1947

Annual Technical Report
Winnipeg Laboratory
Forest Insect Investigation

c.2

SUBJECT INDEX

I. INTRODUCTION

The appointment of a Prairie Representative to the Forest Insects Control Board was the most important development in Forest Entomology in the Prairie Provinces during the year 1947-48. Mr. D. M. Stephens, Deputy Minister of Mines and Resources for Manitoba, was appointed to this post. Shortly after his appointment Mr. Stephens initiated the organization of a Prairie Committee on Forest Entomology to advise him with respect to Forest Insect problems. This Committee had its first and successful meeting in February, 1948, immediately preceding a joint meeting with the Forest Insects Control Board in Winnipeg.

The Forest Insect Survey completed a successful year. The number of samples received increased, and much more detailed information was obtained on the intensity and distribution of the larch sawfly and the spruce budworm. The spruce budworm, according to Survey reports, showed a scattered but general distribution throughout Eastern and Central Manitoba. Jack pine budworm activity was limited to Eastern and Southern Manitoba. Infestations of several insects of minor importance economically, such as the large aspen tortrix, the American Poplar leaf beetle, the poplar borer, the white pine weevil and several others were reported and investigated.

A much better knowledge was obtained of the distribution of larch sawfly parasites. Some progress was made in investigations on the relationship between viable and non-viable eggs of the parasite Mesoleius aulicus. Two colonies of this parasite, obtained from material gathered in British Columbia, were released in Riding Mountain National Park, to determine the effect of the release on the ratio of unhatched parasite eggs to larvae in the release points. A definite reaction will probably not be apparent for several years. Information on Bessa harveyi indicates that this species is increasing steadily in two study areas where liberations were made in 1941-42.

Preliminary work on the influence of water levels on sawfly development indicates that sawflies in cocoons are quite resistant to submergence, particularly in the autumn. Intensive work on this is planned, but a more complete picture of the physical conditions of the cocoon environment is required for an intelligent interpretation of results. It is planned to do this in 1948.

Statistical studies on larch sawfly sampling were analyzed and completed. Results show that populations are declining in the sampling areas. The results also indicate that more adequate methods of sampling for larch sawfly populations are needed.

Studies on the relationship between jack pine budworm abundance and pollen production on jack pine indicate that the micro-climate provided by staminate flowers may be equally, or more important, than the nutritional effect of pollen in favouring the budworm.

A map showing cumulative damage caused by the jack pine budworm in the Sandilands Forest Reserve was prepared and presented to the Manitoba Forest Service. They plan on cutting out areas most heavily damaged by the budworm in an effort to produce more resistant stands of jack pine. Studies to evaluate the effect of this cutting on budworm abundance will be undertaken.

Results of the Biological Control Project on the spruce budworm in the Spruce Woods Forest Reserve indicate that the population declined about 50% in 1947. This was not due, however, to any noticeable increase in biological control factors and must be attributed to causes unknown. Statistical analysis of the method of sampling employed indicates that fairly reliable results are being obtained, but the size of sample or quantity of sampling should be increased somewhat. No recoveries have been made yet of three new species of parasites liberated in the area in 1946 and 1947.

During 1947, a staff of 6 technical personnel, 8 forest insect rangers and 2 stenographers was employed on a continuous basis. In addition, 6 University students and 3 extra labour employees were engaged during the summer months. These were divided among the different projects as follows: Officer in Charge 1; Forest Insect Survey, 3 technical, 1 seasonal, 7 insect rangers, 3 extra labour; Larch Sawfly, 1 technical and 1 seasonal; Jack Pine Budworm, 3 seasonal; Spruce Budworm, 1 technical and 1 seasonal.

Three field stations were in operation. A camp in the Whiteshell Forest Reserve, Manitoba, served as headquarters for jack pine budworm investigations. Spruce budworm biological controlstudies were based in the Spruce Woods Forest Reserve, Manitoba. Investigations on the larch sawfly centered in Riding Mountain National Park, where facilities for carrying on investigations were supplied by the Park authorities and the Dominion Forest Service. The following study centres also contributed information on insect problems; Fort a la Corne Forest on the deterioration of fire killed jack pine, Sandilands Forest Reserve on jack pine budworm and Riverton on the larch sawfly.

Progress was made in providing more adequate laboratory and field facilities for forest insect rangers. Two offices were constructed in the basement of the laboratory, which provide adequate space for the number of insect rangers presently employed. During the winter of 1947-48, supplies were also obtained for the construction of a large double cabin at Prince Albert, to serve chiefly as headquarters for insect ranger work in Saskatchewan.

It was not possible to analyze and report on all the project work conducted in 1947. This was due to the large volume of material accumulated, and the small staff available during the winter months for the preparation of reports. It is, however, hoped that this may be brought up to date during 1948.

Respectfully submitted,

R.R.LEJEUNE
Officer-in-Charge

II ORGANIZATION

R.R.Lejeune	Officer-in-Charge, SSE-3202 - Agricultural Scientist Grade 3 (April 1, 1947 to March 31, 1948).
W.C.McGuffin	SSE-3341 - Agricultural Scientist Grade 2 (April 1, 1947 to September 18, 1947 and then on Leave of Absence Without Pay)
R.B.Barker	SSE-3167 - Senior Agricultural Assistant, (April 1,1947 to March 31, 1948).
B. Filuk	SSE-3011 - Senior Agricultural Assistant, (April 1, 1947 to March 11, 1948).
H.A.Fyfe	SSE-3319 - Senior Agricultural Assistant, (April 1, 1947 to March 31, 1948).
H.R.Wong	SSE-3321 - Senior Agricultural Assistant, (May 1, 1947 to March 31, 1948).
W.B.Ewart	SSE-3038 - Senbr Agricultural Assistant, (May 1, 1947 to September 15, 1947).
W.F.Black	SSE-3322 - Student (Agricultural) Grade 3, (May 1, 1947 to September 25, 1947) and Extra labour from October 1947 to March, 1948.
G. Myrdal	SSE-254 - Student (Agricultural) Grade 2, (May 5, 1947 to September 17, 1947)
W.H.Fell	SSE-3320- (Student (Agricultural) Grade 2, (May 5, 1947 to September 30, 1947).
J.A.Muldrew	SSE-3395 - Student (Agricultural) Grade 2, (May 1, 1947 to September 30, 1947).
J.D.Coats	SSE-3372 - Student (Agricultural) Grade 1, (May 5, 1947 to September 23, 1947).

V. Hildahl	SSE-3177 - Insect Ranger Grade 1, (April 1, 1947 to March 31, 1948).
A.E.Anderson	SSE-3175 - Insect Ranger Grade 1, (April 1, 1947 to March 31, 1948).
L.L.McDowall	SSE-3256 - Insect Ranger Grade 1, (April 1, 1947 to March 31, 1948)
J.A.Drouin	SSE-3255 - Insect Ranger Grade 1, (April 1, 1947 to March 31, 1948.
E.F.Bridgman	SSE-3257 - Insect Ranger Grade 1, (April 1, 1947 to March 13, 1948)
W.Addison	SSE-3258 - Insect Ranger Grade 1, (April 1, 1947 to July 7 , 1947).
D.H.McKay	SSE-3176 - Insect Ranger Grade 1, (May 20, 1947 to December 18, 1947).
R.C.Purse	SSE-3434 - Insect Ranger Grade 1, (July 16, 1947 to October 11, 1947).
H.A.J.Edmunds	SSE-3258 - Insect Ranger Grade 1, (September 4, 1947 to March 31, 1948).
R.A.Lang	SSE-3434 - Insect Ranger Grade 1, (Nov. 12, 1947 to March 31, 1948).
J.B.Martin	SSE-3176 - Insect Ranger Grade 1, (February 9, 1948 to March 31, 1948).
M.M.Cherrett	SSE-3147 - Stenographer Grade 2, (April 1, 1947 to March 31, 1948).
S.I.Dougall	SSE-3297 - Stenographer Grade 1A, (April 1, 1947 to March 31, 1948).
C. Gibson	Extra Labour, Caretaker (April 1, 1947 to March 31, 1948).

B. Mathers	Extra Labour, Laboratory Assistant, (June 24 to August 31, 1947)
G. Kolbe	Extra Labour, Laboratory Assistant, (June 26 to September 20, 1947).
C. Conyers	Extra Labour, Laboratory Assistant, (July 14 to August 31, 1947)
G. King	Extra Labour, Laboratory Assistant, (June 20 to July 12, 1947).

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A. SUMMARY REPORT OF THE FOREST INSECT SURVEY CENTRAL CANADA

By Ruth B. Barker and H. R. Wong
Forest Insect Laboratory, Winnipeg, Manitoba

INTRODUCTION

In 1947, more complete coverage of the forested areas of Manitoba, Saskatchewan and Alberta was achieved than in previous years. The active co-operation of the Provincial Forest Services, Dominion Department of Mines and Resources Branches concerned with forest protection, the Hudson's Bay Company, other companies and private citizens contributed very materially to this greater coverage. In addition, the forest insect ranger staff of the Winnipeg Laboratory was increased to eight during the year.

A total of 1415 collections and 110 negative reports were received. These were augmented by a large number of reports on insect conditions by private co-operators and laboratory personnel. Special significance is attached to these reports in that they supply more detailed information than collections. There were 21 private co-operators in Alberta, 19 in Saskatchewan, 71 in Manitoba, 9 in Ontario (Hudson's Bay Company and private citizens), and 3 in the Northwest Territories.

The number of collections made from each tree species was as follows:

Coniferous host	
White spruce	180
Black spruce	56
Engelmann spruce	3
Norway spruce	2
Spruce(species not given)	79
Jack pine	215
Lodgepole pine	40
Scotch pine	5
Red pine	1
Pine(species not given)	2
Tamarack	208
European larch	2
Balsam fir	45
Douglas fir	2
Alpine fir	1
Common juniper	10
Cedar	5
Total	856

Deciduous host	
Poplar (all species)	164
Willow	92
White birch	37
Birch(species not given)	34
Bur oak	24
White elm	13
Manitoba maple	7
Others	100
Total	471

Miscellaneous and unknown host	
Total	136

GRAND TOTAL--1,463*

* Some collections were made from more than one host.

In addition to making routine collections, the forest insect rangers engaged in other activities of value in forest protection. Two men, assigned to Alberta, attended a three-day ranger school held by the Alberta Forest Service at Red Deer Ranger Station in the Clearwater Forest Reserve and demonstrated insect sampling methods. In Saskatchewan, the men working in this province assisted other laboratory personnel in a survey of larch sawfly activity in the eastern and central regions. A number of reported infestations were inspected in all three provinces and a number of colonies of parasites of forest insects were released in infested areas of Manitoba and Saskatchewan. Details of these activities are given in the sections of this report devoted to various insect species.

During the latter part of the 1947 season, forty-one permanent sample plots were laid out by the Survey ranger staff in Manitoba, Saskatchewan and Alberta. These plots are the first of a large series to be established over a five-year period.

Progress was made in a study of sampling methods being carried on by members of the Survey staff. The purpose of this study is to increase both sampling efficiency and the reliability of samples as indicators of insect populations. The improvement of methods used for rearing insects under the artificial conditions of the laboratory also received attention. Several members of the staff have been engaged in studies of the larvae of certain moths and sawflies to aid in identification of the early stages of these insects.

The assistance of all co-operators is gratefully acknowledged. Special mention should be made of the aerial reconnaissance of eastern Manitoba made possible by the Manitoba Provincial Air Service and the Forest Insect Laboratory at Sault Ste. Marie.

SPECIES CAUSING INJURY AT THE PRESENT TIME

Larch sawfly (<u>Pristiphora</u> <u>erichsonii</u> Htg.).--During 1947, the distribution and intensity of the larch sawfly outbreak in Manitoba, Saskatchewan and Alberta received particular attention from co-operators and laboratory personnel. In Manitoba and Saskatchewan, most of the tamarack stands examined were attacked to some degree. The main body of the outbreak was confined to Manitoba and a limited area of eastern Saskatchewan.

In southeastern Manitoba, tamarack swamps were, in general, heavily infested. At Sundown, the trees were only lightly defoliated by the sawfly, although their sparse foliage indicated that they had not yet recovered from heavy damage of recent years. Near Piney and Vassar, defoliation was heavy; at South Junction, medium; and at Sprague, variable from light to heavy in several small swamps. Near St. Labre, a stand of young growth sustained moderate damage. In the southern part of the Sandilands Forest Reserve, larch sawfly was active in stands one half mile to one mile west of the Reserve Headquarters. All along the Dawson Road (which traverses the northern part of the Reserve) between Richer and the eastern boundary, scattered tamarack swamps were heavily infested. W. W. Ruth, of East Braintree, reported that some trees showed partial damage, some were completely stripped of foliage, and others appeared dead (tp. 7, rge. 14, E.P. mer.).

For the first time since the start of the current outbreak, defoliation in parts of the Whiteshell Forest Reserve was reported as severe (at Red Rock Lake and 11 miles west of West Hawk Lake). Light to medium infestations occurred along the Brereton Lake Road and near Rennie. H. L. Kendrick made a survey of stands north and west of Whitemouth and reported them as 10 to 75 per cent defoliated. Damage was generally worse than in 1946 between Whitemouth and Beausejour, especially in a heavy infestation near Seddon's Corner on the trans-Canada Highway.

Tamarack suffered severe attack in the Winnipeg River area from Pointe du Bois west to Fort Alexander on Lake Winnipeg. R. Gilmore reported a continuing moderate infestation near Stead in townships 17 and 18, rge. 6, E.P. mer.

An aerial survey of the forested areas east of Lake Winnipeg indicated that the larch sawfly was active throughout eastern Manitoba north of the Winnipeg River. Along the eastern shore of Lake Winnipeg, defoliation was observed at Black River Settlement, Hole River Settlement, and Loon Bay; and inland, at Catfish Lake, Round Lake and along the Pigeon and Berens Rivers for a distance of twenty miles. Tamarack was less abundant farther inland but the condition of the scattered stands indicated that the sawfly was active as far east as the Manitoba-Ontario boundary. At Little Grand Rapids, Dogskin Lake, Shoaglinigan Lake, Aikens Lake, Wallace Lake, and Bissett, there were attacks of light to medium intensity.

In the interlake area of Manitoba, most infestations appeared to be subsiding, as evinced by light defoliation at the following places: Riverton, Broad Valley, Hodgson, and Fairford. However, Emile Campbell reported that sawfly activity was common in the district from Ashern, where defoliation was medium, to Gypsumville, where defoliation was very heavy.

The old infestation in the Spruce Woods Forest Reserve has almost disappeared. J. Wright found several cocoons in the southern part of the Reserve, but there was no trace of larch sawfly in the Epinette Swamp which was formerly infested.

In Riding Mountain National Park, all tamarack stands in the western region appeared heavily infested. J. Hyska and R. O. McKinnon reported defoliation ranging from 25 to 100 per cent in this area. In the central region, D. B. Binkley observed very light defoliation near Whitewater Lake and heavy defoliation on the northwest shore of Audy Lake. At the former 'prisoner-of-war' camp, damage to tamarack was slight. Infestations were medium along Lake Audy Road, and medium to heavy along Dauphin Road. Only slight damage occurred near the golf course at the east end of Clear Lake. In the eastern region, heavy defoliation was observed along Norgate Road and at Whirlpool Lake. Tamarack sustained severe attacks along Rolling River Road to the southern boundary of the Park.

Larch sawfly activity was evident west and north of Duck Mountain Forest Reserve near the following towns: Deepdale, Ethelbert, Garland, Cowan, Renwer, Minitonas, and Benito. Most infestations were heavy, particularly between Cowan and Minitonas (R. Clee.). The Manitoba Forest Service reported severe defoliation in the southern part of the Duck Mountain Forest Reserve and a small stand of tamarack in tp. 29, rge. 23, W.P. mer., inside the east boundary of the Reserve, was similarly defoliated. Additional heavily infested areas were found in the vicinity of the Porcupine Forest Reserve near Bowsman, Birch River, Novra, and Mafeking. At the southern end of Swan Lake,

W. Mawdsley and H. C. Cochrane observed severe damage to tamarack. R. R. Ross noted heavy infestations along the C.N.R. right-of-way from Mafeking to Mile 63 (west of Barrows). From Mile 63 to Westgate, the damage decreased to a mere trace. Farther north, at The Pas, Lake Atikameg, Cormorant Lake, and Cranberry Portage, defoliation by this insect was light. H. L. Hislop made collections at Big Island, Cree Lake, and Barrington Lake (latitude 57°), which is the most northerly distribution in Manitoba yet recorded.

In Saskatchewan, the infestation in the Madge Lake area of the Duck Mountain Provincial Park varied in intensity from light to medium. Tamarack stands near Pelly were the most heavily infested in the province and the infestation showed no sign of abating. Defoliation ranged from 25 to 80 per cent. A small number of trees appeared dead as a result of sawfly damage. Numerous small tamarack swamps from Sturgis north through the Porcupine Provincial Forest to Hudson Bay Junction were lightly infested. One stand, south of Reserve, sustained a medium attack. No noticeable defoliation was observed in Greenwater Lake Provincial Park, although a few larvae were collected there. The infestations near Hudson Bay Junction were usually of light to medium intensity but scattered trees in mixed stands were almost completely stripped (tp. 45, rge. 3, W. 2nd mer.). Farther north, W. MacNeill and R. Lockhart found lightly defoliated trees in tp. 66, rge. 30, W.P. mer. Mr. MacNeill also observed light defoliation at Island Falls.

Near Carrot River, defoliation was very light. In the Nipawin region, L. S. Horne reported light infestations in townships 52 and 53, ranges 12, 13, and 14, W. 2nd mer. W. MacNeill observed that tamarack in the southern part of the Fort à la Corne Provincial Forest showed slightly more damage than in 1946, but the infestation remained light. At Prince Albert, four acres of tamarack suffered medium defoliation; this was the most severe damage encountered in central Saskatchewan. Most of the stands near Prince Albert were only slightly defoliated by larch sawfly. Light defoliation was observed in the southern part of the nearby Nisbet Provincial Forest. Collections of this sawfly were made in Prince Albert National Park at three places, two near Waskesiu and the other near the main gate. No defoliation was detected in the Park. The most westerly collection point of larch sawfly in Saskatchewan was in tp. 56, rge. 8, W. 3rd mer. in Big River Provincial Forest. There was no noticeable defoliation.

Several studies on the ecology of the larch sawfly are in progress; among them, the effect of moisture conditions in tamarack swamps on development of the sawfly is being investigated. During the 1947 season, a survey of accessible tamarack stands in Saskatchewan was made to obtain information on defoliation, tree mortality caused by defoliation, swamp conditions in relation to defoliation, and natural control factors operative in each area. Sites for future parasite liberations will be determined to some extent by the present distribution of parasites of the sawfly, as indicated by the examination of sawfly cocoons collected during this survey. Two colonies of the parasite, Mesoleius aulicus Grav., were released in a larch sawfly infestation near Lake Audy in Riding Mountain National Park, Manitoba. Permanent sample plots of tamarack have been established in the Whiteshell Forest Reserve for a more thorough study of tree mortality caused by successive defoliations.

	Collections	Reports
Manitoba............	124	96
Saskatchewan.......	41	19

Jack Pine Budworm (Choristoneura fumiferana Clem.). --Activity of this insect in the most seriously infested areas of the Prairie Provinces, the Sandilands and Whiteshell forest reserves in Manitoba, continued at about the same level as in 1946. More complete information than in previous years on the distribution of budworm in eastern Manitoba was obtained in 1947 by the use of aircraft but the territory is so extensive that it could not be covered adequately with the transportation available.

Early in July, a survey to determine the prevalence of budworm on spruce, balsam, and jack pine was made along the Manitoba-Ontario boundary from Moar Lake in the north to Oiseau Lake in the south. Budworm was found at every place visited in the boundary region. Feeding was observed in all jack pine stands surrounding the following lakes: Moar, Dogskin, Aikens, Wallace, Gem, and Oiseau in Manitoba and Spoonbill, Musclow, Carroll, Wingiskus, Eagle, and Snowshoe in Ontario. (These lakes are located within twenty miles of the boundary. Moar Lake lies almost due east of the town of Berens River and Oiseau Lake lies about thirty-five miles east of Lac du Bonnet.) At the time, budworm activity was described as light in all these places, with the exception of Wingiskus Lake in Ontario where defoliation of jack pine was already noticeable and was estimated at 15 to 30 per cent of the current year's foliage. In the latter part of August, an aerial survey was made of the area between Lake Winnipeg and the Manitoba-Ontario boundary, from the Whiteshell Forest Reserve in the south to Berens River in the north. Only one infestation of the jack pine budworm was observed from the air. The infestation occurred along the southeastern shore of Aikens Lake (mentioned above) and extended southeastward as far as Obukowin Lake. It covered approximately 11,000 acres. Jack pine in this area exhibited a distinctly reddish tinge and the intensity of infestation was classified as medium. Lack of time prevented a ground inspection.

In the Whiteshell Forest Reserve, an infestation of light to medium intensity bordered Red Rock Lake on the east side, but at White Lake, Lake Brereton, West Hawk Lake, and near Rennie, defoliation was very light. Farther west along the trans-Canada highway, a trace of budworm was encountered near Whitemouth. At Seddon's Corner, the scene of a medium infestation in 1946, jack pine was only lightly attacked. North from Seddon's Corner to Lac du Bonnet, jack pine along Highway No. 11 was free of budworm.

The most severe defoliation was encountered in the Sandilands Forest Reserve, Manitoba. The reserve was thoroughly mapped for intensity of budworm defoliation and percentage of dead-topped trees. This information is intended for the use of the Manitoba

Forest Service in planning a cutting program for the development of stands that are more resistant to jack pine budworm attack. The main infestation extended from the southern border of the Reserve to one mile north of the boundary line between townships 6 and 7. North of this line, the infestation declined to light or very light. The intensity of attack in the southern part of the Reserve varied from very light to heavy. Heavy defoliation accompanied by a considerable percentage of dead-topped trees, occurred in townships 5 and 6, ranges 9 and 10, E.P. mer. In this region, it was observed that the only stands of jack pine not infested were those which had previously supported large populations of jack pine scale. South of the Reserve, heavy but scattered infestations existed between Woodridge and St. Labre (tp. 4, rge. 10, E.P. mer.). No jack pine budworm was found elsewhere in Manitoba.

No outbreaks of this insect occurred in Saskatchewan or Alberta. One larva was received from the Nisbet Provincial Forest (tp. 46, rge. 1, W. 3rd mer.) in Saskatchewan.

	Collections	Reports
Manitoba (including Man.-Ont.boundary region)............	74	42
Saskatchewan........	1	1

Spruce Budworm (<u>Choristoneura fumiferana</u> Clem.). --Although the most severe infestation of this insect in the Prairie Provinces continued at its usual level in the Spruce Woods Forest Reserve, interest centred in 1947 on its distribution in eastern Manitoba. During the survey of budworm activity in the Manitoba-Ontario boundary region (referred to in the preceding section on the jack pine budworm), feeding on spruce was observed at the following lakes near the boundary: Moar, Wallace, Gem, and Oiseau in Manitoba and Spoonbill, Muslow, Carroll, Kingiskus, Eagle and Snowshoe in Ontario. Jack pine budworm was also noted at the same lakes and, in addition, at Aikens and Dogskin Lakes. In every case, the budworm populations on spruce were noticeably lighter than those on jack pine in the same area and very little damage to spruce foliage was visible. No feeding on balsam by this insect was noted at any of the above-mentioned lakes in Manitoba but light infestations on balsam were encountered frequently at Ontario points, the nearest to the Manitoba boundary being Musclow Lake.

At Bissett, B. Kuryk found a few spruce budworms but reported no noticeable defoliation. A single specimen taken on spruce was received from G.H. Davies at Basaginnigak Lake, 40 miles north of Bissett.

West of Lake Winnipeg, the scattered spruce stands between Winnipeg Beach and Riverton were very lightly infested but again there was no noticeable defoliation.

Variable infestation levels of the spruce budworm continued in different parts of the Spruce Woods Forest Reserve. An area of moderate to heavy defoliation, west of Carberry and south of the trans-Canada highway, remained the most important centre of infestation. A considerable quantity of dead-topped spruce, mainly young growth, was observed. In the central part of the Reserve, feeding was also moderate to heavy and some budworm-killed trees were recorded. Elsewhere, although larvae were present in spruce over the entire Reserve, budworm damage was either light or described as a 'trace' or 'negligible'. Studies on the biological control of the budworm in the Spruce Woods Forest Reserve progressed in 1947. There was no evidence of the establishment of several parasitic species, which were released in 1946 and 1947. However, if they have survived, it may be several years before these species are recovered from collections of budworm. The spruce foliage worm, Dioryctria reniculella Grote, which normally feeds on foliage, continued to destroy large numbers of budworm larvae and pupae. Populations of the foliage worm were sufficient in some areas to produce appreciable defoliation. This insect was, therefore, both a predator and a competitor of the budworm.

No reports of spruce budworm were received from Saskatchewan or Alberta.

Presence of the spruce budworm at Fort Simpson in the Northwest Territories was indicated by the receipt, early in June, of a number of empty pupal cases, probably of the 1946 season. V. L. Shattuck of the Department of Mines and Resources made the collection. No information about 1947 conditions has been received.

	Collections	Reports
Manitoba(inc. Man.-Ont.boundary region)	24	10
Northwest Territories	1	0

American Poplar Beetle (*Phytodecta americana* Schffr.).--This insect was prevalent in two regions of Manitoba. In the interlake region, light defoliation of poplar was general around Gimli, Poplarfield, Arborg, Hnausa, and Riverton. The severest damage in the area occurred in tp. 24, rge. 4, E.P. mer. and tp. 19, rge. 3, E.P. mer. In the western region, the infestation continued to centre in the Duck Mountain Forest Reserve. Collections made in the eastern and southern parts of the Reserve indicated large populations of the beetle, but the presence of the aspen tortrix on the same trees made the amount of beetle damage difficult to estimate. There was an infestation north of the Reserve in tp. 36, rge. 24, W.P. mer. R. R. Rose reported a considerable amount of defoliation on young poplar near Mafeking. Elsewhere in Manitoba, collections were received from Spruce Woods Forest Reserve and Riding Mountain National Park, but no noticeable damage was reported.

The Duck Mountain infestation extended into Saskatchewan, where the most severe beetle damage observed this year occurred near Benito Beach on Madge Lake. Trees between 2 and 4 inches D.B.H. appeared most heavily attacked. There was light defoliation near Pelly and Usherville and from there north along highway No. 9 to within a few miles of Hudson Bay Junction. A. Johnson observed slight damage near

Glen Elder (tp. 38, rge. 2, W. 2nd mer.). E.L.Millard reported heavy defoliation and increasing severity of attacks which were scattered over several townships in the southern part of Prince Albert National Park. His collection came from tp. 53, rge. 3, W. 3rd mer. W. Crothers found an extensive infestation between Bright Sand Lake and Turtle Lake, both south of Meadow Lake Provincial Forest.

In the Cypress Hills area of southern Alberta, this beetle, although common, caused no noticeable defoliation. In the Castle River area, south of Burmis, it was associated with the large aspen tortrix. The heaviest infestation in the province was reported to be in the Clearwater Forest district. It covered townships 38, 39, and 40, ranges 12 and 13, W. 5th mer., but damage was not severe (R. G. McLaughlin and C. E. Enright). An outbreak at Crimson Lake, west of Rocky Mountain House, abated this year. A collection was made in tp. 55, rge. 9, W. 5th mer., south of Ricinus, and another near Edson, but no infestations were reported at either place.

	Collections	Reports
Manitoba.............	17	7
Saskatchewan.........	8	4
Alberta.............	19	5

Large Aspen Tortrix (Archips conflictana Wlk.). --This insect has been active in the dense aspen stands of the Duck Mountain region for the past four years. The severest infestation in 1947 was near Madge Lake in Saskatchewan. Mature aspen stands east and southwest of the lake sustained heavy defoliation. South of the lake, defoliation was light to moderate. Although the younger trees were damaged to some degree, the older trees suffered heavier attacks. The infestation extended eastward into Manitoba where it was most severe near the border in townships 30 and 31, ranges 28 and 29, W.P. mer. of the Duck Mountain Forest Reserve. Light defoliation was observed in the southern and eastern parts of the Reserve. Collections were received from the interlake area of Manitoba at Hnausa and Riverton in the Spruce Woods and the Whiteshell Forest Reserves.

In the Castle River district of Alberta, an infestation, reported in 1946, had enlarged considerably but was still confined to tp. 6, rge. 2, W. 5th mer. Restricted to four sections of the township in 1946, the area affected in 1947 included twelve sections of semi-agricultural and grazing lands and small bluffs on the open prairie. An inspection of the area took place early in the season before defoliation could be estimated but the infestation appeared heavy. A collection was received from the Cypress Hills Forest Reserve.

In most cases, the large aspen tortrix was associated with the American poplar leaf beetle, both insects contributing to the damage observed. Collections of larvae were made in the Duck Mountain Forest Reserve for use in studies on the biology of the large aspen tortrix.

	Collections	Reports
Manitoba...............	16	6
Saskatchewan.........	8	5
Alberta..............	4	3

White Pine Weevil (*Pissodes strobi* Peck).--Localized damage to young spruce occurred in two areas of Riding Mountain National Park and in the Spruce Woods Forest Reserve (J. J. Wright). This insect attacked jack pine at mile 37, Pointe du Bois road, but the weeviling was not extensive. In Saskatchewan, light damage to spruce was still found in Prince Albert National Park in a stand 5 miles north of Waskesiu on Hanging Heart Road. New damage to jack pine and white spruce was observed along highway No. 2, at intervals up to 15 miles south of Waskesiu. In the Nisbet Provincial Forest, two small areas of infested spruce were located at MacDowall and at Holbein Cabin and infested jack pine was common west and northwest of MacDowall.

A survey to determine the extent of white pine weevil damage to jack pine was completed in the Nisbet Provincial Forest during 1947. During the course of the survey, fourteen temporary sample plots were established in natural regeneration and plantation growth. Weevil damage in plantations exceeded that in natural regeneration. It appears from this study that an overstory of more mature jack pine or trembling aspen, in association with jack pine seedlings, affords a measure of protection from attack.

	Collections	Reports
Manitoba............	4	2
Saskatchewan........	4	5

Birch Sawfly (Arge pectoralis Leach).--Unusual activity by this insect was noticeable in eastern Manitoba in an area that appeared to extend eastward into Ontario in the Kenora-Minaki region. Moderate to severe defoliation of scattered birch stands was observed from the air to extend from Pine Falls south-east to Crowduck Lake and from there south to West Hawk Lake, Falcon Lake, and Shoal Lake. At Waugh, on the west shore of Shoal Lake, birch stands were completely stripped. Heavy attacks also occurred at Falcon Lake and West Hawk Lake where ground inspection revealed defoliation ranging from 75 to 100 per cent. Only slight damage was recorded at nearby Red Rock Lake. A few larvae were collected at Pine Ridge near Winnipeg and at Cowan in the northwestern part of the Province. No collections were received from Saskatchewan or Alberta.

	Collections	Reports
Manitoba............	7	3

Bark Beetles.--A reported infestation of bark beetles in spruce and balsam fir near Embarras Portage, Alberta, was investigated during 1947. The area, in sec. 30, tp. 107, rge. 9, W. 4th mer., where damage was reported, borders the Athabasca River for 2 miles and extends inland for 1½ miles. Bark beetles were not attacking green timber at the time of inspection but were found only in dead trees, all of which were over-mature (15 to 20 inches D.B.H.) and infected with heart-rot. However, several conditions in the area favour an increased population of bark beetles. The stand is over-mature and, in addition, many trees show bark injuries caused by ice during spring floods which reached 4 feet above ground level. The banks of the Athabasca River from the area inspected north to the delta, and of the Embarras River, from the delta north to Lake Athabasca, were free of dead trees and 'red-tops'.

In co-operation with the Alberta Forest Service and the Forest Insect Laboratory at Vernon, British Columbia, a bark beetle survey of the mountain passes between Banff National Park and the Clearwater Forest Reserve was undertaken. Results of this survey appear in the British Columbia report.

In Saskatchewan, two areas of the Pasqui Provincial Forest had been reported as infested. The first area, in sec. 18, tp. 51, rge. 7. W. 2nd mer., consisted of 12 acres of green spruce timber surrounded by a 1942 burn. Cutting operations were already in progress at the time of inspection and the greater part of the merchantable timber had been salvaged. Bark beetle damage was noticeable in the remaining trees, but the beetles appeared to have migrated. The second area, in sections 21, 22, and 27, tp. 48, rge. 8, W. 2nd mer., could not be inspected owing to impassable roads.

Near Saunders, Alberta, R. C. McLaughlin collected a number of pine engraver beetles (Ips pini Say) on white spruce and balsam fir in a district that had been logged for the past two years. This species also heavily attacked burned jack pine in tp. 50, rge. 22, W. 2nd mer. of the Fort à la Corne Provincial Forest. Other collections of bark beetles were made from slash and saw timber at logging sites in western Manitoba.

	Collections	Reports
Manitoba............	8	2
Saskatchewan.......	2	2
Alberta.............	5	3

Poplar Borer (*Saperda calcarata* Say).--An infestation in Alberta, located on Deadman's Flats seven miles east of Canmore, was reported by J. Kovach in 1946. A thorough examination of the area, carried out in 1947, revealed one heavily infested, pure stand of poplar and a smaller mixed stand nearby in which poplar was less severely attacked. The total area of both stands was under one square mile. Poplar in other adjacent mixed stands was lightly attacked. Of one hundred trees tallied in each of three sections of the main infestation, an average of 56 per cent were attacked and 5 per cent were dead. Most of the trees attacked had evidently been unhealthy; they bore evidence of predisposing damage such as chewed bark from grazing animals, 'cankers' or stunted growth. Although it was not likely that healthy stands adjacent to this area would be severely attacked, it was suggested that, if the infested poplar could be utilized, it should be clear-cut and removed as a sanitation measure.

	Collections	Reports
Alberta.............	17	1

White-spotted Sawyer Beetle (*Monochamus scutellatus* Say.)--Near the western boundary in the Fort a la Corne Provincial Forest, jack pine, which had been burned during 1946, was severely damaged by sawyer beetles at the time of examination in July, 1947. In the southern part of the Forest, an area of jack pine was burned over in June, 1947. In August, several members of the laboratory staff made a study of deterioration caused by wood boring insects in the jack pine of this area. Borers were attracted first to the most severely burned trees. By contrast, in white spruce, studies show that the moderately burned trees are attacked first and the most severely burned are permanently immune to borer attack.

	Collections	Reports
Manitoba............	6	0
Saskatchewan........	3	2
Alberta.............	1	0

Bronze Birch Borer (*Agrilus anxius* Gory).-- Damage by this insect was observed in dead and dying white birch in several regions of Saskatchewan and Alberta. 'Dieback' of birch has been attributed frequently to the bronze birch borer, but investigations in the Maritimes indicate that other factors are probably involved.

In Prince Albert National Park, Saskatchewan, the condition of the birch along the road between Waskesiu and Hanging Heart Lakes showed no appreciable change from that of 1946. Most dead and dying trees had been previously infested by the borer. However, at the southeast end of Hanging Heart Lake, where several dead-topped trees were felled and examined, no borer damage was detected. Stands of birch along highway No. 4 from Meadow Lake to Glaslyn appeared vigorous.

