTARIO:											
East Hawk Lake	983	70	7.12	11.43	8.57	20.00	4.29	34.29	12.86	5.71	22.86
Hudson	1220	211	17.30	1.42	2.84	4.26	5.21	18.48	10.90	1.90	59.24

Table 6, which follows, is based on those unemerged pupae whose cause of death could be determined on examination. The number of pnemerged pupae minus those included in "others" is used as a basis for the percentage in this table. It is probable that this procedure provides a truer picture of actual "natural" mortality.

TABLE VI

CONDITION OF ALL UNEMERGED PUPAE WHERE CAUSE OF DEATH COULD BE DETERMINED ON EXAMINATION

	% Parasitised			%	%	%	%
	by Hymen-optera	by Diptera	Total	Injured	Containing Moths	Shrivelled	Diseased
Sandilands For.Res.	24.39	2.44	26.83	4.88	34.15	29.27	4.88
Spruce Woods For.Res.	2.81	3.37	6.18	11.24	42.69	24.72	15.17
Seddon's Corner	17.65	11.76	29.41	5.88	23.53	29.41	11.76
West Hawk Lake	25.00	0.00	25.00	25.00	0.00	50.00	0.00
East Hawk Lake	14.81	11.11	25.93	5.55	44.44	16.29	7.41
Hudson	3.49	6.98	10.47	12.79	45.35	26.74	4.65
AVERAGE	7.89	5.53	13.42	10.00	41.32	25.00	10.27

During 1945 an attempt was made to lower mortality due to so-called "natural" causes. Wooden cages previously used were ventilated with holes on the lower side and top. These holes were covered with fine wire mesh. Water was added every other day to the cages, using a small syringe which produced a fine vapour of moisture. In all but one comparable area the "natural dead" category was reduced from that of the previous year.

Area	"Natural Dead"	
	1944	1945
Sandilands Forest Reserve, Manitoba	12.00%	9.02%
Spruce Woods Forest Reserve, Manitoba	26.12%	12.43%
East Hawk Lake, Ontario.	9.69%	7.12%
Hudson, Ontario.	13.68%	17.30%

In addition to ventilation of cages; moisture relationships were investigated. For this purpose male pupae from East Hawk Lake were segregated into three samples of approximately equal numbers. These samples were reared separately in three cages under the following moisture conditions:

Cage 1: normal: watered every second day: 117 pupae ♂
Cage 2: watered each day: 113 pupae ♂
Cage 3: watered every third day: 114 pupae ♂

The following results were observed:

EMERGENCES:

PARASITE AND MOTH EMERGENCES

	Moths	Parasites	Totals
Cage I	65(55.55%)	38(32.48%)	103(88.03%)
Cage II	65(57.52%)	35(30.97%)	100(88.49%)
Cage III	66(57.89%)	36(31.58%)	102(89.47%)

There is little apparent difference in the emergence figures from these three cages; when measured by moth or parasite emergences, or both. Indeed, although the very slightly higher emergence occurred from the cage into which least moisture was introduced; the emergence figure for the cage into which most moisture was added was only 1% less. Emergence from the cage with an intermediate amount of moisture added was less than either of these. It was further noted that among the residual cage material certain moths, that had not entered the light trap, were found dead. Two were found in each of cages I and II, but III with least moisture content, contained six dead moths.

Residual material was further examined to determine the condition of "natural dead" pupae, with the following results:

RESIDUAL MATERIAL

	Hymen.	Diptera	Total Injured	Moths	Shriv.	Diseased	Others
Cage I	0	0	0	2	1	1	4
Cage II	3	0	3	0	1	3	1	2
Cage III	0	1	1	0	0	4	0	1
TOTALS	3	1	4	0	3	8	2	7

The percentage of cocoons in each cage, which failed to yield emergence, is shown below. These figures are based on the number of pupae placed in each cage for rearing, and are therefore not comparable to the natural mortality percentages calculated for the area on the basis of all the pupae received:

Cage I - 6.84%
Cage II - 8.85%
Cage III - 5.26%

From these figures it appears that the cage where the least water was added produced the least mortality. This definitely does not produce the results expected, since it was felt that inability of fully matured moths to emerge might be due to insufficient moisture.

(iv) Synchronization of Seasonal Appearance, Host & Parasite.

Object: To discover if the synchronization, or lack of synchronization in the seasonal appearance of either host or parasite influenced the degree of parasitism, the following experiment was carried out.

Method: The original plan to collect 100 pupae, daily for a considerable period, was not possible due to scarcity of pupae, lack of time, and limited personnel. All pupae were collected from a single locality at Hawk Lake, Ontario, known as "Post Office Point". They were segregated in Forest Insect Survey rearing jars, with a maximum of 25 pupae per jar. Pupae were retained for emergences of adult budworm and parasites. Unemerged pupae were examined and counted in the Winnipeg laboratory.

In determining the parasites which were present, the two (primary) pupal parasites for this area, Phaeogenes hariolus Cress. and Itoplectis conquisitor Say were divided according to sex. All Diptera were segregated without species determination. Three miscellaneous hymenopterous parasites were recorded. Identification and grouping followed the system outlined in the Revised Outline of directions included in the 1944 Annual report.

Collections began on 18 July, and continued at intervals over a period of two weeks.

Observations: The first record of jack pine budworm pupation in 1945 was recorded from a larval rearing cage on July 16. A further recorded observation indicates that pupation in the field was "nicely started " on July 18. It is possible that pupation commenced, in the field, between July 15 and July 18. It is unfortunate that no observations were made of the progress of pupation during that time.

The following table sets forth the emergences of reared budworm pupae:

TABLE VII

PARASITISM: JACK PINE BUDWORM: By Date Collected

Date of Collection	Collection No.	No. of Pupae	Emerged Moths	Unemerged Moths	Parasitism							
					Total	Precogenes ♂	Precogenes ♀	Itoplectis ♂	Itoplectis ♀	Diptera	Chalcids	Misc. Hym.
July 18	1	10	8	2	-	-	-	-	-	-	-	-
July 20	2	20	17	2	1	1	-	-	-	-	-	-
July 23	3(a)	27	19	1	7	3	-	1	3	-	-	-
	3(b)	27	16	2	9	3	-	3	3	-	-	-
July 24	4(a)	25	23	0	2	1	1	-	-	-	-	-
	4(b)	25	16	2	7	1	-	3	2	-	-	1
	4(c)	25	19	-	6	2	-	1	2	1	-	-
	4(d)	25	14	1	10	1	1	3	3	2	-	-
July 28	5	25	18	1	6	-	1	3	-	-	-	2
July 30	6	25	15	3	7	1	3	-	1	-	25♂ 11♀	-
July 31	7	25	17	1	7	-	5	-	2	-	-	-
TOTALS		259	182	15	62	13 (24)	11	14 (30)	16	3	2	3

Conclusions: The emergences set forth in the above table indicate that, in the small number of pupae collected, the two major pupal parasites occur in approximately the same numbers.

In view of the limited scale of this experiment, it is not practical to set down more than the following generalizations:

The estimated time of first pupation is between July 15 and 18. A male Phaeogenes hariolus was recorded in the collection of July 20, or an interval of between two to five days between first pupation and first record of parasitism. Larger samples, however, might have indicated earlier attacks by these two parasites, and the records obtained should be regarded as merely of a preliminary nature.

There appears to be a difference of only a few days in the times of recorded attack by the two main parasites.

Due to the very low level of occurrence of Diptera and other parasites in the sample examined, it is not possible to generalize about their occurrence.

There seems to be no specific time at which parasites concentrate upon budworm pupae; no exceedingly large number of any one parasite being found in any collection. Slight fluctuations from or even distribution may be attributed to the small size of the collections.

Comment: Several suggestions for future work should be considered in the light of the experience gained in this preliminary study. As it stands, the experiment will only give information on the approximate first dates of parasitism of budworm pupae. It will provide only a very rough picture of the progress of parasitism to its peak, and it will not show when the parasites ceased their activity.

It is proposed therefore, to change the method of sampling, and increase the size of the sample, in order to provide this information. This could be done by delineating a specific sample area, preferably heavily infested regeneration. This area could be examined at regular daily or two day intervals, at which time all pupae would be removed for rearing. Each collection of pupae would, of course, be reared separately. The size of the area to be sampled will depend on the degree of infestation, and the size of collections required, but regardless of the size, the whole area must be thoroughly examined at each inspection interval to remove all the pupae.

(v) Other Host-parasite Relations of the Budworm Pupal Survey:

Other relationships between host and parasite are dealt with in the following tables. These tables list data in the same manner as similar tables presented in all annual reports since the inception of the survey.

TABLE 8

PERCENTAGE MORTALITY OF MALE PUPAE IN 1945

Area	Itoplectis conquisitor	Phaeogenes hariolus	Diptera	Chalcids	Miscell.	Total Parasitised	Natural Dead	Total mortality
MANITOBA								
Sandilands For. Res.	2.62	12.79	2.62	9.84	0.00	27.87	10.82	38.69
Spruce Woods For. Res.	12.63	1.11	4.83	0.19	0.00	18.76	11.05	29.80
Seddon's Corner	3.51	34.21	2.63	3.51	0.88	44.74	7.02	51.75
West Hawk L.	3.03	18.18	3.03	3.03	0.00	27.27	3.03	30.30
ONTARIO								
East Hawk L.	6.54	13.51	2.40	1.31	0.22	23.96	5.23	29.19
Hudson	27.81	0.14	8.99	0.14	0.14	37.22	13.90	51.12

TABLE 9

PERCENTAGE MORTALITY OF FEMALE PUPAE IN 1945

Area	Itoplectis conquisitor	Phaeogenes hariolus	Chalcids Diptera	Chalcids Miscell.	Total parasitised	Natural Dead	Total mortality
MANITOBA							
Sandilands For. Res.	4.13	9.56	2.83	6.96	0.00	23.48	7.83	31.30
Spruce Woods For. Res.	8.68	0.39	4.44	0.20	0.00	13.71	13.90	27.61
Seddon's Corner	1.48	21.48	1.48	1.48	0.00	25.92	8.89	34.81
West Hawk L.	6.90	17.24	1.72	0.00	0.00	25.86	10.34	36.21
ONTARIO							
East Hawk L.	4.96	12.40	1.91	0.00	0.00	19.27	8.78	28.05
Hudson	18.11	0.00	8.86	0.00	0.00	26.97	22.05	49.02

TABLE 10

PERCENTAGE MORTALITY OF ALL PUPAE IN 1945

Area	Itoplectis conquisitor	Phaeogenes hariolus	Diptera	Chalcid	Miscell.	Total parasitised	Natural Dead	Total mortality
MANITOBA								
Sandilands For. Res.	3.53	10.85	2.74	8.10	0.00	25.23	9.02	34.25
Spruce Woods For. Res.	10.71	0.76	4.64	0.19	0.00	16.31	12.43	28.74
Seddon's Corner	2.41	27.31	2.01	2.41	0.40	34.54	8.03	42.57
West Hawk L.	5.49	17.58	2.20	1.10	0.00	26.37	7.69	34.06
ONTARIO								
East Hawk L.	5.70	12.92	2.14	0.61	0.10	21.46	7.12	28.58
Hudson	23.77	0.08	8.93	0.08	0.08	32.95	17.30	50.24

Sex Ratios of Archips fumiferana Clem. pupae; Phaeogenes hariolus Cress. and Itoplectis conquisitor (Say) emergents, are shown in Table 11, below. "Natural Dead" pupae were excluded from the computations.

Sex Ratios of Itoplectis conquisitor (Say) and Phaeogenes hariolus Cress. reared from male pupae and female pupae of Archips fumiferana Clem. are shown separately in Table 12.

TABLE XI

SEX RATIOS OF ARCHIPS FUMIFERANA, ITOPLECTIS CONQUISITOR AND PHAEOGENES HARIOLUS IN THE 1945 PUPAL SURVEY.

Area	Sex ratio of A. fumiferana	Sex ratio of I. conquisitor	Sex ratio of P. hariolus
MANITOBA			
Sandilands For. Res.	.609	0.888	0.744
Spruce Woods For. Res.	.477	0.554	0.750
Seddon's Corner	.537	1.000	0.552
West Hawk L.	.619	0.600	0.812
ONTARIO			
East Hawk L.	.524	0.714	0.567
Hudson	.392	0.228	- *

* One specimen only of P. hariolus in the Hudson sample.

TABLE XII

SEX RATIOS OF ITOPLECTIS CONQUISITOR AND PHAEOGENES HARIOLUS REARED FROM MALE AND FEMALE PUPAE OF ARCHIPS FUMIFERANA CLEM.

Area	MALE PUPAE		FEMALE PUPAE	
	I.conquisitor	P.hariolus	I.conquisitor	P.hariolus
MANITOBA				
Sandilands For. Res.	.875	.667	.895	.814
Spruce Woods For. Res.	.441	.750	.727	.750
Seddon's Corner	1.000	.308	1.000	.896
West Hawk L.	1.000	.833	.500	.800
ONTARIO				
East Hawk L.	.567	.306	.885	.815
Hudson	.192	- *	.304	- *

* One specimen only of P. hariolus in the Hudson sample.

Summary:

A total of 5,339 pupae from six study areas were received in the 1945 Budworm pupal survey. Of these 3311 pupae were received from two study areas of Spruce Budworm; and 2028 pupae were received from four study areas of Jack pine Budworm.

Parasites recovered from this material were:

Hymenoptera:

Phaeogenes hariolus (Cress.)
Itoplectis conquisitor (Say)
Amblymerus verditor, Nort.
Psychophagus tortricis Pt.
Tetrastrichus sp. near caeruleus Ashm.
Theronia atalantae (Poda)
Labrorychus sp.

Diptera:

Nemorilla pyste (Walker)
Zenillia caesar (Aldrich)
Phryxe pecosensis (Townsend)
Gymnophthalma interrupta (Curran)
Madremyia saundersii (Williston)
Phorocera erecta (Coq.)

Pupae mortality from parasitism and from natural causes in six sample areas is set forth below:

Area	% Parasitism	% Natural Mortality	% Total Mortality
MANITOBA			
Sandilands For. Res.	25.23	9.02	34.25
Spruce Woods For. Res.	16.31	12.43	28.74
Seddon's Corner	34.54	8.03	42.57
West Hawk L.	26.37	7.69	34.06
ONTARIO			
East Hawk L.	21.46	7.12	28.58
Hudson	32.95	17.30	50.24

Four of the six sample areas (Sandilands Forest Reserve, Spruce Woods Forest Reserve, East Hawk Lake and Hudson) were sampled in 1944. Parasitism in 1945 remained the same at the Spruce Woods Forest Reserve and at East Hawk Lake. At Hudson, Ontario, parasitism (by all agents) increased by approximately 13%; the increase being due to a marked increase in the numbers of Itoplectis conquisitor, and a slight increase in the numbers of Diptera. At the Sandilands Forest Reserve parasitism decreased by over 9%. This decrease was mainly attributable to a drop in parasitism by Itoplectis conquisitor, which had shown a marked increase in that area during the previous year. This decrease was somewhat offset by a 4% increase in percentage parasitism by Phaeogenes hariolus and a marked increase (7%) in percentage parasitism by Chalcids.

Percentage parasitism by Phaeogenes at the Spruce Woods Forest Reserve reverted to less than 1% and was also less than 1% in the other area of Spruce Budworm, sampled at Hudson, Ont.

Parasitism by Diptera dropped in all areas except Hudson, Ontario, where the increase was only 3%.

A marked increase in the degree of parasitism effected by Chalcids was recorded at the Sandilands Forest Reserve; elsewhere there was little change.

2. Larval Parasites

(a) Methods.

Determination of larval parasitism of the jack pine budworm at localities in Western Ontario, and Manitoba, was undertaken this year by the dissection of preserved larvae. This system had previously been employed with success in 1943 and 1944. The larvae were collected while the majority of those in the field were in the fourth, fifth or earlier stadia. It is following these stadia that the parasite larvae emerge from their host to pupate. In the course of collections, any parasite cocoons or early budworm pupae that were encountered were included.

An aggregate collection of fairly substantial size was obtained from the Hawk Lake, Ont. area, while smaller samples were taken at Mahree Lake, Ontario (on the Trans-Canada Highway) and West Hawk Lake, Manitoba.

The larvae were preserved in Frehling's solution as collected, and dissections were made during the winter of 1945-46. In the course of these dissections, the parasite larvae were identified and recorded either as Hymenoptera or Diptera, and further data as to host, larval instars and sex, where easily definable, was also recorded.

(b) Results.

The following table summarizes the results of the dissections:-

DISSECTION OF JACK PINE BUDWORM FOR LARVAL PARASITES

TABLE I — Area 1 : Hawk Lake, Ontario.

Date of Collection	No. of Larvae Dissected	No. of Larvae Parasitised by:-			Instances of double Parasitism		% Effective Parasitism		
		Hymen.	Diptera	Both Hymen.& Diptera	By Hymen.	By Diptera	Hymen.	Diptera	Total
June 28	55	9	16	0	0	1	16.4	29.1	45.5
July 4	164	36	5	0	0	0	21.9	3.0	25.0
July 4	73	10	1	0	0	0	13.7	1.4	15.1
July 6	44	12	3	0	0	0	27.2	6.8	34.1
July 10	57	18	2	0	0	0	31.6	3.5	35.1
July 11	220-	55	7	0	0	0	25.0	3.2	28.2
July 14	74	31	1	0	1	0	41.8	1.3	43.1
Total	687 (632)*	171 (162)	35 (19)	0	1	1(0)			
Mean.							24.9 (25.6)	5.1 (3.3)	30. (28.9)

* Figures in brackets represent totals or means when Sample 1 (June 28) is omitted.

TABLE II

Area 2 MAHREE LAKE, Ont.

Date of Collection	No. of larvae Dissected	No. of larvae parasitised by:			Instances of double Parasitism		% Effective Parasitism		
		Hymen.	Dipt.	Both Hym.&Dipt.	By Hymen.	By Diptera	Hymen.	Dipt.	Total
July 7	143	17	6	0	0	0	11.9	4.2	16.1

TABLE III

Area 3 WEST HAWK LAKE, Man.

Date of Collection	No. of larvae Dissected	No. of larvae parasitised by:			Instances of double Parasitism		% Effective Parasitism		
		Hymen.	Dipt.	Both Hym.&Dipt.	By Hymen.	By Diptera	Hymen.	Dipt.	Total
July 17	103	22	4	0	0	0	21.4	3.9	25.2

In the course of the 1943 and 1944 dissections, no instances of parasitised larvae with male gonads were discovered. This year's dissections, however, revealed a number of parasitised larvae with well defined testes. (Some of these male larvae contained hymenopterous larvae while others had been parasitised by diptera.) In most cases, however, the organs were in various stages of atrophy. A previous suggestion of a distinct unisexual host preference, on the part of the budworm larval parasites, is therefore discounted. The presence of a parasite larva in the body cavity of the male budworm (and possibly in the case of the female also) definitely appears to retard or restrict gonad development, and to a considerable degree. Thus determination of sex in a parasitised larva is often very difficult.

While pupal population counts of the budworm at Hawk Lake, Ontario, were underway, records were kept of the parasite cocoons encountered on the sample branches. This data is of value in estimating the relative abundance of the two main indigenous larval parasite genera Apanteles and Glypta.

The following table (IV) summarizes the data obtained pertaining to the occurrence of these parasite cocoons.

TABLE IV

Larval Parasites - Hawk Lake, Ontario, based on cocoons collected during pupal population counts.

TREE NO. (Pupal Counts)	Top ½ (200 term.)				Bottom ½ (200 term.)			
	No. of Glypta Cocoons	No. of Apanteles Cocoons	No. of Misc. Hymen. Cocoons	No. of Diptera Codcons	No.of Glypta Cocoons	No. of Apanteles Cocoons	No.of Misc. Hymen. Cocoons	No. of Diptera Cocoons
1	2	1	1	1	0	4	0	0
2	0	0	0	0	0	0	0	0
3	0	1	0	0	0	0	0	0
4	0	1	0	0	0	1	0	0
5	0	0	0	0	0	1	3	0
6	0	0	0	0	0	0	0	0
7	1	1	0	0	2	7	0	0
8	0	6	0	0	0	4	0	0
9	1	7	0	0	1	1	0	0
10	1	3	0	0	0	2	0	0
11	0	1	0	0	0	1	2	0
12	0	2	0	0	0	0	0	0
Totals	5	23	1	1	3	21	5	0

The ratio of the total number of Apanteles cocoons encountered to the total Glypta is Apanteles/Glypta = 5.5/1. This ratio is considerably more in favor of Apanteles than the ratio obtained last year by the same method. The 1944 ratio was 2/1.

In view of the fact that the 1945 larval populations were much smaller than those of 1944, it seems quite possible this differential shift of the ratio Apanteles/Glypta is related to the relative effectiveness of Glypta and Apanteles at low host density. It is suggested that Glypta fumiferanae is not able to sustain itself at low host density. The following tabular summary of data secured since 1939 (Table V) would appear to lend some support to this. These data, however, are not comparable in some respects, as the method used to determine the percentage parasitism was not uniform, throughout the entire period.

Note that Apanteles fumiferanae was first encountered in 1939, and has maintained itself at a reasonably effective level up to the present, even during years such as 1941, 1942 and 1945, when the host larval populations were very low. In contrast to this Glypta fumiferanae Vier. was not encountered in the "Larval Survey"* until 1944, a year of peak host larval density. The considerable decrease in host population evidenced in 1945 has, as previously mentioned, reflected a considerable decline in successful parasitism by Glypta.

Egg counts made at Hawk Lake, Ont. in 1945 indicate that the budworm population will be at an even lower level in 1946 than in 1945. It will be of considerable interest to observe the reaction of Glypta to this condition.

Glypta appears to be a very important parasite of the budworm when the latter is present in large numbers, but to be effective following periods of low host density, during the initial stages of epidemics, it is possible that it would have to be aided by introductions.

* One specimen of Glypta fumiferanae Vier. was reared from a collection of 250 jack pine budworm larvae received from Hawk Lake, Ont. by the Forest Insect Survey in 1941.

TABLE V Records of larval Parasitism, Hawk Lake, Ont., 1939-1945 inclusive

Asterisk (*) indicates presence of Glypta.

Year	No. of Larvae	Total larval parasitism in %	Method used to determine degree of parasitism	Larval Population expressed in nos. of larvae per 100 term.	Parasites encountered and relative abundance
1938	?	3.5	Rearing	----	Meteorus trachynotus & Diptera were the only larval parasites.
1939	?	3.6	Rearing	----	Parasitism solely due to Apanteles fumiferanae
1940	100 to 200	12.6	Rearing	----	Parasitism due to A. fumiferanae, and Campoplex algonquinorum.
1941	241	8.7	Rearing	4.2	Parasites encountered: 16 Braconids (probably A.fumiferanae) & 5 diptera.
1942	?	9.7	Rearing	7.4	Parasites encountered: 6 A. fumiferana, 2 Campoplegidea sp., 5 Diptera.
1943	990	17.3	Dissection	22.9	A. fumiferanae was the only hymenopterous parasite reared, in addition there were a few Diptera.
1944	150	24.7	Dissection	30.2	Both Apanteles & *Glypta fumiferanae Vier. were present also a few Diptera. Ratio: Apanteles/Glypta: 2/1
1945	687	30.0	Dissections	7.6	Both Apanteles and *Glypta present, also some Diptera: Ratio: Apanteles/Glypta: 5.5/1

(c) Conclusions.

The total effective parasitism at Hawk Lake, Ont. in 1945, as determined by dissection of 687 larvae was 30%, an increase of 5.3% over last year's figure. This increase is largely due to an increase from 1.4 % to 5.1% in dipterous parasitism. The figure for dipterous parasitism tends to be an overestimate of the mortality due to the very high incidence of diptera in one small collection of larvae, i.e. the June 28 collection. As seen by the bracketed figures in the above table, however, when this sample is disregarded the overall picture of percentage parasitism is not greatly changed.

The relatively small sample of 143 larvae from Mahree Lake, Ont. on the Trans-Canada Highway just west of Hawk Lake, Ont., on dissection gave a total effective larval parasitism of 16.1%. This is quite a difference from the 30% for Hawk Lake, although the two areas are approximately only 1⅛ miles apart. No figures are available for the budworm population at Mahree Lake, but observation at various times throughout the season indicated that it was at least as heavy as that of the Hawk Lake area.

The 103 larvae from West Hawk Lake, Man., on dissection revealed a total larval parasitism of 25.2%, hymenopterous parasitism 21.4%, dipterous parasitism 3.9%. This is the first record that has been made of budworm larval parasitism in this area of Manitoba. No records of species are available from these last two areas.

3. Egg Parasites

Data pertaining to egg parasites of the jack pine budworm at Hawk Lake, Ontario, during 1945, are presented under "C . Population Studies" this year. On examination of 4,000 terminals only 7 egg clusters were encountered. On examining these clusters no indications of parasitism were revealed by the 299 eggs.

4. Summary

Budworm larval parasitism at Hawk Lake and Mahree Lake in Ontario and at West Hawk Lake in Manitoba was determined by dissection of larvae. The total larval parasitism in the three areas was respectively 30%, 16.1% and 25.2%. For the first time since these dissections were initially undertaken in 1943, parasitized larvae with male gonads were encountered, although even in these instances, the testes were often greatly atrophied.

The ratio of Apanteles:Glypta cocoons encountered in the course of budworm pupal collections was 5.5/1. On the basis of past records it is suggested that Glypta fumiferana Vier. may only be able to maintain itself at fairly high host density.

The egg survey revealed no cases of egg parasitism. This is not surprising in view of the small numbers of eggs that were encountered.

C. Population Studies

Systematic sampling of larval pupal and egg populations of the jack pine budworm at Hawk Lake, Ontario, was undertaken again in 1945. The correlation of the population figures obtained from these counts, with other data pertaining to jack pine pollen production and degree of parasitism of the various stages, reveals something of the trends of population dynamics within this area.

1. Larval Counts

The procedure used in making larval counts was identical with that used in the summer of 1944 (see 1944 Annual Technical Report., Winnipeg Lab., Forest Insect Investigations, p. 51). Similarly a survey of staminate cone-bearing trees in the area, to determine their percentage occurrence, was also made. The formula used in reaching the final calculated larval population is the same as was used in previous years. A full discussion of this formula will be found in the 1942 Ann. Tech. Report (p. 44)

The following table (Table I) summarizes larval population counts made at Hawk Lake, Ont., in 1944. Each sample from either top or bottom is a composite of 2 replicates of 50 terminals each.

From the data in this table, the mean number of larvae per hundred terminals, for the three classes of staminate trees have been calculated as follows:-

Non-staminate 6.80
Lightly staminate 6.58
Heavily staminate 17.5

An estimation of the percentage distribution of staminate trees was made again this year by means of a survey of 785 trees in the same three selected sites as in 1944 (i.e. campsite area, Post Office Point and Dead Horse Point). The percentage arrived at, together with the figures for 1944, are as follows:

	1945	1944
Heavily Staminate	1.27%	14.31%
Lightly Staminate	8.28%	16.70%
Non-Staminate	90.45%	68.99%

TABLE 1

HAWK LAKE ONTARIO LARVAL COUNTS JUNE & JULY 1945.

TREE NO.	STAMINATE CONES	LOCATION OF SAMPLE	NO. OF STAMINATE CONES	LARVAE	TERMINAL BUDS	LARVAE	TOTAL TERMINALS	TOTAL LARVAE	LARVAE PER 100 TERMINALS
1.	Light	Top	4	2	96	3	100	5	5
1.	Light	Bottom	0	0	100	4	100	4	4
2.	None	Top	0	0	100	5	100	5	5
2	None	Bottom	0	0	100	6	100	6	6
3.	None	Top	0	0	100	2	100	2	2
3	None	Bottom	0	0	100	4	100	4	4
4	None	Top	2	5	98	9	100	14	14
4	None	Bottom	0	0	100	4	100	4	4
5	None	Top	0	0	100	4	100	4	4
5	None	Bottom	0	0	100	1	100	1	1
6	None	Top	0	0	100	0	100	0	0
6	None	Bottom	0	0	100	4	100	4	4
7	Light	Top	1	1	99	0	100	1	1
7	Light	Bottom	5	1	95	0	100	1	1
8	None	Top	0	0	100	4	100	4	4
8	None	Bottom	0	0	100	1	100	1	1
9	None	Top	0	0	100	5	100	5	5
9	None	Bottom	0	0	100	3	100	3	3
10	None	Top	0	0	100	8	100	8	8
10	None	B ottom	0	0	100	0	100	0	0
11	Heavy	Top	19	5	81	9	100	14	14
11	Heavy	Bottom	16	4	84	7	100	11	11
12	Heavy	Top	32	20	68	5	100	25	25
12	Heavy	Bottom	13	10	87	10	100	20	20
13	Light	Top	20	3	80	4	100	7	7
13	Light	Bottom	5	1	95	3	100	4	4
14	Light	Top	11	3	89	10	100	13	13
14	Light	Bottom	22	10	78	8	100	18	18
15	Light	Top	6	1	94	4	100	5	5
15	Light	Bottom	3	1	97	6	100	7	7
16	None	Top	0	0	100	3	100	3	3
16	None	Bottom	0	0	92	2	92	2	2.2
17	Light	Top	9	5	91	4	100	9	9
17	Light	Bottom	4	0	96	5	100	5	5
18	None	Top	0	0	100	25	100	25	25
18	None	Bottom	0	0	100	10	100	10	10
19	None	Top	0	0	100	4	100	4	4
19	None	Bottom	0	0	100	13	100	13	13
20	None	Top	0	0	100	6	100	6	6
20	None	Bottom	0	0	100	4	100	4	4
21	None	Top	0	0	100	11	100	11	11
21	None	Bottom	0	0	100	14	100	14	14
22	None	Top	2	0	98	17	100	17	17
22	None	Bottom	0	0	100	10	100	10	10
23	None	Top	0	0	100	0	100	0	0
23	None	Bottom	0	0	100	3	100	3	3
24	None	Top	0	0	100	17	100	17	17
24	None	Bottom	0	0	100	18	100	18	18
25	None	Top	0	0	100	6	100	6	6
25	None	Bottom	0	0	100	3	300	3	3

Comparison of these figures reveals a somewhat considerable inter-annual variation in pollen production. This is a factor which has not been previously noted in the reports of this laboratory bearing on this phase of budworm bionomics. As the percentages arrived at are based on purely ocular and subjective estimations, they are necessarily subject to the limitations inherent in such approximations, and cannot be considered definitive, they are nevertheless indicative of the trends.

By means of the above mentioned formula, the average larval population at Hawk Lake, Ontario, for 1945 was calculated as follows:-

Larvae per 100 terminals =

$$\frac{(1.27 \times 17.5) + (6.28 \times 6.58) + (90.45 \times 6.80)}{100}$$

$$= 6.91$$

This small number of larvae is a considerable decrease from the figures for 1944 (30.18) and 1943 (22.85). T This greatly decreased population density was due in part to the small number of eggs laid in 1944, and the apparent heavy overwintering mortality.

2. Pupal Counts

The method followed in making pupal counts was exactly the same as that used for making larval counts. Records were kept of the number, of sound pupae, emerged pupae, predatorized pupae, late budworm larvae and larval parasite cocoons. No calculations made on the basis of percentage staminate trees were made use of in these population estimations, as the pollen factor appears to have no effect on their distribution.

The replicate size (pupal counts) was increased from 50 to 100 terminals this summer, to determine whether this would give a more reliable estimate of the pupal population. This was undertaken as a result of analyses of last year's data which indicated that a sample of 50 terminals was not sufficiently large to show significant correlation between replicates from the same sample area (top or bottom) of a tree.

Twelve trees were sampled during the pupal count. Table 2 summarizes the data obtained. In this table the figures are so recorded as to indicate the total number of pupae when sound pupae, parasitized pupae, predatorized pupae, empty pupal skins and living larvae are included, and also the number when pupae destroyed by predators are excluded. The inclusion of predator destroyed pupae makes a significant difference in the average number of pupae per hundred terminals. By applying the figures for percentage pupal parasitism (See Pupal Survey Report) to the total when predatorized pupae are excluded, the definitive pupal population can be calculated.

Table 2.

HAWK LAKE PUPAL COUNTS, 1945

Tree No.	Top Half		Bottom Half	
	Terminals examined	Budworm recorded	Terminals examined	Budworm recorded
1	200	2	200	0
2	200	0	200	0
3	200	0	200	0
4	200	1	200	0
5	200	0	200	0
6	200	0	200	0
7	200	1	200	0
8	200	0(2)*	200	4(5)
9	200	1	200	0
10	200	1	200	(1)
11	200	1	200	1
12	200	0	200	0
Totals	2400	7(9)	2400	5(7)

* The numbers in brackets represent the total no. of pupae when predatorized pupae are included.

Disregarding the incidence of staminate trees the average pupal population calculated from the above data (Table 2) was 0.19 pupae per 100 terminals, (0.31 pupae per 100 terminals when predatorized pupae are included). This constitutes a decrease of 97% from the estimated mean larval population. Larval parasitism and larval and pupal predation accounts for some of this decrease. In particular a Pentatomid (Podisus placidus Uhler) in nymphal and adult form (particularly nymphs), was found to be fairly prevalent (see Biol.Control). However the decrease is too great to be accounted for by larval parasitism and predation alone. A similarly large mortality during this period was indicated by last year's counts, and at that time it was suggested that it would be wise to check the accuracy of the pupal count. As mentioned earlier, the pupal counts were not found entirely reliable when subjected to analysis. An attempt to rectify this situation was made by increasing the size of the replicates (from 50 to 100 terminals); in view of the small population it is possible that this was not sufficient. On the other hand it is very probable that other factors which have not been observed or evaluated are effecting considerable mortality during this period. A discussion of this latter possibility more properly comes under the division of the report denoted "Biological Control".

TABLE 3

HAWK LAKE REPLICATE LARVAL COUNTS

TREE NO.	TOP 1/2 NUMBER OF LARVAE		BOTTOM 1/2 NUMBER OF LARVAE	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
1	0	5	4	0
2	4	1	3	3
3	1	1	1	3
4	8	6	2	2
5	2	2	1	0
6	0	0	1	3
7	0	1	0	1
8	1	3	1	0
9	3	2	1	2
10	5	3	0	0
11	6	8	5	6
12	3	22	15	5
13	2	5	2	2
14	6	7	9	9
15	2	3	2	5
16	2	1	0	2
17	8	1	3	2
18	14	11	5	5
19	1	3	8	5
20	1	5	1	3
21	4	7	2	12
22	5	12	4	6
23	0	0	2	1
24	6	11	13	5
25	3	3	2	1

TABLE 4

HAWK LAKE REPLICATE PUPAL COUNTS

Tree No.	Top Half		Bottom Half	
	Number of Pupae		Number of Pupae	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
1	1	1	0	0
2	0	0	0	0
3	0	0	0	0
4	1	0	0	0
5	0	0	0	0
6	0	0	0	0
7	1	0	0	0
8	0 (1)*	0 (1)	1	3 (4)
9	0	1	0	0
10	1	0	0	0 (1)
11	1	0	1	0
12	0	0	0	0
Totals	5 (6)	2 (3)	2	3 (5)

* The numbers in brackets represent the total no. of pupae when predatorized pupae are included.