In Alberta, birch was examined along highway No. 2 from Clyde (northwest of Edmonton) to Driftpile (south of Lesser Slave Lake). Dead and dying trees were common in the scattered birch stands of this partly agricultural area and, in most of these, borer damage was observed. Near Rochester and Tawatinaw (townships 61 and 62, rge. 24, W. 5th mer.)., 'dieback' was severe in some small stands. Between Assineau and the shore of Lesser Slave Lake, there was more 'dieback' in mature trees than in reproductive growth. Between Kinuso and Faust, about 75 per cent of the decadent trees showed borer damage at the time of inspection. South of Faust, in tp. 72, rge. 11, W. 5th mer., no 'dieback' of birch was observed.

	Reports
Saskatchewan......................	2
Alberta...........................	1

Forest Tent Caterpillar (*Malacosoma disstria* Hbn.). Transportation difficulties prevented an inspection of the area around the Narrows of Lake Winnipeg where an infestation of this insect centred in 1946. However, a stand of completely defoliated aspen, covering about one square mile, was observed from the air on the east shore of Lake Winnipeg, 20 miles south of the Narrows. The forest tent caterpillar, having caused damage at the same place in 1946, was the probable defoliator in this instance. A single larva was taken from alder at Dogskin Lake on the Manitoba-Ontario boundary. Foliage loss was very slight on widely scattered aspen trees at Hodgson, Riverton, and Arborg in the interlake area. Farther south at Winnipeg Beach, and in western Manitoba near Dauphin, a few larvae were collected. Those taken near Dauphin were from the only infested tree that was found in the district. The forest tent caterpillar, the large aspen tortrix, and the American poplar leaf beetle together produced moderate defoliation of aspen covering two square miles near Benito Beach in the Duck Mountain Provincial Park of Saskatchewan.

	Collections	Reports
Manitoba............	5	3
Saskatchewan........	1	1

Western Willow Leaf Beetle (Galerucella decora Say).--This insect was found on willow and poplar in the Prairie Provinces. Severe damage, which produced a burned-over appearance in large areas of willow, was observed only in Saskatchewan. Some of the affected areas were in the Duck Mountain Provincial Park and around Kamsack. Others were also observed north of this region as far as Hudson Bay Junction. F.J.Hawkins reported extensive areas of defoliated willow near Kelvington. Severe damage was evident also in the Carrot River district, and in the entire region west of Hudson Bay Junction to Prince Albert. From Jackfish Lake north through the Meadow Lake Provincial Forest, infestations on willow appeared less severe than in 1946.

	Collections	Reports
Manitoba............	9	1
Saskatchewan........	9	4
Alberta.............	11	1

Balsam Fir Sawfly (Neodiprion abietis Harr.).--Only two infestations of this sawfly were reported in 1947. Spruce was lightly attacked at Wasagaming in Riding Mountain National Park. W. MacNeill observed feeding damage to all spruce in the town of Island Falls, Saskatchewan. Collections were received from all parts of Manitoba and from the central forested area of Saskatchewan. The Alberta collections came from Waterton Lakes and Saunders.

	Collections	Reports
Manitoba............	26	14
Saskatchewan........	7	6
Alberta.............	2	11

Red Pine Sawfly (Neodiprion nanulus Schedl.).--Larvae of this insect were found on jack pine throughout Manitoba and central Saskatchewan, but only two reports of feeding damage were received. Near Fairford Settlement, in the interlake area of Manitoba, almost half of the jack pine in a five acre stand was infested. Foliage loss was heavy on the trees attacked. At Dogskin Lake, on the Manitoba-Ontario boundary, scattered trees showed severe damage.

	Collections	Reports
Manitoba............	14	5
Saskatchewan........	5	2

Pine Tortoise Scale (Toumeyella sp.).--In Sandilands Forest Reserve, the area of jack pine infested by scale remained about the same as in 1946. The southern part of the Reserve was most severely attacked and there were small, scattered infestations in the central part of the Reserve. No newly-infested areas were discovered, nor were the infestations extremely active where scale was encountered. Elsewhere in Manitoba, this scale was found near Lac du Bonnet, where it had caused slight damage to a very few trees. H. L. Kendrick reported that an infestation in tp. 12, rge. 9, E.P. mer., near Molson, had increased in size since it was observed in 1946.

	Collections	Reports
Manitoba............	6	4

Yellow-headed Spruce Sawfly (*Pikonema alaskensis* Roh.).--On the evidence of the collections received, this insect was distributed throughout Manitoba, central and northern Saskatchewan, and western Alberta. Collections were sent in also from Fort Smith and Hay River in the Northwest Territories. The only serious damage caused by this insect occurred on planted spruce trees; no infestations were observed on spruce growing under natural forest conditions. V. W. Mitchell at Grande Prairie, Alberta, and A. Sinclair at Cross Lake, Manitoba, both reported severe damage to a few trees. In Saskatchewan, infestations were observed at Waskesiu in the Prince Albert National Park and at MacDowall in the Nisbet Provincial Forest.

A number of colonies of parasites (*Sturmia* sp.) of the yellow-headed spruce sawfly were released at MacDowall and Waskesiu in an effort to check the infestations at these places.

	Collections	Reports
Manitoba.............	44	23
Saskatchewan.........	28	6
Alberta..............	5	2
Northwest Territories	2	1

Pitch Nodule Maker (*Petrova albicapitana* Busck). --In Manitoba and Saskatchewan, jack pine in plantations and in natural regeneration was commonly attacked by the nodule maker. In a plantation 5½ miles east of Douglas, Manitoba, 20 per cent of the jack pine and scotch pine had two or more damaged branches. In a second plantation near Camp Hughes in the Spruce Woods Forest Reserve, 5 per cent of the pine was infested; a third plantation 9 miles east of Douglas was almost free of this pest. The insect was prevalent in the Sandilands Forest Reserve and near Molson (tp. 12, rge. 10, E.1. mer.). Nodules were very abundant in a pine plantation near Red Rock Lake in the Whiteshell Forest Reserve.

In Saskatchewan, all collections received were from young growth in natural regeneration. Nodules were abundant on jack pine in the Nisbet Provincial Forest. Seedlings at the Fort House Ranger Station in Fort à la Corne Provincial Forest and in tp. 55, rge. 17, W. 3rd mer. of the Meadow Lake Provincial Forest were heavily infested.

All the Alberta collections of this insect were made from lodgepole pine. The nodules were not reported as abundant except in townships 37 and 38, ranges 12 and 13, W. 5th mer. near Saunders (R. O. McLaughlin).

	Collections	Reports
Manitoba.............	11	7
Saskatchewan........	8	4
Alberta..............	10	2

Leaf Chafers (Dichelonyx sp.).--In the interlake region of Manitoba, near Fairford Settlement, leaf chafers caused severe defoliation to the young growth of white birch and hazel in tp. 31, rge. 9, W.P. mer. The area affected was about four acres. Near Arborg, the beetles caused light defoliation of a small stand of trembling aspen. No other reports of damage were received.

	Collections	Reports
Manitoba.............	7	2
Saskatchewan........	1	0

Spruce Gall Aphid (Adelges abietis L.).--Planted spruce trees up to 15 feet in height at Wasagaming in Riding Mountain National Park, Manitoba, were heavily infested with aphids. At Wasagaming, a number of insecticidal preparations were tested for their effectiveness in controlling this pest. A. W. May reported a light infestation in a spruce shelterbelt at Dorintosh, Saskatchewan. Although collections were made throughout the Prairie Provinces and at Fort Simpson and Fort Smith in the Northwest Territories, no other infestations were reported.

	Collections	Reports
Manitoba..............	23	3
Saskatchewan.........	3	1
Alberta...............	13	0
Northwest Territories	2	0

Ugly-nest Caterpillar (<u>Archips</u> <u>cerasivorana</u> Fitch).
--Wherever cherry occurred throughout the Spruce Woods Forest Reserve in Manitoba, it was heavily defoliated by this insect. Collections were received from several districts of Manitoba, and from MacDowall in Saskatchewan, but no other infestations were reported.

	Collections	Reports
Manitoba............	4	1
Saskatchewan........	1	0

A Tent Caterpillar (<u>Malacosoma</u> <u>lutescens</u> N. & D.).
--This insect was prevalent on cherry in the Spruce Woods Forest Reserve, Manitoba.

	Collections	Reports
Manitoba............	2	2

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

Hemlock Looper (<u>Lambdina</u> <u>fiscellaria</u> Guen.).--
Most of the collections of this insect, which feeds mainly on spruce and balsam fir, were received from eastern Manitoba, the remainder from the districts of Dawson Bay and The Pas.

	Collections
Manitoba.............	12

Resin Gnat (<u>Retinodiplosis</u> sp.).--Although the resin gnat was common on jack pine in the Sandilands Forest Reserve and in an area near Pointe du Bois in Manitoba, it was not present in sufficient quantity to cause noticeable damage.

	Collections	Reports
Manitoba.............	5	3
Saskatchewan.........	1	0

A few collections of each of the following species were received:

Black-headed Budworm (*Acleris variana* Fern.)
Collections.........................Manitoba 2.

Cankerworm (*Alsophila pometaria* Harr. and *Paleacrita vernata* Peck)
Collections.......Manitoba 9; Saskatchewan 1.

Spotless Fall Webworm (*Hyphantria textor* Harr.)
Collections.........................Manitoba 3.

Spiny Elm Caterpillar (*Nymphalis antiopa* L.)
Collections............Manitoba 1; Alberta 1.

Pine Needle Scale (*Phenacaspis pinifoliae* Fitch)
Collections............Manitoba 2; Alberta 1.

Poplar Vagabond Aphid (*Mordwilkoja vagabunda* Walsh.)
Collections............Manitoba 6; Alberta 2.

LIST OF CO-OPERATORS

Name	Collections	Name	Collections
*Addison, W.	104	Davies, G. H.	3
Alguire, V. C.	1	Davy, J. L.	1
Allan, H. J.	1	Dickie, F.	1
Allen, W.	1	*Dougall, Miss S. I.	13
*Anderson, A. E.	173	*Drouin, J. A.	173
		Dubuc, C.	1
Balchen, B.	1	Dunlop, G.	7
Balderson, G. L.	1		
*Barker, Mrs. W. S.	9	*Edmunds, R. A. J.	9
Barnes, B.	2	Emes, B.	1
Bates, G. H.	2	Enwright, C. E.	4
Bayly, G.	6	Evans, G. F.	5
Bennett, R.	2	*Ewart, W. B.	57
Binkley, D. B.	7		
*Black, W. F.	72	*Fell, W. H.	50
Blefgen, T. F.	1	Fenner, F.	1
Boderick, F. W.	1	Fennley, H.	1
*Bridgman, E. F.	257	*Filuk, B.	53
Brown, J.	4	Foley, F. H.	1
Buchsler, A.	1	*Fyfe, H. A.	42
Campbell, B.	1	Gauthier, A.	1
Campbell, Emile	3	Gilmore, S.	4
Campbell, E.	2	Goodison, J. C.	1
Campbell, P.	10	Graham, Dr. E. E.	1
Camsell, J. H.	1		
Chapman, C. E.	4	Hammond, F.	4
Charron, M.	1	Hand, R. T.	1
*Cherrett, Mrs. W. G.	2	Harrison, J. E.	5
Chome, B.	1	Hawkins, F. J.	2
Clee, H.	2	Heron, R. J.	5
*Coats, J. D.	29	*Hildahl, V.	112
Cochrane, H. C.	1	Hislop, W. L.	5
*Conyers, C.	20	Hodgson, T. R.	2
Cornelius, J. D.	2	Hogue, E.	9
Cowie, J. J.	2	Holden, J.	9
Crothers, W.	1	Holman, G. E.	1
Crump, E. H.	1	Horne, L. S.	6
Cunian, T.	1	Hoskin, A. E.	1

* Members of Laboratory Staff

Name	Collections
Huggins, D. E.	1
Hyska, J.	10
Inkster, J. H.	4
Jackman, E. T.	1
Jervis, F.	1
Johnson, A.	2
Johnson, R. H.	1
Jones, A. R.	1
Kendrick, H. L.	21
Kirk, J. P.	1
*Kolbe, G.	55
Koons, E. A.	1
Kuryk, B.	2
Larson, C.	6
*Lejeune, H. R.	40
Lindsay, W. F.	1
Linn, C. E.	3
Lizotte, W. J.	1
Lockhart, R.	2
Mackenzie, A.	3
MacNeill, W.	17
Marner, E.	1
*Mathers, B.	37
Mawdsley, W.	2
May, A. W.	3
McDavitt, A.	6
*McDowall, L. L.	165
McGuffin, Mrs. W. C.	2
*McGuffin, W. C.	90
McGuiness, W. J.	1
*McKay, D. H.	165
McKinnon, R. D.	7
McLaughlin, R. G.	33
McLeod, W. S.	2
McNeil, O. B.	5
Millard, E. L.	3
Mitchell, V. W.	1
Moen, A.	3
Moore, M. J.	1
*Muldrew, J. A.	53
*Myrdal, G.	78
Norman, J. B.	3
Oldham, E. G.	3
Parnall, H. W.	3
Parsons, Mrs. F.	1
Pateman, Mrs.	1
Patterson, C. H.	3
Paupanekis, F.	2
Pierce, Dr. S. J. S.	1
Pike, R. T.	1
Pittaway, B.	2
Plater, A. W.	1
*Purse, R. C.	113
Quaite, J.	1
Rasmusson, C.	2
Robertson, H.	2
Rolls, Mrs. A.	1
Ross, R. R.	4
Ruth, W. W.	3
Sanders, K. O.	4
Schwarz, F. K.	1
Shankland, W.	2
Shannon, W. A.	1
Shattuck, V. L.	1
Sinclair, A.	3
Smith, S.	1
Smuland, R.	1
Somers, J. G.	1
Stanlake, J. L.	5

* Members of Laboratory Staff

Name	Collections	Name	Collections
Steiner, G.	4	Verhaeghe, M.	3
Strong, B. I. H.	1		
Sveinson, S.	1	Wardrop, W. D.	6
		White, L. W.	1
Thompson, P.	1	Williamson, Major N.B.	1
Townsend, P. B.	2	*Wong, H. R.	59
Turnbull, Mrs. F.	2	Wright, J. J.	6

* Members of Laboratory Staff

B. PERMANENT SAMPLE PLOTS

By V. Hildahl

1. Introduction

During the 1947 season, a new phase of Forest Insect Survey sampling was incepted. A number of permanent sample plots were established in the 3 provinces. Through periodic sampling of these permanent sample plots over a period of years, it is hoped that specific information will be obtained as to what insects are characteristic of the various types of forest stands.

In addition to this, the sample plots will be used for assessing insect populations and determining the effect of insect attacks on tree growth. Some attention will perhaps be given to the use of sample plots as a method of determining tree increments in various forest types and stands.

A total of 41 permanent sample plots were established in the 3 provinces, 16 in Manitoba, 15 in Saskatchewan and 10 in Alberta. A considerable amount of care was exercised in the selection of the sites and the plots were sufficiently distributed throughout the area to produce a representative coverage of the forest stands therein.

The plots vary from 5 to 10 chains in length and are ½ chain (33 ft.) in width with a compass line run through the centre.

In order to have uniformity in the sample plots, a standard set of instructions were issued covering the procedure to be followed for selecting the sites and setting up the permanent sample plots. Every effort was made to establish the sample plots in a Provincial Forest Reserve or on crown land, selecting a site that was relatively free from interference by cutting or logging.

2. Method of Establishing Permanent Sample Plots

The following are the methods which were employed by all personnel for establishing the plots:

(a) The centre line was run by chain and compass. Trees at approximately 50 ft. intervals along the centre line were lightly blazed. (This distance was increased or decreased depending on the density of the stand. However, in any case, the trees on the centre line were blazed or marked so that each succeeding marked tree could be easily seen from the preceeding tree.) If there was no tree on the centre line for marking at the desired point, a tree to the right or left was marked, deviating not more than 5 feet from the line.

(b) A post was placed at the beginning of the centre line, to mark the plot. (The posts were neatly squared, ranging from 3 x 3 to 5 x 5 inches square, roofed at the top to prevent entrance of moisture and painted white or yellow.)

(c) A tree tally of the plot was completed in the following manner:

(i) A distance of 16½ feet was measured to the left of the plot marker at right angles to the centre line and a marking picket was placed at that point. Similarly a marking picket was placed 16½ feet to the right of the plot marker.

(ii) At the first blazed or marked tree, a marking picket was placed to the left and right as was done at the plot marker. (This formed a rectangle divided through the middle by an imaginary line running from plot marker to first marked tree.)

(iii) Trees were tallied in the rectangle on one side of the centre line and then on the other side of the centre line. All tree diameters were measured with diameter tapes or tree calipers for the tree tally. (In Manitoba and Alberta, tree diameters were taken with diameter tapes. In Saskatchewan, tree diameters were taken with tree calipers.)

(iv) Then the first two marking pickets at the plot marker were removed and placed at right angles to the left and right of the second blazed or marked tree on the centre line. This formed a new rectangle adjacent to the one just completed. This procedure was continued until the plot had been completely tallied.

(d) The end of the plot was marked with a squared marker as was done at the beginning.

(e) Trees for marking were selected at random throughout the plot. If any species constituted over twenty per cent of the stand by number, considering only trees over 2" D.B.H., ten trees of that species were marked with numbered aluminum tags for periodic assessment of insect infestation and damage.

(f) Finally, descriptions of the marked trees were made and a form, used for this purpose, "Description of Marked Trees" (Form Wpg. SE 142) completed. (Tree heights for this form were omitted in 1947 due to lack of suitable instruments for measuring heights.)

3. Symbols Used in Recording Data

The following symbols were used in completing form Wpg. SE 142, "Description of Marked Trees":

(a) Crown Class

- (i) D - Dominant, overtopping rest of stand
- (ii) CD - Co-dominant, beneath dominant but receiving full sunlight on top and sides of crown
- (iii) I - Intermediate, beneath co-dominant, receiving sunlight on top only, growth retarded by dominant and co-dominant trees
- (iv) S - Suppressed, beneath all other living classes, receiving little or no sunlight, little chance of recovery
- (v) O - Open-growing, same general height as suppressed but receiving much or full sunlight. Growing in an opening in forest canopy.

(b) Story

(i) O - for Overstory
(ii) L - for Lower story

(c) Shade

(i) F - free, crown and sides freely exposed to light
(ii) PS - partly shaded, receiving sunlight on top of crown but little or none on sides
(iii) FS - fully shaded, receiving little or no direct sunlight on top or sides of crown

(d) Defoliation

This is shown as percentage with name of insect causing the defoliation.

(e) Other Injury

This is simply shown as L., M. or H. (light, medium or heavy).

(f) Cause of Injury

Insect or insects causing injury in (e) above.

4. Definitions Used in Recording Data

(a) Age Class

For our purposes, age classes were placed in the following groups: 1-20 years; 21-40 years; 41-60 years; etc. (Owing to the lack of increment borers, age classes were omitted in 1947.)

(b) Even Aged

A stand in which 95 per cent of all trees 1" D.B.H. and over were in the same age class (see age class above) was considered to be even aged.

(c) Ground Cover

Vegetative covering, grass, brush, shrubs, moss, etc. Vegetation which did not constitute part of the forest crop.

(d) Overstory

The taller of a two-storied forest.

(e) Tree Classes

Seedling, less than 0.5" D.B.H.; sapling, 0.5 - 3.5" D.B.H.; pole, 3.5 - 9.5" D.B.H.; standard, 9.5-23.5" D.B.H.; veteran, over 23.5" D.B.H.

(f) Type

When over 80 per cent of all trees over 1" D.B.H. were of one species, it was called a pure stand; if under 80 per cent, a mixed stand.

5. Uses of Permanent Sample Plots

While the permanent sample plots are planned as a long term project and intended primarily to provide continuity for sampling in observing fluctustions in insect populatious and as a method of observing insect activity in relation to various types of forest stands, they will perhaps serve as a basis for other studies.

Some of the suggested uses of the sample plots are as follows:

(a) To determine the intensity of attack by various insects in relation to the type of forest stand.

(b) To determine whether soil type (growth conditions) has any influence on the insect species prevalent.

(c) To determine the susceptibility of stands to insect attack in relation to the dominant tree species.

(d) To determine, relative rates of tree growth during infestation and non-infestation periods.

(e) To determine what changes take place in stand compositions as a result of insect infestations.

(f) To determine how stand composition affects the severity of damage by certain insects.

(g) To determine how trees recover from insect attacks and what effect such attacks hae on lumber grades, etc.

(h) To determine whether different types of ground cover or a change in ground cover affects the populations of certain forest insect species.

6. Method of Sampling at Plots

In an effort to obtain uniform Forest Insect Survey collections from all the sample plots, a standard method of selecting and beating trees for sampling will be employed. The tentative method to be employed for periodic assessment of insect activity is to select five trees for sampling outside the plot boundaries but as near to the plot as possible.

Care will be taken that all trees selected outside the plot for sampling are representative of the trees in the plot.

This method, of selecting sample trees outside the plot, will perhaps eliminate the danger of causing extensive damage to the trees or upsetting the insect balance within the plot through extensive sampling and examinations.

The five trees, selected at random outside the plot boundaries for sampling, will be beaten, each tree receiving fifteen consecutive strokes with a pole ten feet long. The insects obtained therefrom will constitute a collection from that particular sample plot. If no insects are obtained from the first five trees that are beaten, beating will be continued, on other trees selected at random within the area, until some insects are obtained or until a maximum of ten trees have been beaten. If no insects are obtained from a maximum of ten trees, then for our purposes the result will be classified as a negative report. In addition to sampling these trees by beating, they will be examined visually for such insects which are not normally obtained by beating.

7. Summary of 1947 Permanent Sample Plot Data

The following pages summarize, in tabular form, the information obtained from the sample plots established in 1947. The information thus obtained is summarized individually for each province with the exception of the locations of the sample plots. Tables 1(a), 1(b) and 1(c) give the exact locations of all the sample plots. Tables 2(a) and 2(b) contain information regarding sample plots established in Manitoba; 3(a) and 3(b) contain information regarding sample plots established in Saskatchewan; and 4(a) and 4(b) contain information regarding sample plots established in Alberta.

Table 1(a)

Location of
Permanent Sample Plots--Manitoba

PLOT NO.	FOREST RESERVE	FOREST DISTRICT	SEC.	TP.	RGE.	MER.	DETAILED LOCATION
1	Sandi-lands	Southern	SW 35	5	9	EPM	Marker located 20° S.of W. mag. 100' from jct. of Piney hwy. & Reserve H.Q. road.
2	Sandi-lands	Southern	1	6	9	EPM	1 1/3 mi. NE of Reserve H.Q. on Cote road corner post 35' S. of road.
3	Sandi-lands	Southern	7	6	10	EPM	2 1/3 mi. from Reserve H.Q. on Dawson Cabin Road. Plot is 100' west of road on trail running parallel to it.
4	Sandi-lands	Southern	SW 25	5	9	EPM	1 1/5 mi. SE Reserve H.Q. on Piney road about 25' east of road. Plot runs 35° E. of N.
5	Sandi-lands	Southern	20	6	10	EPM	4 3/10 mi. NE of Reserve H.Q. on Dawson Cabin road 40' E. of road. plot runs 10° S. of E.
6	Sandi-lands	Southern	23	5	9	EPM	2 mi. S. of Reserve H.Q. on road to town of Bedford. Plot on north side of road 10° N. of W.
7	Sandi-lands	Southern	SW 18	5	10	EPM	3/5 mi. SW of jct. on Piney road 3 3/5mi. SE of Reserve H.Q.
8	Sandi-lands	Southern	34	5	9	EPM	1 1/5 mi. W. of Reserve H.Q. on road to Marchand. Marker 100' S. of road. Plot runs 25° E. of S.
9	White-shell	Eastern	18	12	15	EPM	1 3/5 mi. north of camp at big bend in main road. Plot 30' west of road running 80° W. of S.
10	White-shell	Eastern	9	12	15	EPM	350 yds. NW of camp.road 75' north of main road. Opposite picnic grounds.
11	White-shell	Eastern	3	13	15	EPM	3 7/10 mi. north of White Lake.Store on Brereton Lake road 100' west of road.

(continued)

Location of
Permanent Sample Plots--Manitoba
(continued)

PLOT NO.	FOREST RESERVE	FOREST DISTRICT	SEC.	TP.	RGE.	MER.	DETAILED LOCATION
12	White-shell	Eastern	5	10	17	EPM	150' NE of intersection of No. 1 Hwy. and W. Trout hatchery Road which is near mile 106 on No. 1 Hwy. Plots runs 8° E. of N.
13	White-shell	Eastern	4	10	17	EPM	at mi. 104½ on No. 1 Hwy. about 75' west of Hwy. opposite trail to gravel pit. Runs 3° W. of N. parallel to Hwy.
14	Spruce Woods	Southern	SE 19	8	9	WPM	North off No. 2 Hwy. east of Cypress River. Travel 6 mi. along main trail; take right fork 2 mi. inside Reserve boundary on E. side of trail.
15	Spruce Woods	Southern	5	10	15	WPM	250 yds. NNW of Spruce Woods Campsite. Marker can be seen in field.
16	Spruce Woods	Southern	5	10	15	WPM	½ mi. NE of campsite in S.W.F.R. Plot Plot runs 25° S. of E.

Table 1(b)

Location of
Permanent Sample Plots--Saskatchewan

PLOT NO.	FOREST HDR. STATION	FOREST RESERVE	SEC.	TP.	RGE.	MER.	DETAILED LOCATION
1	Prince Albert	Nisbet	NE 22	49	1	W 3rd	4/10 mi. west of Crutwell road. Marker 147' south of Hwy. No. 3.
2	Prince Albert	Nisbet	NW 22	49	1	W 3rd	Marker 190' S.E. of No. 1 plot marker.
3	Prince Albert	Nisbet	SW 1	49	27	W. 2nd	1 7/10 mi. south of Hwy. No. 3. Marker 50' from road on east side.
4	Prince Albert	Nisbet	NW 6	49	28	W 2nd	1 4/10 mi. south of Hwy. No. 3; marker 60' from road east side.
5	Red Rock Block	Nisbet	22	49	25	W 2nd	4/10 mi. E. of Red Rock cabin on north side or road. Marker 70' from road.
6	Red Rock Block	Nisbet	27	49	25	W 2nd	7/10 mi. E. of Red Rock cabin on north side of road. Plot 225 yds. from road.
7	Prince Albert	Nisbet	23	49	1	W 3rd	3/10 mi. S. of Hwy. No. 3. Marker 40' from road west.
8	Prince Albert	Nisbet	SE 27	49	1	W 3rd	3/10 mi. north of Hwy. No. 3. Marker 60' from road on left side of road.
9	Prince Albert	Nisbet	NE 8	49	27	W 2nd	6 mi. W. of Prince Albert. Marker 100' S. of Hwy. No. 3.
10	Prince Albert	Nisbet	16	49	26	W 2nd	100 yds. SE of field officer's cabin, Nisbet Prov. For. H.Q.
11	Prince Albert	Nisbet	SW 21	49	26	W 2nd	1 3/10 mi. north of Reserve boundary on Hwy. No. 2. Marker 75' E.
12	Steep Creek Block	Nisbet	SE 6	49	23	W 2nd	1 3/10 mi. E. of Reserve boundary. Marker 100' S. of road.
13	Steep Creek Block	Nisbet	SE 6	49	23	W 2nd	8/10 mi. E. of Reserve boundary. Marker 200 yds. S. of road.
14	Prince Albert	Nisbet	SW 18	49	27	W 2nd	8 mi. W. of Prince Albert on Hwy. No. 3. Marker 100 yds. N. of Hwy.
15	Prince Albert	Nisbet	SW 26	49	1	W 3rd	4/10 mi. due E. of Crutwell road. Marker 15' from track.

Table 1(c)

Location of Permanent Sample Plots--Alberta

PLOT NO.	FOREST RGR. STATION	FOREST RESERVE	SEC.	TP.	RGE.	MER.	DETAILED LOCATION
1	Leyland	Brazeau	8	47	23	W.5th	SE 1/4 Subdivision 7; 1[illegible]0 yards W. of Ranger Station.
2	Leyland	Brazeau	8	48	23	W.5th	150 yards N.W. of lodgepole pine plots. 45° N. of W.
3	Leyland	Brazeau	8	47	23	W.5th	1/4 mi. from ranger H.Q. in forestry pasture.
4	Leyland	Brazeau	16	47	23	W.5th	120 yards from mouth of Luscar creek 1 9/10 mi. from Ranger Station.
5	Leyland	Brazeau	11	48	22	W.5th	Close to cut line (approx. 300 yds.) on left side of Hwy. 11.1 mi. from Ranger Station.
6	Leyland	Brazeau	29	47	22	W.5th	5/10 mi. from mile post 16; 6.8 mi. from Ranger Station 20 yds. off road.
7	Leyland	Brazeau	19	48	22	W.5th	150 yards from gravel pit on McLeod River trail 11.8 mi. from Rgr.Stat.
8	Coalspur	Brazeau	32	48	21	W.5th	SE portion legal subdivision 9 1/4 mi. from R.R. crossing cut line, base line.
9	Coalspur	Brazeau	23	49	21	W.5th	Legal subdivision 3. Markers visible.
10	Coalspur	Brazeau	32	48	21	W.5th	1 1/4 mi. from R.R. crossing--10 yds off tracks bordered by fireguard.

Table 2(a)

Permanent Sample Plots--Manitoba--1947

PLOT NO.	FOREST DISTRICT	DATE ESTABL. 1947	SIZE OF PLOT (ACRES)	FOREST TYPE	SOIL TYPE	GROWTH CONDI-TIONS	NO. OF TREES TALLIED		TREES PER ACRE BY DIAMETER CLASS *				% OF EACH SPECIES						
							L	D	1"-5.5	5.6-10.5	10.6-15.5	15.5 & over	PJ	Sb	Sw	Ab	Larch	W.Poplar	Birch
1	Southern	Aug.26	2/5	coniferous	sand	good	86	3	85	120	10	0	100%						
2	Southern	Aug.27	7/20	coniferous	sand	good	111	5	157	146	0	0	86						14
3	Southern	Sept.9	1/2	coniferous	sand	good	179	5	164	194	0	0	100						
4	Southern	Sept.11	1/2	coniferous	sand	good	96	1	76	108	8	0	100						
5	Southern	Sept.11	3/10	coniferous	sand	good	55	0	83	97	3	0	85					13 2(B.P.)	
6	Southern	Sept.12	1/2	coniferous	sand	good	311	3	622	2	0	0	100						
7	Southern	Sept.12	1/2	coniferous	sand	good	260	0	510	10	0	0	100						
8	Southern	Sept.13	3/10	coniferous	humus	good	90	5	230	70	0	0		26			72	2(B.P.)	
9	Eastern	Sept.16	7/20	mixed	humus	fair	242	4	386	314	0	0	6					86	8
10	Eastern	Sept.18	1/2	coniferous	loam	poor	117	4	184	60	0	0	100						
11	Eastern	Sept.22	7/20	coniferous	humus	good	62	4	123	54	0	0		61		34	2		3
12	Eastern	Sept.24	2/5	mixed	loam & clay	good	174	8	182	245	10	0	42		33			19	6
13	Eastern	Sept.25	3/10	mixed	sandy humus mixture	good	122	1	197	197	7	0	9		29	42		10	10
14	Southern	Oct.1	2/5	coniferous	sandy humus mixture	fair	89	1	175	42	3	0			100				
15	Southern	Oct.3	2/5	coniferous	sandy humus mixture	fair	129	2	275	40	5	0			100				
16	Southern	Oct.3	2/5	coniferous	sandy humus mixture	fair	69	0	110	60	3	0			100				

* Trees per acre by diameter class taken to the nearest whole number.

Table 2(b)

Summary of Marked Trees
Permanent Sample Plots--Manitoba--1947

PLOT NO.	TREE SPECIES	NO. OF MARKED TREES	AV. D.B.H. OF MARKED TREES	AV. HEIGHT OF TREES	AV. DEFO-LIATION	CAUSE OF DEFOLIATION	OTHER INJURY	CAUSE OF INJURY	NO. TREES SHOWING INSECT DAMAGE
1	Jack pine	10	6 7/8"	33'	4.2%	P.J Bdwm.	L	midge	5
2	Jack pine	10	5 13/16"		8.5%	P.J Bdwm.	Nil	N/A	10
3	Jack pine	10	5 1/2"		9.3%	P.J Bdwm.	Nil	N/A	10
4	Jack pine	10	5 13/16"		7.2%	P.J Bdwm.	Nil	N/A	9
5	Jack pine	10	5 17/20"		8.3%	P.J Bdwm.	Nil	N/A	10
6	Jack pine	10	3 1/16"		11.1%	P.J Bdwm.	Nil	N/A	10
7	Jack pine	10	3 1/2"		20.7%	P.J Bdwm.	L	Midge	10
8	Larch	10	4 3/8"		36.5%	Larch Sawfly	Nil	N/A	10
	B. spruce	10	3 15/16"		3.2%	Not known	Nil	N/A	8
9	T. aspen	10	5 1/8"		1.8%	Not known	Nil	N/A	7
10	Jack pine	10	5 1/8"		12%	P.J Bdwm.	Nil	N/A	10
11	B. spruce	10	3 7/8"		7.9%	Not known	Nil	N/A	7
12	Jack pine	10	7 1/8"		3%	Not known	Nil	N/A	8
	W. spruce	10	4 13/16"		2.9%	Not known	Nil	N/A	8
13	W. spruce	10	4 1/4"		1.5%	Not known	Nil	N/A	6
	Balsam fir	10	5 3/4"		Nil	N/A	Nil	N/A	0
14	W. spruce	10	4 1/16"		.8%	Not known	Nil	N/A	4
15	W. spruce	10	3 3/4"		7%	Bdwm.	Nil	N/A	10
16	W. spruce	10	4 1/2"		6%	Bdwm.	Nil	N/A	10

Table 3(a)

Permanent Sample Plots--Saskatchewan--1947

PLOT NO.	FOREST DISTRICT	DATE ESTAB. 1947	SIZE OF PLOT (ACRES)	FOREST TYPE	SOIL TYPE	GROWTH CONDITIONS	NO. OF TREES TALLIED		TREES PER ACRE BY DIAMETER CLASS *				% OF EACH SPECIES					
							L	D	1"-5.5	5.6-10.6	10.6-15.5	15.5 & over	Larch	Sb	PJ	B.Bp.	W.Pop	W.Spruce
1	Prince Albert Nisbet P.F.	Sept.10	1/2	coniferous	mixture	good	417	19	690	144	0	0	14	80		5	1	
2	Prince Albert Nisbet P.F.	Sept.11	8/20	coniferous	mixture	good	200		475	25	0	0	100					
3	Prince Albert Nisbet P.F.	Sept.12	1/2	coniferous	sand	good	725		1374	76	0	0			100			
4	Prince Albert Nisbet P.F.	Sept.15	1/2	coniferous	sand	good	330		660	0	0	0			100			
5	Prince Albert Red Rock Block	Sept.16	1/2	coniferous	sand	good	206		386	26	0	0			100			
6	Prince Albert Red Rock Blk.	Sept.18	8/20	coniferous	mixture	good	481		1200	2	0	0	100					
7	Prince Albert Nisbet P.F.	Sept.20	1/2	coniferous	sand	good	500	10	994	6	0	0			100			
8	Prince Albert Nisbet P.F.	Sept.23	1/2	coniferous	mixture	good	381	17	762	0	0	0	92					8
9	Prince Albert Nisbet P.F.	Sept.25	1/2	coniferous	sand	good	544	8	1088	0	0	0			100			
10	Prince Albert Nisbet P.F.	Sept.25	1/2	coniferous	sand	good	297		508	86	0	0			100			
11	Prince Albert Nisbet P.F.	Sept.26	1/2	coniferous	sand	good	335		526	144	0	0			100			
12	Prince Albert Steep Crk.Blk.	Sept.27	6/20	coniferous	mixture	good	348	19	1143	16	0	0	98					2
13	Prince Albert Steep Crk.Blk.	Sept.28	1/2	coniferous	mixture	fair	485	21	898	72	0	0	6	94				
14	Prince Albert Nisbet P.F.	Sept.29	1/2	coniferous	sand	good	404		802	6	0	0			100			
15	Prince Albert Nisbet P.F.	Sept.29	1/2	coniferous	sand	good	783		1566	0	0	0			100			

* Trees per acre per diameter class taken to the nearest whole number.

Table 3(b)

Summary of Marked Trees
Permanent Sample Plots--Saskatchewan--1947

PLOT NO.	TREE SPECIES	NO. OF MARKED TREES	AV. D.B.H. OF MARKED TREES	AV. HEIGHT OF TREES	AV. DEFOLIATION	CAUSE OF DEFOLIATION	OTHER INJURY	CAUSE OF INJURY	NO. TREES SHOWING INSECT DAMAGE
1	Black spruce	10 1-10	4		-	-	Distorted top		-
2	Larch	10 11-20	4		4%	Larch sawfly	-	-	2
3	Jack pine	10 21-30	5		-	-	1 Stag Head		-
4	Jack pine	10 31-40	4		-	-	2 Stag Head		-
5	Jack pine	10 41-50	4		-	-	-	-	-
6	Larch	10 51-60	4		10%	Larch sawfly	-	-	6
7	Jack pine	10 61-70	4		-	-	1 Stag Head		-
8	Larch	10 71-80	4		-	-	-	-	-
9	Jack pine	10 81-90	4		-	-	1 Stag Head		-
10	Jack pine	10 91-100	5		-	-	Deformed top	Mistletoe	-
11	Jack pine	10 101-110	5						

(continued)

Summary of Marked Trees
Permanent Sample Plots--Saskatchewan--1947

(continued)

PLOT NO.	TREE SPECIES	NO. OF MARKED TREES	AV. D.B.H. OF MARKED TREES	AV. HEIGHT OF TREES	AV. DEFOLIATION	CAUSE OF DEFOLIATION	OTHER INJURY	CAUSE OF INJURY	NO. TREES SHOWING INSECT DAMAGE
12	Larch	10 111-120	5		10%	Larch sawfly	-	-	3
13	Black spruce	10 121-130	4		-	-	-	-	-
14	Jack pine	10 131-140	4		-	-	1 Stag Head		-
15	Jack pine	10 141-150	4		-	-	1 Stag Head		-

Table 4(a)

Permanent Sample Plots--Alberta--1947

PLOT NO.	FOREST DISTRICT	DATE ESTAB.	SIZE OF PLOT (ACRES)	FOREST TYPE	SOIL TYPE	GROWTH CONDI-TIONS	NO. OF TREES TALLIED		TREES PER ACRE BY DIAMETER CLASS *				% OF EACH SPECIES						
							L.	D.	1"-5.5	5.6-10.5	10.6-15.5	15.5 & over	Lodge. pine	Sw	Sb	Eng. spruce	Larch	W. pop.	B. pop.
1	Brazeau	Sept.19	1/2	coniferous	mixture	fair	235	2	212	252	6		100%						
2	Brazeau	Sept.20	1/4	coniferous	mixture	fair	288	10	904	240	8				100				
3	Brazeau	Sept.22	7/20	coniferous	mixture	fair	296	6	469	354	23					100			
4	Brazeau	Sept.23	7/20	deciduous	mixture	fair	197	27	320	240	3								100
5	Brazeau	Sept.24	6/20	deciduous	mixture	good	194	2	580	66								100	
6	Brazeau	Sept.26	6/20	coniferous	loam	fair	123	1	410								100		
7	Brazeau	Sept.27	8/20	coniferous	mixture	good	232		422	150	8			100					
8	Brazeau	Sept.29	1/2	coniferous	clay	good	312	19	412	214			100						
9	Brazeau	Sept.30	6/20	deciduous	clay	good	254		800	46								100	
10	Brazeau	Oct.1	7/20	coniferous	loam	good	259		740						100				

Table 4(b)

Summary of Marked Trees
Permanent Sample Plots--Alberta--1947

PLOT NO.	TREE SPECIES	NO. OF MARKED TREES	AV. D.B.H. OF MARKED TREES	AV. HEIGHT OF TREES	AV. DEFOLIATION	CAUSE OF DEFOLIATION	OTHER INJURY	CAUSE OF INJURY	NO. TREES SHOWING INSECT DAMAGE
1	Lodgepole pine	10 1-10			-	-	-	-	-
2	Black spruce	10 11-20			-	-	-	-	-
3	Engelman spruce	10 21-30			-	-	root damage	animals	-
4	Black poplar	10 31-40			-	-	-	-	-
5	White poplar	10 41-50			-	-	snow damage	heavy snow	-
6	Larch	10 51-60			-	-	-	-	-
7	White spruce	10 61-70			-	-	light root damage	Trail cutting through plot	-
8	Lodgepole pine	10 71-80			-	-	-	-	-
9	White poplar	10 81-90			-	-	very light snow injuries	heavy snowfall in early spring	-
10	Black spruce	10 91-100			-	-	-	-	-

B. Population Studies.

1. Population Counts.

During 1947 complete population counts were planned for three areas: East Hawk Lake, Ontario; Red Rock Lake, Manitoba; and Sandilands Forest Reserve, Manitoba. However, due to long distances and lack of time and personnel, these were not completed except at Red Rock Lake where larval, pupal and egg counts were conducted; at Hawk Lake larval and egg counts were completed while in the Sandilands Forest Reserve only the egg count was done; this being a preliminary study in that region.

A study of the distribution of staminate trees in each of these areas was also performed in an attempt to correlate the abundance of budworm with pollen production.

It was not possible to conduct the pupal count at East Hawk Lake due to other work at Red Rock Lake which had to be done during the pupal period of budworm at East Hawk Lake.

These studies were carried out for two primary purposes: (1) to show annual fluctuations of budworm populations, (2) to correlate the budworm population fluctuations with abundance of jack pine pollen.

2. Larval Counts.

Larval counts were conducted in the same manner in 1947 as in previous years. (See 1944 Annual Tech. Report Wpg. Lab.)

(a) Hawk Lake, Ontario.

A total of 20 trees was used in this investigation, each one being tagged for future reference and use. 10 of these trees were in the Campsite area, and the remaining 10 on Post Office Point.

The count was carried out when the majority of larvae were in the 5th and 6th stadia.

In conjunction with the larval count, a staminate tree survey was carried out, and the distribution of staminate trees is shown in Table I.

Table I

Staminate Tree Survey - Hawk Lake

Area	Total No. of trees examined	Heavily staminate	% heavily staminate	Lightly staminate	% lightly staminate	Non-staminate	% non staminate
Campsite	140	36	25.71	70	50.00	34	24.29
Dead Horse Point	97	32	32.99	48	49.48	17	17.53
Post Office Point.	428	19	4.44	141	32.94	268	62.62
General Hawk Lake	665	87	13.08	259	38.94	319	47.98

A comparison of % staminate tree types found in this area, with previous years, is as follows:

Pollen Production 1942-1947

	Non-staminate	Lightly staminate	Heavily staminate
1942	70.81	16.34	12.86
1944	1.27	8.28	90.45
1945	14.31	16.70	68.99
1946	70.51	8.45	21.04
1947	47.98	38.94	13.08

Two larval counts were made in the Hawk Lake region; one being conducted in the Campsite area and the other on Post Office Point.

A summary of larvae found in the Campsite area is shown in Table II.

Table II

Larval Count - Hawk Lake, Ontario - Campsite Area, 1947.

Tree No.	Stamin-ate cones	Location of sample	Stamin-ate cones	Number of larvae	Termin-als	Number of larvae	Total Number of term-inals	Larvae per 100 termin-als.
1	Light	Top	80	16	20	7	100	23
		Bottom	38	9	62	4	100	13
2	Light	Top	86	15	14	6	100	21
		Bottom	78	6	22	3	100	9
3	Heavy	Top	73	10	27	5	100	15
		Bottom	29	5	71	3	100	8
4	Heavy	Top	84	9	16	0	100	9
		Bottom	61	11	39	3	100	14
5	Light	Top	57	16	43	10	100	26
		Bottom	48	3	52	0	100	3
6	Light	Top	22	1	78	17	100	18
		Bottom	15	0	85	7	b00	7
7	Heavy	Top	67	10	33	8	100	18
		Bottom	59	2	41	3	100	5
8	Heavy	Top	81	3	19	2	100	5
		Bottom	76	11	24	2	100	13
9	Light	Top	33	3	67	4	100	7
		Bottom	0	0	100	3	100	3
10	Heavy	Top	93	1	7	0	100	1
		Bottom	90	8	10	0	100	8
			1170	139	830	87	2000	226

Using this table the mean number of larvae per 100 terminals for each tree type in the campsite is as follows:

Non staminate	-	-- larvae
Lightly staminate	-	12.9 larvae
Heavily staminate	-	9.6 larvae

By employing the formula used in previous years (P. 44, Ann. Tech. Report 1942) the average larval population per 100 terminals in Campsite area is:

$$\frac{(25.7 \times 9.6) + (50.0 \times 12.9)}{100} = 8.92$$

A summary of larvae found on Post Office Point is shown in Table III.

Table III

Larval Count - Hawk Lake, Ontario - Post Office Point

Tree No.	Staminate flowers	Location of sample	Staminate cones	Number of larvae	Terminals	Number of larvae	Total number of terminals	Larvae per 100 terminals
1	Light	Top	27	6	73	25	100	31
		Bottom	48	12	52	11	100	23
2	Light	Top	35	8	65	26	100	34
		Bottom	37	5	63	9	100	14
3	None	Top	1	0	99	8	100	8
		Bottom	0	0	100	0	100	0
4	None	Top	0	0	100	0	100	0
		Bottom	0	0	100	1	100	1
5	None	Top	46	7	54	15	100	22
		Bottom	0	0	100	3	100	3
6	Light	Top	46	8	54	9	100	17
		Bottom	38	2	62	6	100	8
7	Light	Top	23	3	77	9	100	12
		Bottom	0	0	100	1	100	1
8	Light	Top	18	2	82	30	100	32
		Bottom	14	1	86	11	100	12
9	None	Top	0	0	100	2	100	2
		Bottom	0	0	100	5	100	5
10	Light	Top	18	0	82	12	100	12
		Bottom	0	0	100	1	100	1
			351	54	1649	184	2000	238

, The mean number of larvae per 100 terminals for each tree type on Post Office Point is as follows:

Non staminate - 5.12
Lightly staminate - 16.42
Heavily staminate - not represented

Using formula mentioned above gives an average population of 8.62 larvae per 100 terminals:

$$\frac{(32.94 \times 16.42) + (62.62 \times 5.125)}{100} = 8.62$$

Combining results from the two areas, we find that the number of larvae per 100 terminals for each tree type are:

Non staminate - 5.1
Lightly staminate - 14.7
Heavily staminate - 9.6

The average number of larvae per 100 terminals would then be:

$$\frac{(13.08 \times 9.6) + (38.94 \times 14.7) + (47.98 \times 5.1)}{100} = 9.42$$

i.e. There were found to be 9.42 larvae per 100 terminals in the general region about Hawk Lake, Ontario.

An attempt to compare the populations as compared to pollen abundance in the two areas was attempted, but this was not possible since no non-staminate trees were included in the count at the Campsite, and no heavily staminate trees on Post Office Point. The % of each tree type and number of larvae per 100 terminals is shown in the following table.

Location	Average population	% non-staminate	Larvae per 100 terminals	% lightly staminate	Larvae per 100 terminals	% heavily staminate	Larvae per 100 terminals
Campsite	8.92	24.29	--	50.0	12.9	25.71	9.6
Post Office Point	8.62	62.62	5.125	32.94	16.42	4.44	--
General Hawk Lake area	9.42	47.98	5.125	38.94	14.66	13.08	9.6

The relation between average larval population and pollen production (1941-1947) is shown in the table and graph which follow:

	1941	1942	1943	1944	1945	1946	1947	
Average Number of larvae /100 term.	6.28	8.22	22.85	30.18	6.91	1.05	9.42	
% stam. trees (lightly) (heavily)	---	29.20	---	98.73	85.69	29.49	52.02	

From the above chart, and the following graph it is apparent that larval population varies as the degree of pollen production.

(b) Red Rock Lake, Manitoba.

The original intentions were to carry out two counts in this area; the first when the majority of the larvae were in the 3rd stadium, and the second when the majority of larvae were in the 5th stadium.

The first count was begun but only 6 trees were completed due to other work which had to be done at this time. 2 of the 6 trees were in the Campsite area, and the remaining 4 in the Experimental area.

In the second count a total of 10 trees was examined; 7 in the Experimental area and 3 in the Campsite area.

Table IV shows the distribution of staminate trees in both the Campsite area and the Experimental area.

Table IV

Staminate Tree Survey - Red Rock Lake, Manitoba.

Area	Total number trees examined	Heavily staminate	% Heavily staminate	Lightly staminate	% Lightly staminate	Non-staminate	% Non-staminate
Campsite	233	12	5.15	150	64.37	71	30.47
Experimental	514	165	32.10	320	62.25	29	5.64
General Red Rock Lake	747	177	23.69	470	62.91	100	13.38

As compared with the 1946 survey, the percentage of staminate trees increased.

Pollen Production - Red Rock Lake, 1946 and 1947.

Year	Non-staminate	Lightly-staminate	Heavily-staminate
1946	40.58	11.24	48.16
1947	13.38	62.91	23.69

Table V is a summary of the first count and includes both areas.

Table V
Larval Count Number I - Red Rock Lake, Manitoba

Tree No.	Staminate flowers	Location of sample	Staminate cones	Number of larvae	Terminals	Number of larvae	Total No. of terminals	Larvae / 100 terminals
Campsite:								
1.	Light	Top-	37	21	63	3	100	24
		Bottom	30	10	70	2	100	12
2.	Light	Top	16	21	84	4	100	25
		Bottom	69	40	31	3	100	43
Experimental Area								
1.	Heavy	Top	66	7	34	0	100	7
		Bottom	78	2	22	0	100	2
2.	Heavy	Top	63	4	37	2	100	6
		Bottom	68	8	22	0	100	8
3.	Heavy	Top	75	10	25	0	100	10
		Bottom	75	3	25	0	100	3
4.	Light	Top	27	16	73	0	100	16
		Bottom	60	9	40	0	100	9
			664	151	536	14	1200	165

Mean number of larvae per 100 terminals for 1st count on each tree type:

Non-staminate	-	---
Lightly staminate	-	21.5
Heavily staminate	-	6

By use of formula the average number of larvae per 100 terminals is:

$$\frac{(38.94 \times 21.5) + (13.08 \times 6)}{100} = 9.16$$

Table VI shows number of larvae found in second count and includes both areas.

Table VI

Larval Count Number 2 - Red Rock Lake, 1947

Tree No.	Staminate flowers	Location of sample	Staminate cones	Number of larvae	Terminals	Number of larvae	Total number of terminals	Larvae per 100 terminals
Campsite								
1.	Light	Top	16	3	84	28	100	31
		Bottom	54	19	46	22	100	41
2.	Light	Top	17	3	83	17	100	20
		Bottom	4	1	96	4	100	5
3.	Light	Top	0	0	100	8	100	8
		Bottom	18	7	82	22	100	29
Experimental Area								
1.	Heavy	Top	42	2	58	8	100	10
		Bottom	64	4	36	1	100	5
2.	Heavy	Top	63	4	37	1	100	5
		Bottom	80	6	20	0	100	6
3.	Heavy	Top	55	5	45	1	100	6
		Bottom	91	2	9	0	100	2
4.	Light	Top	9	1	91	5	100	6
		Bottom	20	0	80	2	100	2
5.	Heavy	Top	51	3	49	3	100	6
		Bottom	81	0	19	2	100	2
6.	Heavy	Top	36	2	64	4	100	6
		Bottom	61	3	39	3	100	6
7.	Heavy	Top	52	2	48	8	100	10
		Bottom	62	4	38	2	100	6
			876	71	1124	141	2000	212

Mean number of larvae per 100 terminals for 2nd count on each tree type:

Non-staminate	- ---
Lightly staminate	- 17.62
Heavily staminate	- 5.83

Average larval population per 100 terminals (2nd count):

$$\frac{(23.69 \times 5.83) + (62.91 \times 17.62)}{100} = 12.47$$

Combining the figures for the two counts, the number of larvae per 100 terminals on each tree type are:

Non-staminate	- ---
Lightly staminate	- 16.875
Heavily staminate	- 6.625

Average larval population per 100 terminals using formula:

$$\frac{(23.69 \times 6.625) - (62.91 \times 16.875)}{100} = 12.185$$

Since this study has been carried out in this region for only two years, no definite conclusions regarding budworm population in relation to pollen production can be drawn from the data obtained; the following table would indicate, however, that pollen production has a definite effect on budworm population, but these figures should be treated with caution since the larval count in 1946 consisted only of four trees, and this is not sufficient for an accurate count.

Average number Larvae /100 terminals	1946 4.44	1947 12.185
% staminate trees (light & heavy)	59.40	86.60

3. Pupal Counts.

Only one pupal count was carried out in 1947; this was carried out at Red Rock Lake, Manitoba.

The same procedure was used in the pupal as in the larval counts except that a larger sample was taken; 100 terminals per replicate instead of 50 as in the larval count.

20 trees were picked at random and each one tagged and classified.

Table VII is a summary of larvae, pupae and parasites found; predatorized pupae and dead larvae are tabulated separately.

Table VII

Pupal Count - Red Rock Lake, Manitoba.

Tree No.	Larvae	Parasites	Pupae	Dead Larvae	Predatorized pupae	Total
1	2	7	16	1	1	27
2	2	2	24	0	1	29
3	6	6	16	0	2	30
4	0	5	27	6	1	39
5	1	14	57	0	2	74
6	7	25	15	1	3	51
7	2	7	30	4	0	43
8	8	10	31	1	2	52
9	2	16	28	1	2	49
10	0	12	15	0	0	27
11	2	3	3	0	0	8
12	2	31	72	0	2	107
13	0	6	11	0	1	18
14	1	3	12	0	0	16
15	2	7	19	1	0	29
16	1	5	18	0	0	24
17	0	7	23	0	0	30
18	2	2	34	1	0	57
19	1	8	45	0	0	54
20	1	7	18	2	0	28
TOTAL	42	201	514	18	17	792

Using figures found in Table VII there were:

$$\frac{792}{80} = 9.9 \text{ larvae, pupae and parasites per 100 terminals.}$$

There are only 6.9 larvae and pupae per 100 terminals according to figures in Table VII, therefore there has been only

$$\frac{6.9}{12.2} \times 100 = 56.9\% \text{ survival}$$

from the larval to the pupal stage.

The percentage survival at the time of the pupal count is found to be 44.5 in the Red Rock Lake area.

The reason for this high mortality is hard to ascertain; certainly some is due to parasitism and predation which amounts to 27.5%; the remainder is probably due to factors which are unknown at present.

4. Egg Counts

Egg counts were carried out in three regions: Hawk Lake, Ontario, Red Rock Lake, Manitoba, and Sandilands Forest Reserve, Manitoba.

In each case two branches containing 100 terminals each were cut from the top half and two branches also containing 100 terminals were cut from the lower half; these were then examined for eggs and those found placed in shell vials for counts.

(a) Hawk Lake, Ontario.

Ten trees were sampled in this investigations, 5 in the Campsite area and 5 on Post Office point. The same trees used in the larval count were examined.

Table VIII shows the distribution of egg clusters on each tree in the Campsite area, the number of clusters and the number of eggs in each cluster.

Table VIII

Egg Count - Hawk Lake, Ontario.

Campsite

Tree No.	Location of sample	Number of egg clusters	Number of hatched eggs	Number of unhatched eggs	Total number of eggs.
1.	Top	2	71	0	71
	Bottom	1	28	6	34
2.	Top	6	426	4	430
	Bottom	1	29	0	29
3.	Top	4	98	6	104
	Bottom	4	280	8	288
4.	Top	0	0	0	0
	Bottom	0	0	0	0
5.	Top	4	273	37	310
	Bottom	1	23	0	23
		23	1228	61	1289

From the above data there were;

$\frac{1289}{20}$ = 64.30 eggs per 100 terminal.

$\frac{23}{20}$ = 1.15 clusters per 100 terminals

Average number of eggs per cluster are: $\frac{1289}{23}$ = 56.04

Fertility - $\frac{1228}{1289} \times 100$ = 99.92% for Campsite Area.

Table IX shows distribution of eggs on Post Office Point.

TABLE IX

Egg Count - Hawk Lake, Ontario.

Post Office Point.

Tree No.	Location of sample	Number of egg clusters	Number of hatched eggs	Number of unhatched eggs	Total number of eggs
1	Top	7	333	3	336
	Bottom	11	428	13	441
2	Top	5	137	9	146
	Bottom	0	0	0	0
3	Top	8	328	13	341
	Bottom	2	103	1	104
4	Top	2	51	6	57
	Bottom	4	41	28	69
5	Top	3	133	0	133
	Bottom	4	137	3	140
	TOTAL	46	1691	76	1767

In the Post Office point area there were:

$\frac{1767}{20}$ = 88.3 eggs per 100 terminals

$\frac{46}{5}$ = 9.2 clusters per tree sampled

$\frac{46}{20}$ = 2.4 clusters per 100 terminals

Average number of eggs per cluster: $\frac{1767}{46}$ = 38.4

Fertility: $\frac{1691}{1767} \times 100$ = 95.70% for Post Office Point area.

The following data summarizes results obtained for the general area at Hawk Lake, Ontario:

Trees examined	10
Branches examined	40
Terminals examined	4,000
Egg clusters obtained	69
Eggs obtained	3,056
% Fertility	95.52%
Average number eggs per cluster	44.29
Average number clusters per 100 term.	1.725
Average number of eggs per 100 term.	76.40

In comparing the number of eggs obtained during previous years (no egg counts were done in 1946), it will be observed that there is an upward trend in egg numbers; whether this signifies that an increase in population will occur during 1948 depends on the survival rate of the larvae, and on the degree of fertility of the eggs, which is very high according to the sample taken (95.52%).

1942 - 214 eggs per 100 terminals
1943 - 148 eggs per 100 terminals
1944 - 34.2 eggs per 100 terminals
1945 - 7.48eggs per 100 terminals
1946 - ---
1947 - 76.40 eggs per 100 terminals.

(b) Red Rock Lake, Manitoba.

10 trees were used here, and the same procedure followed as at Hawk Lake. All trees used were in the Campsite Area and were tagged and classified during the pupal count, i.e. the same trees used as in the pupal count.

Table X shows the distribution of eggs found;

Table X

Egg Counts - Red Rock Lake, Manitoba.

Tree No.	Location of sample	No. of egg clusters	No. of hatched eggs	No. of unhatched eggs	Total no. of eggs
1	Top	8	375	8	383
	Bottom	0	0	0	0
2	Top	5	270	2	272
	Bottom	5	181	7	188
3	Top	6	301	6	307
	Bottom	2	137	0	137
4	Top	2	57	0	57
	Bottom	2	150	0	150
5	Top	3	194	0	194
	Bottom	0	0	0	0
6	Top	2	109	0	109
	Bottom	0	0	0	0
7	Top	1	22	0	22
	Bottom	0	0	0	0
8	Top	1	82	0	82
	Bottom	2	77	0	77
9	Top	1	39	0	39
	Bottom	2	32	0	32
10	Top	5	276	0	276
	Bottom	6	392	0	392
	TOTAL	53	2694	23	2717

From the data in Table X; Red Rock Lake area contains:

$\frac{2717}{40}$ = **67.92** eggs per 100 terminals

$\frac{53}{40}$ = **1.325** clusters per 100 terminals

Average number of eggs per cluster: $\frac{2717}{53}$ = **51.26**

Fertility: $\frac{2694}{2717}$ x 100 = **99.15%**

Summary of egg count in Red Rock Lake Area:

Trees examined	- 10
Branches examined	- 40
Terminals examined	- 4,000
Egg clusters obtained	- 53
Eggs obtained	- 2717
% Fertility	- 99.15%
Average No. of eggs per cluster	- 51.26
Average No. of clusters per 100 term	- 1.325
Average No. of eggs per 100 termin.	-67.92

(c) Sandilands Forest Reserve, Manitoba.

The same procedure was used as in two previous egg counts except that a larger sample was taken; 20 trees were examined, 10 in the area of sample plots 19, 20 and 21 (Area I) and 10 along the road to Camp I (Area II)

Distribution parasitism and fertility of eggs found in Area I is shown in Table XI:

Table XI

Egg Count - Sandilands Forest Reserve (Area I)

Tree No.	Location of sample	No. of egg clusters	Parasitized Eggs	No. of hatched eggs	No. of unhatched eggs	Total No. of eggs
1	Top	17	4	389	25	418
	Bottom	5	0	121	4	125
2	Top	17	27	616	22	665
	Bättom	2	3	78	0	81
3	Top	26	41	989	24	1054
	Bottom	2	0	79	1	80
4	Top	13	9	732	15	756
	Bottom	1	0	21	5	26
5	Top	12	7	477	0	484
	Bottom	0	0	0	0	0
6	Top	26	76	1028	23	1127
	Bottom	7	0	379	8	387
7	Top	25	19	965	9	993
	Bottom	6	8	167	0	175
8	Top	14	20	449	25	494
	Bottom	5	2	121	0	123
9	Top	18	15	533	25	573
	Bottom	0	0	0	0	0
10	Top	4	6	227	14	247
	Bottom	3	2	64	3	69
	TOTAL	203	239	7435	203	7877

The area along the road to Sample Plots 19, 20 and 21 contains, according to data obtained (Table XI):

$\frac{7877}{40}$ = 196.72 eggs per 100 terminals

$\frac{203}{40}$ = 5.075 clusters per 100 terminals

Average number of eggs per cluster: $\frac{7877}{203}$ = 38.81

Fertility - $\frac{7435}{7877}$ X 100 = 94.39%

% parasitism - $\frac{239}{787}$ X 100 = 3.03%

Distribution, parasitism and fertility of eggs found in Area II are shown in Table XII.

The area in Sandilands Forest Reserve along the road to Camp I contains, according to data presented (Table XII):

$$\frac{9725}{40} = 243.12 \text{ eggs per 100 terminals}$$

$$\frac{207}{40} = 5.175 \text{ clusters per 100 terminals}$$

$$\text{Average no. of eggs per cluster: } \frac{9725}{207} = 46.98$$

$$\text{Fertility} - \frac{9285}{9725} \times 100 = 95.48\%$$

$$\% \text{ parasitism} - \frac{330}{9725} \times 100 = 2.95\%$$

Combining results obtained from the two areas, the following results are obtained for the general Sandilands Forest Reserve Area:

Trees examined	- 20
Branches examined	- 80
Terminals examined	- 8000
Egg clusters obtained	- 410
Eggs obtained	- 17,602
% Fertility	- 94.99%
% Parasitism	- 3.23%
Average No. eggs per cluster	- 42.93
Aver. No. clusters per 100 term.	- 5.125
Aver. No. eggs per 100 termin.	- 220.03

Through comparison of the number of eggs per 100 terminals for the three regions investigated (below) it will be seen that by far the highest number were found in Sandilands Forest Reserve.

Hawk Lake, Ontario	- 76.40 eggs per 100 terminals
Red Rock Lake, Manitoba	- 67.92 eggs per 100 terminals
Sandilands F.R., Man.	- 220.03 eggs per 100 terminals.

Table XII

Egg Count - Sandilands Forest Reserve (Area II)

Tree No.	Location of sample	No. of egg clusters	Parasitized Eggs	No. of hatched eggs	No. of unhatched eggs	Total No. of eggs
1	Top	7	5	358	3	366
	Bottom	0	0	0	0	0
2	Top	5	0	265	0	265
	Bottom	1	0	77	0	77
3	Top	39	59	1677	47	1783
	Bottom	2	0	48	0	48
4	Top	28	90	1103	19	1212
	Bottom	2	0	109	0	109
5	Top	11	1	668	4	673
	Bottom	6	17	255	0	272
6	Top	10	1	394	3	398
	Bottom	3	0	175	0	175
7	Top	21	23	978	15	1016
	Bottom	3	0	170	0	170
8	Top	10	41	474	1	516
	Bottom	5	0	173	0	173
9	Top	16	35	681	1	717
	Bottom	3	0	198	6	204
10	Top	30	53	1287	10	1350
	Bottom	5	5	195	1	201
	TOTAL	207	330	9285	110	9725

5. Analysis of Larval and Pupal Population Data

(a) Hawk Lake, Ontario.

The data from Table XIII were subjected to analysis to determine how accurate the degree of correlation was between replicate samples.

The correlation coefficient was calculated by the formula used in previous years (Annual Technical Report 1943, page 56) and the following results obtained:

Table XIV

Correlation Coefficients and Significance
Hawk Lake, Ontario.

Stage of budworm	Location	Correlation Coefficient	"t"	5% Pt.	1% Pt.	Signi-ficance
Larva	Upper ½	.3357	1.5963	2.55	2.88	None
Larva	Lower ½	.1704	.9043	2.55	2.88	None

It will be noted that larval population was below 10 larvae per 100 terminals and since only 20 trees were examined the correlation coefficient was low and of no significance.

(b) Red Rock Lake, Manitoba.

The data from Tables XV and XVI were analysed in the same manner as those for the Hawk Lake region, and the following results obtained:

TABLE XIII

Replidate Larval Count - Hawk Lake, Ontario.

Tree number	Top ½ Number of larvae		Bottom ½ Number of larvae	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
Campsite				
1	13	10	12	1
2	10	11	8	1
3	9	6	5	3
4	6	3	7	7
5	15	11	3	0
6	12	6	3	4
7	4	14	4	1
8	2	3	11	2
9	7	0	2	1
10	0	1	4	4
Post Office Point				
1	24	7	6	17
2	21	13	11	4
3	0	8	0	0
4	0	0	1	0
5	16	6	2	1
6	3	14	2	6
7	6	6	1	0
8	11	21	3	9
9	1	1	1	4
10	2	10	1	0

TABLE XVII

Correlation Coefficients and Significance
Red Rock Lake, Manitoba.

STAGE of Budworm	Location	Correlation Coefficient	"t"	5% Pt.	1% Pt.	Significance
Larva	Upper ½	.5685	1.040	2.62	2.98	None
Larva	Lower ½	.6211	2.983	2.62	2.98	strong
Pupa	Upper ½	.3975	1.936	2.55	2.88	None
Pupa	Lower ½	.0863	.7640	2.55	2.88	None

Here again larval and pupal populations were low, and not enough replicates were taken, thus resulted in no significance.

Table XV

Replicate Larval Count - Red Rock Lake, Man.

Tree number	Top ½ Number of larvae		Bottom ½ Number of larvae	
Count I	Replicate 1	Replicate 2	Replicate 1	Replicate 2
Campsite				
1	6	18	7	5
2	19	6	13	30
Experimental area				
1	2	5	1	1
2	3	3	1	7
3	1	9	2	1
4	11	5	4	5
Count II	Replicate 1	Replicate 2	Replicate 1	Replicate 2
Experimental area				
1	5	5	0	5
2	3	2	1	5
3	4	2	0	2
4	2	4	2	0
5	5	1	1	1
6	5	1	3	3
7	3	7	2	4
Campsite				
1	12	17	26	17
2	13	7	3	2
3	2	6	22	7

TABLE XVI

Replicate Pupal Count, Red Rock Lake, Man.

Sound budworm, parasitized pupae and larvae. <u>No</u> parasite cocoons or predatorized pupae.

Tree No.	Top ½ Number of Pupae		Bottom ½ Number of Pupae	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
Campsite				
1	4	10	3	1
2	8	7	5	7
3	5	7	6	2
4	3	5	7	12
5	8	17	25	8
6	4	10	5	3
7	2	6	9	15
8	19	12	4	4
9	18	11	0	3
10	9	3	2	1
11	3	0	2	0
12	20	23	12	20
13	1	7	2	1
14	2	3	3	6
15	11	7	1	2
16	10	7	2	0
17	2	16	0	5
18	8	15	0	15
19	20	6	1	19
20	1	7	8	3

A. The Host Transfer Study.

This study was initiated in 1942 with new transfers being made in each year 1942-1945 inclusive. The object of this study is outlined in the 1942 Annual Technical Report page 62 and the methods and nomenclature in the 1943 Annual Technical Report pages 86-89.

The present report includes only a summary of the 1947 data together with a few pertinent observations. No attempt has been made to analyze the entire mass of data from this study, since the complexities involved in analysis are so time consuming as to be impossible at this time. A table showing all transfers originally begun and their duration is included, however, to indicate the progress of the study.

B. 1947 Notes on the Host Transfer Study.

There were few unusual developments observed in the course of the 1947 rearings.

Pupal measurements were not continued in 1947 since the value of the data obtained appeared to be out of proportion to the time involved in making these measurements.

It is certain that the results for many of the cages are influenced by a lack of food resulting from, either overcrowded conditions or an initial lack of foliage on the seedling. It was therefore deemed advisable in 1947 to limit the original number of larval on each seedling in order to decrease one factor contributing towards starvation. Therefore in the case of the large cages i.e. 33, 41, 65, 67, the original number of egg clusters was divided as equally as possible so that approximately half the eggs laid were placed on the overwintering seedling. By using this procedure serious overcrowding should be avoided and should eliminate the necessity of spring re-transfer.

The degree of needle mining in 1947 is indicated on the basis of the mined needles with regard to the observed population. This is a purely objective comparison but probably represents a better comparison than used in previous years based upon the relative total number of mined needles.

Of considerable interest in 1947 was the occurrence of heavy needle mining by the jack pine budworm, in the overwintering cages of the Pollen Study at Jessica Lake. The larvae in these cages emerged very early, some time before terminal development had begun and hence probably were of necissity forced to mine needles. The larvae apparently were not adversely affected by this premature emergence and actually had at the end of the season surpassed in rate of development the larvae on uncaged surrounding seedlings. From these observations it appears that the jack pine budworm can upon occasion mine needles in order to subsist and therefore the habit of needle mining is not confined to the spruce strain.

Lack of new foliage certainly resulted in starvation in the following cages: 43, 43A, 71 and to a lesser extent in cages 65 and 67. Free larvae found on a black spruce seedling adjacent to cage 43 probably escaped from that cage. In cages 65 and 67, overcrowding resulted in destruction of seedlings towards the end of the season.

An interesting although unexplained development was the extremely high mortality of male pupae in cage 33. Of a total of 43 male pupae, 28 or 65.1% failed to emerge. All these pupae were abortive, being very small and poorly formed. The cause or causes of the mortality as intimated above are not known, since no similar mortality being found in any of the other cages. There was no apparent starvation in this cage, hence the high male pupal mortality unaccompanied by a similar female mortality indicates the possibility of a sex selective mortality factor or factors.

Of eleven cages overwintered 1946-47, three failed to survive through the 1947 season. These were cages 69, 81, 83. In cage 69 no larvae reached the pupal stage, while in cage 81, two moths were recovered but continuation of the cage at such a low level was deemed uneconomical of time, and in cage 83, no female pupae were recovered.

Data for the 1947 rearings are found in the following table.

TABLE I

Rearings of the Host Transfer Study.