3. Analysis of larval and pupal population data.

The replicate larval and pupal counts were again examined statistically by the use of correlation coefficients to determine the relation of replicate samples to each other. Replicates were considered as paired x and y values and the following correlation formula was employed:-

$$r_{xy} = \frac{N(xy) - T_x T_y}{\sqrt{(N(x^2) - T_x^2)\ (N(y^2) - T_y^2)}},$$

The larval correlations for the upper and lower half of the 25 trees examined were easily computed. An inspection of the pupal count, on the other hand, shows that many of the replicate pairs yielded no pupae. Obviously the number of budworm recorded in the sample was too small to permit the calculation of normal correlation coefficients and they have, for this reason, been omitted. It appeared from the sampling conducted in 1944, when the pupae population was appreciably higher than in 1945, that 50 terminals per sample were inadequate, and this number was accordingly increased to 100 in 1945. By that time, however, the pupal population had reached such a low level that even the larger sample seemed far too small to depict accurately the true level.

The correlation coefficients of the larval counts and their significance is indicated in the following:-

TABLE 5

LOCATION	Correlation Coefficient	"t" value	5% pt.	1% pt.	Significance
Upper 1/2	.408	2.14	2.07	2.81	Fair
Lower 1/2	.449	2.41	2.07	2.81	Fair

It is noteworthy that, despite an increase in the number of trees sampled, from 19 in 1944 to 25 in 1945, with a consequent theoretical increase in precision, the significance of the correlation coefficient was not as good in 1945. In both instances, the "t" values fall between the 5% and 1% points. Taking the 5% point as the minimum required level of significance, it will be observed that the "t" value for the upper ½ barely exceeds this level.

It seems reasonable to attribute the decrease in correlation to the decline in the budworm population. The analysis also indicates that the population in 1945 is the minimum level at which a statistically reliable picture of the population can be obtained in the number of trees sampled with the size of replications used. In other words it could be stated, with reservations, that in order to obtain a statistically accurate sample of the budworm population in a series of trees, when the population is roughly 7 per 100 terminals or over, at least 25 trees should be examined with a minimum of 2 replications of 50 terminals each from both the upper and lower strata of each tree. Should the budworm population fall below this level, either the number of trees, number of replications or size of the replications should be increased. It is probable, in the present instance, that by varying the number of trees sampled with corresponding variations in the size of the replications, so long as the total number of terminals examined was the same, that the net statistical picture would remain essentially unchanged. It should be emphasized that these counts are simply a good estimate of the population in the trees sampled, and should not necessarily be regarded as being a reliable estimate of the parameter or true population of the area. Therefore, if any variations in number of trees and size of sample is contemplated, it is suggested that the number of trees sampled be increased, and the size of the replications reduced in order that a more widespread sampling of the area be accomplished.

4. Egg Counts

Egg counts in 1945 were carried out in the same manner as in 1944. Two sample branches of 100 terminals each were taken from both the top and bottom halves of ten trees, and examined for egg clusters. Details as to the height, crown class, D.B.H., staminate cones and foliage density were recorded for each tree. Unhatched egg clusters were kept for larval emergence and then preserved in Frehling's solution, empty clusters were retained for egg counts. Examination of clusters to determine number of eggs, parasitism etc., was made during the winter.

Due to the small numbers of egg clusters which were found an alternate method was given a trial, in which a small tree was cut down and examined in its entirety for egg clusters. As none were found, and as time was limited, this method was abandoned.

The following data embodies the results obtained by the first mentioned method:-

Trees examined	10
Branches examined	40
Terminals examined	4,000
Egg clusters obtained	7
Eggs obtained	299
Eggs destroyed by parasites	0.0%
Sound eggs	100.0%
Infested eggs	0.0%
Avg. no. of eggs per cluster	42.7
" " " " " branch	7.5
" " " clusters per branch	0.18
" " " eggs per 100 terminals .	7.48

The average number of eggs per 100 terminals is considerably less than the figures for any one of the last three years which are listed here for comparison:-

1942 ..... 214 eggs per 100 terminals
1943 ..... 148 " " " "
1944 ..... 34.2 " " " "

5. Summary

Larval and pupal counts were made again at Hawk Lake, Ont., in 1945, larval counts for the 5th consecutive year and pupal counts for the 2nd consecutive year. The larval population averaged 6.9 larvae/100 terminals for 25 trees and pupal population 0.19 pupae/100 terminals (0.31 pupae/100 terminals when pupae destroyed by predators are included) for 12 trees.

The data for larval and pupal counts were subjected to analysis. The significance of correlation between the replicate samples of the larval count was found to be fair, as the small population was compensated by an increase the number of trees examined. The number of individuals occurring in the pupal count (often 0 per replicate) was found to be too small to determine if it depicted the true population level.

Four replicate branches, each bearing 100 terminals, were taken from 10 trees selected at random. These were examined for egg clusters. In all only 7 clusters were obtained, averaging 42.7 eggs per cluster. The results of the survey reveal a very low population figure of 7.5 eggs per 100 terminals for 1945.

D. Rearing, Feeding and Breeding Studies

1. Host Transfer Study

This study was initially undertaken in 1942, and has been continued through to the present with new transfers being made in each successive summer, including 1945. None of the 1942 transfers are extant, but some from each of the other years have been successfully continued. The standardized experimental procedure adopted and the system of nomenclature used is outlined in the 1943 Ann. Tech. Report pp. 86-89.

The present report embodies only a summary of the 1945 data with the inclusion of a few pertinent observations. No attempt has been made here to analyze the data as it is felt that this can be more effectively and satisfactorily carried out in the light of future rearings, and the resultant cumulation of data.

Included in this section are the data pertaining to the jack pine to jack pine transfers which are mainly concerned with determining the importance of pollen in relation to survival and fecundity.

Notes on the Host Transfer Study:-

(a) In the course of rearings of spruce budworm larvae on jack pine, made in the summers of 1942 and 1943, it was found that it was possible to mature at least a few moths and that these adults were capable of laying viable eggs. However, it was found that attempts to over-winter these larvae on jackpine were invariably unsuccessful.

In the Ann. Tech. Report for 1943 it was suggested (p.87) that this complete mortality was due to the fact that the larvae which survived over the winter probably emerged before the unexpended jack pine terminals were suitable for their purposes.

In an attempt to test this supposition, the egg clusters of the 1944 rearings of spruce budworm on jack pine were split into two portions. During the winter of 1944-45, one of these portions was overwintered on a jack pine seedling (cage 45B) as in former years, and the remainder overwintered on a balsam seedling (cage 45A). As noted in previous years, the larvae hibernating on jack pine failed to overwinter apparently due to their inability to establish themselves on emergence from their

hibernaculae, whereas those overwintered on balsam emerged in the spring and were first noticed on May 17, at which time they were actively mining needles. On June 12 and 13 the needling was examined, and 95 larvae (mainly in the 4th stadium*) were recovered and subsequently placed in jars and reared on jack pine. (An additional 5 larvae in the fourth stadium were found shrivelled and limp in the healthy terminals.)

On May 17 three larvae were observed in the cage overwintered on jack pine but on June 29, when the cage was examined, only one larva was recovered and when it pupated on July 23 it was found to be of the jack pine form.

It seems apparent, therefore, that the failure of spruce budworm larvae to successfully overwinter on jack pine is due to their premature emergence with reference to their substituted host (which is particularly important in view of their apparent inability to mine jack pine needle); in other words the larvae have through generations developed a synchronization in growth which parallels that of their natural hosts, and do not readily adapt themselves to new hosts whose development is not coincident with the normal one.

The 1945 rearings of spruce budworm on jack pine are being overwintered on balsam as a result of the above findings. Retransfer of these larvae to jack pine as early in the spring as terminal development will permit will then be undertaken.

(b) Needle mining of spruce budworm larvae

Active mining of needles by larvae shortly after their emergence from their hibernaculae has been noted as being a widespread habit among the spruce type larvae. In the course of observations and studies made by this laboratory, however, no instances of such activity have been observed among jack-pine budworm larvae. (Orr and Wygant, in a recent paper, mention that A. fumiferana larvae feeding on Ponderosa pine in Colorado commonly mine the needles in the spring, but in so doing restrict themselves to one or few more, and do not mine several as do those on fir and spruce).

* Development of these larvae corresponds with that of the spruce form, and not the jack pine forms which lagged by approximately 12-14 days at this time.

In the following table all the cages overwintered during 1944-45, which contained spruce budworm larvae, are listed, and notes re the needle mining habits are given:

NEEDLE-MINING OF SPRUCE BUDWORM (Spring 1945)

Cage	Designation	Date on which needle-mining activities were observed.	Remarks pertaining to the extent of needle-mining
33	Sw-Ab:Go '43	May 17, May 22	Common
39	Ab-Sw:Go'44	May 23	Fairly common
41	Ab-Ab: Go'44	May 22, May 28, June 1	Very common
43	Ab-Sb: Go'44	May 23, 25 & 28	Common
45A overwintered on balsam.	Ab-Pj: Go'44	May 17, 22 & 28	Fairly common on the overwintering host - Ab.
19	Ab-Sw: Go'43		No mining noted, probably accounted for by the low larval survival
45 B overwintered on jackpine	Ab-Pj: Go'44		No mining noted, (there was no overwinter survival in this cage, see note (a)).

1. L.W. Orr and N. D. Wygant - "Experiments in the Use of D.D.T. and other Insectidies for Control of the Spruce Budworm in Colorado in 1944". U.S.D.A. Agr. Res. Adm. Bur. Ent. & Plant Quar., E-669, Aug. 1945.

(c) Cage 38: Jack pine - Jack pine : Go 1943.

An attempt was made during the winter of 1944 to overwinter these larvae in jars. The egg clusters, together with twigs of jack pine were placed in pint sealers. On emergence the larvae established hibernaculae in the twigs and with the coming of fall the jars were stored in a cold chamber, where they remained until the following spring. Difficulty was encountered in keeping the jars cool enough to prevent their emerging from their hibernaculae, in the spring, before the opening of the jack pine terminals. This was all the more difficult due to the retarded spring (of 1945) and the resulting late terminal development. Some larvae did emerge but it was not possible to establish them successfully on cut terminals, partly due to the rapid drying of these, and partly due to the difficulty of handling. With more successful handling satisfactory transfers could probably have been made. Discontinuance of this transfer was due to the disadvantages inherent in the method of overwintering and handling.

Further attempts to overwinter larvae in this manner are being made this winter (1945-46).

(d) Cage 47: Jack pine - White spruce: Go 1944.

This transfer was necessarily discontinued in 1945, due to the failure of the progeny to overwinter on their host (white spruce) during winter 1944-45. Whether this was due in part or wholly to their having been overwintered on a branch rather than on a seedling has not been ascertained, but it is a possibility. Only one pupa was obtained from the cage, from 165 eggs which hatched the previous fall, i.e. a survival of only 0.61%.

Cage 35: Jack pine - White spruce: Go 1943: showed a similarly low survival. In this cage 15 larvae pupated while the number of hatched eggs was 659, i.e. a survival of 2.28%. Cage 35 was also overwintered on a branch on the same tree as Cage 47.

(e) Cages 81 and 82: Jack pine - Balsam: Go 1945.

Fifty larvae were transferred to each of these cages within a day of each other (June 19 and 20 respectively) The larvae were obtained from the same general area and were approximately the same state of development.

There was, however, a very surprising difference in survival between the two cages. In cage 82 there was a very high survival, 30 pupae being recovered. When cage 81 was then

examined only six live larvae were found (three 6th instar and three 5th instar). Very little feeding damage was noted in this case. Two of these larvae died in rearing jars on Aug. 8, and three died on Aug. 13. The remaining larva was in the 7th stadium, and, being still alive on breaking up camp near the end of August, it was taken to Winnipeg and reared in the insectary. It survived with little feeding until late in October, when it was brought into the laboratory due to the cold weather. A day or two after being brought indoors it shrivelled up and died.

No apparent difference was noted between these two seedlings as regards development or site. Nevertheless, it is conceivable that some physiological difference existed between the two, giving rise to the greatly divergent survivals in the two cages.

(f) Cages 43 and 43A: Balsam - Black Spruce : Co 1944.

In the spring of 1945 when the black spruce seedling harbouring the balsam- black spruce 1944 transfer was examined, it was found that the needles had been extensively mined. Spring development of black spruce is always slower than that of white spruce or balsam (the preferred hosts of the spruce budworm), and in the case of black spruce seedlings, harbouring large over-wintering populations of spruce budworm, these on emergence from their hibernaculae mine the needles of their host, thus further retarding its development. Due to this lack of terminal and bud development, the larvae are not able to establish themselves after the mined needles dry out, and consequently heavy mortality or migration ensues due to starvation.

In order to determine the possible course of development and rate of survival that would ensue if the larvae were allowed to feed upon healthy terminals, a number of the larvae (about 53) were removed from their overwintering host, and placed upon another black spruce seedling, whose terminals were developing normally. An interesting contrast was found in the size of the pupae of those pupae taken from the new host seedling (cage 43A), and the original overwintering host (Cage 43). These data are here tabulated:-

Cage	Average Width		Average Length	
	♂	♀	♂	♀
43	0.3165	0.3560	0.9426	1.034
43A	0.431	0.485	1.307	1.408

Again, although a larger number of eggs and egg clusters were secured from cage 43 due to the larger number of moths, the number of eggs per female was much greater in the case of cage 43A:-

Cage	No. of Females	Total No. of Eggs	Average No. of eggs per ♀
43	19	1007	53
43A	6	528	88

The survival in cage 43A was rather low, but comparison with the survival in cage 43 is difficult, due to the lack of knowledge of the exact number of larvae which remained on the original overwintering seedling (cage 43)

(g) Jack Pine - Jack Pine transfer - Pollen Study:-

The following statement, referring to 1944 transfers of jack pine budworm to jack pine staminate and terminal cages, is taken from page 64 of the 1944 Ann. Tech. Report.

"A determined effort was made to disinfest all staminate cones in cages 53,54 and 60, Table 4, before introducing larvae for rearing. It is feared, however, that absolute disinfestation of staminate flowers is impossible without the complete removal of the cones. It is therefore quite probable that a few larvae were missed and the survival date for these cages should be judged accordingly."

Here "---cages 53, 54, 55 and 60, Table 4---" refers to the 1944 rearings of jack pine budworm on jack pine staminate cones (i.e. the Pj stam - Pj stam: Go 1944, transfers).

In an attempt to lessen the discrepencies due to incomplete disinfestation of the jack pine staminate cones, check cages were introduced in 1945. Branches on the same tree, adjacent to those of the staminate transfer rearing cages and bearing approximately the same number of cones, were disinfested as completely as possible in the same manner, and by the same person as were the transfer bearing cages. These branches were then caged and left undisturbed until pupation commenced. At this time they were examined and the number of surviving pupae recorded.

Cages 73, 73A and 74 (Table 5) were located together on the same tree, Cage 73A serving as a check against the other two cages. Cages 75 and 75A were located together on another

tree, the latter cage being the check cage.

On first examination (see Table 5) the survival of pollen fed larvae appears larger than that of terminal fed larvae. However, when survival in the check cages is introduced, the resulting figures indicate a higher survival in the terminal cages.

The possibility of larvae having been overlooked in terminal disinfestion was not considered. Nevertheless, it may be that this factor was of some significance. If this were true, the present figures would not give a true indication. As a further check in future rearings, it is proposed to introduce further check cages to offset incomplete terminal disinfestation and to supplement the staminate check cages.

Under present methods of rearing, it seems that the most feasible method of obtaining more valid results would be to increase the number of replicates and introduce the above mentioned refinements. In the past this has not been possible due to the considerable amount of work initially required in making such transfers, especially as this must be done over a very short period of days.

TABLE 1.

1945 REARINGS OF 1943 HOST TRANSFERS

1943 Cage Numbers	19			
1945 Cage Numbers	19	33	35	38
Original Source of Budworm	Ab	Sw	Pj	Pj
Host in 1944	Sw	Ab	Sw	Pj
Pupae matured in 1945:-				
Males	1	39	7	
Females	2	39	6	
TOTAL	3	78	13	
Dates of Pupation				
Males	July 16	July 7	July 23	
Females	July 16	July 13	July 27	
Average Widths of Pupae:-				
Males	.40	.37	.28	
Females	.43	.40	.29	
Females caged for oviposition	1	30	5	
Egg clusters per female	0	5.2	2.6	
Total eggs per female	0	68.9	42.4	
Hatched eggs per female	0	59.8	31.8	

Discontinued

TABLE 2

1945 REARINGS OF 1944 HOST TRANSFERS

1944 Cage Numbers	39,40	41,42	43,44	43,44	45,46	45,46	47,48	49,50	51,52	53,54 55,60	56,57 58 59
1945 Cage Numbers	39	41	43	43A	45A	45B	47	49	51	53	56
Original source of budworm	Ab	Ab	Ab	Ab	Ab	Ab	Pj	Pj	Pj	Pj.stam	Pj.term
Host in 1945	Sw	Ab	Sb	Sb	Pj	Pj	Sw	Ab	Sb	Pj.stam	Pj.term
Pupae matured in 1945											
Males	1	37	26	7	5		0	6	9	17	13
Females	4	49	25	7	7		1	4	11	9	4
Total	5	86	51	14*	12		1	10	20	26	17
Dates of pupation											
1st Pupa	Jul.10	Jul.17	Jul17	Jul.17	Jul.16		Jul.31	Aug.3	Jul.30	Jul27	Jul.27
50% Pupation	July 16	Jul.18	Jul.18	Jul.18	Jul.21			Aug.3	Jul.31	Jul.27	Jul.28
Avg. Width of Pupae (cM)											
Males	.37	.38	.32	.43	.34			.29	.32	.30	.33
Females	.45	.43	.36	.49	.40		.36	.33	.35	.35	.36
Number of females caged for oviposition	4	25	19	6	5			3	8	8	3
Number of egg clusters per female	7.7	5.8	5.4	4.8	3.			0.66	3.1	1.5	0
Total eggs per female	34	91	53	85	44			16	48	52	0
Total hatched eggs per female	9	82	47	57	33			9	42	40	0

* When larvae were retransferred to this cage (June 5) they numbered 41.

TABLE 3

1945 SPRUCE BUDWORM TRANSFERS

1945 Cage Numbers	65,66	67,68	69,70	71,72
1946 Cage Designation	65	67	69	71
Original Source of Budworm	Ab	Ab	Ab	Ab
Go Host	Sw	Ab	Pj	Sb
Date of Transfer	May 25	May 25	June 13	May 25
Instars transferred	2nd	2nd	3rd & 4th	2nd
Pupae				
Male	38	21	24	13
Female	18	30	31	11
Total	56	51	55	24
Average Width				
Male	.44	.42	.35	.40
Female	.48	.49	.40	.43
Pupation dates (1st Pupa)	(Jul 5(65) Jul 3(66)	Jul 7(67) Jul 10(68)	Jul 17(69) (&70)	Jul 14(71) Jul 6(72)
50% Pupation	July6	July11	July18	July14
No. of females caged	17	20	25	9
No. of egg clusters per female	4.6	9.0	5.0	5.9
Total no. of eggs per female	75	143	68.8	88.
Number of hatched eggs per female	56	121	59.5	74.

TABLE 4

1945 JACK PINE BUDWORM TRANSFERS TO HOSTS OTHER THAN JACK PINE

1945 Cage Numbers	79	80	81	82	83	84
1946 Cage Numbers	79	79	81	81	83	83
Original Host	Pj	Pj	Pj	Pj	Pj	Pj
Go Host	Sb	Sb	Ab	Ab	Sw	Sw
Date of Transfer	June 20	June 22	June 19	June 20	June 19-20	June 21
Instars transferred	2nd & 3rd	2nd & 3rd	2nd & 3rd	2nd & 3rd	2nd & 3rd	3rd
Pupae						
Male	15	18	0	16	16	14
Female	13	15	0	14	15	13
Total	28	33	0	30	31	27
Average width						
Male	.33	.32		.30	.30	.30
Female	.36	.30		.33	.32	.32
Pupation dates						
1st pupa	July 26	July 26		July 30	July 30	July 28
50% pupation	July 26	July 26		July 31	July 31	July 30
No. of females daged for oviposition	25		9		25	
No. of egg clusters per female	0.88		2.0		1.04	
Total No. of eggs per female	13.2		57.2		17.2	
No. of hatched eggs per female	7.7		45.1		13.3	

TABLE 5

1945 JACK PINE BUDWORM TRANSFERS - POLLEN STUDY

	STAMINATE			CONES		TERMINALS		
1945 Cage Numbers	73	74	73A	75	75A	76	77	78
1946 Cage Numbers	73	73		73		76	76	76
Original Host	PJ stam	PJ stam		PJ stam		PJ term.	PJ term.	PJ term.
Go Host	PJ stam	PJ stam		PJ stam		PJ term	PJ term	PJ term
Date of transfer	June 17	June 22		June 15 & 17		June 25	June 25	
Instars transferred	2nd & 3rd	3rd		2nd & 3rd		3rd & 4th	3rd & 4th	3rd & 4th
NO. of PUPAE								
Male	5	19		19		14	12	18
Female	8	24		21		8	7	15
Total	13	43	"	40	"	22	19	33
Total - CHECK=	2	32		24				
Average width of pupae								
Male	.32	.32		.33		.33	.32	.32
Female	.37	.37		.37		.36	.36	.35
Pupation dates:								
1st pupae	Jul 24	Jul 24		Jul 24		Jul 23	Jul 23	Jul 27
50% pupation	Jul 24	Jul 24		Jul 24		Jul 23	Jul 27	Jul 27
No. of females caged for oviposition	25					19		
No. of egg clusters per female	4.2					2.6		
Total no. of eggs per female	158.5					85.7		
No. of hatched eggs per female	148.					75.4		

TABLE XXI

OVERWINTERING MATERIAL FROM HOST TRANSFER STUDY (Winter 1945-46)

TRANSFER	Year of Go Generation	1946 Generation	Original Designation	New Designation	Host S:Seedling B:Branch	LOCATION
Sw -Ab	1943	G3	14,15	33	Sw(S)	Beyond McLeod's cabin on flat below hill
Pj -Sw	1943	G3	16,20,21	35	Sw(S)	Directly east of camp 75' from creek
Ab- Sw	1944	G2	39,40	39	Sw(S)	On east side of hill beyond McLeod's cabin
Ab -Ab	1944	G2	41,42	41	Ab(S)	On flat just beyond McLeod's about 9'east of Cage 33.
Ab -Sb	1944	G2	43,44	43	Sb(S)	Behind camp just north of road in poplar.
Ab -Sb	1944	G2	43,44	43A	Sb(S)	On east side of ridge behind camp.
Ab -Pj	1944	G2	45,46	45A	Ab(S)*	Beyond McLeod's cabin on the flat.
Pj -Ab	1944	G2	49,50	49	Ab(S)	Beyond McLeod's cabin on the flat.
Pj- Sb	1944	G2	51,52	51	Sb(S)	On east side of ridge behind camp.
Pj stam.-Pj.stam	1944	G2	53,54,55 & 60	53	Pj(S)	On west side of ridge behind camp.
Ab -Sw	1945	G1	65,66	65	Sw(S)	On NE side ofhill just beyond McLeod's cabin.
Ab -Ab	1945	G1	67,68	67	Ab(S(	On flat just beyond McLeod's cabin
Ab - Pj	1945	G1	69,70	69	Ab(S)	Beyond McLeod's cabin on flat
Ab -Sb	1945	G1	71,72	71	Sb(S)	North side of hill beyond McLeod's cabin.
Pj stam-Pj stam	1945	G1	73,74, & 75	73	Pj(S)	Directly behind camp on rock ridge.
Pj term-Pj term	1945	G1	76,77,78	76	Pj(S)	On low rock ridge directly behind camp
Pj - Sb	1945	G1	79,80	79	Sb(S)	On east side of rock ridge behind camp.
Pj -Ab	1945	G1	81,82	81	Ab(S)	Beyond McLeod's cabin on flat
Pj- Sw	1945	G1	83,84	83	Sw(S)	Located behind camp near 35.

2. Jack Pine and Spruce Budworm Crosses
(Jack pine budworm x Spruce budworm)

(a) Review of work done in 1944:

The experimental basis of this study and its object are outlined in the 1944 Annual Technical Report, page 70, and need not be reiterated here.

1944 Crosses:-

(i) Source of moths:-

Two sets of crosses were made in the summer of 1944:-

I. Cage 1 - Jack pine ♂ x White spruce ♀. The jack pine budworm moths were obtained from host transfer cages 53, 54, 55 and 60, and the spruce budworm moths originated in cage 33. (Cage 33 contained spruce budworm from white spruce at Spruce Woods Forest Reserve, Manitoba, which were subsequently transferred to balsam in 1943, and whose progeny have been continued on balsam since.) In all 11♀ and 12♂ moths were used in this hybridization.

II. Cage 4 - Balsam ♂ x Jack pine ♀. In this mating 5♀ jack pine budworm moths were secured from cages 53,54,55 and 60, and 3 and 3♂ spruce budworm moths reared on balsam were obtained from cage 33 of the host transfer study.

(ii) Fecundity:-

Records of fecundity of the 1944 Fo generation are somewhat obscure as they indicate only the number of egg clusters oviposited, and not the number of eggs, nor the percentage fertility.

TABLE I

Cage Number	No. of ♀ Moths	No. of ♂ Moths	No. of Egg Clusters On Wh. Spruce	On Balsam	On Jack pine
1	5 Sp *	5 Pj *	14	0	20
2	2 Sp	2 Pj	23	2	0
3	4 Sp	5 Pj	24	4	0
4	5 Pj	3 Sp	[illegible]	0	Ø 4

Combined for future rearing, and designated Cage I.

* Pj - Jack pine budworm
Sp - Spruce budworm

(iii) Overwintering:-

The progeny of all three overwintering cages (1A :1,2,3) of the Jack pine ♂ x White spruce ♀ cross, were overwintered on a single balsam seedling and this series was designated 1A: Fo 1944: Cage 1.

The progeny of Cage 4, i.e. the Balsam ♂ x Jack pine ♀ cross were located on a balsam seedling at Hawk Lake (East), Ontario, and designated 1A: Fo 1944: Cage 4.

(b) Methods and Procedures used:-

The equipment and techniques used were in many details similar to those used in the host transfer study.

(i) Mating:-

The male and female moths employed in hybridization were secured from vials containing sexed pupae of known origin and host types. On emergence from the pupae, the moths of each sex were liberated in oviposition cages of the style used in the host transfer study - i.e. galvanized screen cylinders closed off at either end with factory cotton.

To these cages were then added small but equally sized branches of the various host trees (i.e. jack pine, white spruce, black spruce and balsam - 1944 only the first three of these were included), to provide surfaces for oviposition. The purpose of adding the various host species being to attempt to test the preferences of the moths in oviposition.

(ii) Overwintering:-

After oviposition was complete, the egg clusters from the host plants of each cage were collected, counted and placed in a 60 mesh screen vial containing a label bearing the designation of the oviposition cage. All the vials from the same cross were then hung on a caged balsam seedling for emergence and hibernation of the larvae. The bronze screen cage on the seedling was removed after all the larvae had gone into hibernation and replaced on the seedling in the spring, before their emergence.

(iii) Rearing: - (Methods used in 1945 re 1944 crosses)

In the spring of 1945 when the larvae had reached the third stadium, and were thus large enough to transfer, the overwintering seedling was cut and brought into the insectory. There the larvae were collected and placed in F.I.S. type rearing jars for further development and observation.

In the case of the larvae from Cage 1 - one hundred individuals were secured and half of these were placed in jars to feed on jack pine staminate conelets, the other half were placed in jars with fresh balsam terminals as food. Each jar initially contained ten larvae.

The larvae in Cage 4 were in the 5th and 6th stadia, before they were transferred to rearing jars. Due to their advanced development, and as there were only forty in all, they were reared entirely in balsam. Their satisfactory development in balsam was also a consideration in continuing them on this host plant. Each jar in this series contained five larvae.

The food contained in the jars was changed at frequent intervals (about every 2 days). In the case of the fifty larvae fed on jack pine, these were started on staminate conelets and when these were no longer obtainable, feeding was continued on fresh terminals.

On metamorphosis the pupae were sexed and placed in shell vials for emergence. Mating was carried on as described above, thus completing the F1 generation. The progeny are now being overwintered on balsam at (East) Hawk Lake, Ontario.

(c) Observations on 1944 Crosses during Summer 1945.

(1) Cage I - Jack pine ♂ x White spruce ♀ : F1 1945.

The first signs of activity in this cage were observed on May 17 when a mined needle was seen. The cage was re-examined on May 21 and 28, on the latter date eleven second instar larvae were observed, and also 5 mined needles. By June 11, most of the larvae had left the mined needles and entered the buds. Transfer of the larvae to rearing jars was carried out on June 13, at which time the larvae were in the third stadium.

In the accompanying figure (Fig. I) an attempt has been made to represent graphically the rates of development of the larvae on each on the hosts. It will be noted that the initial lead of the larvae fed on jack pine was later neutralized by a period (June 18-22) of inactivity as regards

Graphs - FIGURE I

Along the ordinate axis are plotted the mean developmental stages of the majority of the larvae at the various intervals when the rearing jars were examined.

Along the axis of abscissas are plotted the days during the period of larval development from time of transfer till pupation.

The ordinate values are taken as the stages of development (stadia) of the majority of larvae in all the jars of each set at the various dates on which the jars were examined. This information was obtained by summarizing the data contained in the notes made in the course of rearing.

F1 1945 (Jack pine ♂ x White spruce ♀)
Cage 1 Summer 1945
Larval Growth.

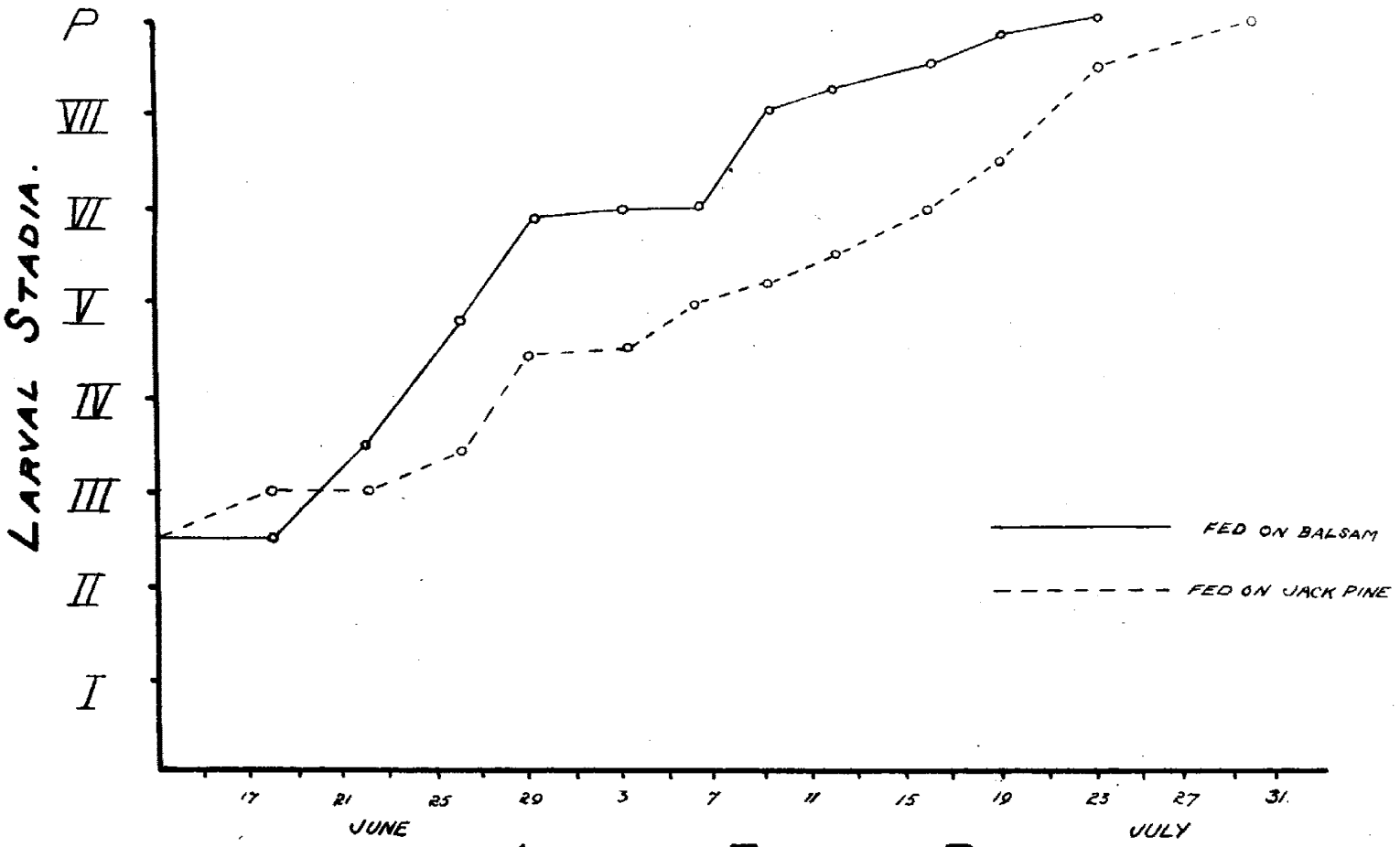


Fig. 1.

growth. During this period the larvae were provided with jack pine staminate terminals and it was noted that the larvae appeared to be ingesting very little of the pollen.

The methods of providing pollen,(i.e. by placing individual conelets (duly infested) in the jars was not entirely satisfactory, and apparently many larvae died due to suffocation when they became coated with pollen lying in the bottom of the jar.

Figure II illustrates graphically a corresponding marked mortality during this period of pollen feeding. Mortality continued high however, even after the pollen was substituted by terminals. On the basis of the writer's observations, this mortality was due largely to the death of larvae that had been retarded during the pollen feeding period.

This graph also depicts the higher survival of the balsam-fed larvae as compared to the jack pine-fed larvae. Thirty-six balsam-fed larvae pupated as compared to 11 jack pine-fed larvae. (The inadequacy of the method of providing pollen should be borne in mind in making any comparison as regards survival between the jack pine and balsam fed larvae).

Table II presents in summary form the numerical data recorded for this cage. The full significance of this data can only be appreciated by comparing the information therein with that of tables I and III of this section of the report, and with the tables of data for the Host Transfer Study.

It is possible that the extremely low sex-ration in the case of the jack-pine fed larvae is an indication of their affinity to the spruce-balsam form. Further confirmation of this would be required, however, before making a conclusive statement. It is of interest to note that Graham (1935) indicated that partial starvation of the budworm tends to decrease the sex-ration.

As noted in the table, the data as regards percentage fertility is somewhat inconclusive. The high figure of 94.9% fertility for one of the oviposition cages of the balsam-fed larvae and the low figure of 12.5% for the other, are in considerable disagreement. The small number of matings make it impossible to give any complete statement on fertility. The most that can be said is that the degree of fertility of the eggs of the heterozygous moths is somewhat less than in the case of single-host strain budworm and that there appears to be no significant difference in fertility between the eggs of these first generation hybrids as a result of their having fed on different host plants.