Cage No.	33	39	41	43	43A	65	67	69*	71	81	83
Original Cage No.	33	39,40	41,42	43,44	43,44	65,66	67,68	69,70	71,72	81,82	83,84
GO.	1943	1944	1944	1944	1944	1945	1945	1945	1945	1945	1945
Transfer	Sw-Ab	Ab-Sw	Ab-Ab	Ab-Sb	Ab-Sb	Ab-Sw	Ab-Ab	Ab-Pj	Ab-Sb	Pj-Ab	Pj-Sw
First Appearance	May 14 Larvae	May 20 Larvae	May 14 Larvae	May 20 Larvae	May 27 Larvae	May 11 Needle Mining	May 17 Needle Mining	June 12 Needle Mining	May 17 Larvae	June 7 Larvae on outer sleeve	June 20 Larvae
Overwintering Survival	13.5%	-	7.1%	-	-	-	19.8%	14.3%	3.2%	-	-
Needle Mining	Heavy	Medium	Heavy	Heavy	Medium	Medium	Medium	Light	Very Heavy	None	None
1st Pupa	June 29	July 3	July 3	July 9	July 9	July 3	June 29	-	July 9	July 11	July 14
Pupae Matured ♂ ♀ Total	43 35 78	14 10 24	40 27 67	4 5 9	15 10 25	27 30 57	45 31 76	-	16 16 32	1 1 2	3 0 3
Survival to pupation i.e. egg—pupa	11.4%	5.0%	6.0%	2.4%	6.2%	19.0%	18.8%	-	37.6%	1.2%	3.4%

Continued-

TABLE I Continued-

No. ♀ caged for oviposition	15	8	23	3	6	25	25	0	9	0	0
Total eggs per female	149.3	47.8	158.2	68.0	82.5	84.2	131.4	-	105.7	-	-
% Fertility	85.4%	46.0%	72.7%	38.7%	57.8%	89.6%	87.2%	-	64.6%	-	-
Egg clusters per female	6.3	4.9	9.6	11.0	7.3	4.6	6.7	-	8.8	-	-
Eggs per cluster	23.8	13.2	16.5	6.2	11.2	18.3	17.7	-	12.0	-	-
Total # larvae on over-wintering seedling	1161	app.176	app.1296	app.79	app.286	941	1430	-	app.615	-	-

* Overwintering on balsam transferred to Pj June 12.

C. Discussion and Explanation of Data.

The overwintering survival figures are based upon re-transfer counts made over a period of ten days. Whether these figures depict true overwintering survival values is open to question. The percentage survival together with the date of retransfer and the stadia of larvae at the time of transfer for each retransferred cage is tabulated below.

TABLE II

Host transfer Overwintering Survival 1946.

Cage No.	% Survival	Date of Transfer	Stadium Transferred
33	13.5%	June 13	3rd
41	7.1%	June 14	3rd
67	19.6%	June 20	5th
69	14.3%	June 12	3rd
71	3.2%	June 21	4th

From the table it is seen that cage 67 realized the highest rate of overwintering survival. The relative rates in order of cages are as follows:-67, 69, 33, 41, 71. This series indicates an almost complete lack of relationship insofar as the host transfer problem is concerned. However, allowance must be made for such occurrences as overcrowding and starvation as well as unknown factors creating a problem of great complexity and probably impossible to conclude satisfactorily with the almost complete inconformity of conditions among the various cages.

From equal numbers of spruce and pine types transferred, no pine strain transfers have survived. This superficially indicates a general lack of ability of the jack pine budworm to survive on hosts other than its own as compared to the spruce budworm.

On the other hand, while the spruce form seems capable of survival on a number of hosts for several generations, it is apparently incapable of survival on jack pine under normal artificial conditions, that is, being reared the entire year on jack pine. In addition, while the spruce form is naturally found on balsam, white spruce and black spruce, the pine form occurrs in numbers only on jack pine. Balsam is the recognized preferred host of the former and it is on this host which the spruce form has thrived best in these experiments.

The remaining cages and their designations are tabulated below:-

Cage 33:	Sw-Ab:	Go 1943	
Cage 39:	Ab-Sw:	Go 1944	
Cage 41:	Ab-Ab:	Go 1944	
Cage 43:	Ab-Sb:	Go 1944	Originally one cage.
Cage 43A:	Ab-Sb:	GO 1944	
Cage 65:	Ab-Sw:	Go 1945	
Cage 67:	Ab-Ab:	Go 1945	
Cage 71:	Ab-Sb:	GO 1945	

Table 3 shows in tabular form the successful generations completed by each of the transfers. A successful generation in the sense means the completion of the developmental period and production of fertile eggs. Although many transfers partially completed an additional generation, only complete generations are indicated.

This table in itself is merely a record of the transfers and is not intended for use in basing conclusions on the ability of either strain to survive on alternate hosts. Many factors must be considered before such conclusions may be drawn.

TABLE III

Cages of the Host Transfer Study 1943-1947.

Cage No.	Original Cage Nos.	Transfer	Go	Successful Generations	Total
19	19	Ab-Sw	1943	'43, '44, '45	3
31	10,11,28	Sw-Sw	1943	'43	1
32	12,13	Sw-Sb	1943	'43, '44	2
33	14,15	Sw-Ab	1943	'43, '44, '45, '46 '47	5
34	17,18	Ab-Pj	1943	'43	1
35	16,20,21	Pj-Sw	1943	'43, '44, '45	3
36	22,23	Pj-Sb	1943	'43, '44	2
37	24,25	Pj-Ab	1943	'43, '44	2
39	39,40	Ab-Sw	1944	'44, '45, '46, '47	4
41	41,42	Ab-Ab	1944	'44, '45, '46, '47	4
43*	43,44	Ab-Sb	1944	'44, '45, '46, '47	4
45**	45,46	Ab-Pj	1944	'44, '45, '46	3
47	47,48	Pj-Sw	1944	'44, '45	2
49	49,50	Pj-Ab	1944	'44, '45	2
51	51,52	Pj-Sb	1944	'44, '45	2
65	65,66	Ab-Sw	1945	'45, '46, '47	3
67	67,68	Ab-Ab	1945	'45, '46, '47	3
69	69,70	Ab-Pj	1945	'45, '46	2
71	71,72	Ab-Sb	1945	'45, '46, '47	3
79	79,80	Pj-Sb	1945	'45	1
81	81,82	Pj-AB	1945	'45, '46	2
83	83,84	Pj-Sw	1945	'45, '46	2

A. Introduction.

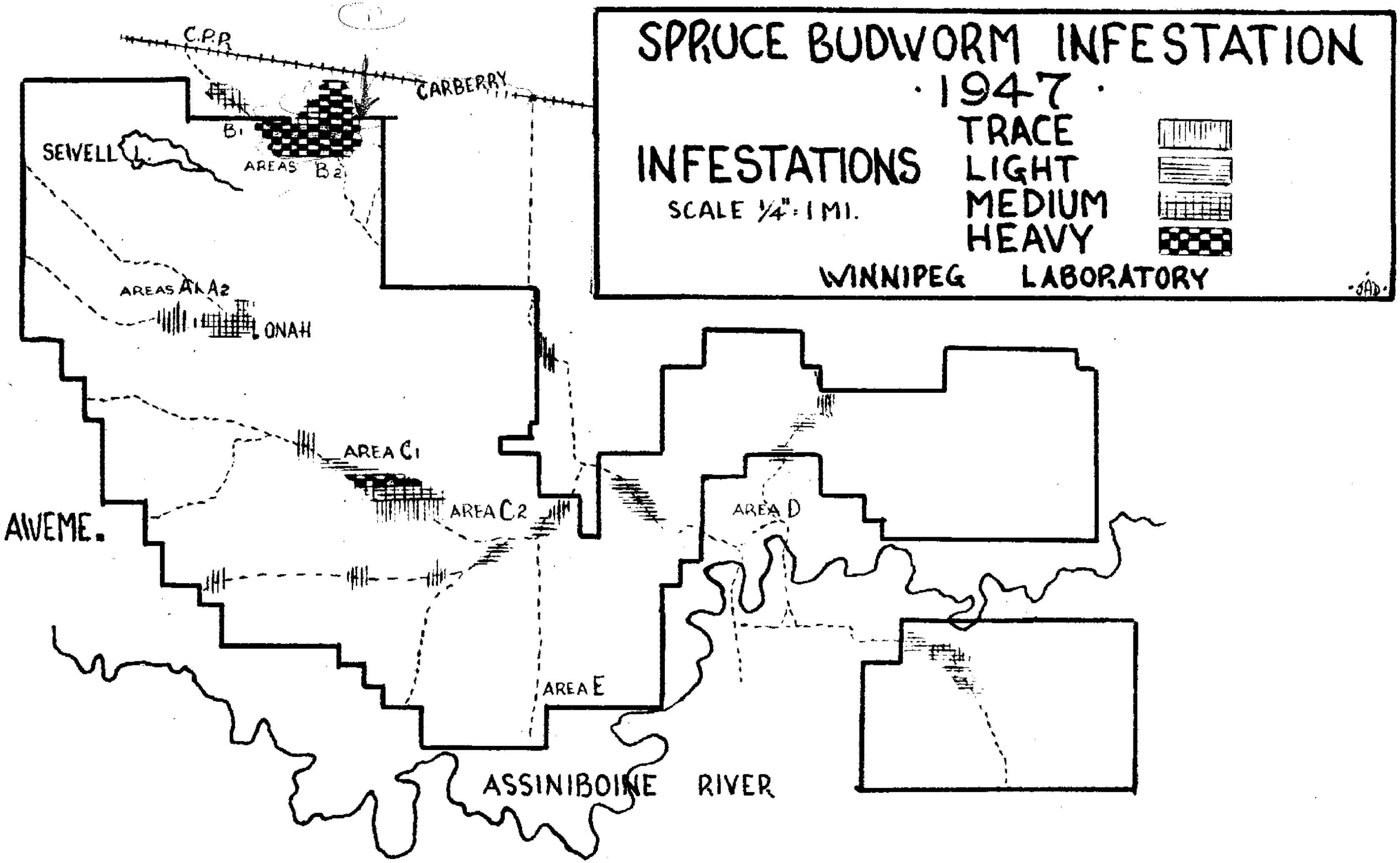
In 1947, the Biological Control Project on *Archips fumiferanae* Clem., initiated the previous year in the Spruce Woods Forest Reserve, was undertaken for the second successive year. The objectives were again very much similar with the primary purpose being the determination of natural control factors operating in this general area, and their qualitative and quantitative distribution. In order to obtain a representative approximation of the budworm population, 24 spruce trees were selected and tagged in 1946. The same trees were again used in 1947. Replicate samples of 100 terminals each were removed from the median portion of each tree, using an extension pruner. The sample was taken from the periphery of the tree, and the foliage was thoroughly scrutinized in order to obtain the most reliable estimation of population.

Reconnaissance was also conducted throughout other portions of the reserve, and this general survey was intended to give some indication of the distribution as compared to previous infestations. For other information concerning the general topographic features and distribution of tree species, the reader is referred to P. 105, Annual Technical Report, Winnipeg Lab. 1946.

B. Status of Infestation.

Budworm investigations throughout the reserve were unhampered during the past year by military activities, and a thorough reconnaissance of the reserve was therefore feasible. This reconnaissance was, however, limited by the distribution of trails and the ease with which they could be traversed in a sandy country of this nature. As a criterion for indicating the intensity of infestation, budworm damage was observed and recorded as a trace, light, medium or heavy, and the symbols are indicated on the accompanying map as such. Of noteworthy mention was the presence of budworm killed white spruce in the general vicinity of Area C_1, where the budworm was first observed

· SPRUCE WOODS FOREST RESERVE ·



in 1939. However, this was an isolated case, and the most extensive infestation now lies in the northern portion of the reserve in what is known as the Carberry Area. With a view to finding the limits of this infestation the territory north of the C.P.R. track was also investigated. The terrain is very much similar to that found within the reserve, but the spruce are, generally speaking, much more widely scattered. All spruce examined in this region were found to be in a healthy condition, and no budworm damage was observed.

C. Phenology.

1. Budworm Development.

With a view to determining the progressive development throughout the budworm life cycle, which may be compared from year to year, some of the more important information has been recorded. The greater part of this information was obtained from routine population counts, and from casual observations in the field. The first budworm larva recorded in 1947 was seen on May 13. Due primarily to inclement weather, budworm development was somewhat retarded when compared with relative dates of the previous year. To illustrate this point, the first 3rd instar larva was recorded on June 2, as compared to May 22 in 1946. The terminal growth on white spruce in the Spruce Woods Forest Reserve escaped frost damage until the end of May, when severe frosts on the nights of May 27 and 28 caused moderate damage to new bud growth. The first pupa appeared on June 27, while the first budworm pupal skins were observed on July 10. The first egg cluster was recorded on July 16.

2. Parasites and Predators.

In an endeavour to determine the relationship of parasite species to the host, the first appearance of cocoons of *Apanteles fumiferanae* (Vier.) and *Glypta fumiferanae* (Vier.) were recorded. With the appearance of these cocoons, a decided decline in the budworm population may be anticipated as it may readily be assumed that each parasite cocoon represents one dead budworm larva. With the major portion of parasite emergence from the host being completed by the 5th instar, an accurate representation of parasitism would not be obtained by the dissection of larvae gathered after the first appearance of parasite cocoons in the field. The first cocoons of Apanteles sp. were observed on June 18. Rearings were made at the campsite and the first adult emerged on July 2, while the last adult emergence was recorded on August 5. On the other hand, the first Glypta cocoon was collected on June 30, with adult emergence taking place between July 10 and 24 inclusive. The first adult of Itoplectis conquisitor (Say) was recorded on June 27, and the first Itoplectis adult emerged from reared pupae on July 17. Dioryctria reniculella was again the outstanding predator. The larval development of this insect appears to parallel that of budworm very closely, although pupation occurs somewhat later. It is after the budworm larvae have pupated, and while Dioryctria is still in the larval stage, that this predator appears to be most prevalent. In many instances, the white silken cocoons of Dioryctria were observed in the immediate vicinity of the predatorized budworm pupae. Adult Coccinelid beetles of Anatis sp. were observed throughout the reserve, at various stages of larval and pupal development. The larval form of this species has been observed to be a predator against spruce budworm larvae. However, no such activity was observed during the course of investigations conducted in 1947. The activity of ants cannot be overlooked, as they appear to be extremely active as a predator, especially on those larvae which have fallen to the ground.

3. Plant Indicators.

The abundance of many plant species within the reserve affords an excellent opportunity to compare relative rates of plant growth with that of budworm development. The purple flower of a species of cactus growing within the reserve was again observed to appear at approximately the same time that budworm pupation commenced. This cactus was observed to be in bloom on July 4, as compared to the first

first appearance of budworm pupae on June 27. Other species of plants, present in great abundance throughout the reserve, would probably be important in gauging the seasonal development of other stages in the budworm life cycle. Plant collections, made at the time when flowering is first observed, would probably be of assistance in determining when various stages of budworm development might be expected in ensuing years.

D. Budworm Population Study.

The determination of population fluctuations throughout the budworm life cycle is one of paramount importance in this project, and is also one of the most time consuming phases of the work.

The same three study areas situated in various portions of the reserve were again used for sampling purposes. They are shown on the map as Areas A_1, A_2 and B_1. A total of 6 white spruce in Area A_1 were tagged and examined periodically to determine population fluctuations. 6 white spruce situated on a ridge and 6 black spruce lying adjacent to the white spruce, and situated on the edge of the Epinette swamp were used for sampling purposes in Area A_2. Both Areas A_1 and A_2 are situated in the vicinity of the Piat Range, and borders the southern edge of the Epinette swamp. Area B_1 lies on the northern side of the Epinette swamp in the region generally known as the Carberry area. The same trees were sampled in 1947 as in the previous year. In some instances foliage became very scarce, as sampling progressed, especially on suppressed black spruce in Area A_2.

The sampling techniques used during the past year were identical with those employed in the previous year. Using an extension pruner with an attached cloth net, branches containing approximately 100 terminals were removed from the median portion of each sample tree. Two such samples were removed from the periphery of the tree during each count. 100 terminals were counted from each branch, and all new terminal growth and equivalent foliage were thoroughly scrutinized and the following information was recorded: living budworm larvae, dead budworm larvae, empty webs, parasite cocoons, other larvae, mined needles, frozen terminals, diseased larvae, predatorized pupae, dead pupae, emerged pupal skins, etc. Five counts were conducted on the 24 spruce trees involving 3 larval, 1 pupal, and 1 egg count. All material obtained from each count was placed in individual labelled vials, and preserved in Frehling's solution for future reference.

One of the controversial issues of this project has been the sampling techniques employed. It has been observed that after the 4th instar much of the new terminal growth is devoured, and the larvae are apparently in a state of mass migration in search of new sources of food. At this time, many larvae are suspended on their webs, and in taking samples vast numbers of larvae can be found in the net. It is difficult to determine what portion of these larvae can be said to have fallen from the 100 terminals, as many may have dropped from higher branches of the tree, and a certain number of the larvae in the net would be attributed to that part of the branch which has a variable number of terminals over and above the 100 terminals necessary for each sample. In compiling the 1946 report it was assumed that one half of the larvae in the net had fallen from the 100 terminals under examination. However, in compiling the data this year, it was decided to omit the larvae from the net entirely. In order that the work would be consistent, population figures from 1946 were revised, omitting the larvae in the net, and a new population reduction graph was drawn up using the revised figures.

Again, during the pupal period, the accuracy of the sampling technique is in doubt. In many instances, large numbers of pupae were observed on the ground foliage beneath the sample trees. Whether or not the larvae fell from the trees, and then pupated on the underlying foliage is a debatable point. The latter may be the case, as this phenomena was observed to be more common with the white spruce situated on the wind swept ridge in Area Ag.

The needle mining habit, characteristic of the spruce budworm, is important in determining the initial population of the budworm population. During the first and second counts, all mined needles found on the foliage of the sample branch were preserved in Frehling's solution, and examined under the microscope to determine whether the larvae were still present in the needles, or whether they had vacated the needles. A resume of the number of needles containing larvae, and the number of vacated needles will be found in Table I.

Table I

Area	Host Tree	Mean Number of Mined Needles per 100 terminals.			
		Needles Containing Larvae		Vacated Mined Needles	
		Count Number		Count Number	
		1	2	1	2
A_1	SW	2.83	3.83	3.50	4.58
A_2	Sb	6.33	4.08	4.25	13.15
A_2	Sw	7.50	-	4.75	.83
B_1	Sw	5.25	.08	2.33	2.66

The majority of budworm larvae had left the needles by June 11, and the last budworm larvae to be found in a mined needle was on June 12. The larvae found in the mined needles are a component of the larval population, and are included in the larval population figures found elsewhere in this report.

Other larvae removed from the sample branches were preserved and identified as closely as possible with a view to determining their relationship to the spruce budworm. Among the more important insect species found were Dioryctria renicullela, Zeiraphera sp. and Peronea variana. Table II reveals the numerical relationship of these three insect species along with several unidentified species to the spruce budworm population.

Table II

Areas / Larvae found in pop. Counts	A_1 No. per count 1	2	3	4	Total	A_2 No. per count 1	2	3	4	Total	B_1 No. per count 1	2	3	4	Total	Relative abundance of larvae
Archipa fumiferanae	24	43	146	41	254	35	166	127	44	372	21	124	82	29	256	71.02%
Dioryetria reniculleia	-	-	46	39	85	-	19	49	12	80	-	5	18	2	25	15.3%
Zeiraphera sp.	-	3	26	9	38	-	7	13	10	30	2	8	21	6	37	8.45%
Peronea variana	-	-	-	-	-	-	-	1	1	2	-	1	2	-	3	.40%
unidentified *	-	-	-	5	5	-	-	6	20	26	1	2	17	9	29	4.83%

* Unidentifieds include unidentified tortricids, sawflies, and others.

Three larval counts and one pupal count were conducted at intervals with a view to obtaining a reliable estimation of the budworm population. Table III is a resume of the figures obtained from these counts.

Table III

POPULATION COUNT DATA

Sample Area A_1, S.W.F.R., Manitoba, 1947
Host tree - White spruce

Tree No.	Number of larvae and pupae per 200 terminals				
	Count No.	1	2	3	4
	Average Stadia	2	2 & 3	4,5,6	7 pre-pupae pupae
	Date	19-V-47	2-VI-47	19-VI-47	2-VII-47
1		--	18	34	7
2		7	9	37	2
3		12	15	15	7
4		17	25	14	11
5		6	5	20	2
6		4	12	25	3
Mean		7.7	14.0	24.2	5.3

Sample Area A_2 S.W.F.R., Manitoba, 1947
Host tree- Black spruce

Tree No.	Number of larvae and pupae per 200 terminals				
	Count No.	1	2	3	4
	Average Stadia	2	2 & 3	3,4,5	
	Date	21-V-47	3-VI-47	20-VI-47	3-VII-47
7		27	9	18	2
8		19	30	30	6
9		9	4	6	3
10		7	6	11	3
11		14	3	11	1
12		13	7	8	4
Mean		14.8	9.8	14	32

Sample Area A_2, S.W.F.R., Manitoba, 1947
Host tree - White spruce

Tree No.		Number of larvae and pupae per 200 terminals			
	Count No.	1	2	3	4
	Average Stadia	2	3 & 4	4,5,6	* pre-pupae pupae
	Date	22-V-47	11-VI-47	25-VI-47	4-VII-47
13		6	30	4	2
14		7	29	20	1
15		50	14	18	5
16		14	15	8	-
17		13	22	11	3
18		20	45	10	-
Mean		18.3	25.8	11.8	1.8

Sample Area B_1, S.W.F.R., Manitoba, 1947
Host tree - White spruce

Tree No.		Number of larvae and pupae per 200 terminals			
	Count No.	1	2	3	4
	Average Stadia	2	3 & 4	4,5,6,7	pre-pupae pupae
	Date	24-V-47	12-VI-47	27-VI-47	10-VII-47
19		19	29	15	2
20		11	9	8	2
21		13	17	19	2
22		15	34	8	2
23		10	14	6	1
24		16	20	23	-
Mean		14	20.5	13.1	1.5

* These figures do not include budworm larvae which have fallen in net.

Table IV

1947 - Summary : Population Count Data S.W.F.R., Manitoba

Count number	1		2		3				4				
Area	Total live bdwm larvae	Total dead bdwm larvae	Total live larvae	Total dead larvae	Total live	Total dead	Total diseased	Total parasite cocoons	Total live bud-worm	Total dead bud-worm	Total pred-ator-ized	Total para-site cocoons	Total emerged pupal skins
A_1	46	1	84	8	145	3	2		32	9	9	5 Apanteles 1 Glypta	
A_2 black spruce	89		59		84				19	2	2		
A_2 white spruce	110	1	155	3	71	2	2	5 Apanteles	11[illegible]	12	12	5 Apanteles 1 Glypta	
B_1	84		123	2	79	3		5 Apanteles	21	12	3	11 Apanteles 3 Glypta	12
Totals	329	2	421	13	379	8	4	10 Apanteles	83	35	26	21 Apanteles 5 Glypta	12
Mean per 100 terminals	6.85	.04	8.77	.27	7.89	.16	.08		1.73	.73	.54		.25

The figures listed in Table III deal only with live larvae and sound pupae, and do not include the various other conditions and factors pertinent to the population counts. With this in mind, Table IV was drawn up, and a summary of some of the more relevant information has been tabulated therein.

A complete egg count was conducted in the various study areas, to obtain an estimate of the potential budworm population for 1948. The same sampling technique was employed, and all egg clusters found were reared at the campsite until the black heads of the emerging budworm larvae were just visible. The egg cluster was then carefully preserved in a labelled vial containing Frehling's solution. In this manner it was hoped to obtain a reliable count of the number of fertile eggs as compared to the number of unhatched eggs, and hence an estimation of the budworm population prior to their going into hibernation. This method proved very satisfactory in most cases, with the young budworm larvae showing up within the egg cluster very well. However, due to inadequate rearing facilities, there was no emergence in some instances and some of the clusters tended to shrivel. This was perhaps due to their being subjected to unusual temperature and humidity conditions.

The results of the egg counts have been tabulated in Table V.

Table V

Egg Count Data S.W.F.R., Manitoba, 1947

Area	No. of Egg Clusters per area	Mean No. of hatched eggs per cluster	Mean No. of un-hatched eggs per cluster	Mean No. of parasitized eggs per cluster	Population per 100 terminals
A1	35	16.4	.75	.11	47.8
A_2 black spruce	14	24.7	1.1	.5	28.8
A_2 white spruce	21	23.4	0	.15	40.9
B_1	49	20.1	.12	.26	82.07

With the "population per 100 terminals" available from the egg count, the figures obtained should be representative of the budworm population going into hibernation. Provided a satisfactory larval count is obtained in the spring, it should be possible to obtain an approximate estimate of the overwintering mortality.

E. Parasitism.

The determination of the various parasite species contributing to the control of the spruce budworm is paramount to the success of this project. A knowledge of the quantitative distribution of these parasites and their effectiveness against the budworm is also very essential.

Parasites are effective against the budworm in the larval, pupal, and egg stages. However, determinations thus far have been confined to only the larval and pupal stages. "Apparent mortality" has been defined as the mortality of that particular phase of the life cycle, while "Actual mortality" is the mortality over the whole life cycle.

1. Larval parasitism.

In an endeavour to determine the parasite species operating in the larval stage, approximately 430 budworm larvae were collected in the various study areas, and sent to the Winnipeg laboratory. These larvae were reared and the parasites obtained were Apanteles, Glypta and one Diptera sp.

As a quantitative measure, to determine the abundance of larval parasites, mass collections of approximately 1200 budworm larvae were made in the various study areas, prior to the appearance of parasite cocoons in the field. These larvae were collected, and the percentage parasitism recorded. It is noteworthy that no dipterous parasites were found in these dissections, which is in line with the larval rearings where only one parasitic fly was obtained. The dissections of mass collections of larvae appears to be one of the soundest methods in the determination of parasitism, as the majority of larvae have attained such size as to facilitate the detection of parasites within the larvae.

It would seem that, in making these mass collections, branches should be removed, and that all foliage be carefully examined, and all larvae obtained from this foliage be preserved. In the past, collections have been made at random throughout the study areas, and the tendency has been to gather the largest larvae which, due to their advanced development, are the more easily gathered, and unfortunately are usually unparasitized.

In order to arrive at a figure for larval parasitism which would be consistent with that of the previous year, it was decided that the percentage parasitism obtained from the mass collections would be disregarded. The figure used was that obtained from the dissection of all 3, 4, and 5 instar larvae retained from the second and third population counts, plus any parasite cocoons obtained from the second and third counts. It was assumed that each parasite cocoon was re-

Table VI

Larval Dissections from Population Study

Area	Tree No.	Number of Larvae per 200 terminals																		
		2nd Count						3rd Count							4th Count					
		Stadia				Parasites		Stadia					Parasites		Stadia				Parasites	
		2	3	4	5	Apant	Glypta	3	4	5	6	7	Apant	Glypta	4	5	6	7	Apant	Glypta
A_1 White spruce	1601	-	17	-	-	1	1	-	6	10	10	-	2	8	-	-	1	-	-	-
	1602	-	9	-	-	-	-	-	2	19	16	-	6	2	1	-	1	-	-	-
	1603	1	-	-	-	-	-	-	10	5	-	-	1	1	1	-	4	2	1	-
	1604	5	-	-	-	-	2	-	2	12	-	-	3	1	1	-	4	1	2	-
	1605	3	1	-	-	1	-	-	7	13	-	-	2	1	-	-	-	-	-	-
	1606	-	-	-	-	-	-	-	5	18	1	1	4	2	1	-	-	-	-	-
A_2 Black spruce	1607	-	-	-	-	-	-	7	11	-	-	-	1	2	-	-	2	-	1	-
	1608	-	1	-	-	-	-	11	13	3	3	-	4	2	-	-	3	3	-	-
	1609	1	-	-	-	1	-	3	3	-	-	-	1	-	1	1	1	-	1	-
	1610	-	-	-	-	-	-	1	9	-	-	-	2	-	-	-	1	2	-	-
	1611	-	-	-	-	-	-	4	4	3	-	-	-	-	-	-	1	-	-	-
	1612	3	2	-	-	-	-	1	7	-	-	-	1	-	-	-	2	1	-	-
A_2 White spruce	1613	2	8	13	5	-	3	-	1	2	-	1	2	2	-	-	-	1	-	-
	1614	1	17	10	1	2	2	-	1	2	13	4	1	-	-	-	-	-	-	-
	1615	11	1	-	-	1	-	-	1	7	8	2	1	1	-	-	-	-	-	-
	1616	1	10	4	-	1	-	-	-	3	3	2	1	2	-	-	-	-	-	-
	1617	1	7	14	-	2	1	-	2	1	5	3	2	-	-	-	-	-	-	-
	1618	-	7	30	7	2	1	-	2	4	3	1	1	3	-	-	-	-	-	-
Area B_1 White spruce	1619	3	12	13	-	2	-	-	4	2	1	2	1	1	-	-	-	-	-	-
	1620	2	3	4	-	1	-	-	2	1	4	1	2	2	-	-	-	-	-	-
	1621	4	7	5	1	1	-	-	4	-	10	3	2	1	-	-	-	-	-	-
	1622	3	22	8	1	2	2	-	-	1	5	2	1	1	-	-	-	-	-	-
	1623	1	3	5	5	3	-	-	1	1	-	1	-	2	-	-	-	-	-	-
	1624	3	7	8	2	-	1	-	3	3	9	8	-	-	-	-	-	-	-	-

presentative of one dead budworm larvae. On this basis a figure of 22.1% larval parasitism was obtained from the examination of 507 budworm larvae.

Larval parasite cocoons were collected in the various study areas, and reared at the campsite to determine emergence dates. A summary of the information obtained from these rearings is shown in Table VII.

Table VII

Rearings of Parasite Cocoons for Emergence

Area	Parasite species	♂	♀	Un-emerged	1st collected	Emergence range
A_1	Apanteles		1	2	2-VII-47	7-VII-47
A_2	"			2	25-VI-47	
B1	"	1	2	12	27-VI-47	9-VII-47 - 5-VIII-47
B_2	"	8	2	1	18-VI-47	27-VI-47 - 10-VII-47
B_1	Glypta	6	1	2	30-VI-47	10-VII-47 - 24-VII-47

2. Pupal parasitism.

The method of determining pupal parasitism was similar to that employed the previous year. Mass collections consisting of approximately 2500 budworm pupae were gathered in the four main study areas, and reared at the Winnipeg laboratory in order to determine parasite species, and to evaluate the numerical distribution of each parasite.

The total pupal parasitism, as computed on the basis of these rearings, was found to be 37.5% with consideration given to all areas in which the pupae were gathered. Itoplectis conquisitor was responsible for 25.06% of the mortality, and is beyond doubt the most important pupal parasite operating in this area. Dipterous parasites accounted for 11.60% of the mortality. The adults of Itoplectis conquisitor were observed in the field prior to pupation, and the first emergence of the adult from the host was recorded on July 17. A summary of the control achieved by pupal parasites is contained in Table VIII.

Table VIII

Pupal Parasitism S.W.F.R. 1947

Area	No. of Pupae in Sample	% Parasitism *	% Natural Mortality	% Total Mortality
A_1	281	39.50	23.13	61.92
A_2	369	33.33	52.03	84.55
B_1 **	1378	43.90	17.56	60.74
B_2	446	19.96	78.92	97.53
Mean		37.51	34.40	71.06

* These percentages are based on the number of pupae from which parasites emerged, plus the number of dead pupae which contained unemerged parasites.

** In Area B1 of the Spruce Woods Forest Reserve, the number of pupae in the sample does not include those pupae damaged by the predator, Dioryctria reniculleia, Grt. In order to obtain an accurate estimate of pupal mortality, future collections should be in no way selective.

E. Parasite Introductions.

As an integral part of the natural control studies in the Spruce Woods Forest Reserve, 3 parasite liberations were made during the 1947 season. On June 10, 296 Phytodietus fumiferanae and 482 Pseudosarcophaga affinis were liberated. The condition of these parasites at the time of liberation was reported as excellent. A factor which may have a bearing on parasite distribution is wind velocity. At the time of liberation, there was a north-west wind with velocity estimated at 35 m.p.h. On June 18, a further 576 Phytodietus fumiferanae were liberated. The condition of these parasites was reported as good, and there was a south-east wind estimated at 15 m.p.h. at the time of liberation. The white cocoons, characteristic of the overwintering stage of Phytodietus were not recovered during the 1947 season. The detection of these parasites, their numerical establishment, and their effectiveness against the spruce budworm are deserving of more attention in future studies.

F. Predation.

One of the most effective predators serving as a natural control factor against the spruce budworm in the S.W.F.R. during the 1947 season was the spruce foliage worm, Dioryctria renicullela. The larval development of the foliage worm closely parallels that of the budworm, and in the very early stages it is difficult to differentiate the two larval species. In order to test the effectiveness of this predator, experiments were conducted at the campsite using equal numbers of foliage worm and budworm, which, in one case, were provided with spruce terminals on which to feed, and, in another case, using the same numbers of larvae but providing them with no food. The results obtained were very disappointing as rearing facilities proved to be inadequate.

Observations in the field indicate that budworm pupate somewhat earlier than the predator, and it was the period just after budworm pupation and prior to the pupation of the foliage worm that the greatest damage was apparently produced. The foliage worm spins a loose, silken cocoon partly enclosing the budworm pupa. On some terminals it was evident that as many as four budworm pupae were eaten by the same foliage worm before pupation.

G. Disease

A collection of budworm larvae which appeared to be diseased, were sent to Dr. K. Graham, at the Sault Ste. Marie Laboratory for examination. With the possibility of disease organisms assuming an increasingly important role in the control of budworm, future collections of budworm larvae should perhaps be more widespread to obtain a more representative picture of disease organisms at work. The inclusion of budworm pupae for disease detection may be of further assistance in determining natural control factors which could be used against the budworm in this particular stage of development.

H. Population Reduction - S.W.F.R. 1947

In an endeavour to ascertain the various factors contributing to the control of the spruce budworm, and the degree of control produced by each factor, an attempt has been made to correlate population count data with that of the controlling factors. The first population count revealed 6.89 larvae per 100 terminals as compared to 9.04 obtained on the second count. Hence, for purposes of indicating population reduction, the figures obtained from the second count have been used as the initial population. A plausible explanation for the small population obtained on the first count may be that this count was initiated somewhat earlier in 1947, and that budworm development was retarded as compared to the previous year. Hence, many of the young larvae may have still been in their overwintering hibernaculae which made their detection very difficult.

The budworm population dropped from an initial number of 9.04 larvae per 100 terminals (when larvae were in the second and third instars) to 1.1 at the end of pupation, which represents a decline of 88.2%. Larval parasitism, as determined from dissections and parasite cocoons taken during counts averaged 22.1%. Pupal parasitism was determined as 37.5% from rearings.

Based on the original population of 9.04 larvae per 100 terminals, the relative mortality caused by various factors was as follows:

dead, diseased, and predatorized	12.8%
larval parasites	19.2%
pupal parasites	7.1%
unknown causes	49.1%

This is illustrated graphically in Fig. 2.

The only larval parasites obtained from dissections and rearings during 1947 were:-

Apanteles fumiferanae (Vier)
Glypta fumiferanae (Vier)

The pupal parasites obtained from rearings of pupae at the Winnipeg Laboratory are listed below in order of abundance:

Hymenoptera
Itoplectis conquisitor (Say)
Phaeogenes hariolus (Cress)
Amblymerus verditer (Nort)
Psychophagus tortricis (Br.)
Brachymeria compsilurae (Cwfd.)

Diptera:
Madremyia saundersii (Williston)
Zenillia caesar (Aldrich)
Phryxe pecosensis (Townsend)
Nemorilla pyste (Walker)

I Revised Population Data S.W.F.R. 1946

In order that data from successive years might be as consistent as possible, the data from the 1946 project was revised to conform with that of 1947. In this regard, in compiling the data, those larvae which were found in the pruning net were omitted so as to conform with the 1947 data. A summary of the revised data is presented in tabular form in Table IX.

The population reduction graph was revised, and the "Actual Mortality" was plotted rather than the "Apparent Mortality" as shown on Page 134 of the 1946 Annual Technical Report, Winnipeg Laboratory. On the basis of calculations used in 1947, the various factors contributed to the 1946 decline as follows:

dead, diseased and predatorized	16%
larval parasites	26.9%
pupal parasites	6.9%
unknown causes	41.1%

The population reduction is depicted graphically in Figure 3.

In an endeavour to determine the relationship of other insect species to spruce budworm, a number of insect species obtained in the Spruce Woods Forest Reserve in 1946 were sent to Mr. G. Stuart Walley for identification.

The following is a list of the identifications and Mr. Walley's comments on each:

1.* Cremastus sp. near epagoges Cush. The latter species has not been reported previously as a parasite of spruce budworm, but it has been reported from the related host Archips cerasivorana.

2.* Apanteles sp. Species name unavailable for this unique male. In some respects it is near A.polychrosides. Vier. rather than A. fumiferanae.

3. Attractodes sp. Habits unknown but probably a parasite of Diptera.

4. Meteorus vulgaris. A common parasite of various species of cutworms pertaining to the family Phalaenidae.

5. Pemphredon sp. Wasps of this genus nest in decaying wood, and provision their nests with aphids as food for the larvae.

6. *Smicroplectrus velox* Wly. Host sawflies of the genus *Pachynematus*.

7. *Sphex* sp.

8. *Podalonia* sp. Members of this genus and the preceding nest in the ground, and provision their burrows with caterpillars of various kinds.

J. Statistical Analysis of Data.

The population data accumulated during 1946 and 1947 was subjected to statistical treatment, in an effort to determine the adequacy of the sampling techniques employed, as satisfactory methods of estimating populations is essential to the success of the project.

To obtain a measure of the variability between replications, the larval counts from the three areas were subjected to analysis of variance. In this analysis, inter-tree variance was tested against intra-tree variance. It was reasoned that, if the former were significantly higher than the latter, the duplicate samples from each tree could be regarded as a good estimate of individual tree populations.

The analysis of variance for the three areas in 1946 and 1947 are contained in Table X.

It was found that, for Area A2 in 1946, the inter-tree variability was significantly higher than intra-tree variability, but this was not the case in the remaining areas A_1 and B_1. In 1947 the difference was highly significant for areas B_1 and A_2, while area A_1 again fell below the minimum required level. The fact that satisfactory results were obtained in three out of six sets of data would indicate that the sampling method is not far

* These specimens were obtained from the 1946 budworm larval rearings, while the remainder were collected as adults.

Table IX

Population Count Data, S.W.F.R., 1946

Count No.	1		2		3		4	
Area	Total live larvae	Total dead larvae	Total live larvae	Total dead larvae	Total live larvae & pupae	Total dead larvae & pupae	Total live larvae & pupae	Total dead larvae & pupae
A_1	202	22	239	5	85	3	80	25
A_2 black spruce	73	15	26		25	2	20	11
A_2 white spruce	255	7	149		45	4	46	31
B_1	334	5	129	4	79	13		
Total	864	49	543	9	234	22	146	67
Mean per 100 terminals	18.0	1.01	11.31	.18	4.87	.45	3.04	1.40

Table X

Area A1 - 1946

	S.S.	D.F.	Var.	F.	5%	1%
Trees	690	5	138	2.3	2.62	3.90
Counts	1192	3	394			
Interaction	1584	15	105.6			
Within Trees	1452	24	60.5			
Total		47				

Area B_1 - 1946

	S.S.	D.F.	Var.	F	5%	1%
Trees	528	5	105.6	1.91	2.62	3.90
Counts	2419	3	806.3			
Interaction	828	15	55.2			
Within Trees	1426	24	55.25			
Total		47				

Area A_2 - 1946

	S.S.	D.F.	Var.	F	5%	1%
Trees	2130.1	11	193.6	10.9	1.99	2.64
Counts	1686.2	3	562.1			
Interaction	2535.7	33	76.8			
Within Trees	855.5	48	17.8			
Total		95				

Table X (continued)

Area A_1 - 1947

	S.S.	D.F.	Var.	F	5%	1%
Trees	105.7	5	21.14	1.34	2.62	3.90
Counts	613.5	3	204.5			
Interaction	3369	15	224.6			
Within Trees	376.5	24	15.7			
Total		47				

Area B_1 - 1947

	S.S.	D.F.	Var.	F.	5%	1%
Trees	202	5	40.4	3.25	2.62	3.90
Counts	354	3	11.8			
Interaction	198	15	13.2			
Within trees	297	24	12.4			
Total		47				

Area A_2 - 1947

	S.S.	D.F.	Var.	F.	5%	1%
Trees	682.8	11	62.1	2.54	1.99	2.64
Counts	704.5	3	234.8			
Interaction	1219.2	33	36.9			
Within trees	1170.5	48	24.4			
Total		95				

below the level that could be considered adequate. Area A_2 gave good results in 1946 and 1947, showing that, for conditions prevailing there, reliable population estimates were being obtained. Evidently in areas A_1 and B_1 conditions were such that sample methods should be modified, probably by increasing the number or size of replications, or the number of trees sampled. In view of results on larval behaviour being obtained at Sault Ste. Marie, unless samples were taken under similar conditions of light, exposure, and temperature, the variability between samples would tend to be increased.

Another check was based on the assumption that there should be a significant correlation between successive counts made on the same trees throughout a season. In this respect, correlation coefficients between successive counts were determined for the three areas combined. For example, for each individual tree the larval populations for the 1st and 2nd counts were considered as paired values. Thus, for the three areas for the 1st and 2nd counts we have 24 paired values from 24 trees. The same reasoning was applied to the correlation between the 2nd and 3rd counts and the 3rd and 4th counts.

The correlation coefficients of the larval counts and their significance are indicated in Table XII.

Table XII

Counts	Year	Correlation Coefficient	"t" value	5% point	1% point	Significance
1 & 2	1946	.555	3.11	2.07	2.82	good
2 & 3	1946	.588	3.15	2.07	2.82	good
1 & 2	1947	.191	.912	2.07	2.82	nil
2 & 3	1947	.388	1.97	2.07	2.82	nil
3 & 4	1947	.353	1.77	2.07	2.82	nil

All correlation coefficients obtained for 1946 were significant, showing that individual tree populations from count to count were definitely related. The correlation coefficients obtained in 1947 were not significant. Here again, differences in weather conditions on successive counts, larval migration or other factors may have caused the poor correlation.

On the whole, it would seem that the method of population estimates employed may be expected to give good results by increasing the number of trees sampled, or the number and size of the replications. Inasmuch as the work involved is most time consuming, the best plan would seem to be to reduce the number of sampling areas and increase the intensity of sampling in each.

K. Summary of Natural Control Factors.

Inasmuch as the factors contributing to overwintering mortality are difficult to determine, the logical starting point in the assessment of natural control factors operating against the spruce budworm is with the first appearance of larvae in the spring. Weather conditions probably have a tremendous bearing on population trends throughout the life cycle, and more specifically when the young larvae first leave their hibernaculae in the spring, and are subjected to extreme temperature fluctuations. Frost damage was not as severe as in the previous year. New terminal growth progressed favourably, and in most instances seemed to provide ample food for the spruce budworm throughout the larval feeding period. Parasites and predators were responsible for varying degrees of mortality throughout the reserve, and disease organisms, although not particularly prevalent at the present time, may be looked to in the future as the outstanding control factor in an area of this nature.

A resume of the factors contributing to budworm mortality in 1947, and the relative effectiveness of each, are listed below:

Apparent Mortality

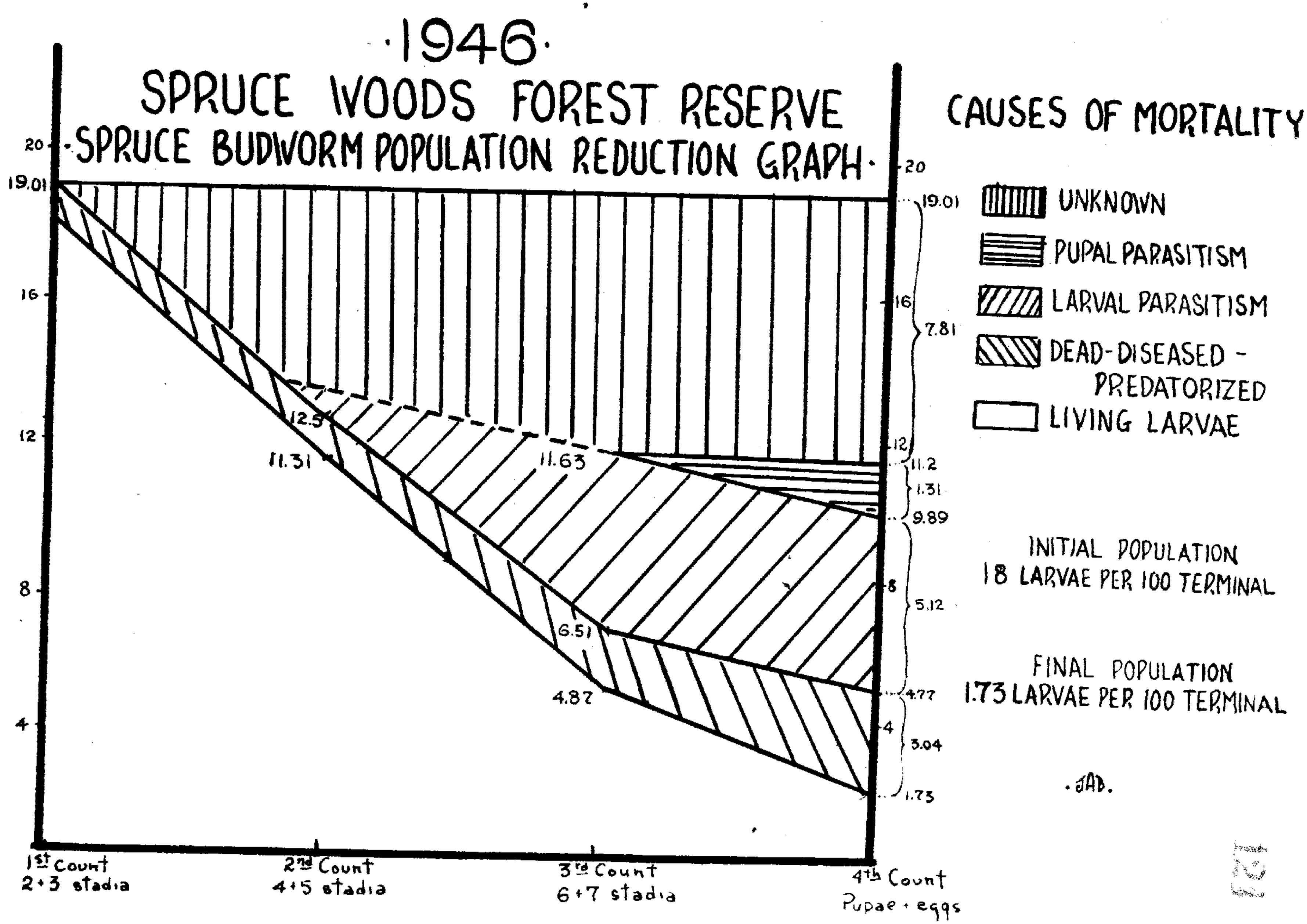
Larval parasitism	:	22.1%
Pupal parasitism	:	37.5%

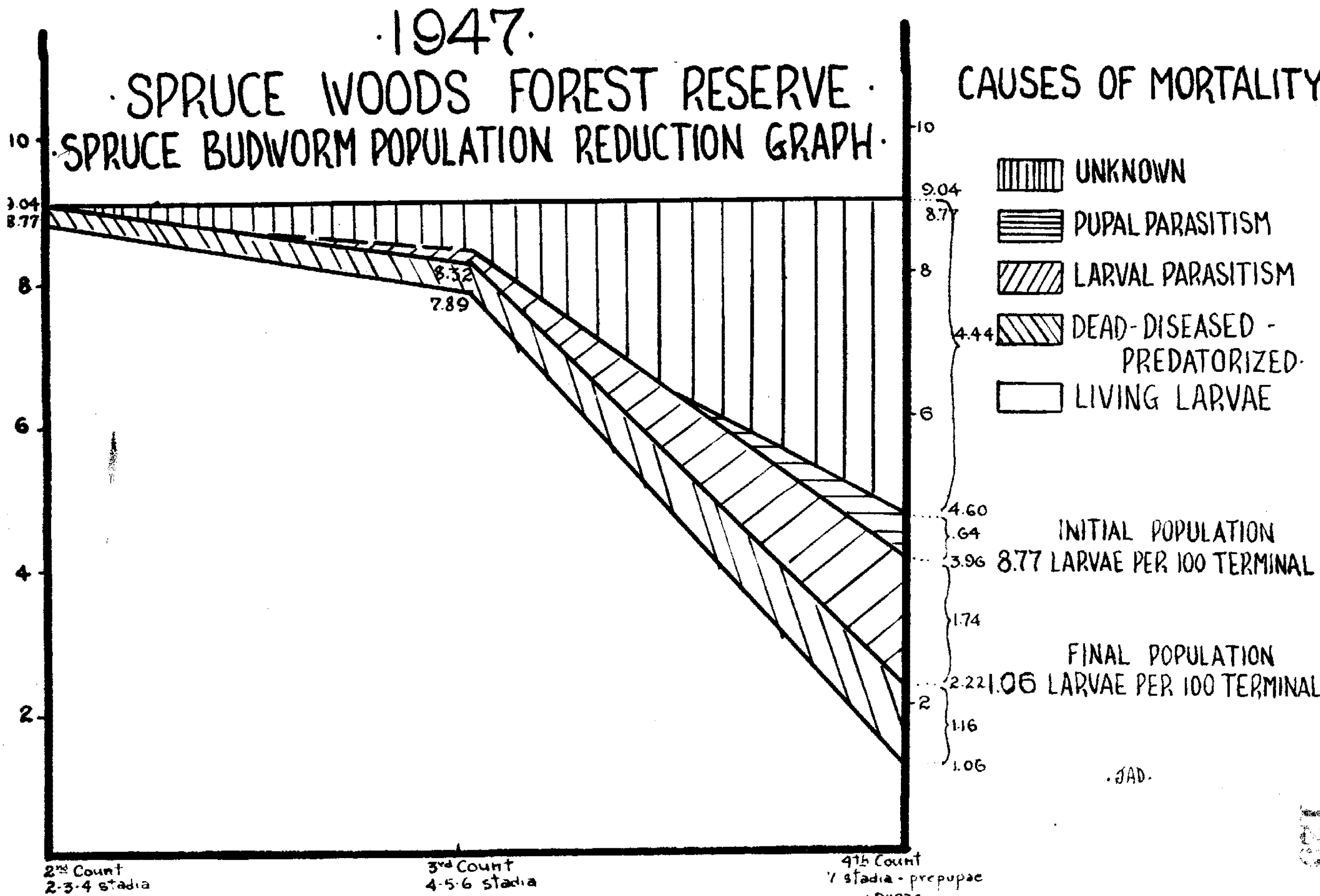
Actual Mortality

Larval parasitism	:	19.2%
Dead, diseased and predatorized	:	12.8%
Pupal parasitism	:	7.1%
Unknown	:	49.1%

Of the 88.2% decline in the budworm population from the initial to the final count, 49.1% was found to be due to unknown causes. It will be of interest to observe the effect which introduced parasites might have on reducing this unknown. A large portion of this unknown is probably due to environmental factors such as weather, frost damage, etc., which, up to the present time, have been difficult to apportion.

Physical factors such as light, temperature, humidity, etc. probably have an influence on budworm movements throughout the larval period, and may affect the accuracy of sampling technique currently being used. The determination of the effectiveness of natural control factors is dependent on the accurate evaluation of population levels, and hence adequate sampling techniques are essential on a project of this nature.


·1946·
SPRUCE WOODS FOREST RESERVE
·SPRUCE BUDWORM POPULATION REDUCTION GRAPH·
CAUSES OF MORTALITY
UNKNOWN
PUPAL PARASITISM
LARVAL PARASITISM
DEAD-DISEASED - PREDATORIZED
LIVING LARVAE
INITIAL POPULATION
18 LARVAE PER 100 TERMINAL
FINAL POPULATION
1.73 LARVAE PER 100 TERMINAL
20
16
12
8
4
19.01
12.5
11.31
11.63
6.51
4.87
11.2
1.31
9.89
7.81
5.12
4.77
3.04
1.73
1st Count 2+3 stadia
2nd Count 4+5 stadia
3rd Count 6+7 stadia
4th Count Pupae + eggs
·JAD.



·1947·
·SPRUCE WOODS FOREST RESERVE·
·SPRUCE BUDWORM POPULATION REDUCTION GRAPH·
CAUSES OF MORTALITY
UNKNOWN
PUPAL PARASITISM
LARVAL PARASITISM
DEAD-DISEASED-PREDATORIZED·
LIVING LARVAE
INITIAL POPULATION
8.77 LARVAE PER 100 TERMINAL
FINAL POPULATION
1.06 LARVAE PER 100 TERMINAL
10
8
6
4
2
9.04
8.77
8.32
7.89
4.44
4.60
.64
3.96
1.74
2.22
1.16
1.06
2nd Count
2·3·4 stadia
3rd Count
4·5·6 stadia
4th Count
7 stadia - prepupae
·pupae
·JAD·

A. Introduction.

The larch sawfly (*Pristiphora erichsonii* Htg.), still remains the major pest in the forested areas of the three prairie provinces. Further efforts to learn more about this insect, and means of controlling it, are discussed in this report. Natural control, rather than insecticide control, appears to be more satisfactory, while water-level fluctuations as a means of control were also tested. Throughout this report, Riding Mountain National Park will be referred to as R.M.N.P.

B. Distribution.

Reports of this insect have been received by the Winnipeg laboratory from a greater area in 1947 than in 1946. The most westerly area, from which samples of larch sawfly have been received, was at Big River Forest Reserve, Saskatchewan. The northern limit in Manitoba from which samples have been received was at Lake Barrington, being north of 57° latitude. No reports of this insect have been received from Alberta.

Sawfly was distributed generally throughout southern Manitoba, wherever tamarack occurred. In the south-east portion of the province, defoliation varied from medium to heavy. Generally, where dry swamp conditions prevail, infestations were found to be declining. An example of the opposite effect was found at Vassar. Here a swamp was very wet, and the infestation was quite heavy. Sandilands Forest Reserve was lightly to moderately infested. Swamps containing larch around Lac du Bonnet were from moderately to heavily infested. Defoliation in the interlake area remained about the same as in 1946, that is, from moderate to heavy. Infestations within R.M.N.P. were about the same as in 1946. Mile 7, Norgate Road, and Mile 13 Audy Lake Road, were the areas of heaviest defoliation. The western portion of the park was not as extensively sampled as in 1946, i.e. only 6 areas were sampled in 1947, as compared with 17 in 1946. Larch stands in the Duck Mountain Forest Reserve were heavily infested, particularly in the northern portion between Renwer and Sclater. Weakened trees and poor foliage development were recorded there. In the eastern portion of the Porcupine Forest Reserve, more severe infestations were reported in 1947 than in 1946.

A special larch sawfly survey was conducted in Saskatchewan to determine the extent of defoliation and mortality of tamarack. It was found that sawfly defoliations decreased in intensity in a westerly direction, and that the average defoliation of tamarack in eastern Saskatchewan was lower than in western Manitoba.

C. Sample Plots.

1. Permanent sample trees.

The final statistical sampling of the population of larch sawfly cocoons was completed in the permanent sample trees established for this purpose in 1944. The exact location of these trees at Mile 7, Norgate Rd., Mile 13, Lake Audy Rd., Golf Course and Riverton, Manitoba, are given in the 1944 Annual Technical report. The same method of cocoon sampling was condusted as in 1946. (See: M. L. Prebble - Sampling studies of the European Spruce Sawfly in eastern Canada. Transactions of the Royal Society of Canada, 3rd series, Sec. V Vol. XXXVII, 1943).

Sampling in 1947 was done over four one foot square areas under each tree. A square frame of this size, (made of wood) was set down to mark the area for sampling, and the sample was secured by cutting the moss with a hay knife around the border of the wooden frame. Samples were taken diagonal to the 4-1 corner of each stake, (1944, 1-2 corner; 1945, 2-3 corner, 1946, 3-4 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, miscellaneous (includes parasitized and dead), and old sound - which were apparently sound cocoons formed prior to 1947. Old sound cocoons were distinguished by the darker colour of the cocoon.

All cocoons found in these foot square samples were tabulated. The average depth and constituents of ground cover from the surface to the mineral soil were recorded. The general condition and current defoliation were also noted.

The following tabulations give the data obtained from sampling of the permanent sample trees at R.M.N.P. and Riverton. It should be noted that at Mile 7, Norgate Rd., stakes A and C under Tree No. 4, stake A under Tree No. 7, stakes B and C under Tree No. 9, stakes A, B, C and D, under Tree No. 11, are all overtopped by foliage from nearby tamarack. Hence these samples may contain cocoons from other trees.

TABLE I (part one) Summary of LARCH SAWFLY STATISTICAL STUDY
1947 - (Permanent Sample Trees)

Riverton, Manitoba.

Tree No.	Condition of Tree	Defoliation 1/12's	Stake A						
			Depth ins.	Cover	Moisture	New Sound	Moused	Misc.	Old Sound
1-319	Foliage partly shed, Healthy.	not* recorded	4"	Moss	dry-moist	5	12	6	0
2.-320	Old curled tips, foliage shed.	"	9"	moss & grass	moist	1	4	1	1
3-321	Foliage shed, tree healthy.	"	3/4"	grass	dry	2	2	0	0
4-322	Some curled tips, healthy.	"	3"	moss	damp	1	19	0	2
5-323	Foliage nearly all shed, healthy.	"	13"	moss	damp	12	77	9	0
6-324	Healthy, curled tips present.	"	2"	moss & grass	damp	0	0	0	0
7-325	Nearly defoliated, tree healthy.	"	1½"	grass	damp	2	2	0	0
8-326	Curled tips present, healthy.	"	9"	moss	moist	12	136	4	0
9-327	Healthy - defoliation complete.	"	4"	moss	damp	4	27	0	0
10-328	Tree healthy and foliage shed.	"	2"	grass & moss	damp	4	14	0	0
11-329	Foliage shed, many curled tips.	"	3/4"	grass	damp	0	0	0	0
12-330	Healthy, foliage shed.	"	3	moss	damp	6	33	7	0
TOTAL						49	326	27	3

* Foliage had been shed when these trees were examined.

Table I (Part two)

Riverton (continued)

Stake B							Stake C							Stake D						
Depth	Cover	Moisture	New Sound	Moused	Misc	Old Sound	Depth	Cover	Moisture	New Sound	Moused	Misc	Old Sound	Depth	Cover	Moisture	New Sound	Moused	Misc	Old Sound
8"	moss	moist	4	9	0	2	6"	moss	moist	8	11	6	1	10"	moss	moist	7	4	2	4
3/4"	grass dirt	damp	1	1	0	1	1"	grass dirt	dry	5	2	0	0	1"	grass	damp	0	1	0	2
½"	grass	dry	0	0	0	0	1½"	grass & dirt	moist	0	3	0	1	3/4"	grass & dirt	damp	0	1	1	0
4"	moss	damp	4	17	1	4	1"	grass	damp	0	2	0	2	2"	moss & twigs	damp	0	0	0	1
6"	moss	damp	6	48	7	0	1"	grass	damp	0	3	1	1	4"	moss	damp	3	49	9	0
2"	moss	damp	6	2	0	0	½"	grass	damp	0	8	0	0	1"	grass	damp	1	12	0	1
2"	grass	damp	1	38	0	0	2"	grass & dirt	damp	5	3	0	0	1"	grass	damp	2	0	0	0
3"	moss & grass	moist	2	0	[illegible]	[illegible]	1½"	grass	damp	1	0	0	0	8"	moss	damp	2	97	2	0
1"	grass	damp	2	7	0	1	14"	moss	damp	3	111	1	0	1"	grass roots	damp	1	3	1	0
3/4"	grass	damp	2	5	0	0	1"	grass	damp	0	1	0	0	1"	grass	damp	6	4	0	2
3/4"	moss & grass	very dry	1	1	0	7	1½	grass & moss	damp	2	0	0	2	1½"	grass & moss	damp	9	7	0	0
3"	grass & moss	damp	5	2	0	[illegible]	3"	moss	damp	0	7	2	6	4"	moss	damp	16	37	11	0
			34	130	10	17				24	151	10	13				47	215	26	10

TABLE II (Part one)

Summary of LARCH SAWFLY STATISTICAL STUDY
1947 - (Permanent Sample Trees)

Mi. 7, Norgate Rd. R.M.N.P.

Tree No.	Condition of Tree	Defoliation 1/16's	Stake A: Depth ins.	Cover	Moisture	New Sound	Moused	Misc.	Old Sound
1-301	Foliage production poor, tree in poor shape	2/16	2	moss & grass	wet	2	0	0	3
2-302	Most branches void of foliage. Tree very poor.	1/16	1	moss & grass	wet	6	0	0	3
3-303	Poor; foliage poor and scarce	1/16	4	moss	moist	2	1	0	4
*4-1472	Nearly dead. Foliage along trunk only.	1/16	1½	moss & grass	wet	2	0	0	1
5-1485	Fair. Foliage production good.	1/16	1½	moss & grass	wet	0	0	0	0
6-1496	Tree dead. No foliage.	-	1½	moss & dirt	moist	0	0	0	0
*7-1499	Fair. Foliage poor and sparse.	1/16	4	moss & grass	wet	6	0	0	0
8-51	Nearly dead. Foliage poor. Along trunk only.	-	2	moss & grass	wet	0	0	0	0
*9-304	Good. Foliage good.	1/16	4	moss & grass	moist	5	1	0	4
10-305	Foliage poor and sparse. Much lichen on leafless branches. Condition poor.	1/16	1	moss & dirt	moist	1	1	0	2
*11-49	Fair. Foliage fair.	1/16	2	moss	wet	3	0	0	3
12-306	Fair. Foliage poor.	2/16	6	moss	dry	4	38	0	0
Totals						31	41	0	20

* Some stakes overlapped by foliage of neighbouring trees.

Table II (Part two)

Mi. 7 Norgate Rd., R.M.N.P. (continued)

Stake B							Stake C								Stake D								
Depth	Cover	Moisture	New Sound	Moused	Misc.	Old Sound	Depth	Cover	Moisture	New Sound	Moused	Misc.	Old Sound	Depth	Cover	Moisture	New Sound	Moused	Misc.	Old Sound
2"	moss & grass	wet	0	0	0	1	6"	moss & grass	wet	3	0	0	0	1½"	moss & grass	wet	1	0	0	0
3½"	moss & grass	moist	8	1	0	2	1"	moss & dirt	wet	0	0	1	0	1½"	moss & grass	wet	0	0	0	0
2"	moss & dirt	moist	1	0	0	0	3"	moss & grass	moist	3	3	0	2	1¼"	moss & grass	moist	0	0	0	2
1½"	moss	wet	2	0	0	1	2"	moss	wet	1	0	0	0	3"	moss	moist	3	1	0	0
1½"	mud water	wet	0	0	0	0	1½"	moss & grass	moist	3	0	0	0	1"	moss & grass	very wet	0	0	0	1
2"	moss & grass	moist	0	0	0	0	2"	moss & grass	moist	0	0	0	0	1½"	moss & grass	moist	0	0	0	0
1½"	moss & grass	moist	1	2	1	0	2"	moss	moist	4	0	0	2	6"	moss	moist	3	2	0	2
1"	mud & grass	wet	0	0	0	0	1"	mud & grass	wet	2	0	0	0	2"	dirt & grass	wet	1	0	0	0
1½"	moss & grass	wet	1	0	0	0	4"	moss	moist	3	0	0	2	3½"	moss	moist	5	1	1	0
3"	moss	moist	7	1	0	0	1"	moss & grass	moist	1	1	0	6	2"	moss & dirt	moist	5	1	0	0
1"	moss	wet	2	0	0	0	2"	moss	wet	5	0	0	0	2"	moss	moist	3	0	1	0
2"	moss	wet	5	0	0	2	2"	moss & water	wet	0	0	0	4	2"	moss & grass	wet	1	1	0	2
			27	4	1	6				25	4	1	16				22	6	2	7

TABLE III (part one

SUMMARY OF LARCH SAWFLY STATISTICAL STUDY

1947 - (Permanent Sample Trees)

	Tree No.	Condition of Tree	Defoliation 1/16's	Stake A Depth ins.	Cover	Moisture	New Sound	Moused	Misc.	Old Sound
Golf Course, R. M. N. P.	1-315	Foliage good, but not regular.	1/16	4	grass & dust	moist	3	0	0	0
	2-316	Lower terminals had no foliage.	1/16	1½	moss grass	moist	1	0	0	0
	3-317	Foliage good, but second growth.	1/16	3	moss	moist	11	2	0	5
	4-318	Not healthy.	2/16	1	moss grass	dry	1	1	1	1
	Total						16	3	1	6

	Tree No.	Condition of Tree	Defoliation 1/16's	Stake A Depth ins.	Cover	Moisture	New Sound	Moused	Misc.	Old Sound
Mi. 13 Audy Lake Rd., R. M. N. P.	1-307	Fair, foliage fair.	6/16	3	ground roots	dry	1	0	0	0
	2-308	Fair, foliage poor.	15/16	3	moss & grass	wet	0	0	0	3
	3-309	Fair, foliage fair.	5/16	4	grass & moss	wet	0	0	0	2
	4-310	Good, foliage medium.	6/16	1	grass & mud	wet	4	0	0	2
	5-311	Fair, foliage poor	5/16	1½	moss	dry	0	0	0	0
	6-312	Good, foliage fair	4/16	1	Mud & grass	wet	0	0	0	0
	6-313	Fair, poor foliage	14/16	2	grass & moss	wet	0	0	0	0
	6-314	Fair, foliage fair	6/16	2	grass & mud	wet	2	0	0	0
							7	0	0	7

Table III (Part two)

(continued) LARCH SAWFLY STATISTICAL STUDY - 1947 (Permanent Sample Trees) Golf Course, RMNP, Mi. 13 Audy Lake Rd., RMNP

Stake B							Stake C							Stake D						
Depth	Cover	Moisture	New Sound	Moused	Misc.	Old Sound	Depth	Cover	Moisture	New Sound	Moused	Misc	Old Sound	Depth	Cover	Moisture	New Sound	Moused	Misc.	Old Sound
1½	grass & moss	moist	1	0	0	1	2	grass & moss	moist	0	0	0	1	2	grass & dirt	moist	0	0	0	6
5	grass & dirt	moist	0	0	0	1	4	grass & dirt	moist	2	8	1	1	6	grass & dirt	moist	1	0	0	0
1½	moss	dry	4	0	1	0	2	moss	dry	1	1	0	0	2	moss & grass	moist	0	0	0	0
3	moss & dirt	moist	1	1	1	0	4	moss & dirt	dry	1	1	0	0	5	moss & grass	moist	1	0	0	0
			6	1	2	2				4	10	1	2				2	0	0	6

3	roots & grass	wet	2	0	0	0	1	grass	moist	0	0	0	1	2	mud & grass	wet	0	0	0	0
2½	grass & moss	moist	3	0	0	1	1	moss grass	moist	3	2	0	1	2	grass & moss	moist	7	1	0	0
2	grass & mud	wet	0	0	0	0	2	grass & mud	wet	0	0	0	3	1	grass & moss	moist	2	0	0	1
1	moss & grass	wet	1	0	0	3	½	grass & moss	dry	4	0	0	1	2	grass & mud	wet	2	0	0	0
1	moss & grass	moist	1	0	0	0	3	grass & moss	dry	0	0	0	0	3	moss & grass	wet	0	0	0	1
2	moss & grass	moist	1	0	0	0	2	moss & grass	moist	8	0	0	2	3	moss & grass	moist	0	0	0	2
2	grass & moss	wet	3	0	0	0	2	moss & grass	moist	3	0	0	1	2	grass & mud	wet	0	0	0	0
1	moss & grass	moist	3	0	0	0	1	moss & grass	moist	6	0	0	0	1	mud & grass	wet	0	1	0	0
			14	0	0	4				24	2	0	9				11	2	0	4

TABLE V

Summary of Sampling on Permanent Sample Trees.

Location		No. of Trees	No. of Sq. ft. of Samples	Cocoons per square foot.				
				New Sound	Old Sound	Total Sound	Moused	Misc.
Riding Mountain National Park	Golf Course	4	16	1.75	1.0	2.75	0.90	0.25
Riding Mountain National Park	Mi.7Norgate Rd.	12	48	2.2	1.0	3.2	1.1	.01
Riding Mountain National Park	Mi. 13 Audy Lake Rd.	8	32	1.75	0.75	2.50	0.12	0
Riverton		12	48	3.2	0.89	4.09	17.1	1.5

The results of sampling over the four years are shown in the following tabulation.

Table VI

AREA	No. of trees	No. of New Sound Cocoons per sq. ft. 1944	1945	1946	1947
Riverton, Manitoba	12	14.4	10.10	4.1	3.2
Mi.7, Norgate Rd., R.M.N.P.	12	8.1	4.9	0.54	2.2
Golf Course, RMNP.	4	19.0	7.0	0.44	1.75
Audy Lk., Mi.13, R.M.N.P.	8	1.1	1.6	3.43	1.75

There is evidence in the above table of gradually declining or more or less stationary populations over the four year period. Inasmuch as these stands are typical of many of the areas attacked at the beginning of the current outbreak, it is probable that similar conditions prevail throughout much of the original infestation.

2. Statistical analysis.

The data from two areas, Mile 7, Norgate Rd., and Riverton, Manitoba, were subjected to statistical analysis to compare the sampling method, as applied to the larch sawfly, with Dr. Prebble's results on the European spruce sawfly. Statistical tests were applied to sound cocoons only. Different terrains provided variable 'moused' cocoon numbers, i.e. in moist samples no cocoons destroyed by mice were found while in a dry sample there was often a cache of moused cocoons found. The recognition of 'old sound' cocoons was not sufficiently accurate for use in this analysis.

The first analysis was to determine the standard deviations and coefficient of variability of the samples, taken singly and then pooling the sub-samples into one large sample for each tree.

Table VII

Population data in terms of Cocoon Density per 1 sq. ft. sample.

AREA	Year	1944	1945	1946	1947
Riverton	Mean $\bar{x}$	13.97	10.10	4.04	3.21
	S.D.x	10.44	7.49	4.08	3.60
	coeff.var.	75%	75%	101%	112%
	S.E.$\bar{x}$	1.51	1.08	0.59	0.52
Norgate Rd.	Mean $\bar{x}$	8.17	4.96	0.54	2.19
	S.D.x	9.00	5.27	0.85	2.15
	coeff.var.	110%	106%	157%	98%
	S.E.$\bar{x}$	1.30	0.76	0.123	0.31

Table VIII

Population data in terms of Cocoon Density per four square ft. sample.