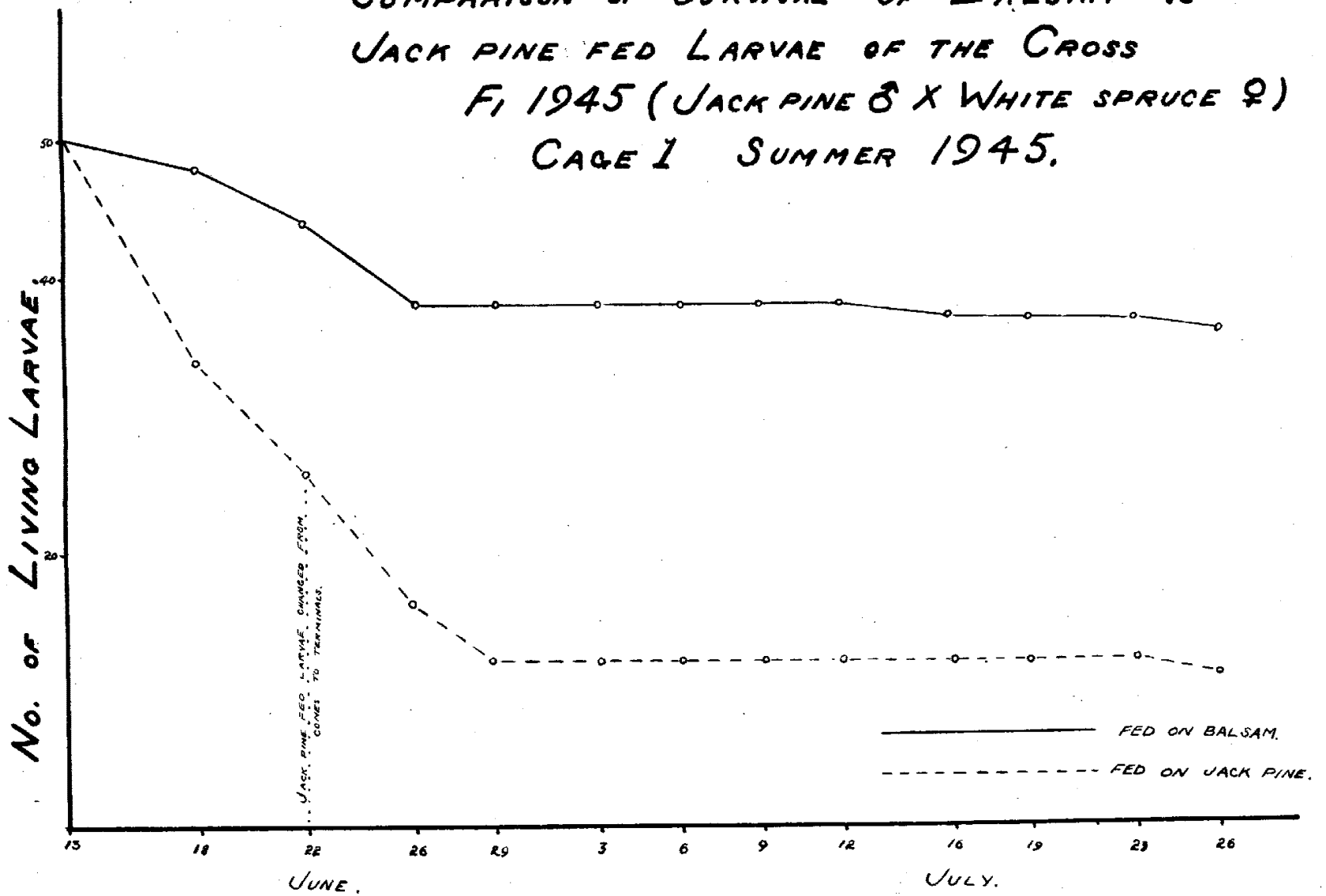

COMPARISON OF SURVIVAL OF BALSAM VS
JACK PINE FED LARVAE OF THE CROSS
F1 1945 (JACK PINE ♂ X WHITE SPRUCE ♀)
CAGE 1 SUMMER 1945.
No. OF LIVING LARVAE.
50
40
20
JACK PINE FED LARVAE CHANGED FROM . . . CONES TO TERMINALS.
FED ON BALSAM.
FED ON JACK PINE.
15
18
22
26
29
3
6
9
12
16
19
23
26
JUNE.
JULY.
LARVAL FEEDING PERIOD (FROM TIME OF TRANSFER TO PUPATION.)

FIG. 11.

(11) Cage IV; Balsam ♂ x jack pine ♀ ; F1 1945.

The first signs of activity, in the cage containing this cross, were observed on May 28. At this time two balsam buds with webs were observed, but no signs of needle mining were seen. On re-examining the cage on June 2, two infested buds and one 2nd instar larvae were seen; needle mining was still not evidenced. On June 11 a larva in the third stadium was observed. Transferring of the larvae to rearing jars was undertaken on June 26, and at this time the larvae were in the 5th, 6th and 7th stadia. On examining the seedling at the time of transferring, no signs of needle mining were observed, so it was concluded that the habit of needle mining was not practised by these larvae.

Forty-four larvae were obtained from the seedling, and of these four were preserved. The remaining forty were transferred to rearing jars, and fed upon balsam terminals until pupation.

As shown by the figures in Table III, the survival of this cross was high, 35 pupae being obtained from the original 40 transferred larvae. The sex-ratio of the pupae was .57, which is very close to the normal sex ratio for single host strain Archips fumiferana Clem. (The mean pupal sex ratio for the jack pine form over the years 1938 to 1945 inclusive (in the Hawk Lake, Ontario area) was .493, and the sex ratio of pupae collected in the field at Hawk Lake, Ont. over an extended period during the summer of 1945, was .467.

As regards the fertility of the eggs of these hybrids, the mean figure of 65.3% appears to represent a fairly good estimate of the degree of fertility.

TABLE II — Cage 1. DATA — Jack pine ♂ x White spruce ♀ : Fo 1944 - Survival & Fecundity, 1945 (Fi 1945)

Larval Host Plant	Initial No. of larvae transferred	Date of transfer	No. of Pupae ♂	No. of Pupae ♀	Date of first ♂ pupa	Date of first ♀ pupa	Sex ratio of pupae	Emergence dates of moths ♂	Emergence dates of moths ♀	Number of Egg Clusters: On balsam	On white spruce	On jack pine	On black spruce	Total No. of Eggs	Number of fertile eggs	Fertility
										5♂	x	8♀		Ovip.cage A / B	ovip.cage A / B	Ovip.Cage A / B
Balsam	50	-	23	11	July 9	July 19	.32	July 23	30	4	9	7	0	216 / 126	205 / 14	94.91 / 12.5
																64.03%
										3♂	x	2♀		Ovip.cage	Ovip.cage	Ovip.cage
Jack pine	50	-	9	2	July 16	July 30	.18	July 27	Aug. 10	3	3	2	0	A	A	A
														97	77	79.38
																79.4%

TABLE III — Cage 4. DATA — Balsam ♂ x Jack pine ♀ : Fo 1944 - Survival & Fecundity, 1945

Larval Host Plant	Initial No. of larvae transferred	Date of transfer	No. of Pupae ♂	No. of Pupae ♀	Date of first ♂ pupa	Date of first ♀ pupa	Sex ratio of pupa	Emergence dates of moths ♂	Emergence dates of moths ♀	14 pairs of moths 1945 Number of Egg Clusters: On Balsam	On White spruce	On jack pine	On black spruce	Total No. of Eggs	Number of fertile eggs	% Fertility
														Ovip.cage A / B / C	Ovip.cage A / B / C	Ovip.cage A / B / C
Balsam	40	June 26	15	20	July 6	July 6	.57	July 21	20	50	-	9	-	182 / 180 / 96	134 / 138 / 27	73.63 / 76.66 / 28.13
																65.3%

(d) Comparative Notes on the Reciprocal Crosses

Cage I : Jack pine ♂ x White spruce ♀ : F1 1945
Cage IV: Balsam ♂ x Jack pine ♀ : F1 1945.

(i) Fertility:-

The fertility of the F1 generation of each of the reciprocal budworm hybrids was much less than 100%. This factor appears to be independent of the food plant, as there was little difference in degree of fertility between balsam and jack pine-fed larvae.

(ii) Sex-Ratio:-

The sex-ratio of the pupae of the jack pine ♂ x white spruce ♀ cross (Cage 1) was abnormally low, especially in the case of those larvae fed on jack pine in which case there were 9♂'s to 2 ♀'s, a ratio of .18.

The sex-ratio of the reciprocal heterozygous pupae (Cage IV) was near normal (.57).

(iii) Needle mining:-

A difference between the reciprocal sets of larval progeny, both overwintered on balsam, was noted as regards the habits of needle mining. Mined needles were first seen in Cage I (Jack pine ♂ x White spruce ♀) on May 17, and these had become quite numerous by May 25. These dates coincide very well with the period of similar activity on the part of spruce budworm larvae being reared on balsam.

In the case of the reciprocal cross, however, (Cage IV: Balsam ♂ x jack pine ♀) the habit of needle mining was entirely absent. The possibility of this being a hereditary sex-linked trait is worthy of consideration.

(iv) Rates of development:

The rates of development of the balsam-fed larvae of each of the reciprocal crosses were almost equal, and closely paralleled that of the Spruce budworm form being reared in cages at Hawk Lake, Ontario. Maturation of the jack pine-fed larvae lagged approximately one week.

(v) Survival:-

Survival was highest in the case of the balsam-fed larvae in Cage I, where the larvae were split into two portions and half fed on jack pine and the remainder on balsam. Survival was high in the case of Cage IV where all the larvae were fed on balsam.

This difference in survival on the two hosts is of doubtful significance due to the previously mentioned adverse effect of the method employed in providing pollen.

(vI) Host preference in oviposition:

In the case of the moths from Cage I no particular preference was exhibited for any specific foliage in oviposition. The moths from Cage IV showed an apparent preference for balsam as an egg laying site but the strength of this evidence is not sufficient to make a conclusive statement.

Complete tabular summary of color notes on F1 hybrid moths released in oviposition cages at Hawk Lake, Ont. Summer 1945

Cage I - Jack pine ♂ x White spruce ♀ : F1 1945 (reared on balsam)

Oviposition Cage	Date released into ovi-position cage	Sex	Color note
A	July 23	♂	None given
A	July 23	♂	None given
A	July 23	♂	None given
A	July 23	♂	None given
A	July 23	♂	None given
A	July 30	♂	None given
A	July 30	♀	None given
A	July 31	♀	None given
A	July 31	♀	None given
B	July 25	♂	None given
B	July 25	♂	None given
B	July 25	♂	None given
B	July 26	♂	None given
B	Aug. 1	♀	None given
B	Aug. 1	♀	None given
B	Aug. 1	♀	None given
B	Aug. 2	♀	"Jack pine budworm type"
B	Aug. 2	♀	"Jack pine budworm type"

Cage I - Jack pine ♂ x White spruce ♀ : F1 1945 (reared on jack pine)

Oviposition Cage	Date released into oviposition cage	Sex	Color note
A	July 31	♂	None given
A	July 31	♂	None given
A	Aug. 1	♂	None given
A	Aug. 2	♂	None given
A	Aug. 5	♂	None given
A	Aug. 10	♀	"Darker than typical jack pine budworm type"
A	Aug. 11	♀	"typical jack pine budworm type"

Complete tabular summary of color notes on F1 hybrid moths released in oviposition cages at Hawk Lake, Ont. Summer 1945

Cage IV - Balsam ♂ x Jack Pine ♀ : F1 1945

Oviposition Cage	Date released into oviposition cage	Sex	Color Note
A	July 20	♀	None given
A	July 20	♀	None given
A	July 20	♀	fuscuus - "typical spruce budworm type"
A	July 21	♀	fuscous - "typical spruce budworm type"
A	July 21	♀	fuscous - "typical spruce budworm type"
A	July 21	♂	fuscous - "tinge of red on wings"
A	July 22	♂	reddish-brown -"not quite typical spruce budworm type
A	July 22	♂	reddish-brown -"not quite typical spruce budworm type"
A	July 22	♂	reddish-brown-"not quite typical spruce budworm type"
A	July 23	♂	None given
B	July 22	♀	fuscous -"typical spruce budworm type"
B	July 22	♀	fuscous- "typical spruce budworm type"
B	July 22	♀	fuscous- "typical spruce budworm type"
B	July 22	♀	fuscous - "typical spruce budworm type"
B	July 22	♀	fuscous - "with reddish tinge"
B	July 22	♂	fuscous - "typical spruce budworm type"
B	July 22	♂	fuscous - "with reddish tinge"
B	July 22	♂	fuscous - "with reddish tinge"
B	July 22	♂	None given
B	July 22	♂	None given
C	July 23	♀	None given
C	July 23	♀	None given
C	July 23	♀	None given
C	July 23	♀	None given
C	July 23	♂	None given
C	July 23	♂	None given
C	July 23	♂	None given
C	July 23	♂	None given

(e) 1945 Crosses of Jack Pine and Spruce Forms of Archips fumiferana Clem.

(i) Records of 1945 matings:-

Fo crosses of jack pine and spruce budworm moths were undertaken again in the summer of 1945. The methods used were the same as those used in the case of the 1944 crosses.

The following hybridizations were made:-

(1) Cage 5 : 1A : Fo 1945 : Jack pine ♂ x balsam ♀
(2) Cage 6 : 1A : Fo 1945 : jack pine ♂ x balsam ♀
(3) Cage 7 : 1A : Fo 1945 : jack pine ♂ x balsam ♀
(4) Cage 8 : 1A : Fo 1945 : balsam ♂ x jack pine ♀
(5) Cage 9 : 1A : Fo 1945 : balsam ♂ x jack pine ♀

The spruce budworm moths* used in the study were obtained from cages 33 and 41 of the host transfer study. Some jack pine budworm moths were obtained from cages 73 - 78 (incl.) of the host transfer study. Other jack pine moths used emerged from jack pine budworm pupae which were collected in the field at Hawk Lake, Ontario, carefully sexed, and then placed in shell vials for emergence.

No color notes were made on the moths used in cages 5 & 6 - then two cages were overwintered on the same balsam seedling. In the case of cage 7 only normally colored spruce (fuscous(Ridgway))** and jack pine (burnt sienna (Ridgway))** budworm moths were used, and the progeny from these were overwintered on a separate balsam seedling.

No color notes were kept in the case of the moths in cage 8. This cross was unsuccessful as regards egg production, and so was necessarily discontinued. Only normally coloured jack pine and spruce budworm moths were used in the cage 9 hybridization. The progeny from this latter cage are being overwintered on a balsam seedling at Hawk Lake, Ontario.

* These spruce budworm moths are indicated above as "balsam ♂" or "balsam ♀" as balsam was their host tree.

** This color terminology is that used by Brown & MacKay in their descriptions of moths of A. fumiferana Clem. in Can. Ent. LXXV (II): 207-211 : 1943.

TABLE IV

DATA RE 1945 CROSSES

	Date	No. of ♂ Moths	No. of ♀ Moths	NO. OF EGG CLUSTERS				No. of Eggs Laid	No. of fertile Heterozygotes	% fertility of heterozygotes
				Black on Spruce	White on Spruce	On Balsam	On Jackpine			
Cage 5 Jackpine ♂ x Balsam ♀ Fo: 1945	July 30	2 jackpine	2 spruce	-	6	2	2	52	18	34.61%
Cage 6 Jackpine ♂ x Balsam ♀ Fo: 1945	July 30	4 jack pine	4 spruce	-	3	1	0	48 approx	15 approx.	31.25%
Cage 7 jackpine ♂ x Balsam ♀ Fo: 1945	Aug. 1	5 jack pine	5 spruce	4	2	4	9	174	153	87.9%
Cage 8 Balsam ♂ x Jackpine ♀ Fo: 1945		3 spruce	3 jackpine	-	0	0	1 very small discarded	-	-	-
Cage 9 Balsam ♂ x Jackpine ♀ Fo: 1945		2 spruce	6 jackpine	0	0	15	7	344	286	83.1%

In cages 5, 6 & 8 the egg clusters were all very small.
In cage 9, the egg clusters were mainly all of the jack pine budworm type, i.e. large and flat.

(ii) Host preference of moths in oviposition:-

No definite and marked preference for any particular host in oviposition was demonstrated by the cross-mated moths. Last year's matings indicated that cross-fertilized spruce budworm females chose white spruce over balsam and jack pine over white spruce, and also that jack pine females laid all their eggs on jack pine (c.f. Ann. Tech. Rep. 1944). The danger inherent in drawing hasty conclusions from such an experiment is borne out in this year's oviposition results (c.f. Table IV), which differ so from those of last year to make any conclusive statement impossible. Before any statement could be made in this regard, it would be necessary to investigate the problem much more intensively with due consideration of the various factors involved.

The following tables present in summary form the average width of male and female pupae of the various 1945 rearings. These widths were obtained by measuring the pupae at their widest point, i.e. the caudad area of the wing pad regions. The calipers used were calibrated to 0.01 mm.

AVERAGE WIDTHS OF PUPAE
1945 SPRUCE BUDWORM GO TRANSFERS To:-

TABLE VI (All measurements are in cms.)

REPLICATE		White Spruce	Black Spruce	Balsam	Jack pine
♂	1	.44	.40	.42	.35
	2				
♀	1	.48	.43	.48	.40
	2				

1945 JACK PINE BUDWORM GO TRANSFERS
To:-

TABLE VII

REPLICATE		JACK PINE STAMINATE CONES	JACK PINE TERMINALS	WHITE SPRUCE	BALSAM	BLACK SPRUCE
♂	1	.32	.33	.30	no pupae	.33
	2	.32	.32	.30	.30	.32
	3	.33	.32			
♀	1	.37	.36	.32	no pupae	.36
	2	.37	.36	.32	.33	.30
	3	.37	.35			

TABLE VIII 1944 Spruce Budworm G1(1945) Transfers To:

	White Spruce	Black 43	Spruce 43A	Balsam	Jack pine
♂	.37	.32	.43	.38	.34
♀	.46	.36	.49	.43	.40

TABLE IX 1944 Jack Pine Budworm G1 (1945) Transfers To:-

	Jack Pine		White Spruce	Balsam	Black Spruce
	Staminate Cones	Terminals			
♂	.30	.33	-	.29	.32
♀	.35	.36	.36	.33	.35

TABLE IX 1943 Spruce Budworm G_2 (1945) Transfers To:-

		White Spruce	Balsam (from white spruce)
♂		.40	.37
♀		.43	.40

TABLE XI 1943 Jack Pine Budworm G_2 (1945) Transfers To:-

	White Spruce	Jack Pine
♂	.28	-
♀	.29	-

OVERWINTERING MATERIAL (1945-46) BUDWORM CROSSES

Cross	Year of Fo Generation	1946 Generation	Original Designation	New Designation	Host S-Seedling B-Branch	Location
Abd x Pj♀	1944	F2	4	4	Ab(S)	On east side of hill, beyond McLeod's cabin
Pj♂ x Sw♀ reared on Ab)	1944	F2	1, 2 & 3	1	Ab (S)	Beyond Mc Leod's cabin
Pj♂ x Sw♀ reared on Pj)	1944	F2	1, 2 & 3	1	Pj (S)	On ridge behind camp on west slope.
Pj♂ x Ab♀	1945	F1	5 & 6	5	Ab (S)	Beyond Mc Leod's cabin
Pj ♂ x Ab♀	1945	F1	7	7	Ab (S)	Beyond Mc Leod's cabin
Abd x Pj♀	1945	F1	9	9	Ab (S)	Beyond McLeod's cabin on flat.

SUMMARY REPORT OF THE FOREST INSECT SURVEY, CENTRAL CANADA

By R. R. Lejeune

Forest Insect Laboratory, Winnipeg, Man.

INTRODUCTION

This is the second year in which the Forest Insect Survey has covered the three prairie provinces: Alberta, Saskatchewan and Manitoba. This grouping is apparently working satisfactorily, as a very successful season has been concluded. It is hoped that with increased personnel and more means of transportation, even the present coverage may be considerably improved.

RESULTS FOR 1945

A total of 627 samples was received in 1945, representing an increase of 114 over the number received in the record year 1944. These collections were distributed among the provinces as follows: Manitoba 348, Saskatchewan 120, and Alberta 97. (The remaining 62 samples were received from Ontario) In Manitoba were 45 co-operators; in Saskatchewan were 27; and in Alberta were 32. In the latter province, all 97 samples were received from our co-operators; in Saskatchewan the number collected by co-operators was augmented by some collected by one of the Forest Insect Rangers; in Manitoba half of the samples were made by co-operators outside this laboratory and the other half by members of our staff.

The jack pine budworm and the European larch sawfly are the most serious pests in central Canada. Manitoba has suffered the heaviest damage from both pests, but Saskatchewan has a severe outbreak of the larch sawfly. A potential threat to the forests of eastern Manitoba is the spruce budworm, as it makes its way westward through northwestern Ontario.

STATUS OF MAJOR FOREST AND SHADE TREE INSECT PESTS DURING 1945.

A. SPECIES CAUSING SERIOUS INJURY AT THE PRESENT TIME.

EUROPEAN LARCH SAWFLY (Pristiphora erichsonii Htg.):- This insect is increasing in severity and continuing its westward movement. It has endangered such an extensive area

of young tamarack that it now ranks as one of the foremost forest pests of Manitoba and Saskatchewan.

The infestation at Riding Mountain National Park, one of several years standing, decreased markedly in some areas, but was newly reported in others. A noticeable decline occurred at Wasagaming, Mile 7 Norgate Road and Mile 13 Audy Lake Road. The foliage on trees in the first two areas is still very sparse as a result of previous defoliation, but the stand at Mile 13 appeared extremely healthy. For the first time, severe defoliation was in evidence in all tamarack stands along the Dauphin Road north to Moon Lake, while heavy damage was also noted in the vicinity of the prisoner-of-war camp. Valuable information concerning the distribution in the western half of the park was provided by park warden John Hyska. It appears that defoliation is widespread throughout this district and extends northward to Gilbert Plains. West of Gunn Lake, the infestation is of medium intensity. Heavy defoliation was recorded in Secs. 15 and 18 Twp. 21 R. 22 and all of Twp. 22 R. 25 WPM.

Sawfly damage in the Duck Mountain Forest Reserve was largely confined to the southern half, but where it occurred, defoliation was most conspicuous. Severe defoliation was observed in tamarack stands surrounding Baldy Mountain, and at points two miles north of the Valley River Indian Reserve, and two miles north of Grifton on the reserve boundary. In addition, Survey collections were received from Grandview and Deepdale.

The outbreak declined somewhat in the inter-lake area, especially north of Riverton where the population dropped about 50% according to field counts, while the condition of the trees was much improved. A small stand seventeen miles northwest of Hodgson in the Redrose district was 60% defoliated. Defoliation of upland tamarack in the Gypsumville and Davis Point districts varied from 75% to 100% whereas the swamp tamarack was practically untouched.

The European larch sawfly was prevalent in most of Manitoba east of Lake Winnipeg. The heaviest defoliation was found in an area bounded on the south by the Manigotagan River and on the north by the Wanipigow River.

It extends eastward inland from Lake Winnipeg for a distance of approximately twenty-five miles and covers an area of some one hundred and fifty square miles. Throughout the remainder of the area the sawfly is noticeably lighter. In the region surrounding Lac du Bonnet, larch sawfly was practically absent. At Seddon's Corner a heavy infestation of about four square miles was discovered.

The infestation in southern Manitoba was generally light. The only heavy defoliation occurred at Sundown in a swamp three-quarters of a mile wide and two miles long. A medium infestation which has decreased from last year was recorded near Dawson Cabin in the Sandilands Forest Reserve. The previously heavy outbreak in the Spruce Woods Forest Reserve was almost non-existant in 1945.

In addition to the foregoing information on distribution and intensity, the Forest Insect Survey received collections from the following Manitoba points: Kississing, Norway House, Deepdale, Hodgson, Woodridge, Marchand, Whitemouth, Rennie and Point du Bois.

It seems that in Saskatchewan the distribution of this insect is still largely limited to the east-central part of the province, although more intensive sampling would no doubt have indicated a more westerly spread. Heavy infestations were recorded at Madge Lake (65% defoliation) and Pelly (85% defoliation). Between Pelly and Sturgis one tamarack swamp was 30% defoliated. From Sturgis to Ushta, wherever larch was encountered, defoliation averaged 50%. North of Ushta to Hudson Bay Junction no sawfly damage was noted. At Hudson Bay Junction only one stand was observed to contain sawfly larvae.

The Forest Insect Survey received samples from other Saskatchewan points as follows: Beaver Lake, Chelan and Prairie River.

No larch sawfly records were received from Alberta.

Investigations on the natural control factors operating against the sawfly have been intensified, and further expansion of the work is planned as soon as personnel becomes available. Co-operators are urged to submit reports and samples whenever possible during 1946.

Samples received: MANITOBA: W. L. Hislop 2, H. L. Kendrick 1, G. H. Davies 2, D. E. Cooper 1, J. H. Inkster 2, R. L. Stevenson 2, T. Lalor 1, C. J. Ritchey 1, C. H. Patterson 1, J. Kokindovich 3, J. E. Harrison 1, J. Hyska 6, R. D. Mc Kinnon 4, C. Dunlop 1, Miscellaneous 15, Total 41. SASKATCHEWAN: O. B. Mc Neil 1, P. C. Hogan 1, C. Schell, 1, H. Abra 1, E. H. Shannon 1, Miscellaneous 14, Total 19. ONTARIO: 5. Total of samples received in 1945, 65.

JACK PINE BUDWORM (Archips fumiferanaClem):- The jack pine budworm, in general, continued to subside and has to all intents and purposes practically disappeared in two previous outbreak centres. The main budworm areas during 1945 were confined to the Sandilands Forest Reserve and the Whiteshell Forest Reserve, Manitoba, There is always the possibility, of course, that these may be the source of renewed damage and defoliation. Smaller outbreaks were recorded at Seddon's Corner on the Trans-Canada highway, Sasagannigak Lake and south of Gypsumville, all in Manitoba.

Budworm was distributed throughout the Sandilands Forest Reserve with the heaviest defoliation recorded in the southern part in the vicinity of Reserve Headquarters. At the worst, however, damage here could be considered moderate and was generally confined to open growing stands. Nevertheless, severe defoliation is anticipated for 1946, as indicated by the fact that five small pines averaging eleven feet in height, examined in August 1945, yielded 8500 eggs per tree. A second area of less intense defoliation obtained in the Dawson Cabin area in the northern part of the reserve. The main damage here was apparently experienced by the fairly extensive regeneration which prevails in the stands examined. A very light infestation covered the remainder of the reserve. Beyond the reserve boundary, southeast to Sprague, only a trace of budworm was found in stands heavily defoliated during 1944.

Three areas of budworm infestation are known to exist in the Eastern Manitoba region. The main body is of medium intensity and located in the southeastern part of the Whiteshell Forest Reserve. It is roughly bounded on the south by the Trans-Canada highway, on the west by Mud Turtle Lake and on the north by a line running southeast from Redrock Lake through Nora Lake into Ontario. This part of the outbreak appears to be limited in extent by the availability of pure stands of jack pine. A small, isolated but severe outbreak, which probably stems from the Whiteshell infestation, is still in progress at Seddon's Corner, east of Beausejour. To the north, pine budworm was recorded

in relatively small numbers around the shore line of Sasaginnigak Lake. It was impossible to determine the inland boundary accurately, but it was apparently neither extensive nor heavy.

The pine budworm was present in very limited numbers at two other points in Manitoba. In the first, twelve miles south of Gypsumville in the inter-lake area, a few pupae were found on jack pine growing on sand ridges. This particular area was similarly reported in 1944. The second, an extremely light infestation, on reproduction, is situated six and a half miles northwest of Mafeking.

Two previously troublesome outbreaks in Saskatchewan and Manitoba have subsided. In the Fort a la Corne provincial forest, there was evidence of light current defoliation in the area east and west of Twin Lake. Elsewhere in the Forest there appeared to be no budworm activity. Not a trace of budworm was to be found in the comparatively short-lived outbreak in Riding Mountain National Park, Manitoba.

There are still no records of this insect occurring in Alberta.

Samples received:- MANITOBA: H. L. Kendrick 1, J. H. Inkster 2, C. H. Patterson 1, J. E. Harrison 2, B. C. Emee 1, Miscellaneous 10, Total 17. SASKATCHEWAN: H. E. Tanner 2, Miscellaneous 1, Total 3. ONTARIO: 4. Total of samples received in 1945, 24.

SPRUCE BUDWORM (Archips fumiferana Clem.):- The seven year old outbreak in the Spruce Woods Forest Reserve, Manitoba, continued to spread in 1945, although the intensity of defoliation remained much the same at a medium level. It has now extended its range from the west side of the Epinnette swamp north west to Onah and in a southerly direction to the Assiniboine River. In the main, the infestation is spotty with islands of heavy defoliation occurring occasionally. The heaviest current damage was noted in the spruce around Onah. This area was visited and reported on by Mr. C. B. Gill of the Manitoba Forest Service. Despite the age of the infestation, there is no evidence of tree mortality or terminal killing in the Reserve.

While the Spruce Woods outbreak gives cause for concern, a much graver menace may threaten the spruce-balsam forests of Eastern Manitoba in the near future. The

spruce budworm, which has caused such widespread destruction in eastern Canada, was discovered in 1945, in epidemic proportions at a point in Ontario, a bare sixty air miles from the Manitoba boundary due east of Lac du Bonnet. Providing susceptible stands are available, it is reasonable to expect a spruce budworm outbreak to build up in this part of Manitoba during the next few years. It is indeed likely that it is already present in endemic numbers because during 1945 several specimens of spruce budworm larvae from black spruce were received from Sasaginnigak Lake. Co-operators in this area are therefore urged to do their utmost to detect the presence of this insect on spruce and balsam in 1946.

Samples received: MANITOBA: G. H. Davies 2, T. P. Williams 1, G. Charnell 1, Miscellaneous 7, Total 11. ONTARIO: 2. Total of samples received in 1945, 13.

FOREST TENT CATERPILLAR: (Malacosoma disstria Hbn.): The tent caterpillar infestation of last year has moved eastward. No damage was noticed in last year's centre around the Duck and Riding Mountain areas. On the other hand, heavy damage was observed in the interlake area, i.e. between Lakes Manitoba and Winnipeg.

This year Manitoba was, with the exception of one report, the only province from which samples and reports of the forest tent caterpillar were received, and all of the samples came from the interlake area. The infestation between Gypsumville and Camper, first reported in 1943, presumably reached its peak in 1944 as this area has been carefully surveyed this year, and the damage estimated as medium. The area occupied by this medium infestation extends east of Lake Manitoba for a distance of about thirty miles. Noticeable at points ten to fifteen miles north of Gypsumville, the infested area extends south to beyond Mulvihill. East of this strip of medium infestation is an area of heavy infestation extending north to the vicinity of Fisher River, and south to Hnausa, beyond Arborg and almost to Chatfield. Many of the islands in Lake Winnipeg bear local outbreaks and a report has come in of an infestation on the eastern shore of Lake Winnipeg, running south from the Bloodvein River to Manigotogan. In the districts suffering the heavy damage, trembling aspen (w. poplar) was completely defoliated, black or balsam poplar was partially defoliated, and the saskatoon crop was reduced to almost nothing. The farmers of the area report that no harm was done to the crops and gardens.

- In 1946, it is hoped that as many observers as possible can survey the area lying east of Lake Winnipeg, to determine whether this insect continues its easterly spread.

The single Saskatchewan report, from F.O. A. Hansen, indicated that this pest was present in Twp. 46, Rge 1 W3M, near Mac Dowall.

Samples received:- MANITOBA: D. E. Cooper 2, C. S. Prodan 1, W. D. Wardrop 1, Miscellaneous 3, Total 9. Total of samples received in 1944: 9.

B. SPECIES NOT CAUSING SERIOUS INJURY AT THE PRESENT TIME, BUT KNOWN TO BE CAPABLE OF DOING SO.

BARK BEETLES: The only new activity by bark beetles was reported by Field Officer O. B. Mc Neil, Prairie River, Saskatchewan, who first noticed white spruce being attacked by beetles of Ips sp. in Sec. 6 Twp. 44 Rge. 8 W2M. The damage was apparently chiefly restricted to weakened root-burned trees and freshly cut logs at the site of a timber operation. The infestation appears to be of a local nature, and is not affecting sound trees. In all probability the infestation owes its origin to the large fire-burn which swept this part of the country in 1942.

Four miscellaneous single samples were received from Alberta, indicating that no serious bark beetle infestations were noted in that province during 1945. Beetles, (Dendroctonus sp.) however, constitute an ever present threat on the east slope, and personnel in this region are urged to continue sampling to detect incipient outbreaks.

Samples received: MANITOBA: W. L. Hislop 2, Total 2. SASKATCHEWAN: O. B. Mc Neil 2, Miscellaneous 1, Total 3. ALBERTA: J. Kovach 1, T. F. Somers 1, A. H. Prowse 1, M. P. Reap 1, Total 4. ONTARIO: 1. Total of samples received in 1945, 10.

WOODBORERS:- Information received indicates that salvage of timber killed by fires in 1942 in the Carrot River country of Saskatchewan was to be completed during the winter of 1944-45. It is reported that a large percentage of the 130,000,000 FBM of white spruce originally burned was finally salvaged and the whole operation is considered to be successful beyond all expectations.

Further salvage of windthrown timber in Riding Mountain National Park, Manitoba, is planned for the winter of 1945-46. Mr. O. E. Heaslip, Park Superintendent, reports that some 2,278,000 F.B.M., 4,723 cords of fuel wood and 9,750 trees for poles were salvaged during the winter of 1944-45, following the storms of the preceding summer.

Samples received: MANITOBA: W. L. Hislop 1, G. H. Davies 3, C. E. Linn 1, T. P. Williams 1, O. Anderson 1, Total 7. SASKATCHEWAN: E. A. Sharman 1, P. C. Hogan 4, Total 5. ALBERTA: J. E. Hackett 1, P. Campbell 2, R. G. Mc Laughlin 1, H. W. Parnall 1, A. H. Prowse, 1, M. P. Reap 1, W. Wood 1, G. Fleming 1, Total 9. Total of samples received in 1945, 21.

BLACK-HEADED BUDWORM (Acleris variana Fern.):- Samples received in 1945 indicate that this pest is not present in infestation proportions throughout Central Canada. Although generally distributed in Manitoba, only a few samples were sent in from the other provinces. The collections in Manitoba were made at Sasaginnigak Lake, Pine Falls, Lac du Bonnet, Sandilands Forest Reserve, Berens River, Spruce Woods Forest Reserve, Grandview, Birch River, Mafeking, Herb Lake and Kississing. The samples in Saskatchewan were found at Carrot River, Amisk Lake and Pierceland. The lone Alberta sample was picked up at Leyland.

Samples received: MANITOBA: W. L. Hislop 1, B. M. Kuryk 2, G. H. Davies 2, J. H. Inkster 1, C. E. Linn 1, A. T. Gringan 2, J. Templeton 1, J. Kokindovich 1, G. Charnell 1, Miscellaneous 6, Total 18. SASKATCHEWAN: E. A. Sharman 1, P. C. Hogan 2, Total 3. ALBERTA: H. W. Parnall 1, Total 1, ONTARIO: 2. Total of samples received in 1945, 24.

YELLOW-HEADED SPRUCE SAWFLY (Pikonema alaskensis Roh.):- This widely-distributed spruce-feeding insect was found in all three provinces. While destructive to isolated trees or groups of trees, particularly ornamentals, it is of minor importance as a forest pest.

Twenty-one samples were received from Manitoba, the province in which most damage from this insect was reported. Infestations were reported at Whitemouth, where some ornamental spruce were infested; at Rennie where shelterbelt trees were attacked; at Sasaginnigak Lake where the spruce on one island near the south side of the lake were noticeably defoliated and at Birch River where a nursery bore an attack. Other points from which samples came were Pine Falls, Lac du Bonnet, Mafeking, Riding Mountain National Park and Kississing. From Saskatchewan eight samples were

Samples received: MANITOBA: J. H. Inkster 1, C. J. Ritchey 1, C. J. Evans 1, T. P. Williams 1, J. G. Goodison 1, D. N. Petley 1, Miscellaneous 3, Total 9. SASKATCHEWAN O. B. Mc Neil 3, C. A. Otterbein 1, P. C. Hogan 1, E. L. Millard 1, E. P. Bilquist 1, L. S. Horne 1, A. M. Howland 1, C. R. Christie 1, A. Johnson 1, Total 11. ALBERTA: T. F. Blefgen 1, J. H. Boulton 1, H. A. Parker 1, Total 3. ONTARIO: 2. Total samples received in 1945, 25.

HEMLOCK LOOPER (Lambdina fiscellaria Gn.):- The samples that were received of this insect, so often a serious pest in other parts of Canada, came from Manitoba. All were collected east of Lake Winnipeg, at the following points: Lac du Bonnet, Sasaginnigak Lake, Berens River and Pine Falls.

Samples received: MANITOBA: B. M. Kuryk 1, A. T. Gringan 1, E. L. Lansdown 1, Miscellaneous 8, Total 11. Total of samples received in 1945, 11.

BALSAM FIR SAWFLY (Neodiprion abietis Harr.):- Twelve samples of this insect were received: six came from Manitoba, (Spruce Woods Forest Reserve, Mafeking, Cross Lake, Herb Lake, Brandon and Grandview) and five from Saskatchewan (Carrot River, Amisk Lake and Loon Lake.)

Samples received: MANITOBA: J. H. Inkster 2, A. Sinclair 1, C. E. Linn 1, J. Kokindovich 1, J. E. Crawford 1, Miscellaneous 1, Total 7. SASKATCHEWAN: C. A. Otterbein 3, P. C. Hogan 1, F. Mitchell 1, Total 5. ONTARIO: 1. Total samples received in 1945, 13.

WHITE PINE WEEVIL (Pissodes strobi Peck):- Four samples of this beetle were received in 1945. These came from the following points: Cookson, and Prairie River in Saskatchewan, and Berens River in Manitoba.

Samples received: MANITOBA: Miscellaneous 1, Total 1, SASKATCHEWAN: O. B. McNeil 1, W. Anderson 1, Total 2. ONTARIO: 1, Total of samples received in 1945, 4.

CANKERWORMS (Alsophila pometaria Harr. and Palaeacrita vernata Peck.):/ The city of Winnipeg in 1945 experienced another but lighter attack of these larvae which caused so much damage in 1944. As at that time the fall cankerworm was much more abundant than the spring cankerworm. Heavy damage was again experienced in Dauphin.

Samples received: MANITOBA: Miscellaneous 10, Total 10, Total of samples received in 1945, 10.

received. These were collected at the following points: Paddockwood, Prince Albert National Park, Carrot River, Nipawin, Chelan, Pierceland, Loon Lake and Mac Dowell. Two Alberta samples were forwarded, one from Little Red River, and one from Hythe. Of an infestation at the latter place, Ranger R. Gicquel states that the damage is medium, occurring in spots, particularly among planted windbreaks in Twp. 73, Rge 10 and 11, W6M.

Samples received: MANITOBA: W. L. Hislop 2, H. L. Kendrick 1, A. T. Gringan 1, C. J. Ritchey 1, J. Kokindovich 3, J. G. Goodison 1, E. L. Lansdown 1, G. Charnell 1, W. F. Mawdsley 1, Miscellaneous 8, Total 20. SASKATCHEWAN: G. L. Holden 1, C. A. Otterbein 1, E. A. Sharman 1, F. Mitchell 1, H. Abra 1, E. P. Bilquist 1, A. M. Howland 1, Miscellaneous 1, Total 8. ALBERTA: R. Gicquel 1, W. J. Lizotte 1, Total 2. Total of samples received in 1945, 30.

GREEN-HEADED SPRUCE SAWFLY (Pikonema dimmockii Cress.):- Although widely distributed this insect appears to be unimportant.

Four samples were received from Alberta (Saunders, Caroline and Rocky Mountain House.) From Saskatchewan came ten samples, distributed as follows(Carrot River, Pierceland, Loon Lake, Hudson Bay Jct., Nipawin, Cookson and Amisk Lake.) The Manitoba collections were from Kississing, Cross Lake, Thicket Portage, Pine Falls, Woodridge, Grandview, Wasagaming, Berens River and Mafeking.

Samples received: MANITOBA: W. L. Hislop 2, A. Sinclair 1, A. T. Gringan 1, G. J. Evans, J. Kokindovich 1, J. E. Harrison 1, J. G. Goodison 1, Miscellaneous 4, Total 12. SASKATCHEWAN: R. G. Mc Laughlin 1, C. A. Otterbein 3, E. A. Sharman 1, H. E. Harrison 2, P. C. Hogan 1, F. Mitchell 1, C. Schell 1, E. L. Millard 1, W. Anderson 1, Miscellaneous 1, Total 13. ALBERTA: E. L. Whidden 1, R. G. Mc Laughlin 1, M. Verhaeghe 2, Total 4. Total of samples received in 1945, 29.

SPRUCE GALL APHID (Adelges abietis L.):- Twenty-one samples of this pest were received in 1945, some from each of the three provinces. The Manitoba samples came from the Sandilands Forest Reserve, Rennie, Thicket Portage, Carberry, Wasagaming, Wabowden, Garland and Sasaginnigak Lake. The Saskatchewan samples were from Prairie River, Amisk Lake, Cookson, Nipawin, MacDowall, Paddockwood, Hudson Bay Jct., and Glen Elder. The three collections made in Alberta were taken at Seebe, Edmonton and Coleman.

AMERICAN POPLAR LEAF BEETLE (Phytodecta americana Schffr.)- Occurring in some abundance in 1945, this insedt had been unreported the year before. In Manitoba an infestation was noted in the Swan River valley, with southern limits near Sclater, northern boundary at Mafeking, and western near the Saskatchewan boundary. This infestation was generally light, a small area of about twenty acres lying north of Cowan was heavy. One sample was also collected at Wasagaming townsite in the Riding Mountain National Park. District Forester A. Bainbridge reported it north of Roblin (Twp. 30 Rge. 29 WPM). The Saskatchewan samples, five in number were received from several points. At MacDowall (Twp. 47 Rge 1, W3M) F.O. A. Hansen reported a light infestation; light infestations in Prince Albert National Park (Twp. 57 Rge 5 W3M; Twp. 53 Rge 1 W3M, and at Rabbit Cabin) were sampled by Park Wardens Sipis, Holden and Barlow: and a small infestation near Prairie River (Twp. 45 Rge 7 W2M). Four out of the five Alberta samples were of single specimens of this beetle, and were collected at Rocky Mountain House, Nordegg, Entrance and Caroline. The fifth, sampled at Morley indicated a small infestation.

It will be interesting to see whether the numbers of this beetle rise or fall in 1946, therefore June sampling of poplar will have twofold importance; an indication of the abundance of both this beetle and of the tent caterpillar.

Samples received: MANITOBA: H. Clee 2, J. C. Goodison 1, Total 3. SASKATCHEWAN: A. Hansen 1, E. A. Sipis 1, G. L. Holden 1, W. Barlow 1, O. B. Mc Neil 1, Total 5. ALBERTA: E. L. Whidden 1, P. Campbell 1, T. G. Wheaton 1, A. H. Prowse 1, M. Verhaeghe 1, Total 5. Total of samples received in 1945, 13.

STATUS OF MINOR FOREST AND SHADE TREE PESTS DURING 1945.

PITCH NODULE MAKER (Petrova albicapitana Busck):- A sample of this nodule was received from the Douglas nursery which indicates that this infestation is continuing. The other Manitoba collection of this pest was made in the Sandilands Forest Reserve where it is fairly common. One sample, accompanied by a report was received from the Nisbet Pines Forest Reserve in Saskatchewan.

Samples received: MANITOBA: F. R. De Delley 1, Miscellaneous 1, Total 2. SASKATCHEWAN: A. Hansen 1, Total 1. Total samples received in 1945, 3.

LITTLE LARCH SAWFLY (Anoplonyx laricis Marl.):- This generally distributed but unimportant insect was received from each of the three provinces. In Alberta, it was collected at Rocky Mountain House, in Saskatchewan at Prairie River, Carrot River, Amisk Lake, Hudson Bay Jct., Pelly, Ushta and Cookson. The Manitoba samples were from Kississing, Grandview, Riding Mountain National Park, Deepdale and Pointe du Bois.

Samples received: MANITOBA: W. H. Hislop 3, J. Kokindovich 2, J. Hyska 2, E. N. Vansickel 1, R. D. Mc Kinnon 2, C. Dunlop 1, Miscellaneous 5, Total 16. SASKATCHEWAN: O. B. Mc Neil 2, C. A. Otterbein 1, P. C. Hogan 1, C. Schell 6, E. L. Millard 1, Miscellaneous 7, Total 18. ALBERTA: E. L. Whidden 1, Total 1. Total of samples received in 1945, 35.

UGLY NEST CATERPILLAR (Archips cerasivorana Fitch):- No heavy infestations of this insect were reported this year. All but one of the samples received came from points in Manitoba (Sandilands Forest Reserve, Seddon's Corner, Birch River, Grandview and a point near the highway twenty-five miles south of the Pas.) One sample was sent in from Prairie River, Saskatchewan.

Samples received: MANITOBA: J. H. Inkster 1, O. Anderson 1, Miscellaneous 3, Total 5. SASKATCHEWAN: O. B. Mc Neil 1, Total 1. Total of samples received in 1945, 6.

FALL WEBWORM (Hyphantria textor Harr.):- Only one sample of this pest was received in 1945 and it came from Dryden, Ontario (O.S.Jackson).

Samples received: ONTARIO: 1, Total 1. Total samples received in 1945, 1.

SPINY ELM CATERPILLAR (Nymphalis antiopa L.):- Three collections were received; two of these were from Saskatchewan (Prairie River and Hudson Bay Jct.) and the other one from Alberta (Coleman).

Samples received: SASKATCHEWAN: E. H. Shannon 1, O. B. Mc Neil 1, Total 2. ALBERTA: J. H. Boulton 1, Total 1. Total of samples received in 1945, 3.

MANITOBA MAPLE TWIG-BORER (Proteoteras willingana Kft.):- Compared with its abundance on the same trees as last year, this pest was less common in 1945.

VAGABOND POPLAR GALL (Mordwilkoja vagabunda Walsh):- Two samples were received, one from Manitoba (near Dauphin) and one from Ontario.

Samples received: MANITOBA: B. Balkan 1, ONTARIO: 1, Total of samples received in 1945, 2.

JACK PINE MIDGE (Retinodiplosis sp. or Theclodiplosis sp.):- A midge infestation has appeared on jack pine in southeastern Manitoba. In Twp. 13, Rge 9, EPM, Ranger H. L. Kendrick reported all trees in the area infested. An infestation of seedlings was noticed near Badger; many of these trees were dead. Samples were taken near Bissett (Twps. 23 and 24, Rges 13 and 14, EPM). This insect seems to resemble in form and habits the midge found on red pine in Ontario.

Samples received: MANITOBA: H. L. Kendrick 1, G. D. Edmonds 3, Total 4. ONTARIO: 1. Total of samples received in 1945, 5.

BENEFICIAL INSECTS

Larval parasites and predators of the jack pine budworm were particularly active in the Whiteshell Forest Reserve, and certain parts of the Sandilands Forest Reserve during 1945. The marked reduction of the budworm larval population in these areas is believed to be due in a large measure to these control factors. Pupal parasitism in the Sandilands, the Whiteshell region and the Spruce Woods area averaged approximately 15%. Pupal parasitism in the Sandilands showed a marked decrease from 40% in 1944. One important pupal parasite Phaeogenes hariolus, which was almost non-existant in the Spruce Woods Forest Reserve, and which increased to 3.5% in 1944, reverted to its original position of scarcity in 1945.

An extensive survey of the introduced parasites of the European larch sawfly was initiated in 1945 with interesting results. A European parasite, Mesoleius tenthredinis, released in 1912-13 in the Spruce Woods Forest Reserve and Riding Mountain National Park was recovered in samples collected all the way from Seddon's Corner near Beausejour to the Duck Mountain. Dissections indicate quite a heavy parasitism in some areas, but several obscure points remain to be solved before the effectiveness of this parasite can be evaluated. Recoveries were made of Bessa harveyi, a parasite liberated in 1939 and 1940, but this species has not yet demonstrated any great ability to spread.

The pine tortoise scale was decimated by the predatory activities of a lady-bird beetle Hyperaspis sp. in certain areas of the Sandilands Forest Reserve. This beetle was particularly abundant in the infestation north of reserve headquarters and was instrumental in helping to bring a previous outbreak under control in the reserve.

LIST OF CO-OPERATORS IN THE FOREST INSECT SURVEY CENTRAL CANADA - 1945

Name	Collections	Name	Collections
Abra, H.	3	Edmonds, G. D.	7
Anderson, A.	88	Emes, B. C.	1
Anderson, O.	2	Enwright, C. E.	1
Anderson, W.	1	Evans, G. J.	3
Balkan, B.	2	Fleming, G.	2
Barker, R. B.	31	Frew, I. B.	1
Barlow, W.	1		
Bennett, R.	1	Gicquel, R.	1
Bilquist, E. P.	1	Goodison, J. C.	2
Black, W.	20	Graham, B.	1
Blefgen, T.F.	5	Gringan, A. T.	6
Boulton, J. H.	5		
Bradshaw, F. G.	2	Hackett, J. E.	1
Buck, D.	2	Hand, R. T.	1
Bussineau, J. M.	1	Hansen, A.	4
		Harrison, H. E.	2
Campbell, E.	1	Harrison, J. E.	4
Campbell, P.	9	Heron, R. J.	11
Chapman, C. E.	2	Hildahl, V.	43
Charnell, G.	1	Hillock, G.	1
Christie, C. R.	1	Hislop, W. L.	11
Churchill, J.	1	Hitchcock, M.	2
Clee, H.	2	Hogan, P. C.	20
Cooper, D. E.	3	Holden, G. L.	3
		Horne, L. S.	1
Davies, G. H.	7	Howland, A. M.	5
De Delley, F. R.	1	Hyska, J. C.	7
Dino, A. R.	3		
Dobie, J. H.	2	Inkster, J. H.	16
Dunlop, C.	3		
Durant, P. W.	3	Jackman, E. T.	1
Durnin, W.	26	Jackson, O. S.	2

Janssen, J. L.	1
Jensen, S. A.	2
Johnson, A.	2
Kendrick, H. L.	8
Kokindovich, J.	7
Koons, E. A.	3
Kovach, J.	1
Kuryk, B. M.	4
Lalor, T.	1
Lansdown, E. L.	2
Larson, C.	4
Lejeune, R. R.	35
Linn, C. E.	3
Lizotte, W. J.	2
Lukinuk, S.	7
Mawdsley, W. F.	1
Mc Davitt, A.	2
Mc Guffin, W. C.	42
Mc Kinnon, R. D.	4
Mc Laughlin, R. G.	7
Mc Neil, O. B.	18
Millard, E. L.	2
Mitchell, F.	2
Muirhead, I, F.	1
Otterbein, C. A.	6
Parker, H. A.	2
Parnall, H. W.	5
Patterson, C. H.	2
Petley, D. N.	3
Porter, M. W. S.	1
Prodan, C. S.	1
Prowse, A. H.	3
Reap, M. P.	1
Richmond, H. A.	2
Richey, C. J.	3
Robinson, W.	1
Sawyer, C.	3
Schell, C.	8
Shannon, E. H.	1
Shannon, T. M.	1
Sharman, E. A.	3
Sinclair, A.	4
Sipes, E. A.	1
Somers, T. F.	9
Stevenson, R. L.	3
Sutherland, A. R.	2
Tanner, H. E.	7
Templeton, J.	1
Thomas, P. O.	49
Vansickel, E. N.	2
Verhaighe, M.	4
Vicars, J. H.	2
Wardrop, W. D.	4
Warner, W. D.	1
Wheaton, T. G.	1
Whidden, E. L.	9
Williams, T. P.	5
Wood, W.	2
Wong, H. R.	47
Wright, J. J.	2

A. Introduction

In recent years activity by this insect in Manitoba and Saskatchewan has been rapidly increasing until it now has the status of a major pest at least equal to that of the jack pine budworm. Indeed, when cognizance is taken of the actual areas threatened by either insect, the larch sawfly may properly be considered the current major forest insect pest of the forested areas in this region. Extensive stands of young tamarack which have replaced those wiped out by devastating outbreaks earlier in the century are now threatened. The protection of these young stands to maturity is of prime concern to the forest services of the two provinces, as there is a heavy demand for the hard durable wood of this tree species.

In view of the serious nature of the epidemic, and as the result of an appreciable increase in personnel, it was possible to effect a considerable expansion in the scope of investigations on this insect in 1945. Particular attention was paid to the elucidation of the current status of the introduced insect parasites. More exact and complete information was required on this because the effectiveness of Mesoleius tenthredinis originally liberated in Manitoba in 1912-13 was somewhat in doubt. At the same time little had been studied on the progress of Bessa harveyi more recently liberated in quantity from 1939 to 1941.

The results of the current work on this problem are both informative and important, since they clear up, in a large measure, some confusing aspects of previous investigations. These findings are bound to have an important bearing on future considerations of biological control against the sawfly in this region.

Cocoon population estimates and recording of tamarack sample plots were continued simultaneously, with the cocoon parasite studies. These records supply information on the relative intensity of sawfly populations between areas and years, thereby providing a check on the course of the outbreak.

B. Distribution.

See Section IV, Summary Report of Forest Insect Survey in Central Canada, 1945, page 84, for complete details.

C. Sample Plots.

1. Permanent Sample Trees.

Statistical sampling of the population of larch sawfly cocoons was continued in the permanent sample areas established for the purpose in 1944. The exact locations of these trees at Mile 7 Norgate Road, Mile 13 Lake Audy Road, and the Golf Course in Riding Mountain National Park, and one near Riverton, are given in the 1944 Annual Report. The method of cocoon sampling was an adaption of Dr. Prebble's third method of sampling for population of European Spruce Sawfly* and is outlined also in the 1944 Report. In 1944, the trees were selected, marker stakes driven, and the first set of samples taken as described therein.

In 1945, sampling was done over four 1 square foot areas, under each sample tree. A square frame of this size was set down to mark the area for sampling, and the sample secured by cutting the moss with a long knife around the border of the frame. Samples were taken diagonal to the 2 - 3 corner of each stake, (1944, 1 - 2 corner). The cover, (usually moss) was removed a handful at a time, placed on a ground sheet, and the contents of the sample examined, counted and recorded as to tree number and stake letter.

The cocoons found in each sample were segregated according to the following classifications: new sound; destroyed by mice (Moused); miscellaneous (Misc.) which included "parasitised and dead" cocoons; and old sound which were apparently sound cocoons from a previous year. Old sound cocoons were distinguished by the darker color of the cocoon. The separation of new sound from old sound cocoons

---

* M. L. Prebble - Sampling Methods in Population Studies of the European Spruce Sawfly, Gilpinia hercyniae (Hartig.) in Eastern Canada. From the transactions of the Royal Society of Canada, Third Series, Section V, Volume XXXVII, 1943.

represents a departure from the method followed in the 1944 sampling when both old and new sound cocoons were classified as "Sound". Only new sound cocoons were retained and layered in moss for later use.

All of the cocoons found in each of the four one square foot samples beneath the foliage of the larch tree were tabulated. The average depth, and the constituents of the ground cover from the surface down to the soil were recorded for each sample. The general condition and current defoliation of each tree were also noted.

The following tabulations give the data relating to sampling of the permanent sample trees at Riding Mountain National Park and Riverton. It should be noted that at Mile 7 Norgate Road, Stakes A and C under Tree 4, Stake A under Tree 7, Stakes B and C under Tree 9, and Stakes A, B, C and D under Tree 11 are all overlapped by foliage from neighboring tamarack trees. The samples taken at these stakes may contain the cocoons of larvae which fed, not on the sample trees, but on this overlapping foliage of other trees.

SUMMARY OF LARCH SAWFLY STATISTICAL STUDY 1945
(Permanent Sample Trees)

Riding Mountain National Park, Manitoba
Mile 7, Norgate Road

Tree No. Rec.Act.	Condition of Tree	Def. (1/16's)	Stake A						
			Depth (Ins)	Cover	Moist.	New Sound	Housed	Misc.	Old Sound
1-301	Bud development poor	14	5	Moss	Moist	13	0	0	9
2-302	" " "	13	2	Grass &thin moss	Moist	1	0	0	1
3-303	" " "	14	7	moss & grass	Moist	6	0	0	6
*4-1472	High defoliation due to poor bud development,only 1/16 to 2/16's due to sawfly	15	4	Moss & grass	Moist	6	0	0	5
5-1485	Defoliation due mainly to unopened buds from weak condition of the trees from previous attacks	11	1	Grass & Moss	Very moist	5	3	0	2
6-1496	Tree appears dead this year.	-	4	Moss & Grass	Moist	1	2	0	1
*7-1499	Defoliation not due to sawfly, but to lack of bud development from weak condition of tree.	9	¾	Grass & Moss	Very moist	7	0	0	0
8-51	" "	14	1½	Moss & Grass	Moist	3	1	0	0
*9-304	General condition, poor Signs of fair amount of feeding.	8?	6	Moss	Moist	10	1	0	2
10-305	General condition poor	14	1½	Moss & Grass	Moist	14	1	-	4
*11-49	Unopened and poorly developed buds common	12	2½	Moss & Grass	Wet	20	2	1 larva	23
12-306	General condition poor	14	12	Moss & Labrador Tea	Moist	3	15	-	1
TOTALS						89	25	0	54

* Some stakes overlapped by foliage of neighboring trees.

SUMMARY OF LARCH SAWFLY STATISTICAL STUDY 1945 (cont.)
(Permanent Sample Trees)

Riding Mountain National Park, Manitoba
Miles 7, Norgate Road

Stake B							Stake C							Stake D						
Depth (Ins.)	Cover	Moist	New Sound	Moused	Misc.	Old Sound	Depth (Ins.)	Cover	Moist	New Sound	Moused	Misc.	Old Sound	Depth (Ins.)	Cover	Moist	New Sound	Moused	Misc.	Old Sound
2	Grass & thin moss	Wet	1	0	0	1	4	Moss roots & sticks	Moist	19	1	1	3	5	Moss	Moist	13	0	0	5
-	-	-	2	0	0	4	-	-	-	6	1	0	5	-	-	-	5	1	1 larva	2
- &	Moss Grass Small roots	Moist	5	0	0	7	5	moss grass roots & roots	Moist	3	1	0	2	2	Moss	Moist	1	0	0	0
3	moss & grass	Moist	1	0	0	2	1½	moss & grass	wet	3	1	0	4	5	moss & grass	Moist	1	1	0	6
3/4	grass moss & mud	wet	0	1	1 dead larva	-	1½	moss & grass	wet	0	0	0	0	1½	moss & grass	very moist	1	2	0	0
1½	grass & moss	very moist	1	1	0	2	1	grass & moss	moist	1	0	0	1	1	grass & moss	moist	1	0	0	0
1½ 3/4	grass & moss	moist	2	0	0	0	2½	moss, some grass	moist	2	0	0	4	2	grass & moss	moist	7	2	-	3
8	moss & Labrador tea	wet	2	0	0	3	2 &	grass some moss	moist	0	0	0	0	1½	grass, some moss	wet	2	0	0	0
5	moss	very moist	7	1	3 larva	1	8	moss	moist	20	3	1 larva	2	1½	moss & grass	wet	4	0	0	0
1½	moss & grass	moist	10	0	0	5	1	little moss grass some moss & roots	moist	1	0	0	0	3	moss & grass	moist	3	0	0	1
2	moss & grass	moist	9	0	0	1	1½	some moss	very moist	8	-	-	1	2	moss grass	wet	3	1	0	7
2	grass & moss	very moist	3	0	0	5	2	grass & moss	wet	-	2	-	1	2	moss grass Labrador tea	moist	2	1	-	5
			43	23	0	31				63	9	1	23				43	8	0	29

SUMMARY OF LARCH SAWFLY STATISTICAL STUDY 1945
(Permanent Sample Trees)

Riding Mountain National Park, Manitoba
Golf Course

Tree No. Rec.Act.	Condition of Tree	Def. 1/16's	Stake A						
			Depth (Ins)	Cover	Moist	New Sound	Moused	Misc.	Old Sound
1-315	Good	2	1	grass	moist	5	0	0	1
2-316	Good	2	2½	Moss & Labrad or Tea	moist	5	0	0	4
3-317	-	8	8	Moss & Labrad or Tea	moist	17	4	0	2
4-318	Some defoliation due to poor development of leaves	6	2½	Moss & Labrad or Tea	dry	8	5	0	4
Totals						35	9	0	11
			Mile 13 Lake Audy Road						
1-307	Good	1	½	grass some moss	moist	1	0	0	0
2-308	Fairly good	1+	2	grass	moist	0	0	0	17
3-309	Good	1	½	grass & moss	moist	0	0	0	21
4-310	Fairly good	1+	1½	moss & some grass	Dry	0	0	0	0
5-311	Fair, some defoliation probably due to poor bud develop.	3	¾	moss & grass	very moist	0	0	0	0
6-312	Fairly good, thin on top	1+	2	moss & grass	moist	3	1	0	2
7-313	Fair condition, thin top 1/4	3	½	grass	moist	1	0	0	0
8-314	Fairly good	1+	½	moss & grass	wet	0	0	0	18
Totals						5	1	0	58

SUMMARY OF LARCH SAWFLY STATISTICAL STUDY 1945
(Permanent Sample Trees) (cont.)

Riding Mountain National Park, Manitoba
Golf Course

Stake B							Stake C							Stake D						
Depth (ins)	Cover	Moist	New Sound	Moused	Misc.	Old Sound	Depth (ins)	Cover	Moist	New Sound	Moused	Misc.	Old Sound	Depth (ins)	Cover	Moist	New Sound	Moused	Misc.	Old Sound
1	Grass	Moist	2	0	0	0	3/4	Grass	Moist	0	0	0	0	1	Moss	Wet	1	0	0	4
-	-	-	1	0	0	0	1	Grass	Moist	1	1	0	2	1½	Grass	Moist	2	8	0	0
1	Moss & Grass	Dry	6	0	0	2	3½	Moss	Fairly dry	26	10	0	0	1¾	Moss	Fairly dry	18-	2	0	1
1	mud, grass and a little moss	Dry	2	0	0	0	1	Grass some moss	& Dry	7	3	0	0	2	Moss & Grass	Fairly dry	11	0	0	4
			11	0	0	2				34	14	0	2				32	10	0	9

666

Mile 13 Lake Audy Road

1/4	grass & mud	Moist	1	0	0	1	1	Moss & grass	moist	3	0	0	0	3½	moss & grass	moist	0	0	0	0
½	grass	moist	1	0	0	0	3/4	grass & moss	moist	1	0	0	0	2½	moss & grass	moist	1	0	0	4
1	grass & moist	moist	1	0	0	2	1/4	moss & grass	moist	0	0	0	0	1½	grass & moss	dry	3	0	0	0
1½	moss & grass	wet	4	0	0	4	1 1/2	grass & moss	moist	0	0	0	14	1	moss & grass	dry	4	1	0	0
3/4	grass & little moss	moist	2	0	0	0	1 1/4	grass & moss	moist	2	0	1 larva	1	3/4	grass & moss	wet	0	0	0	17
2	moss & little grass	Moist	9	2	0	0	-	Some moss	-	5	0	0	2	3/4	grass & moss	moist	2	0	0	1
1	moss & grass	moist	2	1	0	0	1	moss & dewberries	rather dry	1	0	0	0	3/4	& moss	very moist	0	0	0	1
1/2	grass	moist	4	0	0	0	1/2	grass	moist	0	2	0	0	1/2	moss & grass	wet	0	0	0	12
Totals			24	3	0	7				12	2	0	17				10	1	0	35

SUMMARY OF LARCH SAWFLY STATISTICAL STUDY 1945
(Permanent Sample Trees)

Riverton, Manitoba.

Tree No. Rec. Act	Stake A Def.* (1/16's)	Depth (Ins.)	Cover	Moist	New Sound	Moused	Misc.	Old Sound	Stake B Depth (Ins.)	Cover	Moist	New Sound	Moused	Misc.	Old Sound
1 319	-	4	Moss	Moist	1	3	0	1	6	Moss	Moist	19	54	3	0
2 320	-	6	Moss & Mud	Moist	10	7	0	3	3	Moss & Mud	Moist	2	17	0	1
3 321	-	1	Grass & Mud	Wet	1	4	-	-	2	Mud	Moist	0	12	0	0
4 322	-	3	Moss	Moist	22	9	0	5	2	Grass & Mud	Moist	6	1	0	8
5 323	-	12	Moss	Moist	19	87	3	4	6	Moss	Moist	17	0	4	0
6 324	-	4	Moss	Moist	12	19	0	0	8	Moss	Moist	3	0	6	1
7 325	-	1½	Grass & Mud	Moist	2	1	0	1	3	Moss	Moist	16	4	0	5
8 326	-	6	Moss	Moist	17	88	1	5	3	Moss	Moist	31	8	2	5
9 327	-	8	Moss & Mud	Moist	10	27	1	8	3	Grass & Mud	Moist	11	2	0	3
10 328	-	3	Grass & Mud	Moist	10	11	0	5	9	Moss	Moist	14	1	0	0
11 329	-	3	Moss	Moist	4	5	0	3	1½	Moss & Mud	Moist	8	0	0	0
12 330	-	7	Moss	Moist	20	117	8	0	6	Moss	Moist	20	51	2	3
Totals					128	378	13	35				147	150	17	26

* Defoliation estimated at 5/16's to 7/16's.

107

SUMMARY OF LARCH SAWFLY STATISTICAL STUDY 1945
(Permanent Sample Trees)

Riverton, Manitoba.

Stake C							Stake D						
Depth (Ins.)	Cover	Moist	New Sound	Moused	Misc.	Old Sound	Depth (Ins.)	Cover	Moist	New Sound	Moused	Misc.	Old Sound
7	Moss	Moist	18	47	2	6	6 to 8	Moss	Moist	20	60	2	-
2	Moss	Moist	2	0	0	2	3	Loam	Moist	2	8	0	0
2½	Grass & Mud	Moist	3	2	0	0	2	Grass & Mud	Moist	6	12	0	0
2	Grass & Dirt	Moist	5	3	0	4	1	Moss	Moist	2	0	0	0
2	Grass Moss, & Mud	Moist	14	0	0	8	6	Moss	Moist	21	75	2	1
½	Grass	Moist	2	0	0	0	2½	Moss & Grass	Moist	11	3	0	2
1	Mud	Moist	3	2	0	1	2	Grass & Mud	Moist	6	3	0	1
2	Moss	Moist	16	7	0	0	-	-	--	15	34	1	3
7	Moss	Moist	12	28	2	0	4	Grass Mud	& Moist	8	3	0	2
1½	Grass & Mud	Moist	5	10	0	0	2	Grass & Mud	Moist	1	6	0	2
1½	Grass & Mud	Moist	4	2	0	9	3	Moss & Mud	Moist	19	1	0	5
7	Moss	Moist	11	66	3	4	6	Moss	Moist	4	62	1	0
			95	167	7	34				115	267	6	16

2. Non-Permanent Sample Trees

In addition to the sampling done from permanent sample trees located in the areas mentioned above, statistical samples to estimate populations of European larch sawfly were taken in three other areas in Riding Mountain National Park, Duck Mountain Forest Reserve and Spruce Woods Forest Reserve.

(a) Location and General Description of Areas:

Mile 145 Dauphin Rd., Riding Mountain National Park.

Ten of the most heavily defoliated trees in a tamarack swamp lying on the west side of the road were selected for sampling. The stand is a spruce and tamarack mixture, with spruce forming the upper story. Defoliation by sawfly was heavy and averaged about 8/16's. The ground cover of heavy sphagnum moss and some grass, was dry to slightly moist.

* Baldy Mountain, Duck Mountain Forest Reserve.

Ten trees, representative of the most heavily defoliated tamarack in the stand, were sampled. They were located a few hundred feet E.S.E. of the towerman's cabin. Defoliation by sawfly was extremely heavy at about 11/16's. The tamarack were scattered amongst black spruce, with the occasional poplar and birch. The ground cover of duff with some light moss and grass, was extremely dry.

Delta Swamp, Spruce Woods Forest Reserve.

Ten trees were selected in Delta Swamp, lying west of the Spruce Woods Forest Reserve in a bend of the Assiniboine River. The swamp is wooded with tamarack and spruce, with tamarack the more common. The ground cover of moss was very wet, and water was present under the moss. Sawfly defoliation was almost unnoticeable and limited to 1/16 of the foliage.

---

* At the time cocoon collections were made (Sept. 18) two specimens of the arctic white-footed mouse (Peromyscus maniculatus borealis Mearns) were taken in traps. As this mouse is know to feed on Sawfly cocoons, it is probable that it is responsible for some of the predatorized cocoons.

(b) Procedure of Sampling:

All trees selected were free of overhanging branches from other tamarack. A record of the height, D.B.H., and defoliation was kept for each tree.

Sampling was done over two separate one square foot areas of ground cover lying within the periphery of the tree. The samples were secured, and the cocoons segregated, and tabulated, in the same manner as outlined for the permanent sample trees. The average depth and the constituents of the ground cover from the surface down to earth were recorded for each sample.

The following tabulations give the data relating to sampling of non-permanent sample trees in Riding Mountain National Park, Duck Mountain Forest Reserve and Spruce Woods Forest Reserve.