AREA		1944	1945	1946	1947
Riverton	Mean $\bar{x}$	55.92	40.42	16.17	12.83
	S.D.x	15.28	10.63	5.62	3.99
	coeff.var.	27%	26%	35%	31%
	S.E.$\bar{x}$	4.42	3.07	1.62	1.15
Norgate Rd.	Mean $\bar{x}$	32.66	19.83	2.17	8.75
	S.D.x	8.51	7.53	1.38	2.56
	coeff.var.	26%	38%	64%	29%
	S.E.$\bar{x}$	2.46	2.18	0.40	0.74

$$S.D.x = \sqrt{\frac{Sx^2 - \frac{(Sx)^2}{N}}{N-1}}$$

$$\text{Coefficient variability} = 100 \frac{S.D.x}{\bar{x}}$$

$$S.E.\bar{x} = \frac{S.D.x}{\sqrt{N}} \qquad N = 48$$

Another analysis was made to determine the variability between trees and within trees of the population within a stand. The inter-tree variability must be less than intra-tree variability to be of value in determining accurately the population in that area. The following tabulation indicates the comparison of the intra and inter-tree variability.

Table IX

Variance analysis of Intra and Inter-tree Variability in Cocoon Density at Riverton and Norgate Road.

AREA	Year	Inter-tree variance	Intra-tree variance	F*	Mean No. Cocoons per sample
Riverton	1944	233	71	3.281	14
	1945	113	39	2.897	10.1
	1946	32	12	2.666	4.0
	1947	16	12	1.333	3.2
Norgate Rd.	1944	77	83	0.927	8.1
	1945	57	19	3.00	4.9
	1946	2.	.53	3.77	0.54
	1947	6.5	4.1	1.58	2.2

The formulae used are;

$$F = \frac{\text{Inter-tree variance}}{\text{Intra-tree variance}}$$

5% point 2.06; 1% point 2.78

$$T.S.S. = \sum X^2 - \frac{(\sum X)^2}{48}$$

$$S.S. = \sum_1^{12} \frac{(X_a + X_b + X_c + X_d)^2}{4} - \frac{(\sum X)^2}{48}$$

$$S.S.\text{within trees} = \sum_1^{48} X^2 - \frac{\sum^{12} (X_a + X_b + X_c + X_d)^2}{4}$$

It was determined how many samples are actually required to express the definition of means within 5% of the population means. The following tabulation indicates the number of units required per year per area, on the basis of the population recorded.

Table X

Number of sample units required for definition of Means within 5% of population means.

AREA	Samples of Sound Cocoons			
	1944	1945	1946	1947
Riverton	889	898	1600	5625
Norgate Rd.	2025	1806	1892	1529

Table XI

Number of 4 ft. square sample units required for definition of Mean within 5% of population Mean.

AREA	Number of Trees			
	1944	1945	1946	1947
Riverton	119	111	197	155
Norgate Rd.	108	231	653	135

Generally speaking, the cocoon population densities were comparable for the two areas. When the four square foot sub-samples for each tree were pooled to form units of four square feet, the standard deviations and co-efficients of variability were somewhat lower than those recorded by Dr. Prebble on the European spruce sawfly. Considering each sub-sample as a separate unit, however, the coefficients of variability of larch sawfly samples were appreciably higher than that recorded for the spruce sawfly. Nevertheless, analysis of variance of the eight trials over the two areas for four years showed that, in five trials the intra-tree variance was significantly lower than inter-tree variance. (See table No.IX). At Norgate Road, R.M.N.P., the significance decreased directly with the density of cocoon populations, but such was not the case at Riverton. In the former area, the ground cover was even, shallow and moist to wet, while in the latter area the ground cover was very uneven, often with deep moss and was moist to dry.

Despite the lack of significant differences between intra- and inter-tree variability in three trials, it was felt that there were distinct advantages to taking a number of sub samples per tree, pooling and regarding them as single four square foot units.

3. Permanent sample plots.

As a means of recording sawfly defoliation from year to year, groups of trees in four areas were marked with metal tags and white paint. Each year visual defoliation of these trees was estimated in 16ths.

In the Whiteshell Forest Reserve, six new permanent sample plots were established in 1947. Indications during the past two years are that the infestation is increasing. By establishing these new plots, it should be possible to follow the effects of increasing sawfly attacks on the larch.

Records have been kept for seven consecutive years, and the following summary is in the form of a history of larch defoliation from 1941 to 1947 in R.M.N.P.

TABLE XII

Table of Plot Defoliations
(Average defoliation in %)

Plot No.	Location of Plots	Number of Trees	Years						
			1941	1942	1943	1944	1945	1946	1947
1	Mi.13 Lk.Audy Rd.	51	35.0	18.1	6.5	16.1	15.1	41.8	46.7
2	Mi. 7 Norgate Rd.	50	12.6	73.1	51.2	92.5	80.6	46.25	43.0
3	Golf Course	19	6.6	5.6	1.0	0.31	0.0	0.31	0.12
4	Wasagaming Townsite	15	58.3	78.75	71.6	22.5	55.0	43.75	27.0

A significant feature in the above table was the consistently low defoliation in the Golf Course area. It appears that there is some factor that keeps the defoliation at such a low percentage. Nearby areas are much more defoliated. This Golf Course is not isolated by any natural features. Efforts should be made to investigate this fact in that it may lead to the discovery of some new influence not previously studied.

A summary of the 4 plots was very similar to the summary in the 1946 Annual Technical Report. The major difference being that though defoliation decreased slightly, 4 more trees were recorded as dead at Mile 7 Norgate Road. In no other area was tree mortality recorded in 1947.

D. Natural Control.

1. Mass collections.

A series of collections of 'new sound' cocoons was made for dissections and rearings, to determine parasitism. An attempt was made to sample Manitoba as thoroughly as possible in north-south and east-west directions, and to sample the more heavily infested portion of Saskatchewan.

Collected cocoons were layered in moist moss within screened wooden frames and placed in the University root cellar until they were dissected in November. All cocoons collected during 1947 are tabulated in Table 13, as to number, place of collection and disposition of each frame. No cocoons were sent to other laboratories this year, since the viability of the parasite eggs found in sawfly larvae in 1946 was too low to be of appreciable use. The continuation of the water-level experiment required 5,500 cocoons again in 1947. A total of 2425 cocoons have been dissected for parasitism. The remainder were left in the root cellar for winter rearings and dissections.

Table 13

Cocoons Collected in 1947

Date Collected	Locality	No. of Frames	No. of Cocoons per frame	Disposition of Cocoons
Aug. 17	The Pas, Manitoba	1	200	Winnipeg Laboratory for dissection
Aug. 18	Novra, Manitoba	1	200	" "
Aug. 18	Bowsman, Manitoba	1	150	" "
Aug. 19	Renwer, Manitoba	1	300	" "
Aug. 19	Cowan, Manitoba	1	150	" "
Aug. 20	Hudson Bay, Sask.	1	200	" "
Aug. 20	Tall Pines, Sask.	1	200	" "
Aug. 21	Pelly, Sask.	1	200	" "
Aug. 22	Birdtail Valley, R.M.N.P.	1	150	" "
Aug. 26	Madge Lake, Sask.	1	200	" "
Sept. 8	Whirlpool Lake, R.M.N.P.	2	300	" "
Sept. 9	P.O.W. Rd., R.M.N.P.	1	500	" "
Sept. 9	Mi.13 Audy Lk. Rd. RMNP	1	200	" "
Sept. 9	Mi.145 Dauphin Rd. RMNP	1	200	" "
Sept. 9	Mi.7 Norgate Rd. RMNP	1	200	" "
Oct.15	Whirlpool Lake, RMNP	10	300	Buried in 2 swamps at R.M.N.P.
Oct.16	Whirlpool Lake, RMNP	9	200	Used in experiment in Winnipeg Lab.
Oct. 28	Riverton, Manitoba	1	200	Winnipeg Laboratory for dissection
Nov. 5	Whiteshell Forest Res.	1	200	" "
Nov. 5	Seddon's Corner, Man.	1	200	" "
Nov. 7	Sandilands Forest Res.	1	200	" "

2. Larval dissections.

A total of 2425 cocoons from 10 different points in Manitoba and 4 points in eastern Saskatchewan were dissected. Larvae in the cocoons were examined for parasitism by *Mesoleius aulicus* and *Bessa harveyi*, and for disease and fungus. The data obtained are recorded in Table 14.

A table showing the areas within R.M.N.P. with their respective data was formed. See Table 15.

An effort was made to dissect larger samples than those used in 1946. R.M.N.P. was not as thoroughly sampled as in 1946. The high mortality due to fungus found at Riverton in previous years was not evident in 1947. This will be discussed later.

Table 14

Dissection Table for Manitoba and Saskatchewan

Area	No. of Cocoons dissected	Cocoons containing				Total % mortality	Net % parasitized	
		Hymenopterous		Dipterous larvae	fungus & diseased		1947	1946
		Eggs	Larvae					
Sandilands For.Res.Man.	100	1	0	3	0	4	4	0
Whiteshell For.Res.Man.	200	3	2	11	25	21	8	1
Seddon's Corner, Man.	200	1	1	13	7	11	7.5	9
Riverton, Man.	175	14	5	56	0	43	43	33
North of 53//, Man. **	100	0	0	0	1	1	0	1
Hudson Bay Jct. Sask.	100	2	1	1	0	4	4	no dissec
Tall Pines, Sask.	100	1	0	0	0	1	1	"
Novra, Manitoba	100	3	0	0	55*	58	3	"
Bowsman, Man.	75	0	0	0	6	6	0	"
Pelly, Sask.	100	23	9	0	4	36	32	"
Madge Lake, Sask.	100	1	0	1	4	6	2	"
Renwer, Man. ≠	100	2	1	0	10	13	3	2
Duck Mtn.For.Res.Man. ≠≠	100	16	10	1	16	43	27	9
Riding M.N.P., Man.	875	115	25	67	17	21.7	20.5	16.1
Total	2425	182	54	153	145			
Mean	173	13	4	11	10.5		11.3	8.9

* This high number may be due to the long and poor storage.
** This area is some 30 miles south of The Pas along the highway.
≠ This area referred to in 1946 as Mi. 254 Dauphin-Swan River highway.
≠≠ This area referred to as Cowan in the text.

Table 15

Dissection Table for R.M.N.P.

Area	NO. of Cocoons dissected	Cocoons containing Hymenopterous Eggs	Hymenopterous Larvae	Dipterous larvae	Fungus & diseased	Total % mortality	Net % mortality due to parasites
Birdtail Valley	100	19	3	1	12	35	23
Mi.32 P.O.W. Rd.	200	45	9	0	0	27	27
Mi. 145 Dauphin Rd.	100	7	2	1	1	11	10
Mi. 13 Audy Lk. Rd.	100	0	0	0	0	0	0
Whirlpool Lake	200	26	9	17	1	26.5	26
Mi. 7 Norgate Rd.	175	18	2	48	2	40	38.8
Total	875	115	25	67	16		
Mean	146	19	4	11	2.6	23.25	20.6

(a) Parasitism.

i. Parasitism by Mesoleius aulicus. A widespread distribution of this parasite can be observed upon examining Table 14. It is perhaps significant that Mesoleius was not found at Bowsman and The Pas, Manitoba, although the samples dissected were not of sufficient size to rule out the possibility of the parasite's presence. Generally, the highest parasitism by Mesoleius was recorded in those regions where the present outbreak is supposed to have originated, i.e. Riverton, Pelly and R.M.N.P. Without exception, parasitism by Mesoleius was low in eastern Manitoba (Sandilands Forest Reserve, Whiteshell Forest Reserve and Seddon's Corner) regardless of the age of the larch sawfly infestations at these points.

New releases of this parasite have been made at two points within R.M.N.P. (see Table 19) Until 1947 there were no releases of this parasite since 1913. In 34 years this parasite has become widespread over nearly all larch stands, but it appears that many Mesoleius eggs do not hatch in the host, and hence are ineffective in sawfly control. See Sec. 2(b) for a more complete discussion.

ii. Parasitism by Bessa harveyi. Evidence of this parasite spreading becomes more noticeable each year. As can be seen from Table 14, however, its northern limits are very much the same as those of Mesoleius. This parasite was released in 1939-41, and since then it has spread slowly throughout most of the larch stands in Manitoba and eastern Saskatchewan. Two main areas where this parasite has been liberated have been closely watched for the gradual increase of its effect. Table 16 shows that increase at Mi. 7 Norgate Rd. R.M.N.P. and Riverton, Manitoba.

Table 16

	% Sawfly Cocoons containing larvae of Bessa harveyi	
	Riverton	Mi.7 Norgate Road
1944	0.0	4.0
1945	15.0	18.0
1946	21.0	insufficient cocoons
1947	32.0	27.5

Recovery of Bessa harveyi from Seddon's Corner, by the Belleville Laboratory, in 1946 indicates that the parasite is quite numerous there, yet the nearest release point of this parasite was 50 miles away, at Sandilands Forest Reserve (see Table 19). Since recovery of Bessa harveyi from samples collected at or near the release point revealed a very low percentage, it appears that this release did not cause the high parasitism at Seddon's Corner, and points to the possibility that the Bessa harveyi is a native species and may be found throughout the larch stands in varying degrees. It is hoped that new releases when made in areas, that at present are comparatively free, will show a trend of increasing parasitism.

In the Mi. 7 Norgate Rd. sample, two sawfly larvae were found containing five living dipterous larvae. Three were found to contain four parasite larvae and numerous sawfly larvae had at least two parasites in each.

iii. Combined parasitism. The over-all parasitism as determined from these areas, and due to these two parasites, was 11.3%. The highest parasitism was found at Riverton, Manitoba, with 43% as compared with 33% in 1946, in the same area.

From the dissections it was observed that many unhatched Mesoleius eggs still were inside the hosts. From previous studies of Mesoleius aulicus in Manitoba, it was found that many Mesoleius eggs failed to hatch within the host. These eggs were usually brown, shrivelled or encapsulated, and hence not likely to hatch. Thus it would appear that the host has developed a resistance to this parasite, or perhaps that the strain of Mesoleius has weakened considerably since its release in 1913. Since the presence of a Mesoleius egg within the host does not prevent it from reaching the adult stage, the total parasitism figure should be determined by using only Mesoleius larvae (not eggs), and Bessa harveyi larvae. On this basis the 'effective' parasitism is 7.8% for 1947. The highest effective parasitism was found at Riverton to be 36% as compared with 24% in 1946 in the same area.

A comparison table of the cocoons dissected and parasites found in 1947 with 1946 is illustrated below.

Table 17

Comparison Table of Parasitism

Year	No. of cocoons dissected	No. of larvae containing *Mesoleius* eggs	*Mesoleius* larvae	*Bessa harveyi*	% Parasitism	Ratio: Hym. larvae Hym. eggs	% Effective parasitism
1947	2425	182	54	153	11.3	1:3.3	7.8
1946	4600	560	81	43	8.9	1:7	4.05

(b) Ratio study. The number of *Mesoleius* larvae to *Mesoleius* eggs has been closely examined in 1946 and 1947. Percentage parasitism was compared with the ratio of these larvae to eggs in the two years. The following is a table of ratio comparison. (All figures refer to *Mesoleius* only).

Table 18

Area	No. of Eggs recovered.		No. larvae recovered		Ratio: Larvae:Eggs	
	1946	1947	1946	1947	1946	1947
Birdtail Valley, RMNP	22	19	3	3	1:7.3	1:6.3
Mi. 32 P.O.W.Rd, RMNP	50	45	7	9	1:7.1	1:5
Mi.145 Dauphin Rd, RMNP	7	7	1	2	1:7	1:3.5
Whirlpool Lake area,"	151	26	20	9	1:7.5	1:2.8
Cowan, Man.	5	16	4	10	1:1.2	1:1.6
Riverton, Man.	9	14	3	5	1:3	1:2.8

Only comparable areas were used in the above table to indicate the ratio of Mesoleius larvae to eggs during the 2 years. Consistency during the 2 years was found at Riverton and Cowan, Manitoba, both areas having low ratios. The 'effective' parasitism was 2.85% and 10% respectively in 1947, and 3% and 4% in 1946. Considerable reduction in the ratios in 1947 was noticed at Whirlpool Lake, where large numbers of cocoons were dissected, and at Mile 145 Dauphin Rd. (see Table 15 for more complete information on parasitism and number of cocoons dissected per area). In the Whirlpool Lake area, 'effective' parasitism, i.e. due to Mesoleius larvae, was three times higher in 1947 than in 1946. In the same area the ratio of larvae to eggs decreased by 2.7 times in 1947. Similarly, at Mi. 145 Dauphin Rd, 'effective' parasitism increased 2 times in 1947, while the ratio of larvae to eggs decreased by 2 times. With the examples referred to above, there appears to be a direct relationship between increases in 'effective' parasitism and decreases in ratio of larvae to eggs.

A reverse effect was observed at Cowan, Manitoba, where the 'effective' parasitism in 1947 increased 2.5 times, but ratio of larvae to eggs in this case increased slightly. Another area having this reverse effect was Mi. 32 P.O.W. Rd., R.M.N.P. Here the ratio was 1:7.1 in 1946, with a total parasitism of 54% as compared with a ratio of 1:3.5 and a total parasitism of 27% in 1947, yet 'effective' parasitism was 6% in 1946, as compared with 4.5% in 1947. Thus the total parasitism dropped by 2 times in 1947, yet effective parasitism by 1 1/4 times and the ratio decreased 2 times.

The high ratio of Mesoleius larvae to eggs found at Cowan, Manitoba, in the two consecutive years makes this an area from which Mesoleius parasites might be reared in sufficient quantity to be of use elsewhere in the province. Efforts should be made in 1948 to collect large numbers of cocoons from this area, and rear them to establish definitely if parasite emergence is as good as the present figures indicate it should be.

(c) Disease and fungus. From the larval dissections it was also observed that many larvae in cocoons had died due to a disease or fungus (see Table 14). As can be seen in this table, the areas at North of 53// Manitoba; Novra, Manitoba; Bowsman, Manitoba; Pelly, Sask.; Madge Lake, Sask.; Renwer, Manitoba; and Cowan, Manitoba, are in an area between and to the east of the Duck Mountain Forest Reserve and Porcupine Forest Reserve. Each of these areas shows the presence of a disease or fungus. It appears that a disease or fungus may have become established in that region and is working out, the nucleus being at Novra, Manitoba.

Careful checks should be made in 1948 on storage methods, dates of collections and time intervals between these collections and subsequent dissections. In 1947 all the cocoons from the areas mentioned in the above paragraph were collected within 4 days of each other around August 22, and dissected within 7 days of each other, 75 days after collection. The method of storage during that 75 day period differed in that those cocoons from Saskatchewan were stored in moss in wooden frames, and kept in a cool place, while those cocoons from Manitoba were placed on moist cotton in jelly jars, and left in the insectary for a period of time up to one month. Then all cocoons were transferred to the root cellar.

Cocoons resting on sterile cotton appeared to be covered with an external fungus, as well as containing an internal fungus. Those cocoons stored in moss revealed only an internal fungus. An illustration of this was at Red Rock Lake in the Whiteshell Forest Reserve. A sample of 200 cocoons was dissected, with 100 having been stored on moist cotton for at least 60 days while the other 100 cocoons were collected in the field in November, and dissected 2 days later, i.e. Nov. 7, 1947. In the latter, only one cocoon showed signs of disease and fungus. (The two are usually present together). In the former 100 cocoons, 24 cocoons showed evidence of an external fungus which evidently had penetrated the cocoon and attacked the larvae. Care should be exercised in future storage methods of cocoons to be used in any subsequent survey of fungous diseases.

3. Distribution of parasites.

Once again a north-to-south and east-to-west survey of larch sawfly parasites has been carried out. The limits of recovery points of both Mesoleius and Bessa are illustrated in the accompanying map. A table containing all the known releases of the two parasites has been drawn up to show the exact locations of all releases (see Table 19).

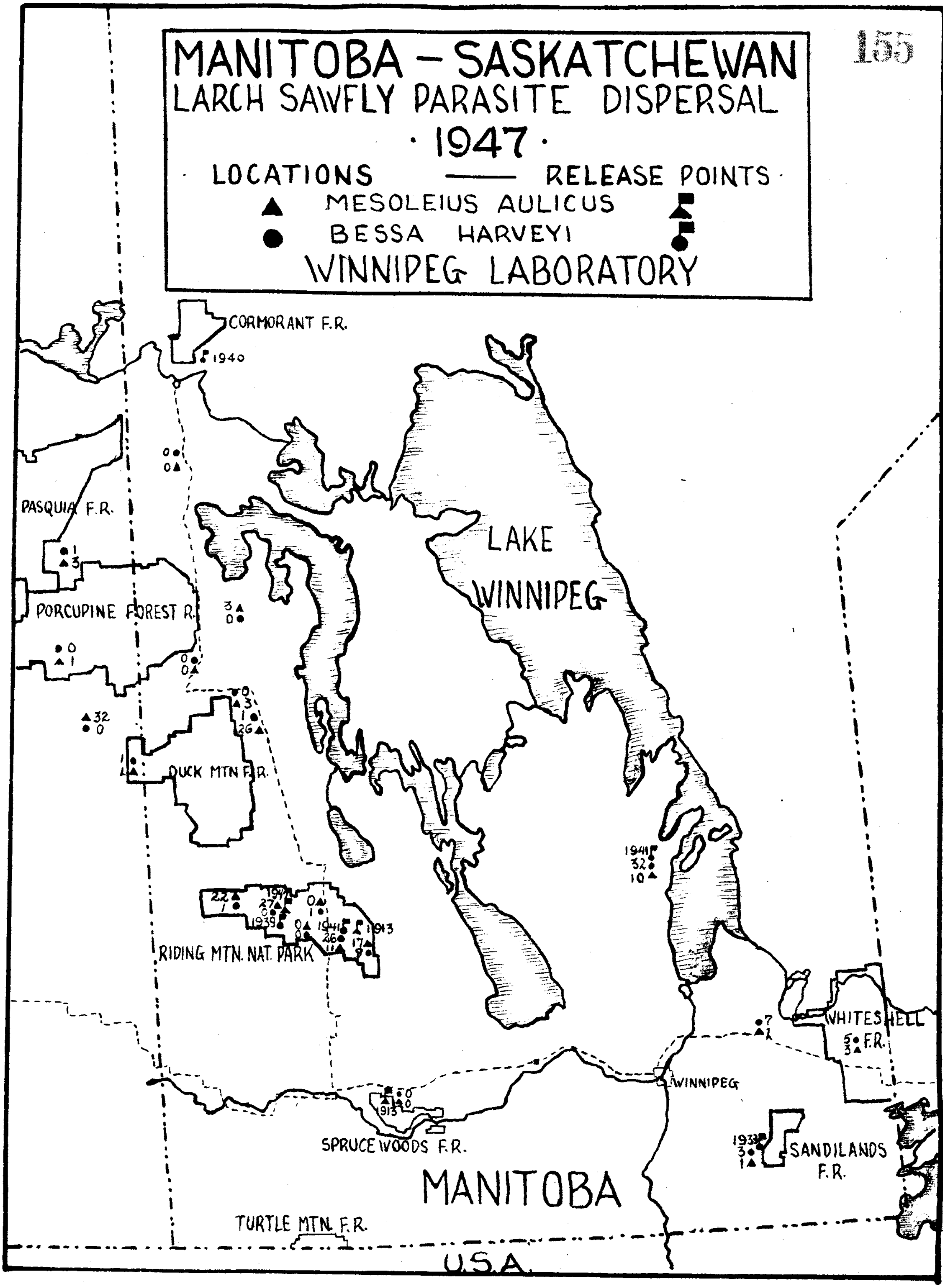
The map has a larger portion of the release points marked on it, along with the percentage parasitism. The collection of cocoons has not always been at the exact release points, so it is impossible to say with any degree of certainty how well each parasite has become established in that particular area. In the future, collections should be made as close as possible to the exact release points. Then working out from these points, it may be possible to determine the spread of these parasites.

Previous reference has been made to the possibility that Bessa harveyi may be an indigenous species, and hence it may be found in nearly all larch swamps if sufficient cocoons are examined. Liberations of this parasite should be made in areas where Bessa is very scarce, followed by studies on its distribution annually in that area.

Table 19

Summary of Larch Sawfly Parasite Liberations in Manitoba.

Year	Species	Number of Female	Number of Male	Location of liberation site.
1913	*Mesoleius aulicus*			Spruce Woods Forest Reserve. In the Epinette Swamp.
1913	*Mesoleius aulicus*			R.M.N.P. "half-way between Wasagaming and Norgate cabin"
1939	*Bessa harveyi*	465	565	" " " " " " "
1939	"	210	135	Ft. Francis Hwy. 15 mi. from junction with Trans.Can.Hwy.
1939	"	300	305	E. Hawk Lake, Ont. In swamp by C.P.R. subway.
1939	" June 27	35	40	Sandilands Forest Reserve. Larch swamp north of Camp 1.
1939	" June 27	360	200	" " " along Marchand Road.
1939	" June 28	75	80	R.M.N.P. "halfway between Clear Lake & Warden's office" on Norgate Rd.
1939	" June 22	200	250	R.M.N.P. Gunn Lake. Sec. 7, Twp. 22, R22.
1939	" June 27	200	200	R.M.N.P. 1. Sec.17-Twp.20 R.20 2. Sec.24-Twp.20 R.21 3. Sec. 5-Twp.21 R.18 4. Sec.31-Twp.19 R.16 5. Sec.36-Twp.19 R.17 (East Slope of the Park)
1940	"	1025	525	Cormorant Lake, Man. (near The Pas). A few hundred yards from Manitoba Forest Service Headquarters.
1941	"	615	555	Riverton, Man. Lake road from Riverton to Shorncliff P.O. going west 6 miles to Ledwyn Hall, thence 5½ miles north to farm of Mike Oster. Point is larch stand across hayfield at entrance gate.
1941	"	1870	1455	Clear Lake, Man. Dom. For. Serv. office - in townsite (RCMP)
1941	"	435	1350	Riding Mountain National Park - Mile 7, Norgate Road.
1947	*Mesoleius aulicus*	250	250	R.M.N.P. Mi. 32 P.O.W. Camp Road, along south side - mileage from Wasagaming, and marked by plaque
1947	"	590	535	R.M.N.P. Mi.13 Lake Audy Rd. no plaque, but liberated in swamp just south of road - down a steep slope.


MANITOBA – SASKATCHEWAN
LARCH SAWFLY PARASITE DISPERSAL
· 1947 ·
LOCATIONS —— RELEASE POINTS
MESOLEIUS AULICUS
BESSA HARVEYI
WINNIPEG LABORATORY
CORMORANT F.R.
1940
PASQUIA F.R.
PORCUPINE FOREST R.
DUCK MTN F.R.
RIDING MTN. NAT. PARK
LAKE WINNIPEG
WHITESHELL F.R.
WINNIPEG
SPRUCE WOODS F.R.
SANDILANDS F.R.
MANITOBA
TURTLE MTN. F.R.
U.S.A.

E. Larch Sawfly Survey in Saskatchewan.

A larch sawfly survey of Saskatchewan was undertaken in the last two weeks of August, 1947. The four main objects of this survey were: (1) to determine mortality of larch due to the sawfly; (2) to determine defoliation; (3) to record swamp conditions in relation to defoliation; (4) to collect samples of cocoons for dissection to determine the degree of parasitism. A sufficient number of cocoons was not available from all larch stands examined. It was possible, however, to collect enough cocoons from the heavily defoliated areas.

Larch sawfly defoliation was evident in all larch stands examined, but only in eastern Saskatchewan was defoliation serious. Rainy weather rendered side roads impassable and hindered a wider search for larch stands. Thus only those stands near highways were examined. Except for 5 trees found dead in a swamp west of Pelly, no tree mortality due to larch sawfly defoliation was observed. Within specific stands, tree defoliation was very irregular. Frequently it was found that adjacent trees in swamps varied in defoliation by as much as 90%.

Most of the swamps examined were quite dry. A few were moist, but only at Madge Lake were they wet. In all these dry swamps only a few sawfly cocoons could be collected - the rest being destroyed by predators such as mice and shrews. Evidence of these predators was found in all swamps, but to a much lesser degree in the wet ones. An example of this occurred in a stand 1/4 mile due east of Hudson Bay Junction. Under one tree in this stand, 8 ft. high and 1½ inches DBH, defoliated 100%, 72 healthy cocoons and 18 'moused' cocoons were found. Thus, by August 20, 20% of the cocoons under that tree had already been destroyed. It would be only logical to presume that a far greater destruction will result before the onset of winter. Along with this method of control, cocoons were collected at various swamps, 200 in each, to be dissected in an effort to determine the extent of parasitism. This was found to be 32% due to *Mesoleius* only, at Pelly, 4% at Hudson Bay Junction and 2% at Madge Lake.

For details of this parasitism, see Table 14. This information will be useful in determining where future parasite liberations should be made.

As mentioned previously, the larch sawfly was found in many parts of Saskatchewan. Its prevalence was more noticeable in the north-eastern part of the province. If the westward movement continues, as it is likely to do, more severe infestations can be expected in the more westerly portions of Saskatchewan in the future. At present the general larch sawfly situation is not serious, but potentially the menace is there, and will in all probability eventually be severe. Natural control and management will have to be relied upon to a large extent to control this impending menace.

The following table presents a summary of sawfly and tamarack conditions in the stands examined. One encouraging feature apparent from the table is the very light mortality experienced to date.

TABLE XXII LARCH SAWFLY SURVEY - SASKATCHEWAN TABLE 20

Date August	Location of stands.	Approx area stand (acres)	No. trees examined	Average D.B.H.	Av. Defol.	No. of cocoons collected	% tree mortality	Swamp condition	Remarks
16	Sec.8, tp. 49, rge. 26, W2nd	4	100	3"	20%	---	---	dry to moist	mixed stand
18	Sec.27 tp. 49, rge.25, W 2nd	5	50	5½"	5%	---	---	very dry	scattered mixed stand
18	Sec.16, tp.48, rge. 19, W2nd	3	50	4"	20%	---	---	dry to moist	pure stand, some foliage yellow
19	Hwy.35, 6 mi. S. of Tisdale	4	50	1½"	trace	---	---	dry	mixed stand
19	10.5 mi. E. of Sylvania	2	50	2½"	trace	---	---	dry	mixed stand
19	14.2 mi. E. of Sylvania	4	50	7"	20%	---	---	moist to wet	8 trees were 50% defoliated. mixed stand
19	20.7 mi. E. of Sylvania	3	50	2½"	5%	---	---	dry	mixed stand
20	Sec.35, tp. 47, rge 3, W2nd	-	50	2½"	trace	---	---	very dry	mixed stand
20	Sec. 9, tp. 45, rge 3,W2nd	-	100	3"	33%	200	---	very dry	some trees 95% defoliated. Mixed stand.
20	Sec. 36, tp. 40, rge 5, W2nd	2	50	3"	15%	---	---	dry	very mixed stand
20	Sec. 22, tp. 38, rge 5,W2nd	-	50	6"	90%	200	---	dry	heavily defoliated, mixed stand
21	Sec. 19, tp. 33, rge 30,W1st	-	100	8"	80%	200	5	very dry	defoliation from trace to 100%,mixed
26	Sec. 27, tp. 30, rge 30,W1st	1	100	3"	50%	100	---	wet, open water	pure stand, variable growth
26	Sec. 26, tp. 30, rge 30,W1st	4	50	3"	50%	50	1	wet, open water	scattered, mixed stand
27	Sec. 36, tp. 30, rge 30, W1st	1	25	5"	60%	50	---	dry, small lake	scattered, mixed stand,some large trees

F. Chemical Control.

1. Object.

Trials on the use of DDT and 666 against larch sawfly larvae were again undertaken in 1947. In 1946, the results did not produce wholly conclusive evidence on the value of these insecticides as a control for the larch sawfly. The object was to simulate, as nearly as possible, dosages and concentrations which might be used by aircraft.

2. Method.

Two areas near Mi. 145 Dauphin Rd. in R.M.N.P. (the same as in 1946) were chosen as having suitable conditions. The terrain was not too rough, and contained very little surface water. Both areas were accessible from the road. Each contained many young tamarack of sufficient density to insure favourable results in the experiment while at the same time all trees could be reached by a 'Dobbins' hand pressure sprayer.

Each area was measured out into small plots 26 ft. square or 1/64 of an acre. Accuracy in measurement was stressed as it was important that concentrations of insecticides be sprayed over fixed and known areas. To guard against drifting from one plot to another, a 10 ft. strip was left between plots. A total of 28 such plots were laid out, 14 in each area.

Two different insecticides were experimented with. One was DDT as an oil suspension in water, and also as a solution in kerosene. The other was 666 as an oil suspension in water and as a solution in kerosene. Linseed oil was added as an adherent. The method of preparation and formulations employed can be found in the 1946 Annual Technical Report pp. 162.

A 'Dobbin's Bighead Compressed Air Sprayer' was used in this operation. To assure accuracy and even distribution, the emission of a given volume at a given pressure was timed. Different pressures were obtained by varying the number of full strokes of the pump. It was found that 25 strokes of pressure forced 12½ fluid ounces of solution out in 50 seconds. With more strokes, quicker emission results. For larger quantities, more strokes of pressure are needed to completely empty the container. With a knowledge of the pressure required for the emission of 12½ fluid ozs. at 50 seconds, it was easier to deliver a more even distribution of spray over the 26 ft. square plot.

Shown in table 21 are the plots, sprays applied, concentrations and date of application.

Terminals from each of these plots were picked and placed in labelled screen cages. The floor of each cage contained a small hole leading to a jelly jar full of water immediately below the cage. These terminals were placed so that their tips could be immersed in water at all times. The foliage remained fresh longer using this method. Twenty larvae picked from unsprayed larch trees were placed in each cage on the sprayed foliage to determine mortality.

In the first test (immediately following the spraying), 10 larvae in the 1st and 2nd instars and 10 larvae in the 3rd instar were placed in each cage. The first 10 all died after 24 hours in the cage. The latter 10 larvae died 36-48 hours after being placed in the cage.

In the second larval transfer, only 3rd and 4th instar larvae were used, as there were not sufficient 1st and 2nd stage larvae for feeding trials. Similar instars were used in the 3rd and 4th transfers.

A daily record was kept of the larval mortality in all of these 28 cages. Every seven days the feedings were terminated and new series started. This was for the purpose of determining the residual effect of the insecticides.

After four such transfers, the experiment was terminated due to the scarcity of larvae. The mortalities per cage were recorded and those mortalities in the check cage were subtracted from the mortalities in the sprayed cages. The net mortality was then calculated.

While it was quite evident that quick and complete mortality was achieved at all concentrations immediately following spraying, heavy delayed mortalities were recorded in the check cages containing unsprayed foliage. On the basis of data obtained, it was difficult to point to a decisive conclusion. Considerable difficulty has been experienced in other experimental work with larch sawfly larval mortality, where the insects were reared under artificial conditions. Rearing techniques must be vastly improved before insecticide experiments such as these are undertaken again.

A commercial water-wettable preparation of 50% 666 (Benexane) made up at the rate of 3 lbs. per 100 gals. of water was sprayed on ornamental larch trees in R.M.N.P. With liberal applications of this spray, complete control was achieved. Some ovicidal properties of this preparation on larch sawfly eggs were also observed.

Table 21

Table of Plots, Sprays Applied, Concentrations and Dates.

Plot No.	Insecticide used.	Fl. oz. of solution used.	Lbs per acre	Date of larval trans.			
				1	2	3	4
				July 12	July 19	July 26	August 2
1	1% DDT	12½	½	"	"	"	"
2	"	25	1	"	"	"	"
3	"	50	2	"	"	"	"
4	2% DDT	6 1/4	½	"	"	"	"
5	"	12½	1	"	"	"	"
6	"	25	2	"	"	"	"
7	check plot	-	-	"	"	"	"
8	1% 666	12½	½	"	"	"	"
9	"	25	1	"	"	"	"
10	"	50	2	"	"	"	"
11	2% 666	6 1/4	½	"	"	"	"
12	"	12½	1	"	"	"	"
13	"	25	2	"	"	"	"
14	check plot	-	-	"	"	"	"
15	1% DDT	12½	½	"	"	"	"
16	"	25	1	"	"	"	"
17	"	50	2	"	"	"	"
18	2% DDT	6 1/4	½	"	"	"	"
19	"	12½	1	"	"	"	"
20	"	25	2	"	"	"	"
21	check plot	-	-	"	"	"	"
22	1% 666	12½	½	"	"	"	"
23	"	25	1	"	"	"	"
24	"	50	2	"	"	"	"
25	2% 666	6 1/4	½	"	"	"	"
26	"	12½	1	"	"	"	"
27	"	25	2	"	"	"	"
28	check plot	-	-	"	"	"	"

ALL applications of sprays made on July 12, 1947.