SUMMARY OF LARCH SAWFLY STATISTICAL STUDY
(Non-permanent sample trees)

Riding Mountain National Park, Manitoba
Mile 145 Dauphin Highway

Tree No.	Height Ft.	D.B.H. (Ins.)	D E F (1/10s)	SAMPLE ONE						SAMPLE TWO						
				Depth (Ins)	Cover	Moist	New Sound	Moused	Misc.	Old Sound	Depth (Ins)	Cover	Moist	New Sound	Moused	Misc.	Old Sound
1	15'	3½	9	- 1	Moss & grass	Moist	1	3	-	1	1	Grass & moss	moist	8	17	-	2
2	18'	4	8	2	Moss & Grass	moist	12	9	-	2	1½	grass	moist	5	1	-	1
3	17"	3	7	2	grass & moss	moist	3	2	-	1	2	moss & grass	moist	7	6	-	0
4	14"	3	5	1½	moss & grass	moist	11	9	-	1	2½	moss & grass	moist	19	2	-	1
5	16"	3½	4	2½	moss & grass	Dry	17	0	-	0	1	Grass	moist to dry	1	1	-	0
6	17"	3	9	12	moss & Lab.tea	moist	34	8	-	0	½	Grass & some moss	moist	40	0	-	8
7	20"	4	11	2	Grass & Moss	moist	35	6	-	1	2	grass & moss	moist	45	1	-	1
8	15"	3	5	1	grass & moss	moist	6	0	-	3	1	grass & moss	moist	3	0	-	1
9	14"	3½	5	5	Moss	Dry	7	0	-	0	2½	moss & grass	moist	14	0	-	2
10	17"	3½	8	4	Moss	moist	2	2	-	0	2	moss & grass	moist	7	1	-	1
Totals							128	39	0	9				149	29	0	17

SUMMARY OF LARCH SAWFLY STATISTICAL STUDY

(Non-Permanent Sample Trees)

DUCK MOUNTAIN FOREST RESERVE, Manitoba
Baldy Mountain

Tree No.	Height (ft.)	D.B.H. (ins)	D.E.F. (1/16s)	SAMPLE ONE Depth (ins)	Cover	Moist	New Sound	Housed	Misc.	Old Sound	SAMPLE TWO Depth (ins)	Cover	Moist	New Sound	Housed	Misc.	Old Sound
1	35	8	12	1	Moss & Grass	Dry	12	3	-	0	2	Moss & Grass	Dry	48	0	-	1
2	36	9	14	1	Moss	Dry	36	0	-	2	3	Moss	-	33	4	-	1
3	30	6	15	3/4	Short moss & grass	Moist	15	0	-	5	1½	Moss & Duff	Dry	31	6	(old 1 para)	1
4	32	7	15	2	Short moss & duff	Dry	18	1	-	6	2	Duff over a layer of old moss	Dry	16	0	-	2
5	30	6	15	2	moss	Dry	30	10	-	0	1 1/4	Duff & grass	Dry	41	67	1 (old paras)	0
6	28	6	13	½	Grass	Dry	34	1	-	1	½	Moss & Duff	Dry	7	6	-	0
7	29	6	15	1½	moss & duff	Dry	39	8	2 (old paras)	0	1½	Moss & Duff	Dry	31	2	2 (old paras)	2
8	28	5	15	1½	moss & duff	Dry	20	0	-	2	1	Moss & Duff	Dry	29	0	-	0
9	28	7	13	1	grass & short moss	Dry	20	2	-	0	2	Moss & Grass	Dry	26	4	-	0
10	29	6	15	1/2	Duff	Dry	51	2	-	0	1/2	Grass & Duff	Dry	45	1	-	0
Totals							275	27	2	16				369	90	6	7

SUMMARY OF LARCH SAWFLY STATISTICAL STUDY

(Non-Permanent Sample Trees)

SPRUCE WOODS FOREST RESERVE, Manitoba

Tree No.	Height (ft.)	D.B.H. (ins.)	D.E.P. 1/16s	SAMPLE ONE						SAMPLE TWO						
				Depth (ins.)	Cover	Moist	New Sound	Moused	Misc.	Old	Depth (Ins.)	Cover	Moist	New Sound	Moused	Misc.	Old.
1	35	10	1	3	Moss	Wet	0	0	0	0	3	Moss	Wet	0	0	0	0
2	35	7	1	1½	Moss	Wet	1	0	0	0	2	Moss	Wet	0	0	0	0
3	22	4	1	2	Moss	Wet	0	0	0	0	4	Moss	Wet	1	0	0	0
4	25	5	1	2	Moss	Wet	0	0	0	0	1½	Moss	Wet	2	0	0	0
5	25	4	1	3	Moss	Wet	0	0	0	0	3½	Moss	Wet	0	0	0	0
6	25	4	1	3	Moss	Moist	0	0	0	0	2	Moss	Moist	0	0	0	0
7	35	7	1	2	Moss	Wet	1	0	0	0	2½	Moss	Wet	0	0	0	0
8	40	9	1	3	Moss	Wet	0	0	0	0	1½	Mud	Moist	0	0	0	0
9	35	10	1	3	Moss, Mud	Wet	0	0	0	0	2	Moss	Moist	0	0	0	0
10	20	3	1	3	Moss	Wet	0	0	0	0	2	Moss	Wet	0	0	0	0
TOTALS							2	0	0	0				3	0	0	0

SUMMARY OF SAMPLING

Permanent Sample Trees

LOCATION	No. of Trees	No. of Sq. Ft. Samples	COCOONS		PER	SQUARE	FOOT
			New Sound	Old Sound	Total Sound	Moused	Misc. (dead or parasitized)
Riding Mountain National Park Golf Course	4	16	7.00	1.50	8.5	2.06	0.0
Norgate Road	12	48	4.96	2.85	7.81	0.94	0.02
Audy L. Road	8	32	1.59	3.66	5.25	0.22	0.00
Riverton	12	48	10.10	2.31	12.41	20.04	0.90

Non-Permanent Sample Trees

Riding Mountain National Park Dauphin Road	10	20	13.85	1.30	15.15	3.40	0.00
Duck Mountain Forest Reserve	10	20	29.20	1.15	30.35	5.85	0.00
Spruce Woods Forest Reserve	10	20	.25	0.00	0.25	0.00	0.00

3. Comparison of Visual Estimates of Defoliation with Population Density of Cocoons.

Comparison of results of two methods of estimating European larch sawfly populations is given below. Visual estimates of defoliation by sawfly, in the Norgate Road sample plot were unsatisfactory as the lack of foliage was the result of poor bud development, from general weakening of the trees following previous attacks. Current feeding by sawfly was hard to estimate, but was probably not very severe.

PERMANENT SAMPLE TREES

Area	Tree No.	Defoliation 1/16's	Average number (for four samples) of new, sound, cocoons per sq. ft.	Remarks
Golf Course R.M.N.P.	1		2.0	
	2	2	2.2	
	3	8	16.8	
	4	6	7.0	- Defoliation partly due to poor bud development.
Lake Audy, R.M.N.P.	1	1	1.2	
	2	1+	0.8	
	3	1	1.0	
	4	1+	2.0	
	5	3	1.0	- Defoliation partly due to poor bud development.
	6	1+	4.8	
	7	3	1.0	
	8	1+	1.0	
Norgate Rd. R.M.N.P.	1	14	11.5	- Defoliation due to poor bud development and sawfly attack for all trees in this plot.
	2	13	3.5	
	3	14	3.8	
	4	15	2.8	- Sawfly defoliation probably only 1/16 to 2/16's.
	5	11	1.5	
	6	-	1.0	- Appears to be dead.
	7	9	4.5	
	8	14	1.8	
	9	8	10.2	- Fair amount of feeding.
	10	14	7.0	
	11	12	10.0	
	12	14	2.0	
Riverton				Defoliation by larch sawfly not recorded for individual trees.

AREA	Tree No.	Defoliation (1/16's)	Average Number (for two samples) of New, Sound Cocoons per square foot.
Mile 145 Dauphin Rd. R.M.N.P.	1	9	4.5
	2	8	8.5
	3	7	5.0
	4	5	15.0
	5	4	9.0
	6	9	37.0
	7	11	40.0
	8	5	4.5
	9	5	10.5
	10	8	4.5
Baldy Mtn. D.M.F.R.	1	12	30.0
	2	14	34.5
	3	15	23.
	4	15	17.
	5	15	35.5
	6	13	20.5
	7	15	35
	8	15	24.5
	9	13	24.
	10	15	48
Delta Swamp S.W.F.R.	1	1	0.0
	2	1	0.5
	3	1	0.5
	4	1	1.0
	5.	1	0.0
	6	1	0.0
	7	1	0.5
	8	1	0.0
	9	1	0.0
	10	1	0.0

E. 1944 Parasite Dissections and Rearings.

1. Rearing of Cocoons for Parasite Emergence.

Complete data on larch sawfly cocoons reared for parasite emergence was not available for inclusion in the 1944 Annual Technical Report, and is therefore summarized here.

(a) Golf Course, Riding Mountain National Park.

In addition to the cocoons which were incubated early in 1945, as described in the above report, a collection of 897 cocoons from the Golf Course sample plot were left in storage until May 1. They were then soaked in water overnight, laid on moist cotton in jelly jars, and placed in the open-air insectary to observe emergence. Emergence data for this collection is included in Tables I and II.

(b) Lake Audy Road and Wasagaming Townsite Plots., R.M.N.P.

29 Cocoons from the Lake Audy Road sample plot, and 8 cocoons from the Wasagaming Townsite plot, were given the same treatment as the Golf Course sample received, but yielded no emergence.

(c) Summary of Emergence.

Table I shows the dates of incubation of the cocoon collections and the dates of emergence of adult sawflies and parasites.

Table II summarizes the emergence of adults and of parasites. The "% Total Cocoons Unemerged" refers to the percentage of the total number of cocoons which yielded neither adults or parasites. The number of unemerged cocoons was high, and variable among areas. In two comparable collections (Hyska's district "A" and "B") the percentage of unemerged cocoons was nearly equal, although rearing methods for the two collections differed (See 1944 Annual Report). Cocoons from the Golf Course Collection, which were not incubated but allowed to emerge at the normal time in the spring, gave the lowest percentage of unemerged cocoons.

Unemerged cocoons, examined after emergence of adults and parasites was completed, were all found to be dead. Parasitism percentages based on the number of cocoons reared

ranged from below 1% to 2.5%. The following parasites were recovered from the cocoons:

Hymenoptera: Mesoleius tenthredinis Morley,
Aptesis indistincta Prov.
Scopinaus analis, Cress.

Diptera: Bessa harveyi Tns.

Mesoleius was recovered in all areas except Mile 7 Norgate Road.

2 Examination of Cocoons for Parasites.

As recorded in the 1944 Annual Technical Report, about 400 cocoons were opened and the larvae within dissected for parasites. Identifications of the parasites from these cocoons are now available, and a summary of the results of the dissections follows. The heading, "% of Cocoons Dead" refers to cocoons which, at the time of examination, were empty or contained decayed, fungus-covered or shrivelled larvae.

1944 Results of Dissection of Cocoons for Parasites

	No. of Cocoons Examined	% Cocoons Dead	% Cocoons Parasitised: Meso-leius	Bessa	Aptesis	TOTAL
R.M.N.P.						
Hyska's district -A	102	5.0	5.9	0.0	0.0	5.9
Hyska's district -B	95	8.4	6.3	0.0	0.0	6.3
Mile 7 Norgate Rd.	100	23	0.0	4.0	0.0	4.0
Riverton	100	50	1.0	0.0	1.0	2.0

For the three collections from Riding Mountain National Park, the rate of parasitism revealed by examination of sawfly cocoon was higher than that calculated from emergence of reared cocoons. However, comparison of dissected and reared cocoons from Riverton showed almost equal parasitism. The value of comparing these records is obviously small when one considers the high percentage of unemerged cocoons from the incubated collections, and the variable percentage of cocoons found already dead at the time dissections were made. Whether or

not parasites had been present in these cocoons could not be ascertained.

Dissections of the 1944 cocoons were spread over a period from January 22 to March 6; some were made immediately after removal of the cocoons from cold storage, and some after a considerable period of incubation. The extent to which these circumstances caused variations in the number of cocoons found dead on the dates of dissection was probably considerable. It was decided advisable to make a series of dissections of 1945 cocoons as soon after collection as possibbe, and in this way to obtain an accurate count of the larvae parasitised before other factors, such as artificial rearing conditions, cause mortality among the sawfly.

Table 1

1944 SUMMARY OF EMERGENCE PERIODS OF COCOONS REARED FOR PARASITES

Area	Incubation Date	Emergence Periods of Adults and Parasites				
		Adult Sawflies	M. tenthredinis Morl.	B. Newmani Tns.	Scoponus Analis Cress.	Aptesis indistincta Prov.
RMNP Hyska's District A	Jan.19/45	Feb.24-Apr.26	Feb.24-Mar.31			
Hyska's District B	Feb.2	Feb.28-Apr.26	Mar.20-26			
Mile 7 Norgate Road	Feb.2	Feb.26-Apr.11		Feb.24-28	Mar.13	
Golf Course	Not incubated	May 2-Jul.17	May23-June 15	June 4		June 25
Riverton	Jan.23	Feb.19-May 5	Feb.28-Mar.20	Feb.10-20 T		April 7

TABLE 2

1944 SUMMARY OF EMERGENCE OF COCOONS REARED FOR PARASITES

Area	No. of Cocoons	No. of adult Sawflies			% oc Cocoons Parasitised					% Total Cocoons Unemerged
		♂	♀	Total	Mesoleuis *	Bessa	Scopiorus	Aptesis	Total	
RMNP Kyska's District A	600	1	274	275	1.0 (6)	0 (0)	0 (0)	0 (0)	1.0 (6)	53.2
Kyska's District B	382	2	162	164	.78 (3)	0 (0)	0 (0)	0 (0)	.78(3)	56.3
Mile 7 Norgate Road	400	2	93	95	0.0 (0)	1.75(7)	.25 (1)	0 (0)	2.0 (8)	74.2
Golf Course	897	5	575	580	1.78 (16)	0.11(1)	0 (0)	.11 (1)	2.0 (18)	33.3
Riverton	750	0	125	125	.93 (7)	1.47(11)	0 (0)	.13 (1)	2.53(19)	80.8

* Bracketed figures refer to actual numbers.

F. 1945 Parasite Dissections and Rearings.

1. Mass Collections of Cocoons.

Mass collections of "New Sound" cocoons were made for dissections and rearings to determine parasitism. Collections were made from the same areas as the population counts, and in addition a small number of cocoons were gathered from a heavily-infested tamarack stand east of the Prisoner-of-War Camp in Riding Mountain National Park. This is an infestation which first reached epidemic proportion in 1945.

All of the cocoons classified as "New Sound", from the population counts were retained, and became part of these collections. The cocoons were layered in moist moss within screened, wooden frames for shipment. Ten frames were brought to the Winnipeg laboratory, ten frames were sent to the Dominion Parasite Laboratory at Belleville, Ontario, and four frames were buried in the moss in suitable locations near the points of collection. These cocoons are to be dug up early in the spring and brought to the Winnipeg laboratory to observe emergence of sawflies and parasites.

The frames of cocoons which were brought to the Winnipeg laboratory were stored in the insectary, being transferred in November to the cold storage chamber where they remained until removed for dissections and rearings.

A summary of the collections and the disposition of the frames of cocoons is given below. (See Table 2a)

2. Examination of Cocoons for Presence of Parasites.

Cocoons from nine areas of European larch sawfly infestation were dissected to determine the occurrence and distribution of parasites. Cocoons for dissection were selected at random from the mass collections made at the following Manitoba points:

Reference Number	Area
1.	Mile 145 Dauphin Road, Riding Mountain Nat. Park
2.	Mile 7 Norgate Road, " " " "
3.	Golf Course " " " "
4.	Mile 13 Lake Audy Road " " " "
5.	Prisoner-of-War Camp " " " "
6.	Riverton
7.	Baldy Mountain, Duck Mtn. Forest Reserve
8.	Delta Swamp, Spruce Woods Forest Reserve
9.	Seddon's Corner, Near Beausejour.

Table 2a.

Date Collected	Locality	No. of Frames	No. of cocoons per frame	Disposition of Frames
Sept. 7	Norgate Rd. RMNP	1	1000	Sent to Belleville, Ont.
" 8	Norgate Rd. RMNP	1	1094	Sent to Belleville, Ont.
" 8	Norgate Rd. RMNP	1	1000	Winnipeg Laboratory
" 11	Golf Course, RMNP	1	476	Winnipeg Laboratory
" 12	Audy Lake Rd.RMNP	1	451	Winnipeg Laboratory
" 12	Dauphin Rd. RMNP	1	1021	Winnipeg Laboratory
" 12	Dauphin Rd. RMNP	1	1000	Sent to Belleville, Ont.
" 13	Dauphin Rd. RMNP	1	1000	Sent to Belleville, Ont.
" 13	Dauphin Rd. RMNP	1	700	Winnipeg Laboratory
" 13	Dauphin Rd. RMNP	1	1000	Buried in moss at a dry spot near golf course, RMNP, about 30 ft. S. sample tree 317, marked by orange stake.
" 13	Dauphin Rd. RMNP	1	1000	Buried moss at a wet spot 200 ft. NW of tree 317 above, marked by orange stake.
" 14	Prisoner-of-War Camp, R.M.N.P.	1	175	Winnipeg Laboratory
" 16	Baldy Mt.,DMFR	1	1000	Winnipeg Laboratory
" 16	Baldy Mt., DMFR	1	1000	Sent to Belleville, Ont.
" 16	Baldy Mt., DMFR	1	1000	Sent to Belleville, Ont.
" 16	Baldy Mt., DMFR	1	1000	Sent to Belleville, Ont.
" 16	Baldy Mt., DMFR	1	1000	Sent to Belleville, Ont.
"26-Oct.5	Riverton	1	1000	Sent to Belleville, Ont.
"26-Oct.5	Riverton	1	1000	Sent to Belleville, Ont.
"26-Oct.5	Riverton	1	1000	Winnipeg Laboratory
"26-Oct.5	Riverton	1	1000	Buried in moss 12 ft. due N. sample tree 319 marked by orange stake.
"26-Oct. 5	Riverton	1	1000	Buried in moss 140 ft. due S. sample tree 319, marked by orange stake.
Oct.10	Delta Swamp,SWFR.	1	300	Winnipeg Laboratory
Oct. 18	Seddon's Corner Beausejour, Man.	1	1000	Winnipeg Laboratory
	TOTAL		21,217	

Each cocoon was opened and, if it was found to be empty or to contain a decayed, shrivelled or fungus-covered larva, the condition was noted. Living larvae were examined for evidence of parasites by first looking at the integument for scars. An incision was made along the mid-ventral line and the integument laid back to expose the body contents. For each larva dissected, a record was kept of the number, stage and kind of parasite if any were present. Scars on the larval integument were noted as well as any unusual features of the parasite or host.

A series of cocoons from each of the nine areas listed above, was examined during the period of September 24 to November 13 (Series One). A second series was done from November 14 to December 4 (Series Two), and a third completed between February 5 and 26 (Series Three).

(a) Summary of Cocoons examined.

Tables 3, 4 and 5, which follow, show the condition of all cocoons examined in Series One, Two and Three respectively.

TABLE 3

SUMMARY OF COCOONS EXAMINED (Series One)

DATA Reference Number	1	2	3	4	5	6	7	8	9
Cocoons examined	129	105	111	100	51	137	101	119	100
Normal larvae(No parasites,no scars on integument,no abnormalities evident)	105	62	61	78	12	59	56	84	90
Dead larvae or empty cocoons	9	5	12	0	0	38	1	19	0
Larvae parasitised by Mesoleius	15	16	18	9	37	18	38	13	3
Larvae parasitised by Bessa	0	19	13	0	0	21	0	0	2
Larvae parasitised by Mesoleius and Bessa IN THE SAME HOST	0	1	1	0	0	4	0	0	0
Total larvae parasitised by Mesoleius and Bessa	15	34	30	9	37	35	38	13	5
Larvae containing small spherical bodies	0	0	2	7	0	1	2	0	1
Larvae containing spherical bodies and parasites in the same host.	0	0	0	0	0	1	0	0	0
Larvae with scars on the integument, otherwise normal.	0	4	6	5	2	5	4	2	2
Other larvae, abnormal				1				1	2

TABLE 4

SUMMARY OF COCOONS EXAMINED (Series Two)

Data Reference Number	1	2	3	4	5	6	7	8	9
Cocoons examined	102	101	109	101	50	133	105	61	101
Normal Larvae (no parasites, no scars on integument, no abnormalities)	77	70	66	83-	14	64	48	37	88
Dead larvae or empty cocoons	2	1	9	1	0	34	5	11	1
Larvae parasitised by Mesoleius	19	12	20	8	34	13	49	13	6
Larvae parasitised by Bessa	1	14	14	0	0	18	0	0	2
Larvae parasitised by Mesoleius and Bessa in the SAME HOST	0	2	5	0	0	1	0	0	0
Total larvae parasitised by Mesoleius and by Bessa.	20	24	29	8	34	30	49	13	8
Larvae containing small spherical bodies.	2	0	0	0	1	0	0	0	0
Larvae containing spherical bodies and parasites in the SAME HOST	0	0	0	0	1	0	0	0	0
Larvae with scars on the integument, otherwise normal.	1	5	5	9	2	4	3	0	2
Other larvae, abnormal.		1				1			2

TABLE 5

SUMMARY OF COCOONS EXAMINED (Series Three)

Data Reference Number	1	2	3	4	5	6	7	8	9
Cocoons examined	100	100	50	50	25	100	100	-	100
Normal larvae, (no parasites, no scars on integument, no abnormalities evident)	56	54	20	38	4	35	42	-	70
Dead larvae or empty cocoons.	7	3	4	0	4	22	10	-	6
Larvae parasitised by *Mesoleius*	14	16	14	3	13	12	34	-	4
Larvae parasitised by *Bessa*.	0	19	3	0	0	23	0	-	1
Larvae parasitised by *Mesoleius* and *Bessa* in the SAME HOST.	0	3	0	0	0	1	0	-	0
Total larvae parasitised by *Mesoleius* and by *Bessa*.	14	32	17	3	13	34	34	-	5
Larvae containing small spherical bodies.	7	6	7	7	7	3	14	-	12
Larvae containing spherical bodies and parasites in the SAME HOST.	0	3	2	0	4	0	5	-	0
Larvae with scars on the integument, otherwise normal.	16	8	4	2	1	6	5	-	7
Other larvae, abnormal.	0	0	0	0	0	0	0	-	0

(i) Cocoons examined:

A total of 2441 cocoons from all areas was examined; the number in several areas being limited by the size of the collections.

(ii) Normal larvae:

Cocoons tabulated under this heading in Tables 3, 4, and 5 appeared to be normal in every respect. They contained no parasites and the larval integument was unmarked. The percentage of cocoons containing normal larvae is shown below:

Series I - 63.7% Series II- 63.4% Series III - 51.0%

(iii) Dead larvae and empty cocoons:

The percentage of cocoons in each series, which contained dead larvae or were empty when examined, is shown below to be fairly constant:

Series I - 8.81% Series II - 7.42% Series III - 8.96%

These dead larvae were decayed, shrivelled, fungus-covered, apparently diseased, etc., and could not be dissected for examination for parasites. Some of the cocoons classed as empty, contained the dried-up head capsules and remnants of the larval skin, but in others no trace of these was found. The percentage of dead cocoons in each area is given below. They show a wide variation among areas, from a negligible percentage at Lake Audy to 25% of the cocoons at Riverton.

AREA	% Dead Cocoons
R.M.N.P.	
Dauphin Road	5.4
Norgate Road	2.9
Golf Course	9.3
Lake Audy	0.4
Prisoner of War Camp	3.2
Riverton	25.4
Duck Mtn. Forest Reserve,	
Baldy Mountain	5.2
Spruce Woods Forest Reserve	
Delta Swamp	16.7
Seddon's Corner	2.3

The cause of the death of these larvae is not readily apparent. Most of the dead larvae were found in varying stages of decay. A fungus was found growing on some larvae from all areas except Lake Audy, but it was most common in larvae from Spruce Woods (40% of the dead cocoons). It is not known whether this fungus is saprophytic or parasitic. About half of the cocoons from Riverton contained hard, shrivelled larvae. This condition was encountered only rarely in other areas, and the cause is unknown.

(iv) Larvae Parasitised by Mesoleius.

Dissections of larch sawfly larvae revealed both eggs and larvae of a Hymenopterous parasite free in the body cavity of the host. The eggs and larvae were identified as those of Mesoleius tenthredinis Morley. on the following evidence. In one host a Hymenopterous larva was found still attached by membranous material to an eggshell from which it had emerged. The light brown egg shell was similar in appearance to the unhatched eggs found in other hosts. The unhatched eggs were therefore assumed to be eggs of the same parasite.

Samples of eggs and larvae were sent to Mr. Graham at the Belleville Parasite Laboratory for identification. An excerpt from a letter (December 10, 1945) received from Mr. Graham follows: "With regard to the identification of the larvae and eggs submitted, we cannot say definitely that the eggs are those of Mesoleius tenthredinis, but it is fairly reasonable to assume that they are, since we have dissected host larvae and found both first and second instar M. tenthredinis and egg shells which are quite similar to the unhatched eggs to be found in other host larva. We have found only one M. tenthredinis in any one host larva. The larvae submitted in vials one and two and four are assumed to be those of M. tenthredinis .....".

Later emergence of Mesoleius tenthredinis adults was recorded from reared sawfly cocoons belonging to the same collections as those dissected.

The parasite was found in larvae from all study areas. From one to four eggs occurred in parasitised larvae, but only one larva was found in any one host, although frequently unhatched eggs were present as well.

Most of the Mesoleius eggs appeared to be alive. The shell of the egg was colorless, and transparent, and contained a small creamy-white well-advanced embryo. Other eggs appeared to contain an embryo but the shell was a light brown color. Several eggs were found in which the shell was split and a small larva appeared to be emerging. In all cases, the egg was completely surrounded by a thick translucent coating, presumably laid down by action of the host. Other eggs found appeared to be already dead; they were empty brown shells, in some cases withered and collapsed.

(v) Larvae parasitised by Bessa.

Some of the dissected larvae contained a Dipterous parasite in the larval stage. A sample of this parasite was sent to the Belleville Laboratory, where it was tentatively identified by Mr. Graham as Bessa harveyi Tns. in the first instar. This identification was later confirmed by emergence of Bessa harveyi as the only Dipterous parasite to be recovered from reared sawfly cocoons belonging to the same collections as those dissected.

Each larva was contained in a respiratory funnel made of the host's integument. At the point where the respiratory funnel originated on the skin of the host, a large scar was visible on the external surface of the larva. The majority of the larvae parasitised by Bessa contained only one parasite larva but it was not uncommon to find two or even three larvae in a host.

Bessa was recorded in three areas of Riding Mountain National Park, at Riverton and at Seddon's Corner.

(vI) Larvae parasitised by Mesoleius and Bessa in the same host.

A total of 18 sawfly larvae from all areas contained both Mesoleius and Bessa in the same host. Where this occurred a Bessa larva (or larvae) was in combination with a Mesoleius egg(s) in fourteen hosts, and in combination with a Mesoleius larva in four hosts. In the latter case, both Hymenopterous and Dipterous larvae appeared healthy at the time of dissection.

(vii) Total larvae parasitised by Mesoleius and by Bessa.

Tables 3, 4 and 5 give the total number of larvae parasitised by Mesoleius and by Bessa. Because of the occasional occurrence of both parasites in the same host, these figures are less than the corresponding sums of the larvae parasitised by Mesoleius and by Bessa individually.

(viii) Larvae containing small spherical bodies.

In each series of dissections some larvae were found to contain a varying number of small brown spherical bodies, the nature of which has not been established. They were found free in the body cavity of the larva. They occurred infrequently in the first and second series of dissections, but in the third series were present in an average of 12% of the larvae. When a series of fifty cocoons from Duck Mountain Forest Reserve were examined from 54 to 56 days after incubation, these small bodies were found in 22%. They occurred in living larvae and pupae. It is possible that they are products of excretion.

(ix) Larvae containing spherical bodies and parasites in the same host.

The presence of spherical bodies does not seem to be related to parasite occurrence as very few larvae were found to contain both.

(x) Larvae with scars on the integument.

Larvae recorded under this heading in Tables 3, 4 and 5 had one or more scars on the integument, but were otherwise normal; that is they appeared healthy and contained no parasites or small spherical bodies.

(xi) Other larvae.

Larvae recorded under this heading were alive when dissected and contained no parasites, but were abnormally discoloured and several appeared diseased.

3. Parasitism by Bessa and Mesoleius

Tables 6, 7 and 8, which follow, set forth the percentage of larvae parasitised by Bessa larvae and by Mesoleius eggs and larvae, as well as host larvae showing double parasitism, for series 1, 2 and 3 respectively. Table 9 shows the same percentage for the three series of dissections combined.

6 2

TABLE 6

PARASITISM BY MESOLEIUS AND BESSA (Series One)

Data Reference Number	1	2	3	4	5	6	7	8	9
% Cocoons parasitised	11.7	32.4	27.0	9.0	72.5	25.5	37.6	10.9	5.0
% Parasitised by Bessa larvae	0.0	18.1	11.7	0.0	0.0	15.3	0.0	0.0	2.0
% Parasitised by both Bessa and Mesoleius in the same host.	0.0	1.0	0.9	0.0	0.0	2.9	0.0	0.0	0.0
% Parasitised by Mesoleius	11.7	15.2	16.2	9.0	72.5	13.1	37.6	10.9	3.0
% containing Mesoleius eggs.	10.9	13.3	15.3	9.0	70.6	10.2	34.6	7.6	3.0
% containing Mesoleius larvae	1.6	1.9	0.9	0.0	5.9	2.9	3.0	3.4	0.0
% containing both eggs and larvae of Mesoleius in the same host.	0.8	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0

TABLE 7

PARASITISM BY MESOLEIUS AND BESSA (Series Two)

Data Reference Number	1	2	3	4	5	6	7	8	9
% Cocoons parasitised	19.6	23.8	26.5	7.9	68.0	22.5	46.7	21.3	7.9
% Parasitised by Bessa larvae	1.0	13.9	12.8	0.0	0.0	13.5	0.0	0.0	2.0
% Parasitised by both Bessa and Mesoleius in the same host.	0.0	2.0	4.6	0.0	0.0	0.8	0.0	0.0	0.0
% Parasitised by Mesoleius	18.6	11.9	18.3	7.9	68.0	9.8	46.7	21.3	5.9
% containing Mesoleius eggs.	13.7	11.9	15.6	6.9	58.0	7.5	43.8	18.0	4.9
% containing Mesoleius larvae.	4.9	0.0	2.7	1.0	10.0	2.3	2.9	3.3	1.0
% containing both eggs and larvae of Mesoleius in the same host.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 8

PARASITISM BY MESOLEIUS AND BESSA (Series Three)

Data Reference Number	1	2	3	4	5	6	7	8	9
% Cocoons parasitised	14	32	34	6	52	34	34	-	5
% Parasitised by *Bessa* larvae	0	19	6	0	0	23	0	-	1
% Parasitised by both *Bessa* and *Mesoleius* in the same host.	0	3	0	0	0	1	0	-	0
% Parasitised by *Mesoleius*	14	16	28	6	52	12	34	-	4
% containing *Mesoleius* eggs.	13	15	28	6	52	12	31	-	3
% containing *Mesoleius* larvae.	1	1	0	0	8	0	3	-	1
% containing both eggs and larvae of *Mesoleius* in the same host.	0	0	0	0	8	0	0	-	0

TABLE 9

PARASITISM BY MESOLEIUS AND BESSA

(Three series of dissections combined)

Data Reference Number	1	2	3	4	5	6	7	8	9
% Cocoons parasitised	14.8	29.4	28.1	7.97	66.7	26.8	39.5	14.4	5.98
% Parasitised by Bessa larvae	0.30	17.0	11.1	0.0	0.0	16.8	0.0	0.0	1.67
% Parasitised by both Bessa and Mesoleius in the same host.	0.0	1.96	2.22	0.0	0.0	1.62	0.0	0.0	0.0
% parasitised by Mesoleius	14.5	14.4	19.2	7.97	66.7	11.6	39.5	14.4	4.32
% containing Mesoleius eggs.	12.4	13.4	17.8	7.57	61.9	9.73	36.6	11.1	3.65
% containing Mesoleius larvae.	2.42	0.98	1.48	0.40	7.93	1.89	2.94	3.33	0.66
% Containing both eggs and larvae of Mesoleius in the same host.	0.30	0.0	0.0	0.0	3.17	0.0	0.0	0.0	0.0

(a) Parasitism by Bessa harveyi.

(i) Distribution and occurrence.

The parasite Bessa harveyi occurred in larvae from Mile 7 Norgate Road and the Golf Course at Riding Mountain National Park, and at Riverton, averaging 15%.parasitism for these three areas. It also occurred at Mile 145 Dauphin Road (0.3%) and at Seddons's Corner (1.7%).

(ii) Release points of Bessa sp.

During 1939, 1940 and 1941 shipments of Bessa sp. were received from the Belleville laboratory and released at the following points:

Riding Mountain National Park
Norgate Road (halfway between Wasagaming and Norgate Cabin)
Wasagaming Townsite
Gun Lake
Riverton, Manitoba,
Cormorant Lake, Manitoba,
Sandilands Forest Reserve, Manitoba,
East Hawk Lake, Ontario,
Fort Frances Highway, Ontario.

Areas where Bessa harveyi occurred in appreciable quantities this year coincide closely with these release points. In Riding Mountain National Park, Mile 7 Norgate Road is approximately halfway between Wasagaming and Norgate Cabin; the Golf Course plot is about three miles from Wasagaming Townsite. On the other hand, Mile 145 Dauphin Road, where Bessa parasitism was only 0.3%, is at least twelve miles from the nearest release point. No Bessa harveyi occurred at Lake Audy Road or the Prisoner-of-War-Camp. Both areas are at least eight miles from release points. Release and recovery points at Riverton are less than five miles apart. No releases were made near Seddon's Corner, where Bessa parasitised 1.7% of the cocoons.

(iii) Bessa selecta and Bessa harveyi

There is some doubt as to whether the Bessa sp. liberated should be called B. selecta or B. harveyi. In a reply (Jan. 21, 1946) to an enquiry concerning this point, Mr. A. R. Brooks says:

"There is a dispute whether the European Bessa selecta My. is the same species as the North American Bessa harveyi Tns.

There is no reason to believe, however, that our Bessa (whether a distinct species or not) originally stemmed from Bessa selecta liberations in this country, as Bessa has been collected and reared from two dozen or more different hosts in all parts of the country, and has been known for many years, harveyi Tns. being described in 1892.

"The liberations made by the Belleville laboratory in Manitoba were from material originating in Quebec, and New Brunswick, and are therefore native stock. These should be known as Bessa harveyi Tns. until the matter can be settled."

(b) Parasitism by Mesoleius tenthredinis.

(k) Distribution and occurrence.

The parasitic Mesoleius tenthredinis occurred in larvae from all study areas, in amounts varying from 67% in one area to as low as 4.3% in another. Mesoleius eggs were found in the majority of these larvae as Tables 6 to 9 indicate. Only a few sawfly larvae contained both larvae and unhatched eggs of Mesoleius. Mesoleius larvae occurred in 11.4% of the cocoons parasitised by Mesoleius, or in 2.45% of cocoons examined from all areas.

(ii) Viability of Mesoleius eggs.

Most of the eggs of Mesoleius found in the first series of dissections appeared to be living eggs, although surrounded by a thick coating, possibly laid down by phagocytic action of the host. In the second and third series, a large number were browned, and many appeared dead. In view of these circumstances, it seemed unlikely that the eggs of Mesoleius developed beyond the stage in which they were found. If this were true, were the eggs completely ineffective as parasites, or did their presence adversely affect the host?

In an attempt to answer these questions, 50 cocoons from the Duck Mountain Forest Reserve collection were removed from incubation, and examined, on April 3. They had been incubated for 54 to 56 days, and emergence of adults was still progressing.

RESULTS OF DISSECTIONS OF COCOONS
(after 54-56 days incubation)

Cocoon contents	No.	No. Parasitized by Mesoleius		Condition of Mesoleius Eggs
		Larvae	Eggs	
Living larvae	32	0	6	7 unhatched eggs, 1 brown egg shell
Dead larvae	10*	1(dead)	0	-
Living pupae	3	0	1	1 brown eggshell
Dead pupae	4	0	1	2 unhatched eggs
Adult ♀ (emerging from cocoon)	1	0	1	1 unhatched egg, 1 brown eggshell

* 5 larvae were decayed, and could not be examined for presence of parasites.

The presence of Mesoleius eggs in larvae, pupae and one adult, indicates that these eggs do not develop beyond their present stage. The fact that Mesoleius eggs were found in a fully-formed emerging adult sawfly proves that the host can successfully complete its development although parasitized.

Whether the presence of Mesoleius eggs adversely affects the host is not entirely clear from these dissections. One dead pupae contained a parasite egg, but of the 10 dead larvae found, five were decayed, and it could not be determined whether they had contained Mesoleius eggs, or what had been the cause of death of these larvae.

According to reports received from the Belleville laboratory, Mesoleius eggs were found in dissected larvae during examination of cocoons collected in 1941 at three points, in Riding Mountain National Park and the Epinette Swamp, Spruce Woods Forest Reserve. Mr. Graham advises us (letter Dec. 10, 1945) that Mesoleius eggs were found in eggs and pupae of the host, but that they were unable to get the parasite eggs to hatch.

(iii) Cause of Mesoleius eggs in hibernating sawfly larvae.

A possible explanation of the presence of eggs in overwintering sawfly larvae is that the eggs were laid in late stage larvae, and that they did not have time to hatch before the larvae spun their cocoons. Phagocytic action of the host then rendered the eggs incapable of further development.

Late deposition of the eggs in the host larvae is substantiated by the finding of a large number of larvae containing Mesoleius eggs, and also bearing scars on the integument presumably made by the ovipositor of the parasite when depositing the eggs. In the third series of dissections, 60% of the larvae containing Mesoleius eggs (no larvae) also had scars on the integument. In the same series, out of six host larvae containing Mesoleius larvae (no eggs), only one had scars. (This one also contained several small spherical bodies).

How much significance can be attached to the presence or absence of scars on the integument of the host is not known, since in the same series 24% of the cocoons examined (exclusive of those parasitised by Bessa) contained larvae bearing scars. These larvae contained either Mesoleius eggs, small spherical bodies or appeared to be normal except for the scars, so that it becomes doubtful whether all the scars were caused by the same agent.

There is also the possibility that the eggs of Mesoleius were laid late in the season, and did not have time to hatch before cold weather began. The Manitoba region may be near the northern limits of distribution of this species. Mr. Graham says that in the experience of the Belleville laboratory, the finding of Mesoleius eggs is peculiar to Manitoba. Mr. G. R. Hopping, of the Vernon Laboratory, states (letter Jan. 21,1946) that they have never encountered eggs of Mesoleius in their work at Vernon.

It is planned to direct field work in the coming season towards discovering the time of oviposition by Mesoleius, both in terms of the season, and in terms of the stadium of the host.

4. Incubation of Cocoons for Parasite Emergence.

(a) Method.

During February 4 to 9, larch sawfly cocoons from each of the nine study areas in Manitoba were placed in incubation, after a period of cold storage. The cocoons were divided into approximately equal portions, and one portion was incubated immediately. The other portion was soaked (in the moss in which it had been stored) in snow which gradually melted and rose to room temperature. After 48 hours soaking, these cocoons were incubated. The purpose of dividing the collections was to see if there was any difference in the emergence of cocoons treated by two methods.

Cocoons were placed, in lots of 50, for incubation in jelly jars. Moistened cotton was used in the jars to increase the humidity. Humidity in the incubator was recorded at from 65 to 80% with an average of slightly over 70%. The humidity in the jelly jars was probably higher as the cotton on which the cocoons rested was kept very moist. The temperature in the incubator was maintained at about 68° F. for the first two weeks, for the second two weeks it was about 71° F., and since then to the present time the temperature has been about 75° F. The maximum recorded temperature was 78° F.

COCOONS INCUBATED FOR EMERGENCE OF PARASITES

	Incubated immediately after removal from cold storage	Soaked 48 hours before incubation
R.M.N.P.		
Mile 145 Dauphin Rd	650	714
Mile 7 Norgate Rd	350	327
Golf Course	100	88
Lake Audy	100	89
Prisoner-of-War Camp	39	--
Riverton	300	302
Duck Mountain Forest Reserve	350	235
Spruce Woods Forest Reserve	--	113
Seddon's Corners	350	323

(b) Results of incubation.

Emergence of sawfly adults is still continuing at the time of writing, so that complete emergence results cannot be given.

(1) Parasitism by Bessa harveyi.

Emergence of Bessa harveyi took place during a period 20 to 33 days after incubation began, and may be considered complete. This parasite was recovered from the following points:

AREA	% Cocoons Parasitised
R.M.N.P.	
Mile 145 Dauphin Rd	.07
Mile 7 Norgate Road	2.1
Golf Course	2.1
Riverton	2.5
Seddon's Corner	.15

This distribution of Bessa harveyi is the same as that determined by dissections of larvae, but the percentage of cocoons yielding adult Bessa was very small compared to the percentage of cocoons parasitised by Bessa as indicated from dissections.

(ii) Parasitism by Mesoleius tenthredinis.

Mesoleius tenthredinis has been recovered to date from only two areas of Riding Mountain National Park, Mile 145 Dauphin Road and Mile 7 Norgate Road, although dissections indicated that it was present in all nine study areas of Manitoba.

(iii) Comparison of rearing methods.

Results of rearing to date show a slightly higher emergence of adult sawflies and parasities from the cocoons which were soaked in melting snow for 48 hours after cold storage, and prior to incubation.

(iv) Emergence from incubated cocoons.

Although emergence is not yet complete, indications are that the number of unemerged cocoons will be high. Emergence of parasites from incubated cocoons does little more than provide adults for identification. The effectiveness of the different species of parasite cannot be evaluated for two reasons. Neither the mortality of the sawfly, due to rearing methods, nor the number of larvae which normally would continue in diapause, is known. Cocoons of the 1944 season when examined at the end of incubation were all dead, and thus no information was obtained on the numbers in diapause.

(c) Rearing of cocoons buried at collection points.

4000 cocoons collected at Riding Mountain National Park, and at Riverton, are buried in moss near the collection area. These cocoons will be brought to the Winnipeg laboratory about May 1, and the emergence from them observed. It is proposed to retain the unemerged cocoons after emergence is completed, to obtain data on the number of cocoons still in diapause.

G. Conclusions.

In Riding Mountain National Park larch sawfly cocoon counts taken beneath permanent sample trees indicated a substantial reduction in population from 1944 at the Golf Course Plot. A noticeable decline in the infestation at Mile 7, Norgate Road, was reflected in a lower cocoon count than in 1944. The extremely healthy tamarack stand at Mile 13, Lake Audy Road, showed a slightly higher cocoon count than in 1944, although defoliation was lighter. At Riverton, Manitoba, a 50% drop in population was indicated both by observation of defoliation and by cocoon counts.

Cocoon counts taken beneath non-permanent sample trees, to compare infestation intensities in various areas, indicated that the outbreak in the Dauphin Road, Riding Mountain National Park, was heavier than any other sampled area in the park, but lighter than that at Riverton. The Duck Mountain Forest Reserve infestation was the most severe of all areas. The infestation at Spruce Woods Forest Reserve was almost negligible.

Visual estimates of defoliation of tamarack by the larch sawfly were in close agreement with indices of populations derived from cocoons counts, except in the case of trees injured so severely by previous defoliation that bud development was impaired. For these trees, it was not possible to estimate the current defoliation due to feeding.

Investigation on the biological control of the European larch sawfly by parasites was directed towards determining the status of two insect parasites, both of which had been released in quantity in Manitoba.

A parasitic fly, Bessa harveyi Tns., was released from 1939 to 1941. It was recovered from 1945 cocoons collected from three areas of Riding Mountain National Park, Riverton, and Seddon's Corner.

In three sampled areas near points of liberation, effective parasitism averaged 15% of the cocoons. In two other areas, not near points of liberation, parasitism was less than 2%. Bessa harveyi has not yet attained wide distribution, but it shows promising results as a control factor of larch sawfly. Its dispersal may have to be actively assisted by increased liberations.

The other parasite, a wasp, Mesoleius tenthredinis, Morley, was originally imported from Europe and liberated, in 1912 and 1913, in two areas of Riding Mountain National Park, and at Aweme near Treesbank, Manitoba. It appears in the intervening time to have survived periods of low host density, and as well to have achieved a wide dispersal in Manitoba. It was recovered from all study areas. However, its present effectiveness as a control factor of larch sawfly is very doubtful. Although Mesoleius parasitism varied from 4.3% in one area to as high as 67% in another, only 11% of the cocoons parasitised by Mesoleius contained Mesoleius larvae, and the remainder contained unhatched Mesoleius eggs. It was demonstrated that the sawfly can complete its development and emerge although parasitised by Mesoleius eggs. Thus, assuming that the unhatched parasite eggs have no harmful effect on the host, the effective parasitism was lowered to an average of 2.4% for all areas.

At present, parasitism by Mesoleius does not present an encouraging picture. The fact that Mesoleius has survived and spread from the original release points, despite the low survival rate of its eggs, may indicate that certain strains of the parasite, successful in Manitoba, are developing naturally. It seems essential to discover the true cause for the low survival of Mesoleius and, having done so, it may be possible to rectify the situation by breeding, selection or other means.

VI. FALL CANKERWORM

The INFLUENCE of D.D.T. TREE BANDING on ADULTS of the FALL CANKERWORM, Alsophila pometaria, Harr.

During September, 1945, a block of deciduous trees, contained in five lots on Kingston Crescent of the Elm Park suburb, Winnipeg, Man., was treated with D.D.T. for Fall Cankerworm control. This insect had been quite active in this area during the summer of 1945. Trunks of trees in this area were painted with bands of a D.D.T. solution over which female adults would have to pass as they ascended to deposit their eggs.

In conjunction with this treatment, certain experiments were carried out with the view of determining the effect of such banding upon the Fall Cankerworm adult female. These experiments were divided into two parts as follows:-

A. Field Experiments:
(1) D.D.T. banding; Sept. 5 to Sept. 12,1945,
(2) D.D.T. banding; Oct. 4 to Oct. 5, 1945.

B. Laboratory Experiments:

A. FIELD EXPERIMENTS

1. D.D.T. Banding: Sept. 5 to Sept. 12, 1945.

(a) Methods.

Trees in a complete block in the Elm Park area were selected for treatment with three concentrations of D.D.T. In all, five lots; 333,335,337,339 and 341; were covered in the course of the experiment. Using three concentrations of the D.D.T. substance, bands 2 feet wide and about 5 feet from the base were painted on all trees in the area. A 5 inch brush was used for these applications. Eight trees, only, remained unpainted and were used as controls. A stock solution of 1000 cc. of "Velsicol" containing 300 gms. of D.D.T. was prepared. This solution was diluted with kerosene at the rate of 1 part stock solution to 2 parts of kerosene, to produce a final concentration of about 10% D.D.T.

When applied to the tree the area of the 2 foot band was computed from measurement of the circumference. The 10% solution applied as follows:-

Sept.5,6 -Lot 333 - rate 60 cc/sq.ft.-or- 6 gms. D.D.T./sq.ft.
Sept. 11 -Lot 335 - rate 30 cc/sq.ft.-or- 3 gms. D.D.T./sq.ft.
Sept. 6 -Lot 337 - rate 30 cc/sq.ft.-or- 3 gms. D.D.T./sq.ft.
Sept. 7 -Lot 339 - rate 30 cc/sq.ft.-or- 3 gms. D.D.T./sq.ft.
Sept. 7 - Lot341 - rate 15 cc/sq.ft.-or- 1.5 gms.D.D.T./sq.ft.

All banding was completed by Sept. 11th.

Eleven test trees were labelled and [illegible] received a 3" band of tanglefoot above the D.D.T. painted band. Check trees bore only the band of tanglefoot. All numbered trees were periodically examined until October 31st.

TABLE I

Test Trees

Lot	Nos. of Check Trees	Nos. of Test Trees	Date Painted D.D.T.	Concentration D.D.T. per sq. ft.
333	1, 2	3, 4	5 Sept./45	6 gms/sq.ft.
337	5	6, 7	6 Sept./45	3 gms/sq.ft.
339	8, 9	10,11	7 Sept./45	3 gms/sq.ft.
341	12,13	14,15	7 Sept./45	3 gms./sq.ft.
335	17	16,18,19	11 Sept/45	1.5gms/sq.ft.

(b) Observations.

First emergence of adult Fall Cankerworm was recorded on the 2nd of October. The following table sets forth the reults of periodic examination of the tanglefoot rings on D.D.T. treated, and untreated, trees.

TABLE 2

NOS. OF FEMALES CAUGHT IN TANGLEFOOT BANDS

	6 gm. per sq. ft. TREES Number			3 gms. per sq. ft. TREES Number							1.5 gms./sq.ft. TREES Number				CHECK (Untreated) TREES Number								
DATE	3	4	Tot.	6	7	10	11	14	15	Totl	16	18	19	Tot.	1	2	5	8	9	12	13	17	Totl
2 Oct.	-	-	0	-	-	-	-	-	-	0	-	-	-	0	-	-	-	-	-	-	-	-	0
3 Oct.	-	-	0	-	2	-	-	-	-	2	-	-	-	0	-	-	-	-	-	2	-	-	2
4 Oct.	-	-	0	-	-	2	-	-	-	2	-	-	-	0	-	-	-	-	-	-	-	-	0
5 Oct.	-	-	0	-	-	-	-	-	-	0	-	-	-	0	-	-	-	-	-	-	-	1	1
9 Oct.	-	-	0	4	13	3	-	4	7	31	-	-	-	0	5	1	1	1	2	9	-	-*	19
10 Oct.	-	1	1	3	14	7	1	1	3	29	3	5	-	8	14	-	3	-	7	14	11	1	50
11 Oct.	-	1	1	2	10	5	-	4	5	26	5	1	-	6	5	1	5	-	9	4	7	1	32
12 Oct.	1	4	5	-	29	6	-	2	11	48	-	4*	1	5	5	4	1	3	1	9	4	5	32
16 Oct.	6	-	6	18	18	3	9	7	16	71	4	16	6	26	26	4	5	6	24	11	5	-	81
17 Oct.	2	2	4	9	20	2	2	2	17	52	3	3	4	10	13	7	4	1	11	7	20	5	68
20 Oct.	5	-	5	3	10	6	7	3	18	47	1	4	7	12	2	4	11	3	7	5	12	2	46
22 Oct.	-	1	1	1	5	1	-	1	5	13	-	-	2	2	2	2	10	-	1	-	3	2	20
26 Oct.	4	1	5	-	10	-	-	2	-	12	1	4	3	8	7	1	4	1	4	-	2	-	19
31 Oct.	-	-	-	2	4	-	-	1	4	11	1	-	5	6	-	1	1	1	1	-	4	-	8
TOTAL	18	10	28	42	135	35	19	27	86	344	18	37	28	83	79	25	45	16	67	61	68	17	378
	(2) Av/Tree 14.0			(6) Av/Tree 57.3							(3) Av/Tree 27.7				(8) Av/Tree 47.25								

*Egg Clusters

Miscellaneous observations during the course of the experiment include:

Oct. 3. - One female moth from a D.D.T. free tree was transferred to a tree banded with a 2 foot band of D.D.T. applied at the rate of 6 gms per sq. ft., and allowed to cross the band twice. No ill effects were noticeable. The female adult was retained. It is recorded that heavy rains following the application of D.D.T. may have washed off some of the D.D.T.

Oct. 4. - Two female moths which had passed the D.D.T. (3 gms/sq. ft.) but had not yet reached the tanglefoot were retained for observation.

Oct. 5. - The three female moths listed above alive and active.

Oct. 9. The female moth (Oct. 3) died today after an attempt to oviposit.

Oct. 12. Large numbers of egg-clusters were found below the tanglefoot regardless of the D.D.T. One egg-cluster was found on a leaf stuck in the tanglefoot.

Oct. 16. Moths not having reached the tanglefoot were transported to the lab. for further experiments. Moths still copulating.

Cankerworm is more active in the evening, and the majority occur on the western side of trees during the daytime.

Oct. 17. - Egg-clusters occur in the midst of the tanglefoot, copulation continues.

Oct. 20. - Light snowfall during the night of 18th Oct., melting as it fell; copulation not observed.

Cankerworm adults appear to prefer trees with rough bark, most specimens being taken from such trees.

Oct. 31. - Tanglefoot becoming stiff under the cold weather, and the majority of cankerworm adults were recovered near the top of the tanglefoot ring.

(c) Summary.

378 Female moths were removed from tanglefoot on 8 untreated trees.
455 Female moths were removed from tanglefoot on 12 D.D.T. treated trees.

Moths per untreated tree.....	47.25
Moths per D.D.T.treated tree.....	38.0
1.5 gms/sq. ft.....	27.7)
3 gms/sq. ft.....	57.3)
6 gms/sq. ft.....	14.0)

In no case was the solution of D.D.T. strong enough to kill the female moths immediately, or to inhibit oviposition. It is apparent that female moths were able to cross the 2' wide band of D.D.T. in concentrations up to 6 gms/sq.ft. without apparent effect. Fewer female moths were taken from treated trees than from non-treated trees; a possible indication that the moths attempted to avoid treated trees; but it is doubtful that such a small difference is significant.

In case some of the potency of the D.D.T. substance had been leached away during the month of September. Trees were banded on 4th October, and experiments conducted as set forth in Pt. 2 below:-

2. D.D.T. Banding - 4 October 1945.

(a) Method:-

Eight trees in lots 335 and 337 Kingston Crescent, Winnipeg, Man. were again treated with D.D.T. solution on 4 October 1945. Trees chosen ranged in Diameters at Breast Height from 4" to 10". A stock solution of 300 gms. of D.D.T. per 1000 cc. of "Velsicol" was diluted with kerosene at the rate of 2 parts of kerosene to 1 part of the stock solution. The final solution was applied to the trunks of the trees as follows; using the methods described in Pt. 1 to procure the correct concentration of D.D.T. substance.

4 trees (A,B,C,D) - 6 gms/sq.ft - 4' wide ring of D.D.T. solution,

4 trees (E,F,G,H) - 3 gms/sq.ft - 4' wide ring of D.D.T. solution.

Table 3 sets forth the amounts of the D.D.T. solution applied to eight test trees.

Table 3.

Tree No.	Species	Circumference at 5 ft. level	Area of 4 ft. band	Volume of DDT solution
A	Box Elder	2.5'	10.0 sq.ft.	600 cc.
B	" "	1.8'	7.2 sq.ft	432 cc.
C	" "	1.4'	5.6 sq.ft.	336 cc.
D	Elm	2.2'	8.8 sq.ft.	528 cc.
E	Elm	1.8'	7.2 sq.ft.	216 cc.
F	Elm	2.5'	10.0 sq. ft	300 cc.
G	Elm	1.2'	4.8 sq. ft.	144 cc.
H	Elm	1.4'	5.6 sq. ft.	168 cc.

A tanglefoot band was painted on the trunks of these trees, above the band of D.D.T. solution.

(b) Observations:

Table 4 sets forth the results of periodic examination of the tanglefoot bands on the D.D.T. treated trees.

(c) Summary:

183 female moths were removed from 8 test-trees.
376 female moths were removed from 8 check trees.

Average No. of moths per tree treated with D.D.T.:
rate 3 gms/sq. ft. - 6.0
rate 6 gms/sq. ft. - 39.5

It would seem that the concentrations of D.D.T. used were not such as to prevent the female moth from crossing a 4 ft. wide band painted on the tree trunk. Indeed, among the test trees, more moths per tree crossed the bands of higher concentration of D.D.T.

TABLE 4

NUMBERS OF FEMALE FALL CANKERWORM ADULTS CAUGHT IN TANGLEFOOT BANDS

Test Trees	Trees with 4' band of D.D.T. (6gms / sq. ft.)					Trees with 4' band of D.D.T. (3 gms / sq. ft)					Check Trees Untreated								
Date	A	B	C	D	Total	E	F	G	H	Total	1	2	5	8	9	12	13	17	Tot.
Oct. 5,1945	-	-	-	-	0	-	-	-	-	0	-	-	-	-	-	-	-	1	1
Oct. 9,1945	-	-	-	3	3	-	-	-	-	8	5	1	1	1	2	9	-	-	19
Oct.10,1945	-	3	-	5	8	1	-	-	2	3	14	-	3	-	7	14	11	1	50
Oct.11,1945	9	-	-	-	9	-	1	-	-	1	5	1	5	-	9	4	7	1	32
Oct.12,1945	-	-	-	-	0	-	-	-	-	0	5	4	1	3	1	9	4	5	32
Oct.16,1945	24	5	9	9	47	-	-	-	-	0	26	4	5	6	24	11	5	-	81
Oct.17,1945	14	7	1	26	48	11	-	-	2	13	13	7	4	1	11	7	20	5	68
Oct.20,1945	28	1	1	3	33	-	2	1	2	5	2	4	11	3	7	5	12	2	46
Oct.22,1945	2	-	-	-	2	-	-	-	-	0	2	2	10	-	1	-	3	2	20
Oct.26,1945	4	3	1	-	8	-	2	-	-	2	7	1	4	1	4	-	2	-	19
Oct.31,1945	-	-	-	1	1	-	-	-	-	0	-	1	1	1	1	-	4	-	8
TOTALS	81	19	12	47	159	12	5	1	6	24	79	25	45	16	67	61	66	17	376

Av/tree-39.5 moths Av/tree -6.0 moths Av/tree - 47.0 moths

No dead moths were recovered at the base of the test trees.

B. LABORATORY EXPERIMENTS

1. Introduction

In an attempt to determine the concentration of D.D.T. required to kill female adult cankerworms or to inhibit oviposition by these adults; supplementary experiments were conducted in the Winnipeg Laboratory. Active specimens of Alsophila pomentaria Harr. were obtained from the infestation area in the Elm Park suburb. Unfortunately only 13 adult females were available for these experiments. Of this number four were used as check specimens.

2. Apparatus and Methods.

A four-foot length of 2" x 4" stock was prepared as a runway by affixing a 1" strip of corrugated paper along the long axis. The rough corrugated portion representing a tree's bark. Two boards $\frac{3}{4}$" x $\frac{1}{2}$" x 4' were used to hold the "bark" in place, and provide a channel 1" wide and 4' long. The resulting runway was painted with a D.D.T. solution prepared in a manner similar to that used in field experiments. A concentration of 6 grams of D.D.T. per square foot was painted on the corrugated paper with a 5" paint brush. When the solution had dried for 15 minutes, the runway was placed upright against a wall, and 3 female moths were introduced at the base. The time from contact with the D.D.T. until the moth fell from the board was recorded. Moths were then retained in a jelly jar for observation, and provided with pieces of bark as oviposition sites. When three moths had been so treated, (Specimen 1, 2 & 3) the board was given a further coating of D.D.T. solution to bring the residual D.D.T. coating to a concentration of 12 gms per sq. ft. When the solution had dried for 1 hour, 6 female moths (Specimen 4,5,6,7,8 & 9) were allowed to climb the runway.

Four female moths (Specimen 10,11,12 & 13) were retained as check moths for comparison of oviposition and length of life of gravid and exhausted females, subjected and not subjected to D.D.T. contact.

3. Observations.

(a) The following tables set forth the length of time female moths were in contact with D.D.T. on the runway, and the effect of this contact on oviposition and life span.

Table 5.

Specimen Number	Condition	Concentration of D.D.T.used	Commencement of treatment	Completion of treatment	Duration of treatment	Distance travelled	Time of death
1	gravid medium-size very active	6 gms/sq.ft	10:11½ hrs 18-10-45	10:15 hrs 18-10-45	3 min 30 sec	3'-8"	10:45 hrs 20-10-45
2	gravid very large & active	6 gms/sq.ft.	18-10-45	10.50 hrs 18-10-45	10 min 20 sec	5'-4"	
3	exhausted small,less active	6 gms/sq.ft	18-10-45	11.05 hrs 18-10-45	2 min 5 sec	2'-0"	0900 hrs 20-10-45
4	exhausted small	12 gms/sq.ft	18-10-45	13.25 hrs 18-10-45	0 min 13 sec	0'-1"	0945 hrs 19-10-45
5 *	exhausted	12 gms/sq.ft	18-10-45	1330 hrs 18-10-45	3 min 32 sec	0'-1"	1337 hrs 18-10-45
6 *	gravid	12 gms/sq.ft	18-10-45	1335 hrs 18-10-45		0'-0"	1340 hrs 18-10-45
7	gravid	12 gms/sq.ft	1343.40 hrs 18-10-45	1345 hrs 18-10-45	1 min 20 sec	0'-3"	
8	exhausted	12 gms/sq.ft		1355 hrs 18-10-45	4 min 41 sec	0'-10"	0900 hrs 20-10-45
9	gravid	12 gms/sq.ft		1404 hrs 18-10-45	2 min 43 sec	0'-1"	1345 hrs 21-10-45
10-13	10-exhausted 11,12,13gravid	check moths	----	----	----	----	----

* These specimens placed on a wet spot, became saturated and stuck to the runway. Runway was allowed to dry for ½ hour before the experiment continued.

Table 6.

Female Moths : Results of Contact with D. D. T. Substance

Specimen	Strength of D.D.T. solution	Time in contact with D.D.T.	Distance travelled over D.D.T.	State of Female	Time lapse before death	Oviposition after Contact	Remarks
1	6 gms/sq. ft.	210 secs	3'-8"	Gravid	2 days	nil	---
2	6 gms/sq.ft.	620 secs.	5'-4"	Gravid	5 1/2 days	nil	---
3	6 gms/sq.ft.	125 secs.	2'-0"	Exhausted	2 days	nil	---
4	12 gms/sq.ft	13 secs.	0'-1"	Exhausted	3/4 days	nil	---
5.	12 gms/sq.ft.	212 secs	0'-1"	Exhausted	7 min.	nil	specimen came in contact with moist DDT spot on runway, and was saturated with DDT sol'n. (as above)
6	12 gms/sq.ft	188 secs	0'-4"	Gravid	5 min.	6 eggs	
7.	12 gms/sq.ft.	80 secs	0'-3"	Gravid	7 days	nil	eggs laid immediately prior to death. No pattern nor cluster
8	12 gms/sq.ft	281 secs.	0'-10"	Exhausted	1 3/4 days	nil	---
9	12 gms/sq.ft.	163 secs	0'-1"	Gravid	3 days	nil	---
10	check moth	---	---	Exhausted	8 days	nil	---
11	check moth	---	---	Gravid	9 days	cluster	---
12	check moth	---	---	Gravid	10 days	large cluster	---
13	check moth	---	---	Gravid	10 days	large cluster	---

(b) Certain observations were recorded during the course of this experiment.

(i) Moths seemed aware of the D.D.T. substance, and made an attempt to escape. After a few seconds contact, abdomens were held higher than usual, and were kept so until the moths fell from the boards.

(ii) After 20 seconds, moths in contact with D.D.T. at a concentration of 6 gms/sq. ft. seemed to lack complete control of their legs, and appeared to lose their sense of direction. These moths wandered aimlessly until they fell from the runway.

(iii) These moths never regained a normal locomotive ability. For several minutes they exhibited periodic jerks of leg or antennae. Their movements increased in violence to become almost convulsion-like; a condition which lasted for several hours before relapsing to the former state of periodic jerking.

(iv) Moths in contact with D.D.T. in concentration of 12 gms/sq. ft. lost apparent control of locomotion more quickly than those in contact with the lesser concentration of D.D.T. These moths seemed unable to seek to escape from the runway, but seemed able only to cling to the cardboard. Violent convulsion-like movement was of lesser duration than for the specimen placed in contact with the 6 gms./sq. ft. D.D.T. concentration.

4. Summary

The following table sets forth a summary of the results of this experiment:-

Table 7

Female Moths - Result of Contact with D.D.T. Substance

Experimental Conditions	Contact with Concentration 12 gms/sq. ft.	Contact with Concentration 6 gms./sq. ft.	Check Moths No. Contact
No. of Moths	4 *	3	4
Average time in contact with DDT	134.25 secs.	318.33 secs.	---
Average distance travelled over D.D.T. substance	0"-3.75"	3' - 8.0"	---
Survival - Average No. of Days	3 1/8	3 1/12	9 1/4
No. of gravid females	2	2	3
No. of gravid females ovipositing	1**	0	3

* Moth specimen Nos. 5 & 6 are not considered in this table.

** Six eggs were laid by this female immediately prior to death. They followed no pattern, and were not clustered.

5. Comments

It is unfortunate that only 14 female moths were available for this experiment, and that consequently the average results may be subject to large errors. Nevertheless, there are certain definite results which might be used as an indication for further experiments. The oviposition of Moth Specimen No. 7 is believed to have been due to a nervous reaction, and not deliberate. This female was not in a normal ovipositing position, and the eggs were scattered.

6. Conclusions

(a) Concentrations of D.D.T. at the level of 6 and 12 gms./sq. ft. are not sufficient to cause mortality of female moths immediately on contact; although the life span is reduced by approximately two-thirds in each case.

(b) Contacts with D.D.T. concentrations of 12 gms./sq.ft. required about one-third the time to produce the same effect as produced by concentrations of D.D.T. at 6 gms./sq.ft. During this time the moths moved over less than one-tenth of the runway distance.

(c) In neither of the test-cases did gravid females oviposit an appreciable number of eggs.

C. RESULTS AND COMMENTS

1. Female moths of the fall cankerworm were able to cross both 2' and 4' bands of D.D.T. in the concentrations used in the field, viz. 1.5, 3 and 6 gms. per sq. ft. of surface area without immediate effect.

2. Laboratory experiments indicate that a concentration of 12 gms/sq. ft. of surface may prevent female moths from crossing such bands.

3. It is apparent that it requires at least three days for any of these concentrations of D.D.T. painted on surfaces crossed by these moths, to kill the female moths.

4. There is a definite indication that egg-laying is inhibited in moths which cross D.D.T. concentrations of 6 gms. or 12 gms. per sq. ft. Moths may lay a few eggs during the death spasm (lab. experiment specimen No. 7).

5. It is suggested that further experiments should be carried out, both in the laboratory and in the field, using larger numbers of specimens, to determine:-

(a) To what extent oviposition is inhibited.
(b) Whether or not eggs laid during death spasm are viable.
(c) If D.D.T. banding repels moths from trees so painted.
(d) What concentrations, in the field, are necessary to kill moths or prevent oviposition.

6. Collections of moths, in the field, for observation after they have crossed the D.D.T. band and before they reach the Tanglefoot, would be desirable.

D. APPENDIX

The following tables list the areas painted, and the amounts of D.D.T. substance applied in the block of trees treated in the Elm Park suburb, Winnipeg, Man., during September of 1945.

Table 8

Lot 333 Area of Bands painted with D.D.T. Substance

Tree No.	Area of 2' band at 5' height	Tree No.	Area of 2' band at 5' height	Tree No.	Area of 2' band at 5' height	Tree No.	Area of 2' band at 5' height
1	4.5 sq.ft.	10	5.5 sq. ft.	19	3.5 sq.ft.	28	6.0 sq.ft.
2	4.5 sq.ft.	11	3.5 sq. ft.	20	3.0 sq.ft.	29	4.5 sq.ft.
3	4.0 sq.ft.	12	4.5 sq. ft.	21	5.0 sq.ft.	30	10.5sq.ft.
4	5.5 sq.ft.	13	6.0 sq. ft.	22	4.5 sq.ft.	31	7.5 sq.ft.
5	4.5 sq.ft.	14	3.0 sq. ft.	23	5.5 sq.ft.	32	7.5 sq.ft.
6	3.5 sq.ft.	15.	4.5 sq. ft.	24	7.0 sq.ft.	33	7.0 sq.ft.
7.	2.5 sq.ft.	16	1.5 sq. ft.	25	6.0 sq.ft.	34	2.5 sq.ft.
8	9.5 sq.ft.	17	5.5 sq. ft.	26	4.5 sq.ft.	35	8.0 sq.ft.
9	7.75 sq.ft.	18	4.5 sq.ft.	27	7.5 sq.ft.	36	2.75 sq.ft.

Date Treated: 5 Sept. 1945
Total No. of Trees Treated: 36
Total Area of Bark Treated: 180.75 sq. ft.
Final Concentration of D.D.T. Substance: 6 gms/sq.ft. -60 cc/sq.ft
Total volume of Solution Used: 10860 cc.

TABLE 9

Lot 337 Area of Bands painted with D.D.T. Substance

Tree No.	Area of 2 ft band at 5 ft.height	Tree No.	Area of 2 ft band at 5 ft.height	Tree No.	Area of 2 ft band at 5 ft.height	Tree No.	Area of 2 ft band at 5 ft.height
1.	8.0 sq.ft.	6	7.5 sq.ft.	11	9.75 sq.ft	16	5.0 sq.ft.
2.	14.0 sq.ft.	7	15.0 sq.ft.	12	9.0 sq.ft	17	2.5 sq.ft.
3	5.5 sq.ft.	8	8.0 sq.ft	13	5.5 sq.ft	18	2.5 sq.ft.
4	8.0 sq.ft.	9	8.0 sq.ft	14	6.5 sq.ft		
5	7.5 sq.ft.	10	9.5 sq.ft	15	4.25sq.ft		

Date Treated: 6 Sept. 1945
Total No. of Trees Treated: 18
Total Area of Bark Treated: 136 sq. ft.
Final Concentration of D.D.T. solution: 3 gms/sq.ft.-30 cc/sq.ft.
Total Volume of Solution Used: 4100 cc.

TABLE 10

Lot 341 Area of Bands painted with D.D.T. Substance

Tree No.	Area of 2 ft band at 5 ft.height	Tree No.	Area of 2 ft band at 5 ft.height	Tree No.	Area of 2 ft band at 5 ft.height	Tree No.	Area of 2 ft band at 5 ft.height
1	12.5 sq. ft.	8	8.0 sq. ft.	15	5.5 sq. ft.	22	5.0 sq. ft.
2	5.0 sq. ft.	9	4.0 sq. ft.	16	5.5 sq. ft.	23	7.5 sq. ft.
3	7.0 sq. ft.	10	5.0 sq. ft.	17	4.25 sq.ft.	24	6.25 sq. ft.
4	5.0 sq. ft.	11	5.0 sq. ft.	18	2.5 sq. ft.	25	5.5 sq. ft.
5	5.25 sq.ft.	12	5.5 sq. ft.	19	3.25 sq. ft.	26	4.5 sq. ft.
6	8.5 sq. ft.	13	3.5 sq. ft.	20	3.5 sq. ft.	27	1.25 sq. ft.
7	8.0 sq. ft.	14	5.25 sq.ft.	21	4.5 sq. ft.		

Date Treated: 7 Sept. 1945
Total No. of Trees Treated: 27
Total Area of Bark Treated: 146.25 sq. ft.
Final Concentration of D.D.T. Substance: 1.5 gms/sq.ft.-15 cc/sq.ft.
Total Volume of Solution Used: 2200 cc.