G. Water Level Studies.

1. Object.

An investigation into the possibility of regulating water levels in swamps to control larch sawfly was begun in the fall of 1946. Previous preliminary experiments indicated that the method had possibilities as a means of control.

Several phases of this investigation were proposed. These were: (1) the sawfly stages and periods most susceptible to submergence in water, (2) the period of submergence required to produce death, (3) sawfly cocooning habits in relation to water-levels, (4) influence of submergence on diapause, (5) influence of flooding on growth of tamarack and (6) feasibility of flooding and draining swamps.

2. Method.

In the fall of 1946, two swamp areas in R.M.N.P. were selected. In these swamps, cocoons were buried at various levels in relation to the original water level. Complete details are listed in the 1946 Annual Technical report, pp. 174. Very few observations were made on the effect of submergence during 1946, (see the 1946 Technical report p. 175).

During the spring of 1947, the effects of submergence were investigated under three sets of conditions; (1) controlled laboratory conditions, (2) known but uncontrolled field conditions and (3) natural field conditions.

The effect of submergence on sawfly development was determined by cocoon dissections supplemented by rearings where necessary. The stage of development attained by a sawfly at the time its cocoon was opened was described in every case. The terms employed by Prebble* in his studies on the diapause of the European spruce sawfly were adopted. While his morphological descriptions do not correspond exactly with those occurring in the larch sawfly, analogous eonymph and pronymph phases were recognized.

* Prebble, M. L. 1941. The diapause and related phenomena in *Gilpinia polytoma* (Hartig). Can. Jour. Res. D.19:225-322.

The controlled laboratory study required the storage of cocoons for definite periods of time under known moisture conditions. Wooden frames 3½ inches deep covered with galvanized screen wire on the top and bottom were constructed. Two hundred cocoons were placed between an upper and a lower layer of sphagnum moss in each frame. The frames were then placed in individual metal pans to which water could be added or removed as required.

Cocoons in frames were subjected to the following treatments; (1) dry at all times, (2) submerged at all times, (3) submerged during the fall and winter and dry in the spring, and (4) dry in the fall and submerged in the spring. Duplicate frames in separate pans were used for each treatment. The term 'dry' in referring to treatments may be somewhat misleading. Actually the intention was to provide conditions known to favour sawfly development, and some moisture was added to the moss occasionally to prevent dessication. The frames were stored in an open air insectary throughout the course of the experiment.

For the second experiment similar but larger frames, each 1 foot square and containing 200 cocoons, were buried in pits dug in two swamps at Riding Mountain National Park, Manitoba, on September 23, 1946. The pits were 18" square, and excavated to a depth well below water level. A marker was driven into each pit for the purpose of recording the water fluctuations. The water level at the time the frames were buried was arbitrarily selected as zero. Five frames were then tiered in each pit in such a manner that cocoons were at depths of 6 inches and 3 inches below water level, at water level and at 3 inches and 6 inches above water level. Pits were constructed in two swamps, and in each swamp duplicate sets of five frames were buried in adjacent pits.

Series of 20 cocoons were removed from each frame in the laboratory and field experiments at intervals of one month for dissection and rearing. No removals, however, were made during the winter months when the ground was frozen. The condition of the sawflies was recorded using the terms dead, alive or doubtful. When doubtful individuals were encountered an additional sample of cocoons was reared for 7 days at room temperature and at high humidity. These conditions were provided for the purpose of stimulating larval activity to permit the classification of doubtful cocoons as either dead or alive. It is felt, however, that this rearing test for doubtful larvae was not entirely satisfactory, and it seems that a more precise biological test to detect living larvae could be advantageously employed.

As a check on the above experiments cocoons lying both above and below the water line under natural field conditions were collected and dissected during the summer of 1947. Five areas were sampled and 20 cocoons above and below the water level were removed at each sampling. Collections were made on May 20, June 2, June 8, June 18 and June 26, making a total of 300 cocoons dissected from this source. Unfortunately, no records of water fluctuations are available for the sites examined, and therefore the periods of submergence of these cocoons are not known.

3. Results.

Table 22 summarizes the results obtained from the controlled laboratory studies. Due to the difficulty of interpreting results from the two sources, dissection and rearing, and inasmuch as the two techniques were employed for the same end, namely to distinguish living from dead sawfly, the data from dissections and rearings have been condensed into two columns, % dead and % living. When the dissections indicated beyond doubt that the individuals examined were either dead or alive, the dissection figures were used in table 1. However, when doubtful larvae were encountered, an additional series of cocoons was reared, and data secured from the rearings were then used to express sawfly mortality. The same procedure was followed in Table 24.

Table 22

Mortality and Development of Larch Sawfly Cocoons Subjected to Four Controlled Water Treatments.

Examination dates	Treatment *	Submerged period (days)	% dead	% alive	Phase of dead sawfly	Phase of living sawfly
Oct.25 1946	A	0	0	100	-	eonymph
	B	30	0	100	-	"
	C	30	0	100	-	"
	D	0	0	100	-	"
May 12, 1947	A	0	0	100	-	2 pupae 38 eonymph
	B	244	100	0	eonymph	-
	C	228	100	0	"	-
	D	16	85	15	"	eonymph
June 12, 1947	A	0	0	100	-	5 pupae 35 eonymph
	B	275	100	0	eonymph	-
	C	228	100	0	"	-
	D	47	92	8	"	pronymph
July 12, 1947	A	0	30	70	adults**	8 pupae 20 adults
	B	310	100	0	eonymph	-
	C	228	100	0	"	-
	D	82	100	0	"	-
Aug. 12, 1947	A	0	100**	0**	20 eonymph** 20 adults	-
	B	336	100	0	eonymph	-
	C	228	100	0	"	-
	D	108	100	0	"	-
Sept.12 1947	A	0	35	65	"	adults
	B	367	100	0	"	-
	C	228	100	0	"	-
	D	139	100	0	"	-

* A-dry at all times; B-submerged at all times; C-submerged fall and winter, dry in spring; D-dry in fall, submerged in the spring and summer.

** Development normal but mortality apparently due to dessication.

Table 24

Mortality and Development of Larch Sawfly
Subjected to Known Submergence Under Field Conditions

Examination dates	Treat-ment *	Submerged period (days)	% dead	% alive	Phase of dead sawfly	Phase of living sawfly
Oct. 18 1946	A	0	0	100	-	eonymph
	B	25	0	100	-	"
	C	5-16	0	100	-	"
Nov. 14 1946	A	0	0	100	-	"
	B	52	0	100	-	"
	C	5-39	0	100	-	"
June 11 1947	A	10-14	15	85	eonymph	(4 pronymph (2 pupae (28 eonymph
	B	261	100	0	eonymph	
	C	5-197	90	10	"	eonymph
July 16 1947	A	10-14	70	30	"	"
	B	296	100	0	"	-
	C	5-197	85	15	"	eonymph
Aug.12 1947	A	10-14	100	0	"	-
	B	323	100	0	"	-
	C	5-197	95	5	"	eonymph
Sept.11 1947	A	10-14	100	0	"	-
	B	353	100	0	"	-
	C	5-197	100	0	"	-

* A - above water continuously except for 10-14 days in May, 1947;
B - continuous submergence;
C-- intermittent submergence.

The first dissection of cocoons on October 25, 1946, 30 days after commencing treatment, yielded no dead larvae. Those which had been submerged were inactive, but the larvae from an additional series became quite active after a rearing period of seven days. This indicates that more than one month of submergence in the fall is required to kill the larvae.

Freezing weather following this inspection, and formation of ice in the containers holding submerged cocoons, prevented further examination until the following spring.

The next examination, made on May 12, 1947, 244 days after treatment commenced, showed complete mortality of the larvae in cocoons which had been submerged during the fall and winter. Those receiving the submergence treatment in the spring had been under water for 16 days prior to dissection. The larvae from these cocoons were classified as doubtful, and, upon rearing, 15% of the larvae in cocoons recovered. Complete survival of larvae from cocoons stored under dry conditions was recorded.

On June 12, an 8% survival of larvae in cocoons that had been submerged since April 26 was recorded, but by July 17 all the larvae in this category had died. The sawflies in cocoons which were stored under dry conditions developed normally throughout the summer.

Both continuous and fall-through-winter submergence had the effect of arresting development of the larvae, since none subjected to this treatment passed beyond the eonymph stage. Some of those submerged in the spring were able to develop to the pronymph stage before dying, whereas, under dry conditions, normal development of the larvae proceeded.

In the field experiment it was the intention that buried frames should receive water treatments, some submerged continuously, some intermittently, and others not at all. Unfortunately, excessive rains followed the burying of the frames, and interfered with these plans.

Owing to the subsequent high water levels in the tamarack swamps, 12 frames were submerged continuously, 6 intermittently and only 2 were above the water level continuously except for a period of from 10-14 days in May, 1947.

This experiment is being repeated under slightly different conditions which will permit greater control to be exercised over the periods of submergence.

Table 2 indicates the fluctuations of water levels above the zero marks in the two experimental plots. In inspecting this table, it should be remembered that a height of 6 inches or more above the zero level effects complete immersion of all cocoons.

Table 23

Fluctuations of Water Levels in Experimental Plots during Study Period.

Date	No. of Days	Heights above original level in inches			
		Golf Course		Mi.7 Norgate Road	
		Pit A	Pit B	Pit C	Pit D
Sept.23,1946	0	0.0	0.0	0.0	0.0
Oct. 18, 1946	25	6.5	6.5	3.0	3.0
Nov. 14, 1946	52	5.5	5.5	2.5	2.5
May 12, 1947	231	7.0	7.0	5.5	6.0
June 11, 1947	261	7.0	6.0	4.0	3.0
July 16, 1947	296	4.0	4.0	0.5	2.0
Aug. 12, 1947	323	2.0	2.0	1.0	1.0
Sept. 11, 1947	353	1.5	1.5	0.5	0.0

Table 24 provides a summary of results from the four replicated sets of frames buried in pits at Riding Mountain National Park. The immersion treatments are here classified as continuous, intermittent and above water continuously except for a short period. In view of the slightly different classifications employed, the results are not completely comparable with corresponding treatments in the laboratory study.

On the whole, the results of the field study parallel those obtained from the laboratory experiment. In the field study no larval mortality resulted in the fall from fall submergence, but, at the time of the first spring examination on June 11, 1947, all the larvae in cocoons which had been continuously submerged, had died in the eonymph stage. Similar results were obtained in the laboratory study, but it should be noted that the examination of field cocoons was made about one month later, due to the difficulty of removing cocoons from the frozen moss.

A 100% survival of sawflies in cocoons intermittently submerged and those above water for a continuous period was recorded throughout the fall examination. In the following spring, however, significantly different survivals were in evidence, with those above water for a continuous period showing by far the highest percentage living in June, but only a slightly higher survival in July. Surprisingly, by August all the sawflies in cocoons above water for a continuous period had succumbed, while 5% of the larvae from cocoons intermittently submerged were alive. By September all the sawflies in cocoons submerged intermittently were dead.

Larvae in cocoons immersed intermittently did not progress beyond the eonymph stage, but some unexpected findings were recorded from those above water for a continuous period. On June 11, 4 pronymphs and 2 pupae were observed, while in succeeding examinations no development beyond the eonymph stage was recorded. One explanation may be those most of the cocoons remained in diapause, and only those which had developed beyond the eonymph stage completed metamorphosis during June and early July. If, after that time, only cocoons in diapause remained in the frames, no development beyond the eonymph stage could be expected. Perhaps if this is so, diapause was induced or continued by excessive moisture.

No sawfly mortality was recorded in the third phase of this study, involving the examination of cocoons removed from their natural cocooning positions in the moss of tamarack swamps. However, while the larvae in cocoons collected above water level developed normally through the pronymph, pupal and adult stages, the larvae in submerged cocoons apparently remained in diapause in the eonymph stage throughout the period of the examinations. The important point is that, under natural conditions, immersion during some period of the spring and summer is not necessarily lethal. It should be remembered, however, that the length of submergence of these cocoons under water is unknown, and it would appear to be desirable to investigate thoroughly the resistance of the larch sawfly to submergence under field conditions, as opposed to experimental conditions.

4. Discussion and Conclusions.

Indications are that larvae in cocoons are resistent to submergence during the fall, as, in one series so treated, no mortality had occurred after an immersion period of 52 days. The effect of fall immersion only, on subsequent mortality in the spring, has not yet been tested. If fall immersion is continued through the winter months, complete sawfly mortality is effected by the following spring under experimental conditions.

The sawfly larvae appear to succumb most quickly under experimental conditions to spring and summer submergence during the period when leaves are normally undergoing metamorphosis. Perhaps this crucial period can be more precisely established. It seems natural to suppose that the sawfly may be more susceptible to immersion at this time due to its higher oxygen requirements for metabolic processes.

Continuous submergence resulted in complete mortality of the larch sawfly larvae, but in practice such conditions are not often encountered in the field, nor would continuous controlled flooding be desirable from the standpoint of tree growth.

The most favourable conditions for sawfly development were those referred to as 'dry'. These conditions would be similar to those obtained in well drained tamarack stands.

It is evident from the results obtained to date that, under certain experimental conditions, immersion in water is lethal to larch sawfly larvae in cocoons. It is also apparent, however, that as experimental conditions approach natural field conditions the chances of surviving immersion are appreciably improved. It is difficult, nevertheless, to draw a parallel between the results of the treatments to which cocoons were subjected, inasmuch as the period and conditions of submergence were not always comparable.

Numerous records of defoliation in relation to water levels in swamps, compiled by the Winnipeg Laboratory, show that sawfly abundance, as reflected by defoliation, is often at variance with the experimental results. On the whole, trees growing in dry sites experienced the lowest defoliation. Sites classified as 'moist' showed the highest defoliation of tamarack, while those termed 'wet' fell in between the other two. It may be that a further sub-division of the classification 'wet sites' is desirable, because many of those now designated are possibly borderline cases which might more correctly be classified as 'moist' sites. Another discrepancy might have been introduced by the fact that water levels prevailing during the crucial period of sawfly metamorphosis in the cocoons are not necessarily the same as those obtained at the time defoliation is recorded later in the season. More reliable information can be procured by following the progress of sawfly development and variations in the defoliation and water levels in selected tamarack swamps.

This preliminary work has indicated the considerable complexity of the problem. It has shown the need for determining the effect of a number of possible variations in water levels, alone and in combination with other physical factors, on sawfly mortality, development, diapause, cocooning habits, physiological processes, biotic potential and sawfly parasites and predators.

In the fall of 1947, a new series of cocoons was buried at R.M.N.P. New pits were constructed and the frames containing cocoons were tiered in a different manner. Since the water levels in the swamps rose abnormally during the summer of 1947, only three moisture conditions could be tested, namely: continuous submergence, intermittent submergence and above water at all times. Therefore the new series of cocoons was placed in the pits in such a position as to assure these 3 conditions, during the summer of 1948. This may require manipulation of the frames during the summer to retain these three moisture conditions which are under study.

A total of 10 frames each containing 300 cocoons was buried. Five of these frames were placed in each pit. The pits are located within 10 feet of the Pits A and C as designated in the 1946 Annual Technical report. Two frames were placed below the water level, two well above the water level, and one frame was placed in a moss hump in an extremely dry location. This placement was duplicated in the other swampl

On Nov. 13, samples of 50 cocoons were taken from a frame below and from a frame above the water-level. These cocoons were placed in an incubator on Nov. 20, and were kept at 60° F, in an effort to break their diapause.

A sample of 5 cocoons from each moisture condition was examined each week. Each larva in the cocoon was examined for any signs of progressive development and general condition, and recorded. No success in the breaking of their diapause has been attained up to the writing of this report.

A survey to determine the abundance of white pine weevil on jack pine was conducted in the Nisbet Provincial Forest Reserve between August 20 and August 28. In this connection, 14 temporary sample plots were established in plantation and natural regeneration in various portions of the reserve. Two temporary plots were established in planatation plot No. 12/18, and one plot in plantation plot No. 13/18. All other plots were established on natural regeneration.

Weevil damage is characterized by injury to leaders which turn brown and die leaving a tunnelled leader which breaks off readily. In most trees attacked, the leader was tunnelled down as far as the upper whorl of laterals but in other cases the tunnels extended as far as the second whorl of laterals, thus removing two years growth. In rare instances three years growth was affected. "Old Weevil Damage" was recorded whenever the main leader was dead and examination of the uppermost whorl of living laterals revealed that one of the laterals had predominated and was assuming the role of the new leader.

Table 1 provides a brief summary of results obtained from the 14 non-permanent plots.

The figures in Table I show the number of leaders currently infested by weevil and those which have been subjected to weevil attack in the past. The difference between the total leader damage and the number of trees per plot indicates the number of undamaged trees. Substantial numbers of leaders were sent to the Winnipeg Laboratory, and upon subsequent examination, it was found that in addition to Pissodes strobi, larvae of the shoot borer and of a Pyralid were found in the infested leaders. These have been identified tentatively as Eoteleia dodecella and Tetralopha robustella Zell. respectively, pending positive determination upon completion of rearings.

Table II indicates the number of currently infested leaders in relation to density and age class. The 1918 jack pine plantation plots falling in density class B appear to have suffered the most severe weevil injury, while natural regeneration in the same density class and in the age class 5-10 years appear to have been least affected. Of the natural regeneration, the plots of lowest density falling in the age class 10-15 years have been most affected.

Other tree species occurred in some of the plots with trembling aspen predominating. No other coniferous species were encountered. In some instances more mature jack pine did not lend itself readily to ocular examination. The three natural regeneration plots most severely attacked by the weevil were not overtopped by more mature jack pine or other tree species while the remainder of the natural regeneration plots were at a relatively low degree of infestation, and were overtopped by more mature jack pine or trembling aspen. This would seem to indicate that an overstory, in association with jack pine seedlings, affords some measure of protection and thus reduces the prevalence of white pine weevil on jack pine.

This preliminary assessment in the Nisbet Forest Reserve, Saskatchewan, showed the weevil to be more prevalent than would be indicated by superficial appearances. It seems that the white pine weevil is most abundant in plantations. Chemical control might be feasible in plantations inasmuch as they represent a considerable capital investment, and, in addition, such plantations are normally well defined and limited in area.

TABLE I

Sample Plot Number	LOCATION OF Pj PLOTS		No. of Pj per 1/10 acre	Average Age	Average Height	Current Weevil Damage to Leaders	Old Weevil Damage to Leaders	Overstory
1	2.2 mi. N.W. of MacDowall H.Q. along North Cabin Road	L.s. 3in4-47-1-3	654	13 yrs	8 ft	117	15	nil
2	1.9 mi. in N.W. direction from junction of Bare Hill Rd. and North Cabin Rd. along the latter	L.S.8in25-5-47-2-3	555	10	5	12	3	Trembling aspen ranging from 6" to 10' in height.
3	.7 mi. along North Cabin Rd. from junction of Bare Hill Rd. and former.	L.S.8in.6-47-1-3	301	8	5	3	5	25 Pj not less than 10" DBH.
4	Plantation Plot No.12/18A North and West boundaries of plot take same lines as those of plant plot	L.S.14 in 33-6-1-3	216	29	25-30	83	1	nil
5	Southeast corner post of plantation plot 12/18 forms SE corner of 1/10 acre plot	L.S.14 in 32-46-1-3	205	29	25-30	53	7	6 trembling aspen 10'-15' in height
6	N.E. Corner of Plantation Plot 13/8	NE¼ L.S. 16in31-46-1-3	262	29	30-35	70	5	nil
7	.5 mi. along North Cabin Rd. from Junction of Wingard Rd. & former	L.S. 2 in 4-47-47-1-3	654	9	5	62	15	trembling aspen ranging from 10' to 15' in height
8	1.4 mi. along Wingard Rd. in westerly direction from junction of North Cabin and Wingard Rds.	L.S.8 in 32-46-1-3	1007	6	2	62	0	Many Pj in this plot not less than 10" DBH
9	4.6 mi. along Wingard Rd. in westerly direction from junction of North Cabin and Wingard Rds.	L.S. 8 in 11-46-2-3	172	9	7	10	1	20 matured Pj trembling aspen scattered throughout plot. Max. ht. 16 ft.
10	5.8 mi. from junction of North Cabin and Wingard Rds. along the latter in westerly direction.	L.S.16 in 3-46-2-3	262	10	8	10	0	15 matured Pj. not less than 10" DBH
11	.3 mi. in north direction from junction Wingard & North Cabin Rds along the latter	L.S.16 in 33-46-1-3	116	14	7	34	15	Trembling aspen seedling abundant. Max. ht. 8'.
12	1.6 mi. from junction Bare Hill Rd. & North Cabin Rds. along the latter. in N.W. direction	L.S.12 in 6-47-1-3	329	6	3	13	4	20 Pj not less than 10" DBH
13	3.5 mi. from junction Bare Hill Rd. This plot is .1 mi. north from this reading on another trail	L.S.2 in 35-47-2-3	167	5	2	8	2	18 Pj not less than 8" DBH.
14	4.8 mi. from junction Bare Hill Rd. & North Cabin Rd. Along the latter in westerly direction	L.S. 2 in 34-47-2-3	90	12	7	21	2	nil

TA : II

Density Classes	Plot Number	% Trees currently infested AGE CLASSES (years) 5-10	10-15	Plantation Plots 29 years	% Trees subjected to old weevil damage	Total % weevil damage per plot
A	9	5.81	--	--	.58	6.39
0 - 200	11	--	29.31	--	12.93	42.24
Per 1/10 acre	13	4.79	--	--	1.19	5.98
	14	--	23.33	--	2.22	25.55
B	3	.99	--	--	1.66	2.65
200 - 400	4	--	--	38.42	.46	38.88
per 1/10 acre	5	--	--	25.85	1.95	27.80
	6	--	--	26.72	1.90	28.62
	10	3.85	--	--	--	3.85
	12	3.95	--	--	1.21	5.16
C	1	--	17.99	--	2.29	20.28
400 +	2	2.16	--	--	.54	2.70
per 1/10 acre	7	9.48	--	--	2.29	11.77
	8	6.15	--	--	--	6.15

A. Introduction

The large aspen tortrix (*Archips conflictana* Wlk.) has caused serious defoliation of trembling aspen in parts of Manitoba, Saskatchewan and Alberta in the past few years. As a number of details of its life history in this region were not known with certainty, a study was begun in June, 1947.

B. Method

Insect material used in this study was obtained from the Duck Mountain area of Manitoba, where severe infestations have been reported.

1. F.I.S. 47 W 117

A collection of larvae for this study was made on June 9, in the Duck Mountain Forest Reserve (sec. 16, tp. 30, rge. 29, W.P.M.) Sixty-three larvae were placed for rearing on trembling aspen foliage in lantern globe cages on June 12. The first pupa was observed on June 24. Pupation continued until June 30. One male moth emerged on July 2 and six female moths emerged during the period July 4 - 10. A large number of the larvae were parasitized by Diptera and Hymenoptera.

As the moths emerged, they were placed for mating and oviposition in a lantern globe rearing cage, the base of which contained water. Twigs of trembling aspen were inserted into the water to keep them fresh for oviposition. Eggs were observed on July 10 on the inside surface of the glass container. Egg laying continued until July 15 on the sides of the container and on the upper surface of the leaves. A number of eggs were preserved in 30 percent alcohol and later transferred to 70 percent alcohol for storage.

The remaining eggs failed to hatch.

2. F.I.S. 47 W 300

Three larvae and 21 pupae were collected in the Duck Mountain Forest Reserve (tp. 31, rge. 29, W 1st mer.) These insects were reared in jelly jars. The pupae were placed on dampened absorbent cotton. Three male moths emerged on July 7 and July 9, and three female moths on July 8. These were placed in a lantern globe rearing cage as described above. Eggs were laid on July 10, but they failed to hatch.

3. F.I.S. 47 W 129, 130, 132A, 133, 134, 212.

These collections of large aspen tortrix larvae were all made in the Duck Mountain Forest Reserve from June 10 to June 17. Some of the adults which emerged from this material from July 3 to July 5 inclusive were placed in a lantern globe rearing jar as previously described.

DATE	NUMBER	SEX	SOURCE
July 4	1	♂	F.I.S. W 130
	1	♂	F.I.S. W 132A
	1	♀	F.I.S. W 133
	1	♀	F.I.S. W 134
July 5	1	♀	F.I.S. W 129
	1	♀	F.I.S. W 212

Eggs were laid on July 10. A few were deposited on the upper surface of the aspen leaves but most of them were found on the glass container in large clusters.

Larvae hatched from the eggs on July 15. Several were placed in Frehling's solution for later study and the remainder were reared. Details of rearing methods are given below.

On July 15, a single larva was placed in each of nine vials for individual study. These were six drachm vials with tight-fitting screw tops. Several small leaves of trembling aspen were placed in each vial. A few small pieces of bark were added to provide shelter for the hibernating larva. Fresh foliage was provided as required. In addition to the larvae reared individually in vials, a number were placed in jelly jars and provided with twigs of poplar to observe the feeding habits of the larvae in a less confined habitat.

On July 25, six larvae were removed to individual glass vials provided with several trembling aspen leaves and a few pieces of bark or twigs. The vials were plugged with absorbent cotton which was moistened periodically. Fresh foliage was provided as needed. The remainder of the larvae were transferred to a pint sealer containing twigs and leaves of aspen. A cloth was fastened tightly over the sealer and sprayed with water daily to increase the humidity in the sealer.

The two series of larvae in vials were intended for overwintering in the ground. The remainder of the larvae were overwintered in a roothouse on the grounds of the laboratory.

On October 3, the vials containing larvae in hibernacula were prepared for overwintering. Absorbent cotton was used as a plug above and below the specimens which were concealed in bark fragments or in silken coverings on leaves. The cotton was dampened slightly. These vials were buried between layers of moss in a screen frame just below the surface of the ground. A light covering of earth and leaves was placed over the frame. Larvae intended for overwintering in the roothouse were prepared by placing slightly dampened cotton at the bottom of the sealer containing the pieces of bark etc., in which the larvae had formed hibernacula. The top was then screwed on tightly and the sealer placed in the roothouse where the minimum temperature recorded during the winter was approximately 40° F.

On May 21, 1948, the vials were removed from the ground as poplar foliage was available for feeding by that time. Surviving larvae were placed in screw-top or cotton-plugged vials as before and fresh foliage added as required. Dates of larval moults were recorded and head capsules retained for measurement. Larvae developed to the pupal stage but failed to emerge as moths.

No larvae survived overwintering in the roothouse.

C. Observations.

Observations recorded below refer to insect material from collections F.I.S. 47 W 129, 130, 132A, 133, 134, 212.

1. F.I.S. W 47 129, 130, 132A, 133, 134, 212.

The female moths laid eggs 6 to 7 days after being placed with the male moths in the mating cage. Egg deposition occurred on July 10.

(a). Eggs

The green eggs were laid overlapping each other slightly, in clusters on the upper leaf surface and on the sides of the glass container. The lower (or leaf) surface of the egg was flattened and the upper surface appeared slightly rugose. Eggs were oval in outline. One egg measured was approximately 1.08 mm. long and .76 mm. wide viewed from above.

(Zeiss Binocular 01.12, ocular 10, objective 6, laboratory micrometer, calibrated at 1 square = .216 mm.)

(b) Larvae

Larvae hatched 6 days after deposition of the eggs (July 15). They commenced feeding immediately. Some larvae webbed between adjacent leaves. On an isolated leaf, it was observed that the larvae fed on the upper surface of the leaf, eating the top layers of tissue. They were also observed resting on a silk film spun on the top surface of the leaf, protected between the film and the leaf surface. Other larvae ate completely through the leaf tissue. Only a net-work of veins remained of the leaves attacked in this manner.

By July 22, the larvae were still moving about in the jelly jars used for rearing. Some were still feeding. By July 25, feeding had evidently ceased and larvae were moving about constantly. They were negatively geotropic. Of those transferred on July 25 to a pint sealer, a few briefly resumed feeding on July 26. The first hibernacula were observed on July 26, in crevices of the jar and lid. The larva formed a white, semi-opaque silken covering.

Hibernacula were constructed between leaves, on upper or lower surfaces of leaves, in crevices and angles of glass surfaces, or completely concealed in crevices of bark. Several larvae were still wandering in the vials on August 8. These had left their hibernacula and did not survive.

(i) <u>First Instar Living Larva</u>: The first instar larva had a black head and yellow-green body. The prothoracic shield and the anal plate were light brown. The thoracic legs were the same color as the body or slightly brownish in tone.

Head width of a measured specimen was .304 mm. (Dorsal view at the widest part of the head - Estimated error $\pm$ .022 mm.) The overall length of the larva was 1.9 mm. approximately. Measurements were made with Zeiss Binocular (O1.12), Ocular 10, Objective 6, using 'laboratory' micrometer calibrated at 1 square = .216 mm.

(ii) <u>First Instar Preserved Larva</u>: Head widths of ten larvae which had been preserved in Frehling's solution on July 15, 1947, were measured using a Zeiss Monocular (O1.21), Ocular 10, Objective 10, with the 'laboratory' micrometer calibrated at 1 square = .128 mm.

	Head Width		Head Width
1.	.294 mm. ± .0128 mm.	6.	.294 mm.
2.	.282 mm.	7.	.269 mm.
3.	.294 mm.	8.	.282 mm.
4.	.294 mm.	9.	.294 mm.
5.	.294 mm.	10.	.307 mm.

Average head width .290 mm. ± .004 mm.

(iii) Second Instar Living Larva: Head width of a living larva was measured in its hibernaculum on July 29, 1947. The head width was .432 mm. ± .022 mm. (Equipment used was the Zeiss Binocular and accessories described above.)

The second instar larva had a brown-black head, prothoracic shield and anal plate. The body color was distinctly yellow with the integument completely covered with greyish granules. The setal bases on the body were grey and distinct. The thoracic legs were brown in color.

(iv) Second Instar Preserved Larva: A larva was removed from its hibernaculum and preserved in Frehling's solution on July 29, 1947. The head width of this larva was .346 mm. ± .0128 mm. (Equipment used was the Zeiss Monocular and accessories described above.)

A second larva was removed from its hibernaculum and preserved on August 8, 1947. The head width was .410 mm. ± .016 mm. (Equipment used was Zeiss Monocular, Ocular 10, Objective 8, with 'laboratory' micrometer calibrated at 1 square = .160 mm.

(v) Overwintered Larvae: Only one larva of those reared in vials with screw tops survived overwintering. It hibernated in a crevice of bark. Two larvae reared in cotton-plugged vials survived. These also formed hibernacula in bark crevices. One of the latter larvae died several days after removal from the ground on May 21, 1948.

Larvae emerged from their hibernacula and commenced feeding soon after being placed with foliage in the rearing vials. On May 25, it was observed that one larva was feeding while webbed between two leaves. It had skeletonized part of a leaf. The other larva, newly emerged from its hibernaculum, was feeding in a curled leaf on that date.

(a) Larvae reared in cotton-plugged vials: The following observations were made from the surviving larva (No. 6) reared in a cotton-plugged vial.

May 21 - Larva out of hibernaculum - second instar.

May 25-26 - One or more moults had taken place but no head capsule was found. The third(?) instar larva had a black head, grey body and distinct black setal bases.

May 28 - Larva in a silken nest in a leaf furrow.

June 1-2 - Larva moulted. The cast head capsule measured .845 mm. ± .0128 mm. (Zeiss Monocular, Ocular 10, Objective 10). Larva had a black head and grey-black body.

June 10-11 - Larva pupated. The head capsule attached to the cast skin measured 1.312 mm. ± .016 mm. (Zeiss Monocular, Ocular 10, Objective 8). The pupa was black in color, sex-female.

Only four instars were actually observed during the development of this larva. No head capsules were found between May 21 and June 2, but at least one moult, possibly several, took place in this period.

(b) Larvae reared in screw-top vials: The following observations were made from the surviving larva (No. 5) reared in a screw-top vial.

May 21 - Second instar larva in hibernaculum.

May 26 - Second instar larva was feeding. Larva had a black-brown head and yellow body.

May 27-28 - Second moult occurred. The cast head capsule measured .333 mm. ± .0128 mm. (Zeiss Monocular, Ocular 10, Objective 10.) Previous to moulting, the larva did not eat the lower leaf layers. After moulting, the third instar larva ate all leaf layers.

May 31-June 1 - Third moult occurred. The cast head capsule measured .602 mm. $\pm$ .0128 mm. (Zeiss Monocular, Ocular 10, Objective 10).

June 2 - Fourth instar larva had black head and grey-black body.

June 3-4 - Fourth moult occurred. The cast head capsule measured .998 mm. $\pm$ .0128 mm. (Zeiss Monocular, Ocular 10, Objective 10).

June 6-7 - Fifth moult occurred. The cast head capsule measured 1.504 mm. $\pm$ .016 mm. (Zeiss Monocular, Ocular 10, Objective 8).

June 15-16 - Larva pupated. The head capsule attached to the cast larval skin was not found. The pupa was black in color, sex-female.

Six instars were recorded during the development of this larva, a female.

D. Summary

The pupal period of the large aspen tortrix as observed during this study was from June 24 to July 4, and the period of moth emergence was from July 2 to July 10.

Forest insect survey records for Manitoba, Saskatchewan, and Alberta from 1944 to 1947 show that pupation takes place from June 12 to July 4. Emergence of adults occurs from June 22 to July 10.

Eggs were deposited on July 10, 6 to 7 days after male and female moths reared in this study were confined in the mating cage. The eggs were laid in clusters on the upper surfaces of the leaves and on the glass container. The larvae hatched on July 15, 6 days after deposition of the eggs.

The larvae began to feed immediately. They were observed on isolated leaves feeding without protection on the upper layers of leaf tissue. Some larvae webbed between adjacent leaves and others fed beneath a silk covering on the upper surface of the leaf. Some first instar larvae ate all layers of the leaf tissue.

The first hibernacula were observed on July 26. It was not ascertained whether the first or second instar larva constructed the hibernaculum. However, all larvae which were examined in their hibernacula were in the second instar. It is probable that the second instar larva constructs it as no cast head capsules were found within hibernacula. One second instar larva was examined and its head capsule measured, after it had spun a loose silk covering between a leaf and the glass vial. This larva later formed its hibernaculum on a leaf. The latest date for spinning the hibernaculum was not observed as most of the larvae concealed themselves in crevices of bark. Several larvae were still moving about in the rearing vials on August 8, but these had left their hibernacula. They died later.

Under the rearing conditions of this study, the hibernacula were spun in crevices of bark, or between and on leaves. No earth was provided in the rearing containers. This study therefore, failed to show where the larvae overwinter under natural conditions.

Second instar larvae emerge from their hibernacula to commence feeding on trembling aspen foliage soon after the foliage appears in the spring. The larvae reared under insectary conditions commenced feeding between May 21 (when they were removed from storage in the ground) and May 25. The larvae fed in webbing between leaves or within a curled leaf. The leaves were either skeletonized by the second instar larva or the upper layers only were eaten. Third instar larvae ate all the leaf layers.