TABLE 11

Lot 339 — Area of Bands painted with D.D.T. Substance

Tree No.	Area of 2 ft band at 5 ft.height	Tree No.	Area of 2 ft band at 5 ft.height	Tree No.	Area of 2 ft band at 5 ft.height	Tree No.	Area of 2 ft band at 5 ft.height
1	7.5 sq.ft.	9	7.5 sq.ft.	17	6.5 sq.ft.	25	2.25 sq.ft.
2	7.75 sq.ft.	10	7.0 sq. ft.	18	4.25 sq.ft.	26	2.0 sq.ft.
3	5.0 sq.ft.	11	5.0 sq. ft.	19	5.5 sq.ft.	27	2.5 sq.ft.
4	9.0 sq.ft.	12	5.0 sq.ft.	20	5.5 sq.ft.	28	1.5 sq.ft.
5	6.0 sq.ft.	13	4.5 sq.ft.	21	4.5 sq.ft.	29	2.0 sq.ft.
6	5.5 sq.ft.	14	4.25 sq.ft.	22	3.5 sq.ft.	30	3.5 sq.ft.
7	8.0 sq.ft.	15	4.25 sq.ft.	23	4.25 sq.ft.	31	2.0 sq.ft.
8	8.5 sq.ft.	16	2.5 sq.ft.	24	5.5 sq.ft.		

Date Treated: 7 Sept. 1945
Total No. of Trees Treated: 31
Total Area of Bark Treated: 150.5 sq. ft.
Final Concentration of D.D.T. Substance: 3 gms/sq.ft.-30 cc/sq.ft.
Total Volume of Solution Used: 4520 cc.

TABLE 12

Lot 335 Area of Bands painted with D.D.T. Substance

Tree No.	Area of 2ft. band at 5 ft.height	Tree No.	Area of 2ft. band at 5 ft.height	Tree No.	Area of 2 ft. band at 5 ft.height	Tree No.	Area of 2ft band at 5 ft.height
1	7.0 sq.ft.	10	7.25 sq.ft.	19	3.0 sq.ft.	28	3.0 sq.ft.
2	7.5 sq.ft.	11	7.0 sq.ft.	20	2.0 sq.ft.	29	2.5 sq.ft.
3	7.0 sq.ft.	12	2.0 sq.ft.	21	2.5 sq.ft.	30 2	3.25 sq.ft.
4	8.0 sq.ft.	13	4.5 sq.ft.	22	3.0 sq.ft.	31	6.0 sq.ft.
5	8.25 sq.ft.	14	2.0 sq.ft.	23	3.5 sq.ft.	32	7.75 sq.ft.
6	8.25 sq.ft.	15	5.5 sq.ft.	24	2.0 sq.ft.	33	5.5 sq.ft.
7	6.25 sq.ft.	16	7.5 sq.ft.	25	3.5 sq.ft.	34	6.25 sq.ft.
8	8.5 sq.ft.	17	3.0 sq.ft.	26.	2.5 sq.ft.		
9	7.5 sq.ft.	18	5.0 sq.ft.	27	4.5 sq.ft.		

Date Treated: 11 Sept. 1945
Total No. of Trees Treated: 34
Total Area of Bark Treated: 172.75 sq.ft.
Final Concentration of D.D.T. Substance: 3 gms/sq.ft.-30 cc/sq. ft.
Total Volume of Solution Used: 5200 cc.

A. A. E. Anderson

1. Introduction

The following report covers the work and activities of Forest Insect Ranger A. Anderson, for the Forest Insect Survey during 1945, in the Western Forest District of Manitoba and the Hudson Bay Junction and Prince Albert Districts of Saskatchewan.

2. District Conditions

(a) Western District of Manitoba.

(i) Description of traversed area. In the Western Districts of Manitoba there are three forest reserves, Riding Mountain, Duck Mountain and the Porcupine Mountain. These are very large ridges of hills with the surrounding country, for the most part, under cultivation. At the north east corner of the Duck Mountains are good stands of jack pine. These stands extend approximately five miles east of the highway. From there to Lake Winnipegosis there is mainly black spruce and tamarack lying in low swampy land. In these three mountain ranges the timber is of great commercial value, with the dominant host jack pine. There are also good stands of white spruce, black spruce and tamarack. Poplar is abundant but is used mainly for fuel.

(ii) Personnel contacted.

District Forester A. Bainbridge, at Dauphin
Forestry Engineer B. Falkan, Dauphin
Senior Rangers R. Bell, Dauphin, and E. Koons, Swan River.
Forest Rangers H. Clee, Minitonas, B. Maudsley, Birch River, J. Thompson, Mafeking, J. Norman, Garland; C. Dunlop, Durban, and J. Kokindovich at Grandview.

(iii) Intelligence: All highways in the Western District are gravelled and are well kept. The roads in the Riding Mountains are good. In the other forest areas the roads are dirt, with a lot of them being mere trails.

Places of accommodation are very few in this district. The Hotel Hamilton at Dauphin also serves good meals. At Swan River the Vimy Hotel is very good. At Wasagaming in the Riding Mountain there is a choice of lodges. The Wasagaming Lodge and the Chalet are very good, with the Idylewylde Restaurant providing the best meals.

(iv) Insect Conditions

(a) Jack Pine Budworm, Archips fumiferana Clem.

Jack pine budworm was found in only one spot in the Western District of Manitoba. This was at a point 6½ miles northwest of Mafeking, right on the boundary of the Porcupine Forest Reserve. This infestation was light, and on reproduction pine only. This patch was surrounded on three sides by large mature jack pine with high crowns. On the fourth, or east, side was a swamp of black spruce and tamarack.

The infested trees were from 6 to 14 ft. in height, and averaged about 1 1/4 in. in D.B.H. None of the larger trees sampled had any budworm on them.

Note: Those larger trees were medium staminate (staminate flowers are thought to have a great bearing on the feeding of budworm larvae).

(b) European Larch Sawfly, Pristiphora erichsonii Htg.

Sawfly was encountered in two locations only, both being in the Duck Mountain Forest Reserve. The first location was in Mr. Sinclair's district two miles south of Alpine school. In this area host trees are very scattered and of no commercial value, being of the orchard type and very twisted. Any sawfly found was not classified as an infestation, all eggs had not hatched, and one female adult was caught, so possibly all eggs had not been laid.

In the Grandview area on the south side of the Duck Mountains, in Ranger Kokindovich's district, sawfly was again encountered in two places. The first spot was two miles straight north of the Valley River Indian Reserve, along a bulldozed road. The larvae were very active, and the infestation was classified as medium. The swamp in this locality was small, with the trees being scattered, and averaging 14 ft. in height.

The second spot was two miles north of Grifton, situated right on the Forest Reserve boundary. The swamp was very wet at the time, but infestation proved heavy with averaging defoliation being 35%. This swamp covered approximately 100 acres with tamarack along all sides, willows and other shrubs scattered toward the middle, and a small marsh in the middle.

(c) American Poplar Leaf Beetle, Phytodecta americana

This infestation covers the whole of the Swan River Valley, with its southern boundary at Sclater, its eastern limit at Lake Winnipegosis, westward it extended to the Saskatchewan boundary and as far north as Mafeking. The general infestation is light, with the exception of one small spot north of Cowan, which was heavy and approximately 20 acres. This heavy infestation was on young reproduction poplar growing in a burned-over area, and is surrounded by jack pine forests.

Throughout the whole valley this infestation appeared on trees averaging from 1 to 2 in. D.B.H.

(b) Eastern District, Saskatchewan.

(i) Description of traversed area.

In the Eastern District of Saskatchewan the terrain is much the same as in the western district of Manitoba. There are the same mountain ridges as in Manitoba. The domineering trees are jack pine, the only one of commercial value, with scattered poplar ridges, and the tamarack mixed with black spruce in the lower areas. As one gets further north towards Hudson Bay Junction, the land levels off with mostly black spruce and tamarack until you reach the Pasquia Forest Reserve. In this there are very good stands of white spruce. West of Hudson Bay Junction to Prince Albert, the land remains moderately level, with no timber except for the Fort a la Corne Forest Reserve. This is practically all jack pine growing on very sandy soil. As yet the trees are of very little use, being too small, averaging from 4 to 7 in. D.B.H.

The Nisbet Provincial Forest, west of Prince Albert, is much the same as Fort a la Corne. Here again the soil is sandy and the trees are small with a few scattered timber berths.

(iii) Personnel contacted:-

District Superintendents Marshall, Hudson Bay Junction, and Mr. Mac Askill, Prince Albert. Field officers encountered were Mr. Potter, Lake Madge; Mr. Dobie, Pelly; Mr. C. Schell, Hudson Bay Junction; Mr. Clay, Nipawin, and Mr. H. E. Tanner at Holbein.

(iii) Intelligence:-

Most of the roads in this area of Saskatchewan are poor, being of dirt with gravelled stretches in various places, and all side roads of dirt.

Hotel accommodations on the average are very poor. At Hudson Bay Junction the hotel is clean, but old. In the town there is no place where one can secure a decent meal. At Canora, Hotel Canora is very nice, but has no running water in the rooms. Nipawin has a new hotel under construction, with all modern conveniences. The Empress Hotel in Price Albert is highly recommended with the Palace Cafe serving very good meals.

(iv) Insect Conditions:

(a) Jack Pine Budworm, Archips fumiferana Clem.

The budworm infestation in the Fort a la Corne Forest Reserve has practically disappeared. Only 6 pupae were collected in all, and these were taken from 22 trees, in only one location. This spot is on the north side of the Twin Lakes road, approximately 5 miles west of English Cabin.

The area covered in this reserve was from Beaver House west to Twin Lakes and south to the Saskatchewan River. Trees that had budworm pupae on, showed no signs of damage, these trees were of the young generation, being about 20 ft. in height.

(b) European Larch Sawfly, Pristiphora erichsonii Htg.

Sawfly was first encountered in the Eastern District of Saskatchewan at Lake Madge, where the infestation appeared heavy; the trees had been 65% defoliated. The infested areas were along the south and east sides of Lake Madge from Ministik Lodge to Benito Junction. Host trees ranged from 8 to 35 ft. in height with the infestation appearing heaviest on those from 12 to 25 ft. in height.

The sawfly was found next at Pelly in four different spots, the first being ½ mile south of the ranger station. This infestation was very heavy with some of the trees being 100% stripped, and the average defoliation being 85%.

Two other places were about 5 and 6 miles straight north of Pelly, here again the infestation was heavy, with average defoliation about 60%. These swamps are small, with trees averaging 4 in. D.B.H. At the last spot, 4 miles west of Pelly, along the highway, the infestation occurred again but the trees were only about 30% defoliated.

Here the trees are very scattered and mixed with stands of black spruce. The tamarack trees averaged 4 to 6 in. D.B.H.

From Sturgis to Ushta, wherever tamarack was encounted, the infestation remained from medium to heavy, with defoliation averaging 50% and the trees were from 1 to 6 in. D.B.H.

No sawfly was encounted from Ushta north to Hudson Bay Junction, and only in one place was it found there; this being 1 mile east of the town, along the railroad. Sawfly was very scarce, and only one collection of larvae was available.

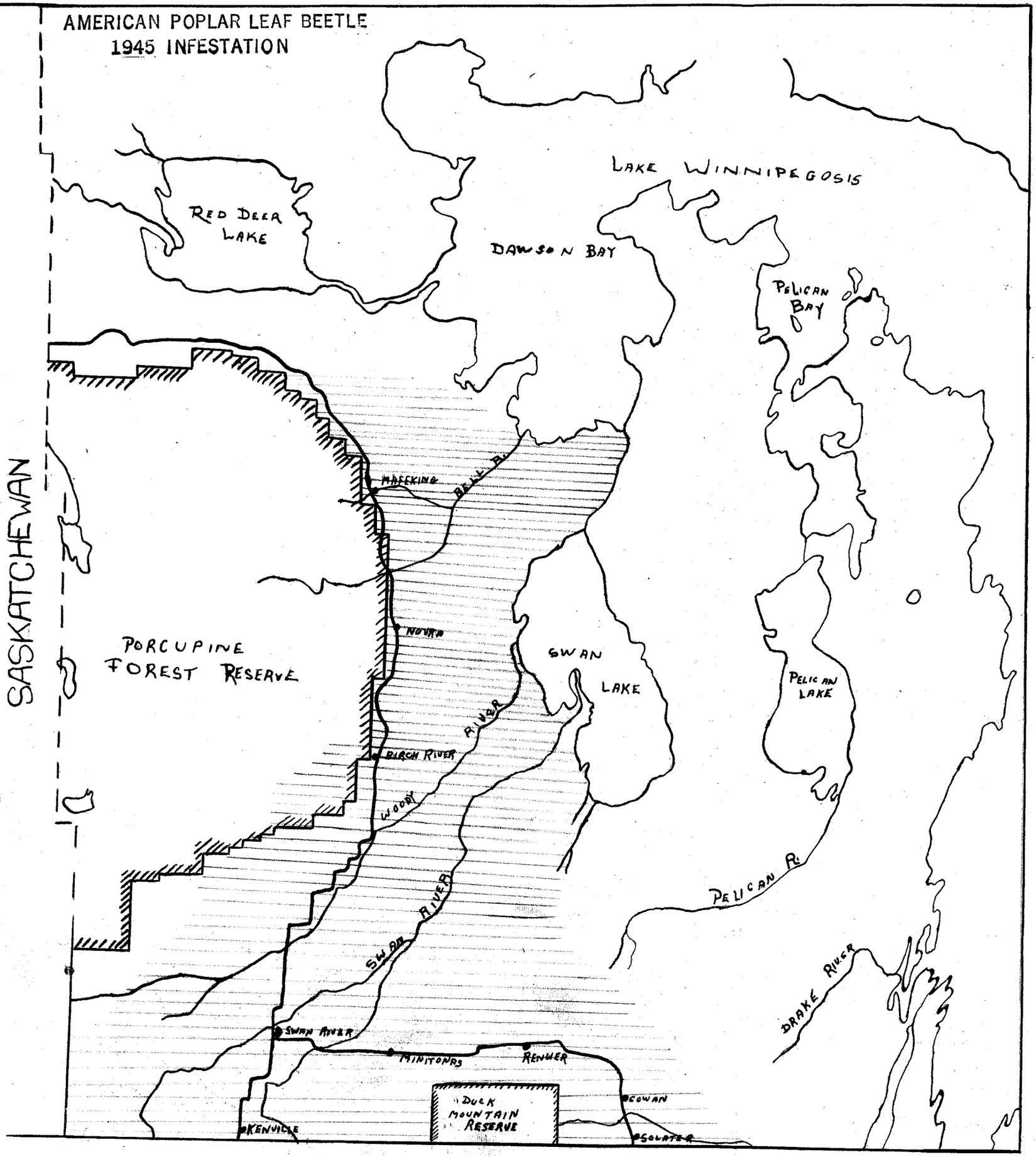
(c) Jack pine Scale, Toumeyella sp.

The jack pine scale infestation in the Nisbet Forest Reserve, Saskatchewan, is heavy. It appears in strips from 1 to 2½ miles wide, running across the reserve from the Saskatchewan River north to the reserve boundary.

There are three strips all running in the same general direction. One runs from McKenzie Ellis Lake to the river; another from the town of Holbein to the river; and the other one is from the north boundary of Timber Berth 859 south along the third Meridian Road to the southern boundary of the reserve.

The infestation was seen in August, when the scale is in the adult stage, and at that time was not active. Large numbers of the scale were empty. It is quite probable that they had been parasitized.

All trees infested showed a decidedly black colour, giving them the appearance of having been swept by fire.


AMERICAN POPLAR LEAF BEETLE
1945 INFESTATION
LAKE WINNIPEGOSIS
RED DEER LAKE
DAWSON BAY
PELICAN BAY
SASKATCHEWAN
PORCUPINE FOREST RESERVE
MAFEKING
BELL R.
NOVRA
SWAN LAKE
PELICAN LAKE
BIRCH RIVER
WOODY RIVER
SWAN RIVER
PELICAN R.
DRAKE RIVER
SWAN RIVER
MINITONAS
RENNER
DUCK MOUNTAIN RESERVE
BOWSMAN
KENVILLE
SOLSTER

A. P. O. Thomas

1. Introduction

The following report covers the Forest Insect Survey projects and observations carried out in the southern and eastern districts of Manitoba by Forest Insect Ranger P. O. Thomas, for the year 1945.

2. District Conditions

(a) Southern District of Manitoba.

(i) Description of traversed area. The following district description covers an area from the northern boundary of the Sandilands Forest Reserve to the international boundary in the area of Sprague and Vassar.

Jack pine is the predominant tree throughout this entire district. As the majority of this species is only medium in size, its only commercial value is for fuel.

In the Sprague and Vassar districts, millions of feet of lumber have been manufactured from white and black poplar in the last year. Large numbers of cedar poles have also been produced, but the commercial cedar in this area is being rapidly reduced. The remaining cedar is very small, but is in a healthy condition.

Tamarack and spruce in the district is small, but healthy.

The largest areas damaged by fire lie in the Sprague-Vassar district. Fire damage in the district as a whole is light.

(ii) Personnel contacted. Rangers contacted in this district included Mr. J. Inkster, chief ranger for the district, residing at ranger headquarters, on the Sandilands Forest Reserve. Mr. T. Harrison residing at the Woodridge Ranger Station, and Mr. J. Wright at the Sprague Ranger Station were contacted. Several attempts were made to contact Mr. B. Emes who resides at the Dawson Ranger Station, but each visit found Mr. Emes out. All rangers contacted co-operated to the fullest extent, especially Mr. J. Inkster. With the latter, considerable time was spent as the Forest Insect camp was situated at reserve headquarters.

Several visits were paid to the reserve headquarters by Mr. W. Wardrop, District Forester, and Mr. Gill of the Manitoba Forest Service. On occasions of these visits, problems were discussed and ideas exchanged. Both of these gentlemen are highly interested in this branch of the service, and take every opportunity to encourage their rangers to co-operate.

(iii) Intelligence:- The terrain in this district is flat and heavily wooded. The soil is very sandy with few stones. The road from Winnipeg to Marchand is gravel, but is kept well graded. From Marchand to Piney, a distance of approximately fifty miles, the road is reduced to a trail consisting of two deep ruts, making it very awkward for two vehicles to pass. From Piney to Sprague the road is again gravel, except for a small section near South Junction, where the road again becomes a trail.

At reserve headquarters very good camp accommodation is available. Two platforms have been erected, 9'x 12', with four foot walls and rafters over which a tent can be placed, making roomy and comfortable living quarters. The nearest hotel accommodation is at Marchand, a distance of six miles from headquabters. Meals may be obtained at this hotel at a very reasonable rate.

The Piney Hotel is clean and has reasonable rates, meals must be purchased at a cafe across the street. The Sprague Hotel is highly recommended for its cleanliness and well-prepared meals.

Ranger J. Wright has built two cabins, one at Whitemouth Lake and the other near Rosenfeld. These cabins have been graciously placed at the disposal of the insect rangers.

(b) Eastern District of Manitoba.

(i) Description of traversed area: The northern boundary of the traversed area in the interlake district is a line drawn from a point five miles northwest of Gypsumville, east to Fisher Bay on Lake Winnipeg.

The southern portion of this district is flat, the soil light and very stony. Further north the land rises in ridges, with swamps in the valleys. The swamps become larger and more numerous as one goes north.

The most predominent tree in this district is white poplar. Spruce, tamarack, and jack pine make an appearance

with the ridges. The interlake district has very little timber suitable for lumber. A large amount of the coniferous trees are stagnant and permits are to be issued for the cutting of stagnant trees in the Lake St. George district. The majority of the trees cut will be used as fuel.

Fire damage throughout this district is heavy, especially in the northern portion.

(ii) Personnel contacted: Rangers contacted in this district include Mr. D. Cooper at Hodgson, and Mr. D. Wardrop at Riverton. Ex-ranger Fraser at Moosehorn was paid a short visit. He cooperated generously with information on the Moosehorn district. Rangers Cooper and Wardrop did everything possible to assist the writer while in their respective districts.

(iii) Intelligence:- The road from Winnipeg to Hodgson is gravel, and in a good state of repair. To go from Hodgson to Gypsumville, two stretches of dirt road must be covered. One stretch lies between Poplarfield and Ericksdale, a distance of 25 miles, and the other between Grahamdale and Gypsumville a distance of 35 miles. The road from Grahamdale to Steeprock is also dirt, these roads are not passable in wet weather.

The hotels in Hodgson and Gypsumville are clean and comfortable, and meals may be obtained in both. At Steeprock the only accommodation is Mrs. Finnson's boarding house, which is highly recommended.

Travel in this district is difficult off the highway. A sharp look-out must be kept for stones, and all bridges must be taken slowly as they are in a very poor state of repair.

3. Insect Conditions

(a) Jack Pine Budworm (*Archips fumiferana* Clem).

The jack pine budworm is general throughout the Sandilands forest reserve. The heaviest infestation of budworm covered the following area in the vicinity of reserve headquarters, R. 9,T.5, the southern half of sec. 35 and the SW half of sec. 36. Travelling south it covers the eastern half of sec. 27, all of sec. 26 and 3/4 of sec. 25, being absent from the SE corner. Farther south it covered the eastern half of sec. 22, all of sec. 23, and the area west of a line drawn from the middle of the northern boundary of sec. 24 to the SW corner of the same section. The southern boundary of

this infestation covers the NE quarter of sec. 15 and the NW quarter and half of the NE quarter of sec. 14, being absent from the SE corner of the NE quarter of this section.

Although this is the most heavily infested area on the reserve, the infestation is only of a medium intensity. The majority of the trees in this are are small and of the orchard type. There was no evidence of the infestation being heavy enough to cause the death of any trees in this area, or any other part of the reserve.

The next infestation of approximately the same density as the one just mentioned lies at the northern part of the reserve, and covers an area around the Dawson ranger station, R.'s 10 and 11, T. 7. Starting at its northern limits and working west to east the sections covered are as follows: R. 10, the southern half of sec. 35, the same part of sec. 36; over to R. 11, the southern half of sec. 31 and sec. 32, and the SW quarter of sec. 33; back to R. 10, the NE quarter of sec. 27, all of secs. 26 and 25; over to R. 11, all of secs. 30 and 29, also the N and SW and the SE quarter of sec. 28; back to R. 10 the NE quarter of Sec. 22, all of secs. 23 and 24; over to R. 11, all of sec. 19, 20 and 21; back to R. 10, the NE quarter of sec. 14, the north half of sec. 13, and finally over to R. 11, the north half of secs. 18, 17 and 16. These boundaries are reasonably accurate.

The trees in the northern part of the reserve are much larger than in the southern portion, and are mostly of the high crowned type. There was, however, a heavy undergrowth of seedlings in the northern areas, and it was among these that the budworm was more plentiful. A very light infestation covers the remainder of the reserve, and extends south to the international boundary, in the vicinity of Sprague and Vassar. Looking north from the fire tower at Sprague, small clumps of jack pine with brown tops were noticed. This would indicate the infestation was spotty and not of a general nature.

On the reserve there are large areas of jack pine scale infestations. In these areas very few budworm are to be found, as budworm and scale do not seem to mix. The boundaries of the scale infestation on the reserve are to be found in the report on jack pine scale (see below).

In the most heavily infested budworm area, the one around reserve headquarters, a jack pine budworm egg count was made. This was carried out to obtain some idea of the

oviposition of the budworm and what can be expected next year. The egg clusters from each tree were preserved in Frehlings solution, and each labelled as follows:-

Exp. 1 R
Sandilands For. Res.
Tree No. 1 Aug. 14/45

For this five jack pine were cut at random. The dimensions and conditions of the trees cut are as follows:-

Tree No. 1 of good foliage, heavily staminate, DBH 2 in. height 12 ft. From this tree 205 egg clusters were obtained.

Tree No. 2 was cut 12 ft. from tree No. 1. It was heavily foliated and also heavily staminate, DBH 3 in. height 12½ ft. From this tree 207 egg clusters were obtained.

Tree No. 3 was cut 45 ft. from tree No. 2. It was lightly foliated and lightly staminate, DBH 2 in. height 10 ft. A small amount of scale was found on this tree which was not noticed before it was cut. From this tree only 59 egg clusters were obtained.

Tree No. 4 was cut 28 ft. from tree No. 3. It was of medium foliage and lightly staminate, DBH 2 in. and height 11 ft. From this tree 98 egg clusters were obtained.

Tree No. 5 was cut 37 ft. from tree No. 4. It was lightly staminate and very heavily foliated, DBH 1¾ in. height 8½ ft. From this tree 101 egg clusters were obtained.

After being returned to the laboratory, twenty egg clusters were picked at random from each vial. Separately the egg clusters were put under the microscope and the number of eggs in each cluster counted. The eggs fell into three categories as follows:-

(a) Sound eggs, (b) parasitized eggs, (c) eggs destroyed by predators.

To insure a random selection of the egg clusters, the following procedure was observed. A petri dish was placed on a piece of cardboard, and a circle drawn the size of the dish. The dish was then removed and the circle was divided into twenty equal segments. The segments were numbered from one to twenty. Twenty small pieces of paper were cut and also

numbered from one to twenty. These were then placed in a container. The petri dish was then placed back on the circle and the entire contents of a vial containing the egg clusters was deposited in it, and spread as evenly as possible over the bottom. A piece of paper bearing a number was then taken from the container (sight unseen). If this number happened to be five, all the egg clusters covering segment five on the cardboard were removed from the petri dish and put in a separate dish containing a 30% solution of alcohol. This procedure was repeated until twenty egg clusters had been removed from the petri dish. The remainder of the egg clusters were discarded. The following tables represent the result of the counts:-

Sandilands, Man.

JACK PINE BUDWORM EGG COUNT

Tree No. I

Egg Cluster Number	Sound Eggs	Parisitized Eggs	Predatorized Eggs	Total
1	85			85
2	63			63
3	107			107
4	60	8		68
5	61			61
6	38	7		45
7	134	1		135
8	77	1	10	88
9	39			39
10	49			49
11	31			31
12	47	5		52
13	34			34
14	32			32
15	47			47
16	25	1		26
17	63			63
18	78			78
19	45	3		48
20	39	1		40
TOTALS	1154	27	10	1191

Tree No. 2.

Egg Cluster Number	Sound Eggs	Parasitized Eggs	Predatorized Eggs	Total
1	47			47
2	63		9	72
3	63			63
4	116			116
5	28			28
6	45			45
7	56			56
8	83	2	6	91
9	49			49
10	45	1	3	49
11	71	14		85
12	35			35
13	47			47
14	46			46
15	59			59
16	34		15	49
17	101			101
18	29			29
19	22			22
20	56			56
TOTALS	1095	17	33	1145

Tree No. 3.

Egg Cluster Number	Sound Eggs	Parasitized Eggs	Predatorized Eggs	Total
1	49			49
2	84			84
3	103			103
4	52			52
5	32			32
6	96			96
7	62	3		65
8	50			50
9	87	1		88
10	40			40
11	73			73
12	57	3		60
13	81		10	91
14	32			32
15	30		21	51
16	91			91
17	76	24		100
18	65			65
19	51	8		59
20	62			62
TOTALS	1273	39	31	1343

Tree No. 4.

Egg Cluster Number	Sound Eggs	Parasitised Eggs	Predatorized Eggs	Total
1	70			70
2	30	6		76
3	99			99
4	64			64
5	83			83
6	178			178
7	32		14	46
8	49			49
9	87			87
10	63			63
11	93			93
12	66			66
13	62	8		70
14	86			86
15	43	3		46
16	47			47
17	15	28	18	61
18	35			35
19	46			46
20	52			52
Totals	1200	45	32	1277

Tree No. 5.

Egg Cluster Number	Sound Eggs	Parasitised Eggs	Predatorized Eggs	Total
1	96			96
2	72			72
3	73			73
4	60			60
5	32			32
6	80			80
7	57			57
8	48			48
9	42			42
10	29			29
11	46	43		89
12	114			114
13	78			78
14	61			61
15	57			57
16	87			87
17	63	1		64
18	18	15		33
19	104			104
20	62			62
Totals	1279	59		1338

Summary Table of Egg Counts

Tree Number	D.B.H.	Height	Sound Eggs	Parasitized Eggs	Predatorized Eggs	Total Eggs
1	2"	12'	1154	27	10	1191
2	3"	12½'	1095	17	33	1145
3	2"	10'	1273	39	31	1343
4	2"	11'	1200	45	32	1277
5	2"	8½'	1279	59	0	1338
TOTAL	11"	54'	6001	187-	106	6294

Average number of eggs per mass - 63
Average number of egg clusters per tree - 134
Average number of eggs per tree - 8442
Average D.B.H. 2.2"
Average height of trees - 10.8'

The egg counts of the preceding tables are as accurate as possible. A few egg clusters, however, were damaged when collected, and in the counts some of these may have been confused with predatorized eggs. This is the only source of error, and in no case exceeded ten eggs from the true count. The trees from which the count was made were rather small, and no doubt a much larger number of clusters would have been obtained had mature trees which dominate in this area been used. In the southern part of the reserve, however, there are large plantations of jack pine that correspond in size to the ones used in this egg count. A few of these plantations are budworm infested, but the majority of them are heavily attacked by scale. From the information gained through this egg count, a heavy infestation of budworm is expected next year.

Jack pine budworm parasites in the infested area around reserve headquarters exist in large numbers. The parasites referred to here are larval parasites only. Those found in the largest numbers were dipterous parasites. Also present, but not so abundant, was the parasite Glypta fumiferanae. As the infestation in this area has dropped considerably from that of last year, it is quite possible that this is due to the activities of these parasites.

Observations on the budworm in the inter-lake district of Manitoba are very favorable. The observations were made in the Hodgson, Gypsumville, and Davis Point areas. In these districts there are very few jack pine except on the ridges. The majority of the trees are deciduous. The majority of coniferous trees are spruce and tamarack. The jack pine encountered were only very lightly infested with budworm.

(b) European larch sawfly (Pristiphora erichsonii Htg.)

The infestation of the European larch sawfly in southeastern Manitoba is very light. A heavy infestation was discovered south of Sundown and two miles north of the international boundary. This infestation was confined to a tamarack swamp 3/4 of a mile wide and approximately two miles in length. This infestation was very heavy, and almost 100% defoliation had been inflicted. This was an exceptional case, and was not repeated again over the entire district. In the Sprague and Vassar districts, the sawfly is very light, and trees that had been heavily attacked in previous years are now coming back. The tamarack in this district is small, and has not reached commercial size. There was a medium infestation near the Dawson cabin. However, this infestation has decreased considerably from that of last year.

Sawfly in the Hodgson district is light. The only sign of defoliation was on the leaders. There was one stand located in the Redrose district, covering approximately three acres, where the defoliation was 60%. The Redrose district lies north, northwest of Hodgson, approximately seventeen miles.

In the Gypsumville and Davis Point districts, the tamarack can be divided into two groups; tamarack growing in swamp and that growing on ridges. The swamp tamarack is in a very healthy condition, and evidence of sawfly is almost nil, whereas the defoliation among the ridge tamarack is from 75% to 100%. It was common to see whole stands of ridge tamarack almost completely defoliated. Many of the trees had apparently died.

(c) Jack pine scale (Toumeyella).

The heaviest infestation of scale found in south-eastern Manitoba was on the Sandilands Forest Reserve. The heaviest infestation being in the southern portion of the reserve. It was a common occurrence in the most heavily infested area to notice an individual tree that had not been attacked. These trees were examined in an effort to determine the reason for this immunity to scale. The only result from these inspections was the discovery of a few jack pine budworm. Some of these trees that were immune to scale, but had a light infestation of jack pine budworm, were sometimes 1½ miles from an area where budworm were abundant.

The area covered by the heavy infestation is as follows, R.9, T.6, SE quarters of section 24, R.9 T.4 NE and SE quarters of section 13; east to range 10, all of sections 18 and the NW and SW quarters of section 17; back to R.9,T.5 the NW and NE quarters of sec. 12; Rge. 10, T. 6, all of Sec. 7 and 8, and all of sec. 6 and 5, the NW and SW quarters of sec. 4, the NE quarter of sec. 31 and the NW and NE quarters of sec. 32, as well as the NW quarter of sec. 33.

There is also an infestation further south that covers the NE quarter of sec. 30, the NW and NE quarters of sec. 29, as well as the NW quarter of sec. 28. This infestation extends south twoards the town of Woodridge for a distance of 3/4 of a mile to a mile.

A scale count was made in the heaviest infested area of the former infestation. This was on the Kerry school road,

six miles south of reserve headquarters, and half-mile north of M.F.C.T.S. Camp I. The count was carried out to determine the mortality of the scale in this particular area. Nine trees were inspected up to a height of eight feet from the ground. Each branch was covered thoroughly. The average D.B.H. of the trees was 5½ inches. The scales were divided into three groups, as follows: 1. living scale, 2. dead scale, 3. parasitised scale. Living scales were the ones that were still actively killing the trees. Dead scales were those that were no longer active, but where no visible cause of death was evident. Parasitised scales were those that had been definitely killed by parasites. These were easily determined from those that died from natural causes. 1658 were found to be alive and active, a large number of these were just newly formed. As these were not kept separate from the older ones, the true parasitism is underestimated, as the parasites would no doubt have attacked many of these young scales before long. 717 scales were found dead from unknown causes. 866 parasitised scales were found. The parasites in this area were very effective. The most active of the parasites were the dipterous and hymenopterous larvae. There were very few larvae of the Coccinellid predator, Hyperaspis binotata in this area.

The scale infestation north of reserve headquarters did not cover as large an area as the one in the south. This infestation probably would have spread and caused more serious damage but for the large numbers of Hyperaspis binotata. These predators existed in this area in great numbers. On one tree of 10 inches D.B.H. a square foot was marked off, and the H. binotata in this space was counted. Twenty-eight larvae, all active and in good condition, were observed. This tree was no exception. Three weeks after the appearance of the larvae the scale in this area was estimated to have decreased 50%. This infestation covers the following area: Rge.10T.6, the SE quarter of sec. 33 and the SW and SE quarters of sec. 34, the NW and NE quarters of sec. 28 and the NW quarter of sec. 27.

A great deal of damage was done by the scale among the pine plantations. The average size of trees in the plantations averaged DBH two inches, height eight feet. These are the types of trees scale seems to prefer.

In all scale infested areas there are large numbers of ant hills. These ants have been seen in combat with the H. binotata and in the engagements observed, the ant was always the victor.

No scale mortality count was made in the infestation north of reserve headquarters. It would have been interesting to compare the mortality of an area where H. binotata was abundant to one where they were scarce.

(d) Forest tent caterpillar, Malacosoma disstria, Hbn.

The main object in mapping the forest tent caterpillar in the inter-lake district of Manitoba was to obtain some idea of the direction it was travelling. As it was reported at The Pas a few years ago, the infestation is believed by the writer to be travelling in a SE direction.

The southern boundary of this infestation (ref. to map) is a line drawn from Hnausa on Lake Winnipeg to a point two miles north of Chatfield, across to another point two miles south of Mulvihill, continuing on a slight angle south to Lake Manitoba. The infestation extends northward as far as the existence of deciduous trees in groves. The northern boundary of this infestation could not be given, as travel that far north is impossible except by foot or boat. Inform- on the caterpillars' existence north of Fisher Bay was obtained from lumbermen, the local doctor and the schoolteacher from Jackhead Pt. This infestation has crossed Lake Winnipeg, and also exists on the majority of the islands in the lake.

Large areas of white poplar in this district were completely defoliated. This damage was inflicted early enough to enable this particular host to put forth a second growth of foliage. This was not the case for black poplar. The leaves on the black poplar were not completely stripped, but were only half destroyed, as a result no second growth took place. The foliage on this particular host changed color and fell before its time. The Saskatoon crop in this district was almost nil as a result of this infestation.

It seems that the first year of a forest tent infestation is only medium in intensity. The second year they are usually extremely heavy, covering fence posts, railway tracks, telegraph poles, and even houses with their numbers. The third year their intensity is again medium.

Great alarm was caused by these insects among the farmers, as they expected them to attack crops and gardens, but none of these were damaged.

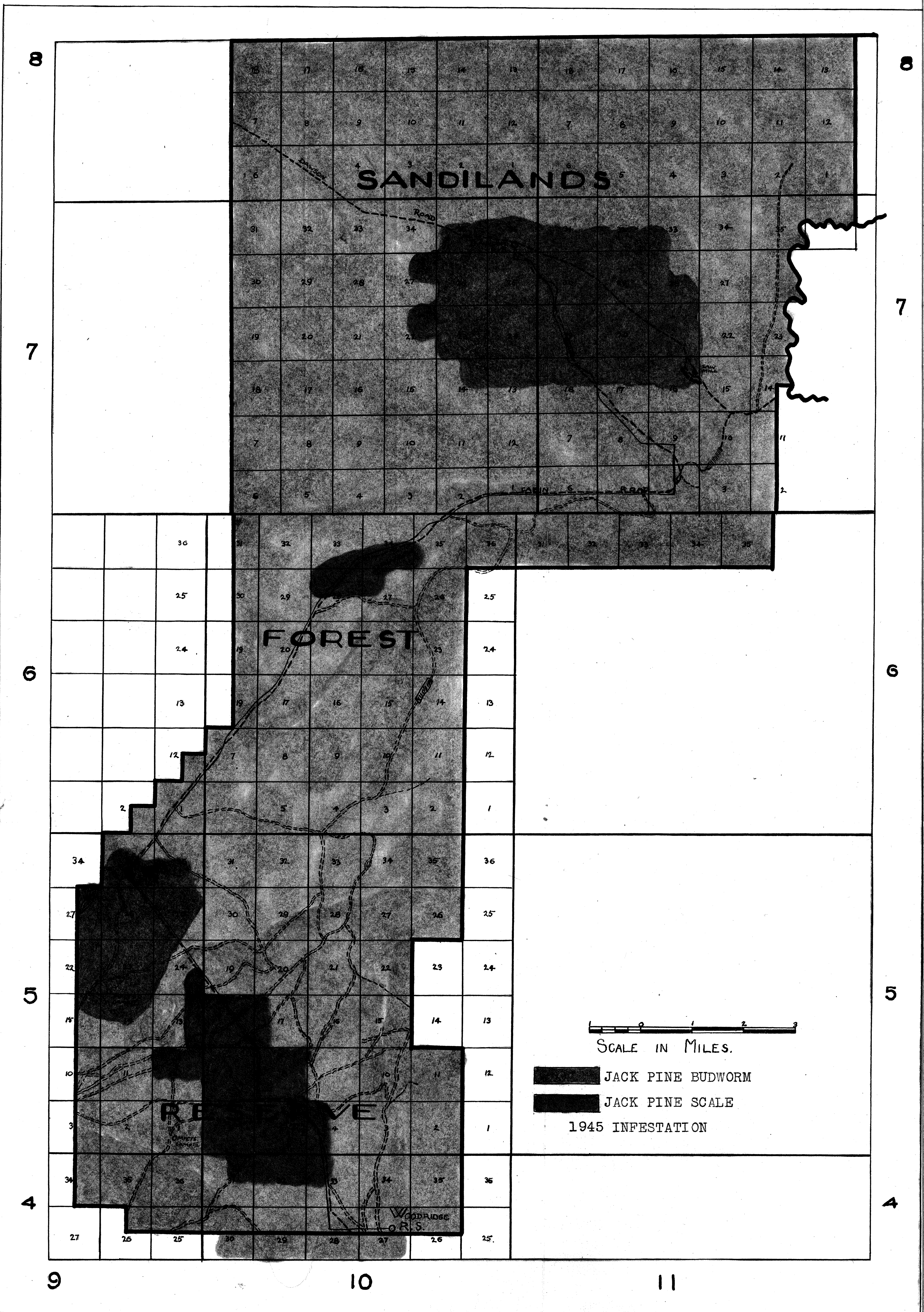
In many cases after feeding on deciduous trees, the caterillar would transfer over to a nearby spruce or pine and there

pupate. No damage was inflicted on the latter mentioned trees.

The course of this infestation would be very difficult to anticipate. The weather diaries of the ranger at Hodgson, Mr. D. Cooper, and the ranger at Riverton, Mr. D. Wardrop, were compared as to prevailing wind directions in their respective districts. At Hodgson the prevailing wind for the summer months is from the NW. At Riverton the prevailing wind for the same period was from the SE. The line where wind direction changes may be seen on Lake Winnipeg, in the vicinity of Hecla and Black Islands, on a calm day. This information was obtained from Ranger D. Cooper, who has flown over the spot many times. This change of wind direction may have been the cause of the infestation crossing the lake. How far east of the lake the caterpillar will travel is difficult to say. On the east side of the lake the deciduous trees are limited, due to large burned-out areas, and an increase in coniferous types.

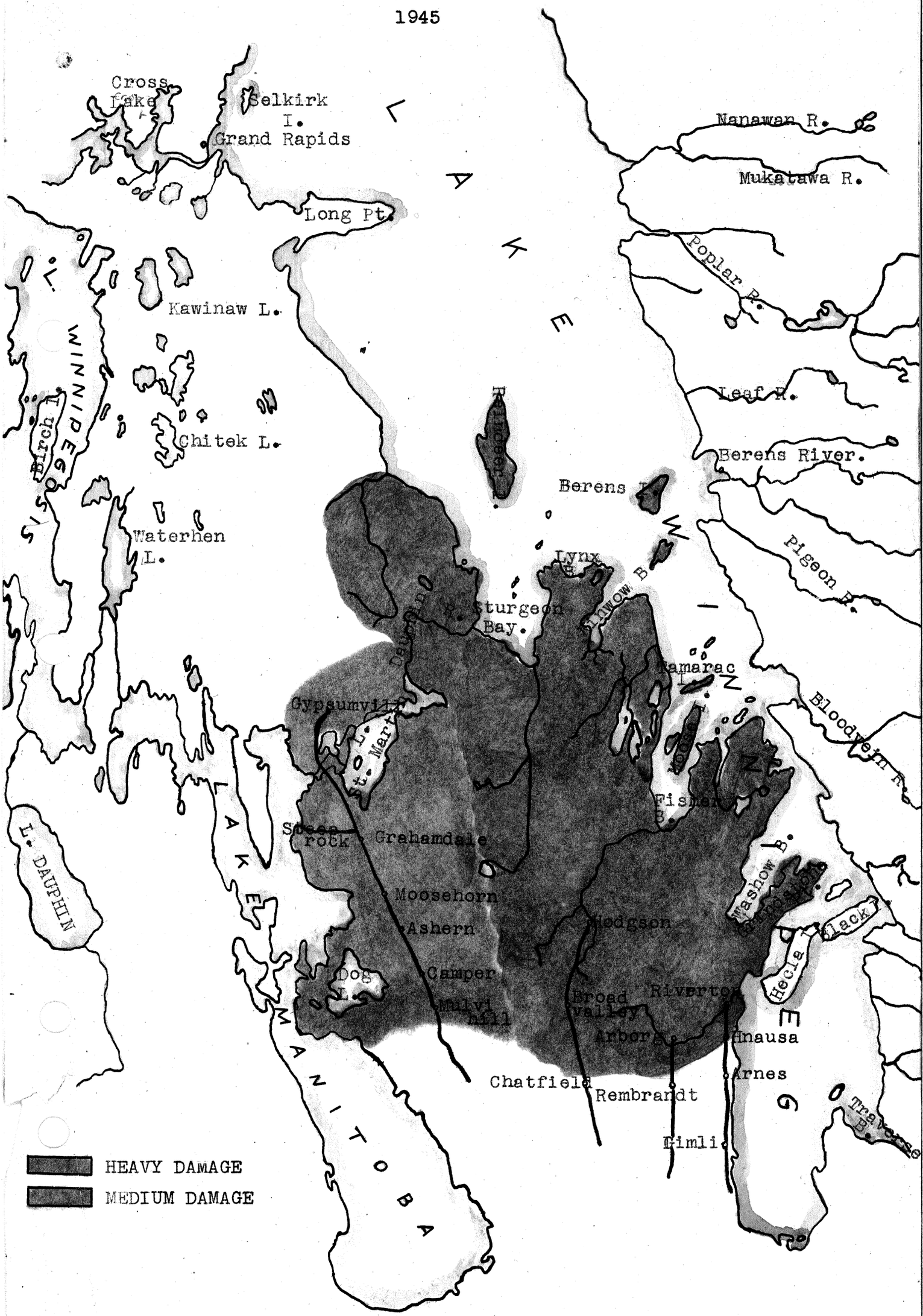
(e) Pine midge, Retinodeplosis sp.:

While travelling between Woodridge and Piney, en route to Sprague, a heavy infestation of midge was discovered. The heaviest portion of this infestation was in the Badger district. As this infestation was not mapped, its boundaries can not be given. Numerous dead seedlings were observed due to the midge. As this has never been reported before, it cannot be said whether the pest has declined or increased this year. The midge is general throughout south-eastern Manitoba, but is very light in intensity.


SANDILANDS
FOREST
RESERVE
ROAD
WOODRIDGE
R.S.
0 1 2 3
SCALE IN MILES.
JACK PINE BUDWORM
JACK PINE SCALE
1945 INFESTATION
8
7
6
5
4
9
10
11

FOREST TENT CATERPILLAR
INTER-LAKE DISTRICT OF MAN.

1945



A. V. Hildahl

1. Introduction

The following report covers the Forest Insect Survey observations carried out in the Eastern Forest District of Manitoba by Forest Insect Ranger V. Hildahl for the year 1945.

2. District Conditions

(a) Eastern District, Manitoba.

(i) Description of traversed area: The greater part of the Eastern Forest District of Manitoba is composed of rock ridges, sparsely wooded with jack pine, separated by occasional swamps and muskegs and interlaced with numerous lakes and rivers. All lakes and rivers are bordered with heavy stands of white and black spruce. Tamarac is the predominant tree in all swamps, with occasional stands of spruce. Poplar is abundant throughout the district, but of very little commercial value at present.

Recent fires have raised havoc with many large stands of timber in the Eastern District. Perhaps the most serious of these were the fires at Berens River and at Sasaginnigak Lake. At both these points hundredsof acres of spruce and balsam stands were destroyed. A recent fire destroyed many of the important and most valuable spruce stands at Hole River. This fire, perhaps, was more important commercially due to the easy access to the stands for logging operations.

All recently fire burned areas in the district are being replaced by new growth jack pine ranging from five to twelve feet high.

(ii) Personnel contacted:

Mr. E. Marner, Forest Ranger, Lac Du Bonnet
Mr. C. T. Mitchell, Forest Ranger, Lac Du Bonnet
Mr. G. H. Davies, Fire Ranger, Bissett
Mr. B. M. Kyurk, Fire Ranger, Sasaginnigak Lake
Mr. W. Barker, Fire Ranger, Hole River
Mr. W. D. Berens, Fire Ranger, Berens River
Mr. S. Cook, Fire Ranger,Bloodvein River

(iii) Intelligence: Suitable living accommodations are at a minimum throughout the entire Eastern District. No accommodations whatsoever can be obtained at Hole River, Bloodvein River and Little Grand Rapids, and complete camping outfit must be carried when visiting these points. At Berens River

the Manitoba Forest Service cabin is at the disposal of all forestry personnel and affords suitable accommodation for all stop-overs. Supplies can be obtained from the Hudson Bay Trading Post at Berens River. Sasaginnigak Lake is very isolated and has a fire ranger cabin only. Bissett has one hotel, semi-modern, with suitable accommodations. Travel is very limited throughout the entire district, transportation being the major problem. The only transportation available at present is the use of Manitoba Forest Service equipment.

3. Insect Conditions and Maps.

(a) Jack pine budworm (Archips fumiferana, Clem.): Only one infestation of this jack pine-feeding insect was found in the Eastern Forest District and this was at Lake Sasaginnigak. Due to the difficulties encountered when attempting to proceed inland, no accurate inland boundary can be given for this infestation. However, it would be reasonable to assume that traces of this insect could be found some distance inland. On close observation, jack pine budworm was found along the entire shore-line from the southeast corner to the northwest corner of Sasaginnigak Lake. Beating operations carried out on the north shore revealed no budworm was present, indicating the northern boundary of this infestation to be Sasaginnigak Lake. In 1945 this infestation had not reached epidemic proportions and was found on reproduction pine only. Defoliation was unnoticeable and larval activity was practically nil.

Pupal counts of jack pine budworm on jack pine terminals were made and the following data recorded:-

North shore of L. Sasaginnigak:
Jack pine budworm activity - nil.

Southeast shore:

No. of trees examined	- 50
No. of trees with budworm present	- 20
Percentage of trees infested	- 40%
No. of terminals examined	- 100
Percentage of terminals infested	- 2%

South shore:

No. of trees examined	- 30
No. of trees with budworm present	- 18
Percentage of trees infested	- 60%
No. of terminals examined	- 225
Percentage of terminals infested	- 3.4%

West shore:

No. of trees examined	- 60
No. of trees with budworm present	- 50
Percentage of trees infested	- 83.3%
No. of terminals examined	- 175
Percentage of terminals infested	- 4%

All trees examined for the above counts were approximately ten feet high.

(b) European larch sawfly (Pristiphora erichsonii, Htg.) An infestation of this insect is prevalent throughout the entire region of the Eastern Forest District lying south of Berens River and east of Lake Winnipeg.

However, an aerial survey showed the status of this infestation in 1945 varied in density from place to place. The heaviest defoliation of tamarack appeared to be confined to an area bounded on the south by the Manigotogan River, and on the north by the Bloodvein River, and continuing eastward from Lake Winnipeg, a distance of approximately twenty-five miles, with the exception of an extremely heavily defoliated area between the Manigotogan and Wanipigow Rivers, where nearly all tamarack, from the air, appeared dead or dying. Throughout the remainder of the district larch sawfly is prevalent but defoliation is noticeably lighter, and could be classed as a light infestation. At Lac du Bonnet and surrounding district, larch sawfly has become almost non-existant and no noticeable defoliation is present.

Around Seddon's Corner for an area of approximately twenty square miles, larch sawfly is now quite abundant, and is attacking all tamarack stands within that area. This infestationdid not appear to have reached its peak in 1945, and severe damage to tamarack can be expected next year.

An outbreak of larch sawfly which in past years has been causing severe damage to all tamarack stands around Riverton declined sharply in 1945, and a further decrease in density is expected in 1946.

(c) Yellow-headed spruce sawfly (Pikonema alaskensis, Roh.). A very heavy and unusual infestation of this insect was found on an island in Sasaginnigak Lake, where it is attacking all black spruce. On close observation throughout the Lake Sasaginnigak area it was found this infestation is confined, thus far, to one island. At the time of observation, larvae

were feeding actively on spruce and defoliation was noticeable both from the ground and from the air. Approximately one-half to one-third of the crowns of all spruce appeared reddish in colour.

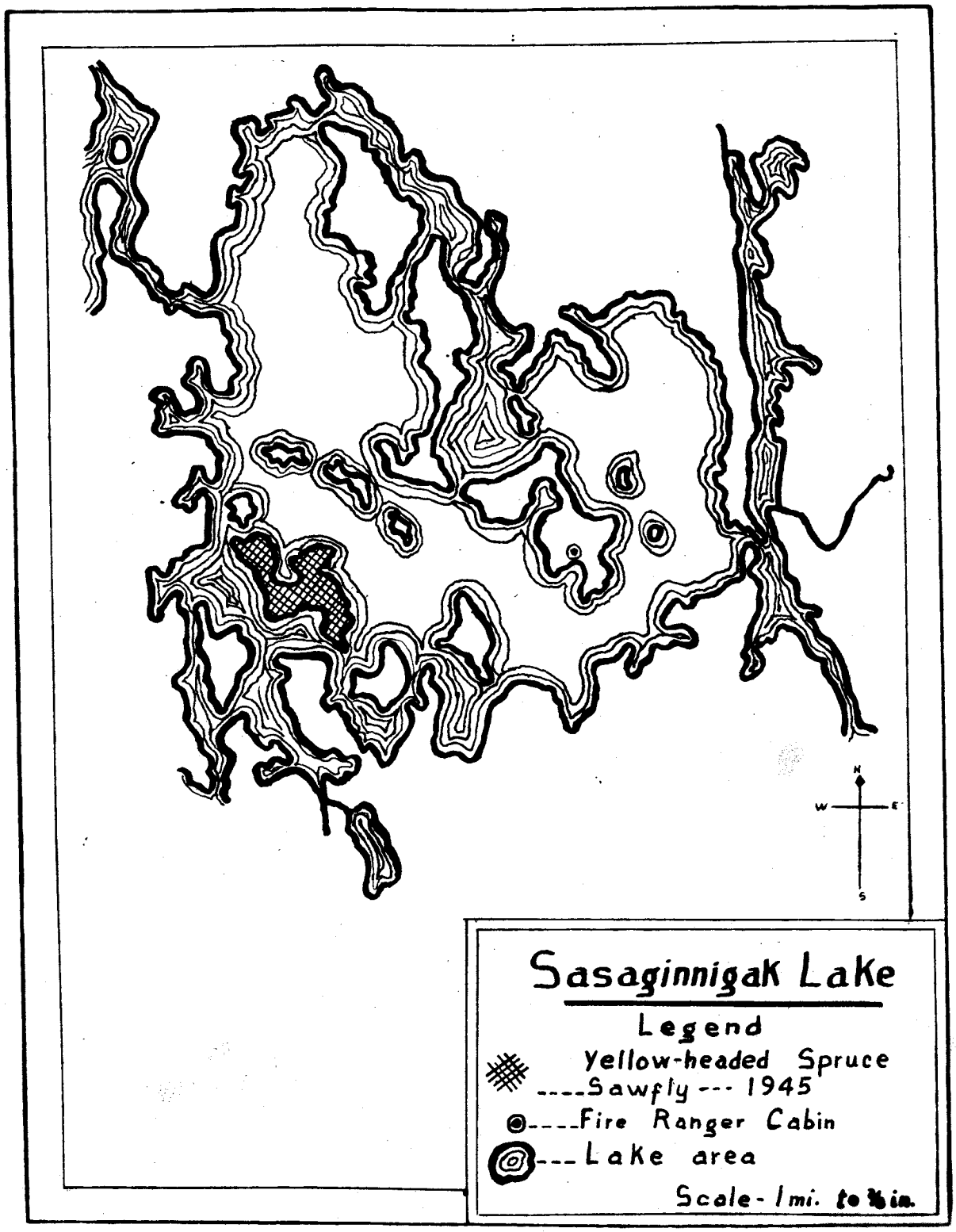
(d) Spruce Budworm (Archips fumiferana, Clem):- In a search for the spruce budworm in the Eastern district, one sample only of this insect was found and it was at Lake Sasaginnigak. Although reported here last year, this infestation has not become active.

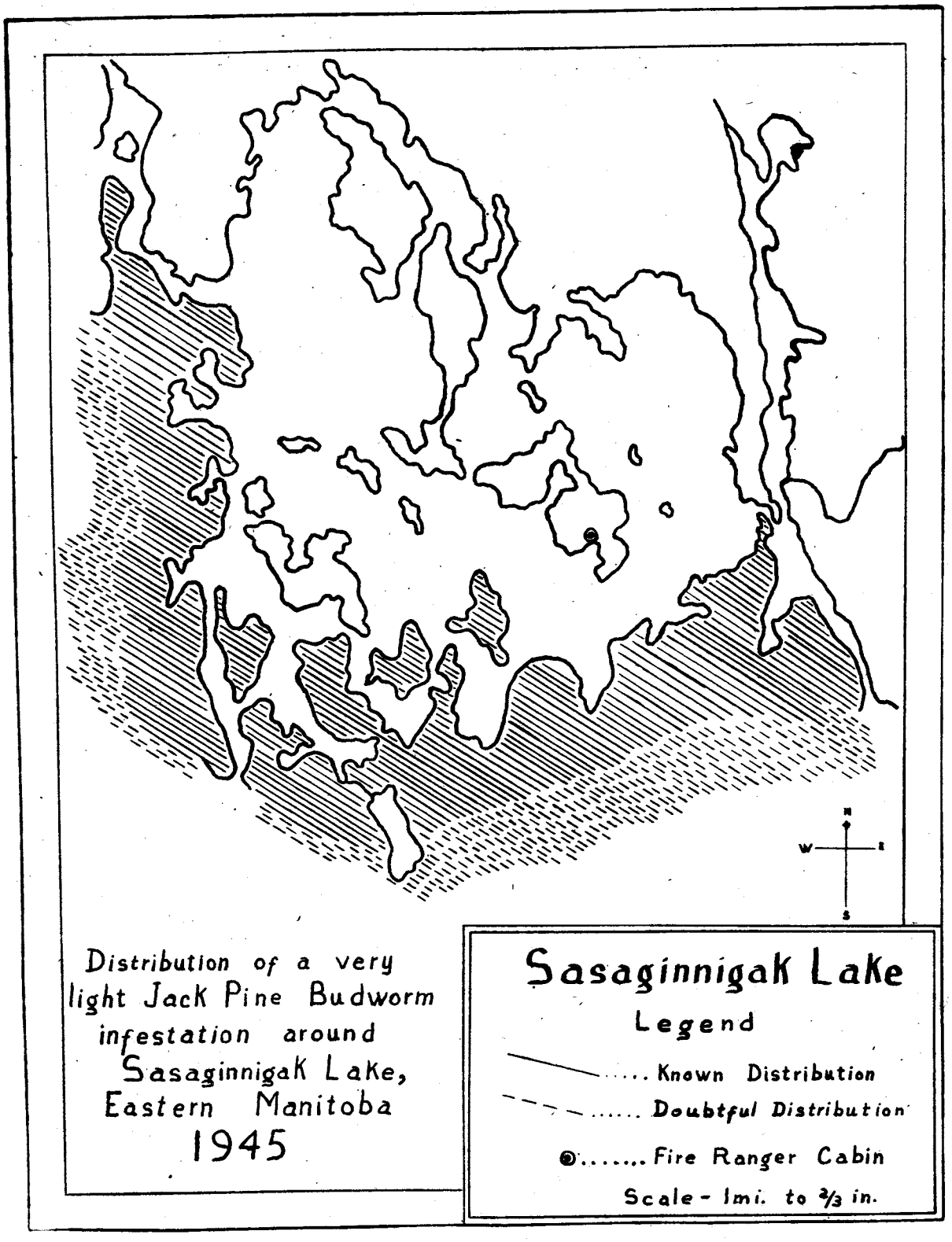
(e) Hemlock Looper (Lambdina fiscellaria, Guen.):- On the basis of samples taken, this insect seems to be generally distributed throughout the Eastern Forest District. No. decided increase of this insect was noticeable in 1945, and there is no immediate danger of it doing serious damage in 1946.

(f) Black-Headed Budworm (Peronea variana, Fern.):- Although this insect was reported as generally scattered throughout the Eastern Forest District in 1944, in a search for this black-headed budworm in 1945, one sample only was found, and it was at Lake Sasaginnigak. Larvae of this insect are not sufficiently humerous to produce any noticeable defoliation.

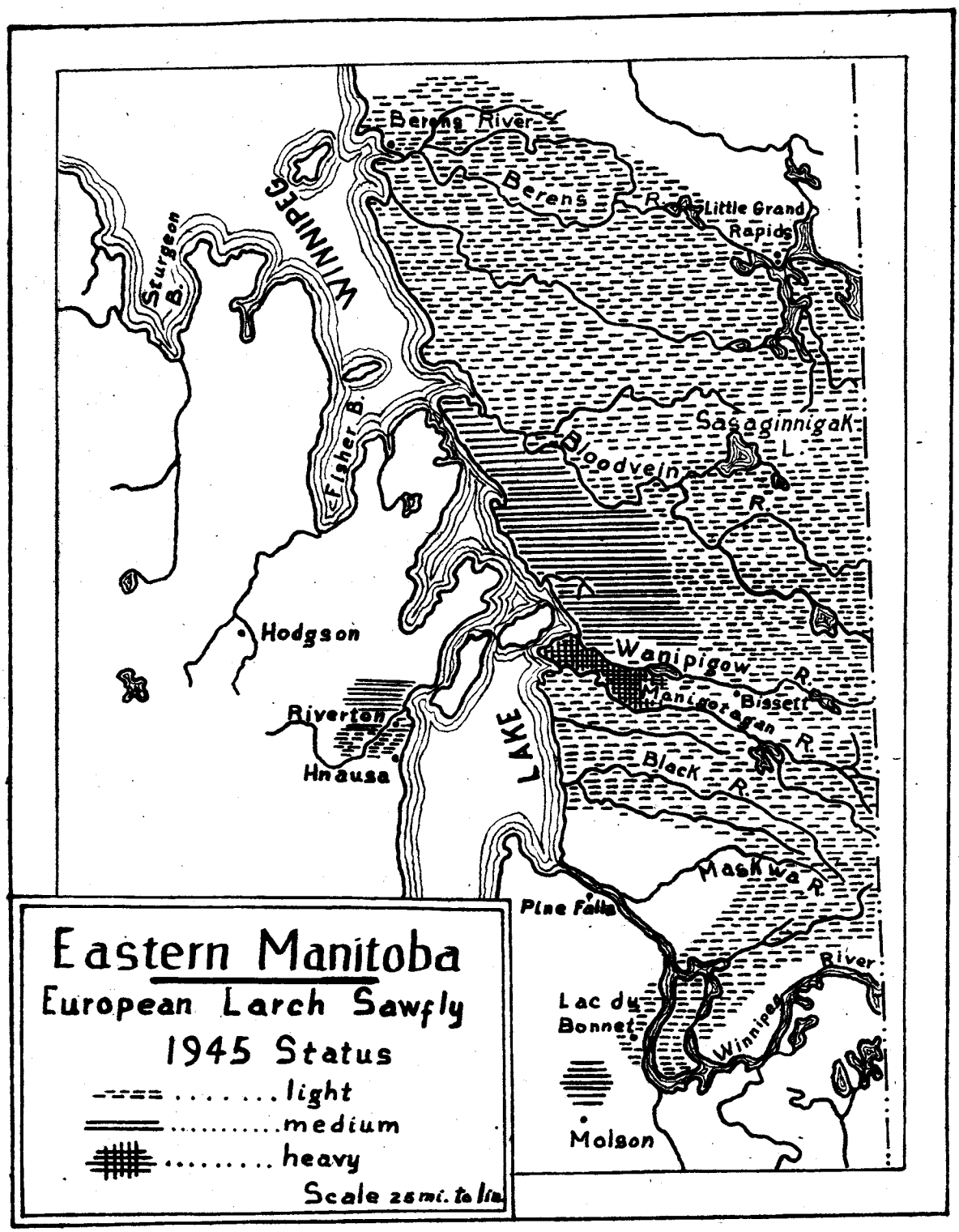
(g) Pine Bark Beetles (Ips pini,Say.):- This insect is generally distributed throughout the Eastern Forest District. The heaviest infestation appeared to be in the Bissett area. At this point bark beetles were attacking all cut logs, and wind-thrown trees. Examinations in August, 1945, of approximately 250 cords of jack pine and spruce logs, showed signs of heavy bark beetle activity. In this particular area, as many as 150 bark beetles per square foot of bark were counted, indicating that a heavy increase in population can be expected in 1946. At the time of observation, no bark beetle activity was noted on living and healthy trees.

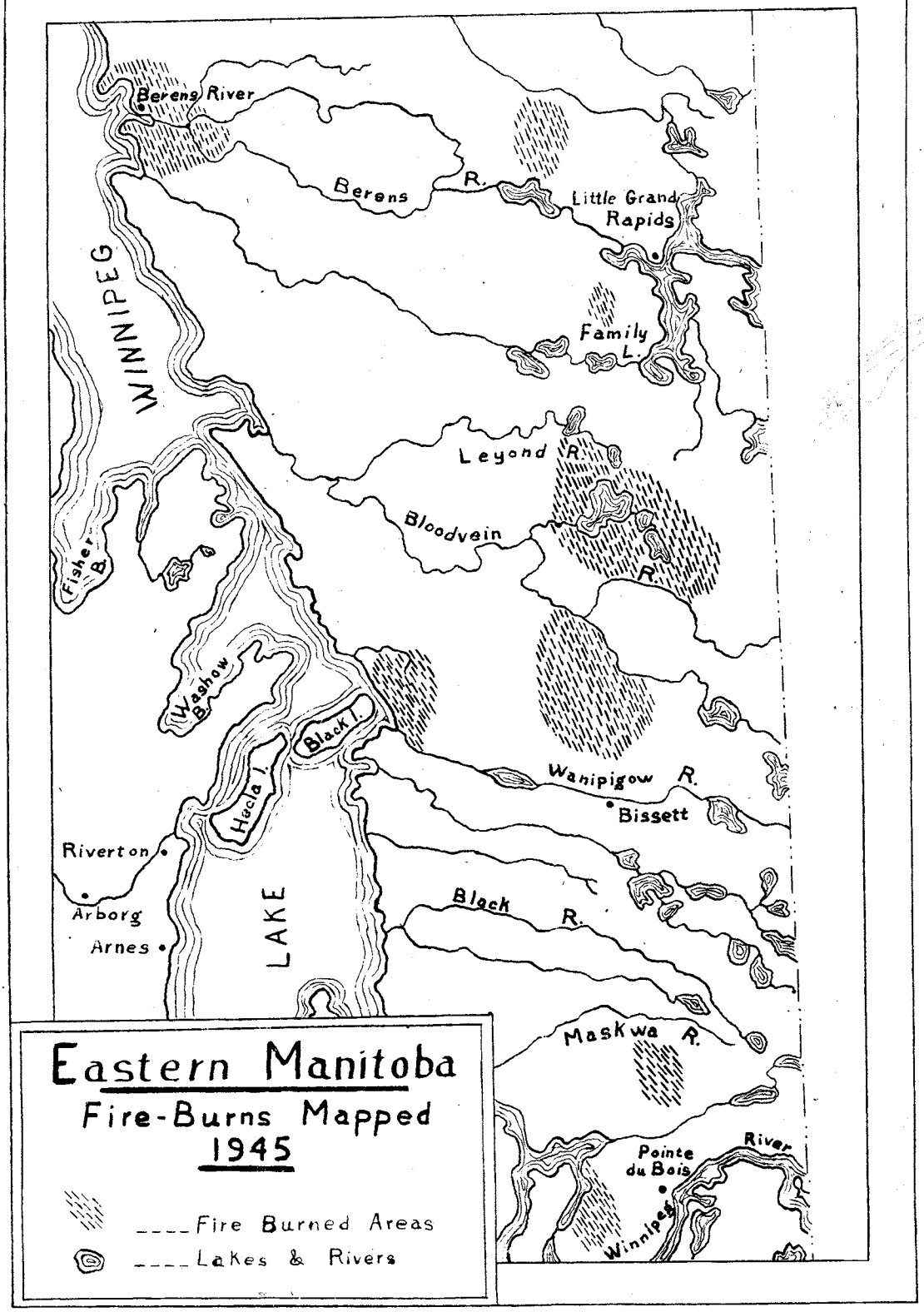
(h) Round-Headed and Flat-Headed Wood Borers:- These insects maintained their usual status, being generally distributed but nowhere abundant in the Eastern Forest District. Only a limited number of specimens were found, and they were taken from trees that had been dead for a number of years.


N
W
E
S
Sasaginnigak Lake
Legend
Yellow-headed Spruce
----Sawfly --- 1945
----Fire Ranger Cabin
---Lake area
Scale- 1 mi. to ½ in.



Distribution of a very light Jack Pine Budworm infestation around Sasaginnigak Lake, Eastern Manitoba 1945


Berens River
Berens R.
Little Grand Rapids
Sturgeon B.
WINNIPEG
Fisher B.
Bloodvein R.
Sasaginnigak L.
Hodgson
Wanipigow R.
Manigotagan R.
Bissett
Riverton
Hnausa
LAKE
Black R.
Maskwa R.
Pine Falls
Lac du Bonnet
Winnipeg River
Molson
Eastern Manitoba
European Larch Sawfly
1945 Status
light
medium
heavy
Scale 25 mi. to 1 in.


Berens River
Berens R.
Little Grand Rapids
WINNIPEG
Family L.
Leyond R.
Bloodvein R.
Fisher B.
Washow B.
Black I.
Hecla I.
Wanipigow R.
Bissett
Riverton
Arborg
Arnes
LAKE
Black R.
Maskwa R.
Pointe du Bois
River
Winnipeg
Eastern Manitoba
Fire-Burns Mapped
1945
____Fire Burned Areas
____Lakes & Rivers

1945-46

	TOTALS	GENERAL ADMINISTRATION	FOREST INSECT SURVEY	SPRUCE BUD-WORM	BARK BEETLES & BORERS	NURSERY GROUNDS	LARCH SAWFLY	CANKER WORM	PHOTOGRAPHY	CAPITAL	LAB. MAINTENANCE	IMPROVEMENTS
Buildings & Repairs	285.00										285.00	
Salaries:												
Permanent 826.04												
Temporary 12,733.12	1455 9.16	3245.96	6129.12	3455.23	42.41	5.74	1383.72	140.91			11.04	145.03
Wages:												
Temporary	1092.88		514.74	95.80		3.00	10.53				417.24	51.57
Equipment:												
General 755.34												
Scientific 1809.99	2565.33									2565.33		
Express, Freight & Cartage	82.30	42.86	11.25	11.46					2.35	14.38		
Miscellaneous	184.94	1.89		5.28			4.50			18.60	153.67	1.00
Supplies:												
General 722.79												
Photographic 48.16												
Scientific 83.84	855.29	28.74	103.04	309.00	11.37		4.00	34.38	13.00	53.61	9.73	79.80	208.62
Communication:												
Telegraph 15.32												
Postage 2.11												
Telephone 88.17	105.60	88.42	4.28	9.95				2.95				
Travelling Expenses:												
General 1079.56												
Maintenance 1331.10												
(Passenger Cars												
Maintenance 491.97												
(Trucks												
Maintenance												
(Outboard Motor 6.53												
Maintenance												
(Canoes 75.76												
Mileage 250.02	3234.94	1587.91	547.83	513.78	5.38			567.17	12.87			
TOTALS	22965.44	4995.78	7310.26	4400.50	59.16	8.74	8.50	1998.75	166.78	55.96	2608.04	946.75	406.22

1946

Northern 1945 Winnipeg Insect and Disease Species Index