The female larva has as many as six instars. Possibly a smaller number may occur. No male larvae were reared. The two female specimens reared to the pupal stage from eggs required approximately three weeks from the time the larvae commenced feeding in the spring, to the time they pupated (June 11 - 16). The pupae failed to emerge as moths so that the pupal period was not ascertained for these specimens.

Overwintering mortality of the larvae prevented the proper completion of this study. Larvae should be obtained early in the spring, if possible in hibernacula, for rearing to determine definitely the number of instars which may occur, and to obtain specimens of all instars for detailed description.

This study was undertaken in the southeastern portion of the Ft. a la Corne Reserve, to determine the extent of damage caused by wood boring insects feeding on fire killed and injured jack pine. The particular area of investigation was situated 1.3 miles east of Fort House along the New Fort Road. The fire, reportedly driven by a high velocity wind, swept through this area on the night of June 13. The jack pine in this area are of small size and have been subjected to varying degrees of burn; i.e. from a severe crown burn to a light, rather harmless, ground burn. Hence, all burn types were found to be available in a comparatively small area. This study was conducted between August 11 and August 19.

The method of classifying burn types was in accordance with that employed in "The Deterioration of Fire Killed White Spruce by Wood Boring Insects in Northern Saskatchewan", by H. A. Richmond and R. R. Lejeune.

All trees falling into a given burn type have the characteristics contained in the description of that burn type, in common. Five major burn types were evolved in the white spruce study, and the characteristics of each in relation to jack pine have been interpreted for this study.

The fire burn types for jack pine have been defined below. The descriptions apply to conditions existing approximately two months after the fire.

Burn Type 1 - Most severe type of burn. Bark has been burnt through or bark scales have subsequently dried and fallen. Cambium may be cooked and dry, and in this condition is usually brown in colour, or cambium may be moist but not sticky and greyish-black in appearance. A bluish-green mould is usually associated with the latter condition.

Burn Type 2 - Less severe burn than that of Type I. Bark is badly charred and does not peel readily. Cambium badly scorched being dry, and black in appearance due to excessive heat, or may be mottled tan to brown in colour. Inner and outer bark may be separated, the former peeling readily in strips.

Burn Type 3 - Less severe burn type than Type 2. Bark is scorched but not necessarily charred, and peels readily in one layer. Cambium is usually mottled tan to brown with sticky surface.

Burn Type 4 - Bark obviously subjected to intense heat but appears undamaged by flames or, more infrequently, bark may be lightly charred on opposite side of sampling area. Cambium is white, moist and sticky, and in some instances a slight discoloration may be apparent.

Burn Type 5 - Tree has suffered only a mild root burn and foliage on upper portion of tree may be undamaged. Cambium is white, moist and sticky, and appears similar to that of tree unaffected by fire burn.

A measured area of bark was removed from the basal region of fifty trees of each burn type. Records were made of D.B.H., diameter where sample taken, and insect populations per fixed area. A resume of the findings will be found in the following table.

Burn Type	Mean DBH	Number of trees examined	Area of bark removed in sq. ft.	Number of Monachamus scutellatus per sq. ft.	Number of Stenocorus sp. per sq. ft.	Number of Ips pini per sq. ft.	Number of Clerid sp. per sq. ft.	Number of Monochamus entrance holes located per sq. ft.	Mean depth of penetration in inches
1	7.01	50	24.03	5.29	22.64	.42	.08	1.91	1.24
11	6.71	50	2404	4.78	24.87	1.71	.58	.95	1.43
III	6.12	50	23.17	1.73	5.54	1.05	--	--	--
IV	6.49	50	23.54	.08	.51	.04	--	--	--
V	6.91	50	24.42	--	--	--	--	--	--

The main destructive insect pest, although not comprising the largest population per fixed area, was found to be Monochamus scutellatus Say.

The numbers in the column "No. of Monochamus scutellatus per sq. ft.", include those larvae which were found in the entrance holes as well as those larvae which were found between the bark and the wood, and had not yet started tunnelling into the wood. Larvae of this insect which had commenced tunnelling were found at a mean depth of penetration of 1.24 inches in type 1 burn, while type 2 burn revealed a mean depth of penetration of 1.43 inches. The maximum depth of penetration into the wood in any one instance was found to be 3 3/8 inches on a type 1 burn.

Another borer, living between the bark and wood in large numbers has tentatively been identified as Stenocorus sp., pending positive identification when adults are obtained. The larvae of Stenocorus are normally found between the bark and wood of all coniferous trees with one exception. They require a certain amount of moisture, usually preferring trees which have been dead only a short time. Field conditions revealed this insect to be present in large numbers, as shown in the table, but it was not observed to be causing damage to the wood, nor is it expected to do so.

A third larval type was found between the bark and wood, and has been identified as Clerid sp. In the larval stages these insects are usually carnivorous, living under bark and in the burrows of wood boring insects upon which they prey. The predatory habit was not observed under actual field conditions.

A species of bark beetle, identified as Ips pini, Say, was also found, but only in relatively small numbers. These insects are bark feeders, and do not damage the wood. In addition a fly maggot was found and preserved, but as no adults were reared through, the relationship to the wood borers is unknown.

In all the trees examined, only 3 flat headed borers were found, and these were associated with burn type 1. Upon identification the larvae were found to be possibly

Paecilonota sp. The key used was: U.S.D.A. Bull. No. 437, "Flat-headed borers affecting Forest Trees in the United States", by H. E. Burke, 1917. These insects are reported to be bark and wood miners in the trunks of injured willow, aspen and cottonwood throughout the United States, but no mention is made of attacks on coniferous trees.

Mr. R. Wong, of the Winnipeg Laboratory, rendered valuable service in the identification of insects dealt with in this study. (An interesting feature of this study is that the heavier insect populations, with the exception of Monochamus scutellatus are associated with burn type 2, but, in general, conditions which are apparently attractive to a given insect population in a given burn type are constantly fluctuating. Therefore it is probable that less severe burn types may, a year hence, readily provide satisfactory conditions for increased populations. In this connection it is significant that the number of Monochamus entrance holes found on Type I burns were exactly double the number found on Type 2. The small insect populations associated with the three less severe burn types would appear to indicate that these types have, as yet, not deteriorated to such an extent as to provide a suitable habitat for these destructive forest pests.

Worthy of attention is the remarkable difference found in the susceptibility to round-headed borer attack of the different burn types in jack pine and white spruce. The following table illustrates these differences in the two burns. In both instances the burn took place in June, so that the interval between the occurrence of the fire and the examination of trees was very similar.

Burn type	Carrot River, September 1942 Pop/sq.ft.on white spr.	Ft. a la Corne, August 1947 Pop/sq.ft. on jack pine
1	nil	5.29
2	1.00	4.78
3	1.80	1.73
4	3.06	.08
5	5.15	nil

It will be observed that burn types 1 and 2 on white spruce were largely unaffected by borers, while so far these have been the most attractive types on jack pine. On white spruce, the borer population increases with the lighter burn types, while on jack pine the population decreases. If past experience is a criterion, however, the lighter jack pine burns should eventually become more attractive to borers, and hence a different picture may develop by 1948.

On the basis of this preliminary investigation, it would seem that recommendations for the salvage of fire killed white spruce require some alteration in the case of jack pine. Inasmuch as jack pine burn types 1 and 2 are the first attacked, for maximum utilization as saw timber these should be salvaged immediately or as soon as possible after the fire. By late summer of 1948 it is probable that the borers will have completed most of the damage of which they are capable. Burn types 3, 4 and 5 are still largely free of borers, and will provide the best quality salvage this winter, although if volume is a major consideration burn types 1 and 2 should be utilized first and the remaining burn types last. Burn types 3, 4 and 5 may become infested during the summer of 1948, but it is possible, under favourable temperature and humidity conditions, that little further infestation will occur.

I. MISCELLANEOUS SPRAYS OF ORNAMENTAL TREES

On May 19, 1947, several ornamental spruce trees near the tennis court at Riding Mountain National Park were discovered to be covered with nymphs, of what has been tentatively identified as a species of mealy bug. On May 20, all but one of these infested trees were sprayed with a solution of nicotine sulphate, 1 part to 500 parts of water, to which soap had been added. The unsprayed tree was left as a check. The spray was applied liberally with a Dobbin's hand sprayer.

Subsequent daily checks were made by examining foliage under a binocular microscope. For three days after spraying no mortality was observed, but within the next two days all the numphs on the foliage examined were dead. However, at the same time about 75% of the nymphs on the check tree were found to be dead, and by May 27 no living nymphs were found. It appears, therefore, that while the nicotine sulphate achieved a measure of control, all the nymphs would have died within seven days in any case.

Table I shows the results of twig examination.

TABLE I

Mortality of Aphids

	Sprayed Trees									Unsprayed Trees								
Number of days since spray applied	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Number of nymphs examined	60	50	50	75	75	75	50	50	50	50	40	60	50	40	50	60	75	50
Number of Nymphs dead	0	1	3	40	75	75	50	50	50	0	0	0	3	29	40	60	75	50
% Mortality	0	2	6	53	100	100	100	100	100	0	0	0	6	75	80	100	100	100

The same group of trees was literally covered with what appeared to be egg clusters of a woolly aphid by June 14. From 8-15 eggs were found per cluster, and usually several clusters were found on each needle. Eggs were deposited on both old and new needles, and under nearly every egg mass a large wingless living 'stem' mother was found. These are, in all probability, associated with the nymphal stages found earlier in the season on these same trees, but the seasonal activity between the last appearance of living nymphs and the first appearance of egg clusters is completey unknown. Small nymphs began to emerge on July 1st.

At this time a number of trees were sprayed with a commercial water-wettable powder containing 50% of a 12% gamma isomer of Benexane. This powder was used at the rate of 3 lbs. per 100 gallons of water. Two trees were left unsprayed to serve as checks. Daily examinations were made of the sprayed and unsprayed trees. It was found that nearly all the eggs failed to hatch on the sprayed trees, but that the egg hatch on unsprayed trees was good. On July 9 no living nymphs were found on sprayed trees and many egg clusters were still unhatched. The check trees on the other hand contained many living and few dead nymphs. Although it was not possible to follow this experiment through, it appears that 666 has some ovicidal properties against this insect, and that fairly good control was achieved.

The ornamental elm trees bordering the promenades just north of the administration building were found to be infested with the woolly aphid, Shizoneura lanigera on July 9. Nests of these aphids were found inside of numerous curled leaves. In each nest were several different stages of these aphids, usually one large wingless adult, several small winged forms, and very many small wingless nymphs. They appeared to leave their nest and move about in the open, retreating to their curled leaves at first warning of danger.

Using the same 666 solution, 10 trees were liberally sprayed with a 'Dobbins' hand sprayer. It was impossible to devote sufficient time to determine exactly the effect of this spray. Examination of numerous curled leaves two days after they were sprayed revealed many dead nymphs. No nests were completely vacated, but some had very few living nymphs in them. Probably as the nymphs emerged from their nests the residue was sufficient to destroy them. It is unlikely that the spray would reach inside each curled leaf but with a more powerful spray mechanism, this penetration may be possible. If the residual effect is to be relied upon, DDT may be a better insecticide since its residual effect is superior to that of 666.

It should be explained that the foregoing spraying experiments were carried out at the request of officials at Riding Mountain National Park. The park authorities are most concerned about protecting their valuable ornamental trees from insect damage, and these experiments were, therefore, undertaken as a co-operative gesture. Inasmuch as the investigative party stationed in the park was assigned specifically to larch sawfly studies, it was obviously impossible to carry out this additional work thoroughly, and completely. However, some excellent results were achieved, and those responsible for the protection of ornamental trees were extremely grateful for the services rendered.

It would therefore seem to be worthwhile to devote a little time to this work, since it promotes a feeling of good-will towards the forest insect unit. Moreover, the work has stimulated the interest of the park people to such an extent that they are considering the purchase or construction of a spraying unit. The forest insect laboratory personnel could well afford to assist their efforts by providing technical advice and assistance.

A. V. Hildahl

1. Introduction

The following report outlines the activities of forest insect ranger V. Hildahl during the summer season of 1947 and contains observations made in various parts of Manitoba for the Forest Insect Survey. No definite itinerary was followed by the writer as the season's work was devoted to supervision of the insect rangers in the field and to special trips and investigations.

The latter part of May and first part of June was spent at the Winnipeg Laboratory. During this period, the writer made two trips to the Spruce Woods Forest Reserve; one on June 5 to collect spruce budworm larvae for shipment to the Dominion Parasite Laboratory, Belleville, Ontario and a second trip on June 10 to release spruce budworm parasites.

On June 12 and 13, the writer accompanied Mr. W. C. McGuffin on a trip to the Whiteshell Forest Reserve to conduct Forest Insect Survey sampling (tree beating) experiments. The object of the experiments was to determine a standard method for making insect collections which could be used by all field personnel.

An aerial survey of the Manitoba-Ontario border region, conducted jointly with Mr. G. R. Carter from the Forest Insect Laboratory, Sault Ste. Marie, Ontario, was carried out during the first part of July. The purpose of the survey was to determine the prevalence of spruce budworm and jack pine budworm in the forested areas along the Manitoba-Ontario border. Aerial mapping of budworm damaged spruce and jack pine stands throughout the same area was undertaken during the latter part of August and the early part of September. The aircraft used throughout the aerial reconnaissance was supplied by Forest Insect Investigations, Sault Ste. Marie, Ontario.

The period July 20 to 27 was spent inspecting the field work being carried out in Alberta by the forest insect rangers. At the same time, several contacts were made with personnel of the Alberta Forest Service.

From August 13 to 21, the writer was in the Prince Albert area inspecting the field work being carried out in Saskatchewan and contacting personnel of the Saskatchewan Department of Natural Resources. Preliminary arrangements were made, at that time, with the Saskatchewan Department of Natural Resources for the erection of a forest insect ranger cabin at Prince Albert.

The period from August 25 to September 17 was devoted to supervising the establishment of permanent Forest Insect Survey sample plots in various types of timber stands throughout the forested areas of the three provinces. Field work for 1947 was terminated on October 7.

2. Insect Conditions

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

Early in July, a survey to determine the prevalence of budworm on spruce, balsam and jack pine was made along the Manitoba-Ontario boundary. This survey extended from Moar Lake in the north to Oiseau Lake in the south. (Moar Lake lies almost due east of the town of Berens River and Oiseau Lake lies about 35 miles east of Lac du Bonnet.) Jack pine budworm feeding was observed in all the jack pine stands surrounding the following lakes: Moar, Dogskin, Aikens, Wallace, Gem and Oiseau in Manitoba and Spoonbill, Musclow, Carroll, Wingiskus, Eagle and Snowshoe in Ontario. (These lakes are located within 20 miles of the Manitoba-Ontario boundary.) At the time of the survey (July 1-7), jack pine budworm activity was relatively light in all the above mentioned places with the exception of Wingiskus Lake in Ontario where defoliation ranged from 15 to 30 per cent of the current year's foliage. In the latter part of August and early part of September, an aerial survey was made of the area between Lake Winnipeg and the Ontario boundary from Rennie in the south to Berens River in the north. Only one infestation of jack pine budworm was observed from the air throughout this area. The attack occurred along the south-eastern shore of Aikens Lake and extended south-eastward as far as Obukowin Lake covering an area of approximately 11,000 acres. Throughout the infested area, defoliation was quite noticeable and the jack pine showed a distinct reddish tinge indicating that the attack was of medium intensity.

(b) Spruce Budworm (Choristoneura fumiferana Clem.)

During the survey carried out in the Manitoba-Ontario boundary region, spruce budworm feeding was observed at the following lakes: Moar, Wallace, Gem and Oiseau in Manitoba and Spoonbill, Muselow, Carroll, Wingiskus, Eagle and Snowshoe in Ontario. In every case, the budworm populations on spruce were considerably lighter than those on jack pine in the same area and very little damage to spruce foliage was observed. No serious outbreaks of the spruce budworm were seen from the air during the aerial reconnaissance.

(c) Larch Sawfly (Pristiphora erichsonii Htg.)

This larch feeding insect continued to cause severe defoliation of tamarack stands east of Lake Winnipeg in Manitoba. An aerial reconnaissance of the area, carried out during the latter part of August and early part of September, indicated that, for the most part, larch sawfly was quite active in all larch stands and, although it varied in intensity in individual swamps, in no instance did it show signs of being less abundant than it had been in previous years. Heavy infestations occurred along the south-east end of Lake Winnipeg and around Pine Falls, the Black River Settlement, Hole River, Loon Bay and inland along the Pigeon and Berens Rivers for a distance of approximately 20 miles. Small tamarack swamps around Catfish Lake and Round Lake also suffered heavy defoliation. Eastward, toward the Manitoba-Ontario boundary, tamarack is less abundant, but all stands throughout the inland area showed light to medium defoliation. Scattered larch stands throughout swamps around Little Grand Rapids, Wasaginnigak Lake, Wallace Lake, Dogskin Lake and Aikens Lake all suffered light to moderate attacks.

It was observed during the survey made along the east side of Lake Winnipeg that in some cases only the outer edge of the swamp was heavily attacked, with little or no defoliation in the centre (lower) area. Probably this condition was associated with the high water levels throughout the region which may have adversely affected the development of the larch sawfly.

(d) Birch Sawfly (<u>Arge pectoralis</u> Leach.)

This insect caused moderate to severe defoliation in scattered birch stands throughout south-eastern Manitoba in 1947. The main body of the outbreak was bounded on the north by Pine Falls and the Winnipeg River and extended south-eastward to Crow Duck Lake and thence south past West Hawk Lake and Falcon Lake to Shoal Lake. The heaviest attacks occurred around Waugh, Manitoba, on the west side of Shoal Lake. Birch stands in this area were completely stripped. Heavy attacks also occurred at the south end of West Hawk Lake and along the north side of Falcon Lake. Defoliation of birch at these two points ranged from 75 to 100 per cent. Examination of birch stands around Lac du Bonnet and Point du Bois indicated that birch sawfly had been active throughout these areas. However, these examinations were made late in the fall after the leaves had commenced falling and, therefore, no definite conclusions regarding the severity of the attack were reached.

3. Special Investigations

(a) Budworm Survey--1947--Manitoba-Ontario Boundary Region

Early in July, a survey to determine the prevalence of budworm on spruce, balsam and jack pine was made along the Manitoba-Ontario boundary from Moar Lake in the north to Oiseau Lake in the south. (Moar Lake lies almost due east of the town of Berens River and Oiseau Lake lies about 35 miles east of Lac du Bonnet.) The survey was conducted jointly with Mr. G. R. Carter from the Forest Insect Laboratory at Sault Ste. Marie, Ontario. The aircraft used throughout most of the survey was supplied by Forest Insect Investigations, Sault Ste. Marie. The Manitoba Provincial Air Service assisted greatly by supplying aircraft for the latter part of the reconnaissance. Aerial mapping of budworm damaged spruce and jack pine stands throughout eastern Manitoba from the Whiteshell Forest Reserve in the south to Moar Lake in the north was undertaken during the latter part of August and early part of September. For the results of the survey, refer to Section II parts (a) and (b) of this report.

(b) Larch Sawfly Reconnaissance--1947

During September, an extensive aerial reconnaissance was made to determine the distribution and intensity of larch sawfly throughout tamarack stands in eastern Manitoba. The aircraft used for the reconnaissance were supplied by the Manitoba Provincial Air Service. The survey covered the part of eastern Manitoba lying east of Lake Winnipeg from the Winnipeg River in the south to the Berens River in the north. Throughout the area covered during the survey, larch sawfly was generally distributed and was causing moderate to severe defoliation to most tamarack stands. For further results of the survey, refer to Section II, part (c) of this report.

Table 1.

4. Personnel Contacted

NAME	RANK	PLACE	PROVINCE	DEMONSTRATION OF SAMPLING
T. H. Vermilyea	District Forester	Winnipeg	Manitoba	no
J. J. Wright	Forest Ranger	Carberry	Manitoba	no
D. E. Cooper	Forest Ranger	Marchand	Manitoba	no
A. W. Braine	District Forester	Winnipeg	Manitoba	no
C. H. Patterson	Senior Forest Ranger	Lac du Bonnet	Manitoba	no
J. Maspor	Forest Ranger	Lac du Bonnet	Manitoba	no
E. Warner	Forest Ranger	Riverton	Manitoba	no
C. J. Ritchey	Forest Rgr-in-Charge	Rennie	Manitoba	no
J. H. Inkster	Forest Ranger	Rennie	Manitoba	no
E. J. Marshall	Director of Forests	Prince Albert	Saskatchewan	no
H. J. Peddle	District Supt.	Prince Albert	Saskatchewan	no
H. P. Kisler	Forester	Prince Albert	Saskatchewan	no
R. A. Matheson	Field Supervisor	Prince Albert	Saskatchewan	no
J. M. Brown	Field Officer	Prince Albert	Saskatchewan	no
T. F. Blefgen	Director of Forestry	Edmonton	Alberta	no
D. Buck	Forest Supt.	Edson	Alberta	no
E. Noble	Timber Inspector	Edson	Alberta	no
W. Lumsden	Clerk	Edson	Alberta	no
P. Brodie	Supervisory Warden	Wasagaming	Manitoba	no
R. Taylor	Senior Ranger	Red Lake	Ontario	--
G. R. Carter	Forest Insect Ranger	Sioux Lookout	Ontario	--
J. M. Bussineau	Forest Insect Ranger	Vermillion Bay	Ontario	--
E. O. Clinton	Forest Insect Ranger	Sioux Lookout	Ontario	--

B. E. F. Bridgman

1. Introduction

A survey of forest insect conditions in Manitoba was carried out in the summer of 1947 by W. Addison, R.C. Purse and E. F. Bridgman (writer). Field work was commenced in late May and was completed in mid-October.

The last few days in May were spent in the Turtle Mountain and the Spruce Woods Forest Reserves, but due to the late season, very little insect activity was observed at this time.

During the first two weeks of June, a general insect survey was conducted in the Western Forest District of Manitoba. The areas visited included Riding Mountain National Park and the Duck Mountain and Porcupine Forest Reserves.

The survey was continued during the latter half of June in forested areas of the inter-lake region as far north as Gypsumville, Hodgson, and Riverton.

The writer spent four days in the first week of July in the Bissett area, which was reached by aircraft of the Manitoba Air Service. Here, an inspection of spruce and balsam fir for the presence of spruce budworm was carried out and general insect sampling continued.

Two weeks in mid-July were spent in a special survey of jack pine budworm in the Sandilands and Whiteshell Forest Reserves. At the same time, a search for evidence of spruce budworm in the latter reserve was made.

During the balance of July, an inspection of insect conditions in the Pine Falls-Lac du Bonnet district was made. This included a one day survey of the Manitoba Pulp and Paper Company's pulpwood berth north of St. George.

Larch sawfly reconnaissance was begun while in this district. The last few days in July were spent on a larch sawfly survey of the areas around Sundown, Piney, Sprague, and Whitemouth Lake in the southeastern corner of the province.

All of August was spent on a larch sawfly survey and on general collecting in western Manitoba, from Riding Mountain National Park north to The Pas. An airplane flight from The Pas over the central portion of northern Manitoba to detect larch sawfly was made by R. C. Purse.

Further larch sawfly reconnaissance was carried out for the purpose of detecting defoliation by larch sawfly during the first week in September in the inter-lake region of Manitoba. The remaining three weeks of September were spent in establishing permanent sample plots in the Whiteshell, Sandilands, and Spruce Woods Forest Reserves.

A thorough survey of budworm damage in the Sandilands Forest Reserve was conducted during the second week in October. This completed the season's field activities.

Details of the summer's work and reports of insect conditions are given in the following pages.

2. Insect Conditions

(a) Larch Sawfly (*Pristiphora erichsonii* Htg.)

This insect continued in 1947 to infest most of the tamarack stands examined in the southern part of Manitoba.

In the southeastern portion of the province, tamarack swamps, for the most part, were heavily infested, although in a few places the intensity appeared to be decreasing somewhat and in others increasing. Three miles east of Sundown, in a swamp covering about three sections, the infestation was very light. However, it was apparent from the sparse foliage that this tamarack had suffered heavy defoliation in past years. Dry conditions prevailed in the area examined. The trees were fairly mature (8 to 9 inches D.B.H.). Several small tamarack stands in the Sprague district suffered light to heavy infestations of sawfly. The more mature trees in this area appeared less affected, especially where the swamps were fairly dry. In a pure stand of young tamarack, 5 miles north of Vassar, a moderate to heavy infestation of sawfly was found. This swamp, which was very wet, extends in a northwesterly direction from the highway and covers 20 to 25 sections. A wet swamp, two miles west of St. Labre, contained scattered young tamarack, which were being attacked quite severely by larch sawfly.

Tamarack about one-half mile west of the Sandilands Forest Reserve headquarters was badly defoliated and all tamarack stands along the Dawson Road between Richer and the eastern boundary of the reserve were heavily infested with the pest.

In the Whiteshell Forest Reserve, there are several swamps along the Brereton Lake Road, which runs some 20 miles north from highway No. 1. Almost all tamarack in these swamps was infested by sawfly in light to medium intensity. About 11 miles east of Rennie, along the north side of the C.P.R. main line, there was a moderate to heavy infestation of sawfly in the tamarack throughout several acres of swamp.

In the area between Whitemouth and Beausejour, defoliation was heavy in most of the tamarack stands examined. It was definitely more severe than that of 1946 in several areas.

Tamarack in swamps between Seddon's Corner and Lac du Bonnet suffered heavy defoliation again in 1947. Between the town of Lac du Bonnet and Pinawa Lake, tamarack in general was heavily attacked by the sawfly. In a large swamp of young tamarack and black spruce, located in sec. 24, tp. 15, rge. 11, E.P. mer. and sections 30 and 31, tp. 15, rge. 12, E.P. mer., east of Lac du Bonnet and in a similar swamp 4 miles west of Pinawa, tamarack was heavily defoliated.

Between Lac du Bonnet and Pine Falls, several swamps were examined and all tamarack stands in them were suffering medium to heavy infestations of larch sawfly. Tamarack was heavily defoliated in a swamp about 8 miles east of Pine Falls (tp. 19, rge. 11, E.P. mer.) and also in the Fort Alexander Indian Reserve.

The tamarack stands in the Riverton area were attacked again this year by the larch sawfly, although it appeared to be still on the decline.

There was a light sawfly infestation in most of the tamarack in swamps 2½ miles west of Hodgson and one mile north of Broad Valley.

Near Ashern, two swamps were examined, in both of which tamarack was heavily infested. Across the road from one of these swamps, the tamarack was only lightly infested (sections 2 and 3, tp. 27, rge. 7, W.P. mer.).

A stand of larch 2 miles north of Fairford Settlement was only lightly infested in 1947; however, poor foliage production indicated that serious defoliation had occurred in past years. A few trees in this swamp appeared to have been killed by the larch sawfly.

In the Spruce Woods Forest Reserve, little or no larch sawfly activity was observed, although tamarack there had been infested in the past.

In the western part of Riding Mountain National Park, conditions were much the same as in 1946. Defoliation of tamarack appeared to be generally quite heavy, although in one swamp (sec. 18, tp. 23, rge. 25, W.P. mer.), it was very light. In the central portion of Riding Mountain National Park, most tamarack stands were again affected by a medium infestation of larch sawfly, with the exception of some in a very wet swamp, located in sec. 36, tp. 20, rge. 21, W.P. mer. and in a swamp about 3 or 4 miles southeast of Audy Lake, along the Park boundary, where the infestations were light.

Medium infestations also occurred in all the swamps examined along the Dauphin Road, between Moon Lake and Clear Lake in the eastern part of the Park. Similar infestations, possibly more severe, existed in larch swamps at Miles 7, 10, and 13 on the Norgate Road. Tamarack in four swamps examined along the Rolling River Road, from the Norgate Road south to the Park boundary, were all heavily infested with larch sawfly.

Along all tamarack stands examined in western Manitoba were infested with this sawfly, as far north as "The Bog" on The Pas highway (53° 15' N).

In a stand 4 miles north of Ethelbert, the infestation was light, but the larch had apparently suffered heavy defoliation in the past. Tamarack examined in tp. 29, rge. 23, W.P. mer. of the Duck Mountain Forest Reserve was heavily defoliated.

Similar conditions were observed in a stand south of Cowan on highway No. 10 and from Cowan to Renwer all tamarack was again heavily attacked in 1947.

East of the Porcupine Forest Reserve, tamarack was examined at points 12 miles northwest and 8 miles west of Bowsman; also near Birch River and Novra. All stands throughout this area were heavily infested with the insect.

In the Dawson Bay area, larch sawfly was very active in tp. 49, rge. 25, W.P. mer. Along the highway just north of Mafeking, the tamarack was also heavily infested.

Between the north end of "The Bog" (Mile 47 on The Pas highway) and The Pas, only very light activity was observed. Similar conditions existed in areas inspected north of The Pas and around Atikameg Lake. There only the occasional tree had been attacked and feeding damage was confined to one or two branches on the tree. A flight in an aircraft of the Manitoba Air Service was made from The Pas to Wabowden in central northern Manitoba. No larch sawfly infestations were observed in the territory covered.

In comparing this year's distribution of the larch sawfly with that of 1946, it appears that in the western portion of Manitoba the insect is gradually moving northward in infestation proportions.

Further information about the tamarack swamps inspected during the course of the survey is given in Tables 1 and 2 which appear on pages 224 and 226.

(b) Jack Pine Budworm (<u>Archips fumiferana</u> Clem.)

A light to medium infestation of this insect was found to exist in the jack pine stands around Red Rock Lake in the Whiteshell Forest Reserve. There were also very light infestations at the northern and the southern ends of Lake Brereton. Samples were collected from the eastern side of White Lake, the southeastern end of West Hawk Lake, and at several points along highway No. 1 in tp. 10, rge. 15, E.P. mer. Defoliation was not noticeable in these places.

The Sandilands Forest Reserve was again attacked by this jack pine-feeding insect. In 1947, a moderate to heavy infestation extended from the southern boundary of the reserve to approximately one mile north of the line between townships 6 and 7. Budworm activity in the northern part of the reserve was very light.

During July, some preliminary mapping was done in this reserve at the height of the budworm's feeding period. It was found that this year's attacks varied in intensity from very light to heavy, although only a comparatively small area of the reserve could be classed as heavily infested. It was also found that the intensity of infestation varied considerably within a small area.

In the southern half of the Sandilands Forest Reserve, most of the jack pine not infested, or only lightly infested, by the budworm showed evidence of attacks in past years by the pine tortoise scale (<u>Toumeyella</u> sp.). Scale activity observed this year was light and spotty. There were only a few places where budworm defoliation was severe in areas of jack pine attacked by scale. Only in rare cases were jack pine budworm and pine tortoise scale collected from the same branch or twig.

A survey of damage to jack pine in the Sandilands Forest Reserve was made during October. Further information about this survey appears under the heading "Special Investigations" in this report.

Outside the southern boundary of Sandilands Forest Reserve, jack pine budworm attacks were moderate to heavy in sections 13, 20, 21, and 29 in tp. 4, rge. 10, E.P. mer.

During the course of the summer's work, a search for jack pine budworm was made in several other forested areas of Manitoba. Between Seddon's Corner and Lac du Bonnet, jack pine stands along the road were examined thoroughly, but no signs of the budworm were found. A further search was made around Novra in the Birch River district and north of Mafeking along highway No. 10, without result.

(c) Spruce Budworm (<u>Archips fumiferana</u> Clem.)

No infestations of this insect were discovered outside the Spruce Woods Forest Reserve. A few samples were collected at scattered points along the west side of Lake Winnipeg between Winnipeg Beach and Riverton. The locations of these collections are as follows: sec. 20, tp. 18, rge. 4, E.P. mer.; sec. 24, tp. 20, rge. 4, E.P. mer.; sec. 21, tp. 19, rge. 3, E.P. mer. In each case, only a few budworm larvae were found on examination of several white spruce. In this district, spruce are scattered throughout the area in small stands, seldom exceeding 50 to 10 acres.

Two collections of budworm, feeding on spruce, were made in eastern Manitoba. One collection from white spruce was made at Bissett. A single larva was taken from white spruce near West Hawk Lake in sec. 7, tp. 10, rge. 17, E.P. mer. However, the date of the latter collection (July 18) indicates that it was a stray jack pine budworm. No sign of budworm damage to spruce was observed at either of these places.

(d) Aspen Tortrix (*Archips conflictana* Wlk.)

This insect enemy of white poplar was found again in infestation proportions in the Duck Mountain Forest Reserve, where it occurred mainly in the western part. The infested areas examined included: the northern half of tp. 30, rge. 28; the southern part of tp. 31, rge. 28; the northwestern corner of tp. 30, rge. 29; the western part of tp. 31, rge. 29, W.P. mer.

In the affected areas, defoliation was severe on individual trees, but not more than half of the trembling aspen examined appeared to have been attacked. The inspection was carried out in the first week of June and, since the season was particularly late in 1947, it is fairly certain that defoliation by this insect became more severe later in the month.

A small infestation was found in the southern part of the Duck Mountain Forest Reserve, located in sec. 12, tp. 27, rge. 26, W.P. mer. A great part of the defoliation in this area appeared to be caused by the American poplar leaf beetle.

Elsewhere in the western part of the province, samples were taken near Roblin, inside the eastern boundary of the Duck Mountain Forest Reserve, and in sec. 30, tp. 29, rge. 23, W.P. mer.

Other samples were obtained from the inter-lake area between Gimli and Riverton, but no defoliation was observed there.

(e) Pine Tortoise Scale (*Toumeyella* sp.)

Although no organized survey of scale attacks in the Sandilands Forest Reserve was carried out in 1947, it appeared that the extent of scale activity was about the same as in 1946. Collections were made as far north as sec. 33, tp. 6, rge. 10, E.P. mer. and in the center of the infested area, sec. 18, tp. 5, rge. 10, E.P. mer.

It is not known whether active scale was more severe this year than last, as it was not mentioned in the 1946 report whether the damage was current or that of previous years. However, as it does not appear to be spreading in the Sandilands district and, as no areas of heavy scale activity were encountered, it is probable that the infestation is on the wane.

Outside of the Sandilands Forest Reserve, only one collection of pine tortoise scale was made in Manitoba. It was taken from two trees in a jack pine stand 7 miles southwest of Lac du Bonnet (sec. 16, tp. 14, rge. 10, E.P. mer.). A careful search was made in this area for further signs of scale activity, but none were found.

(f) Forest Tent Caterpillar (Malacosoma disstria Hbn.)

Due to transportation difficulties, it was not possible to visit the areas around the Narrows of Lake Winnipeg which were infested by this insect in 1946.

No new infestations were discovered this year, although collections were obtained in the inter-lake region at Arborg, Riverton, and Hodgson. One sample was taken 6 miles southeast of Dauphin. In each case, only one tree was found to be affected in the area sampled.

(g) Red Pine Sawfly (Neodiprion nanulus Schedl.)

A small area infested by this insect was found in a jack pine forest 4 miles north of Fairford Settlement. The infestation was located in sec. 7, tp. 31, rge. 9, W.P. mer. Less than half of the jack pine had been attacked. However, the affected trees were being badly defoliated, at the time of inspection in July. Many branches had been completely stripped by the feeding larvae.

(h) Balsam Fir Sawfly (Neodiprion abietis Harr.)

No infestations of this insect were found in Manitoba this year. In the Whiteshell Forest Reserve, collections were made from black and white spruce at Red Rock Lake, West Hawk Lake, Falcon Lake, and near Rennie. At Falcon Lake, two samples were taken from balsam fir and, in each case, the sawfly had stripped some branches completely, but was confined to only one or two trees.

It was found to be causing slight damage to some small white spruce at Reader Lake, north of The Pas, and to an occasional black spruce 2 miles west of Pine Falls.

(i) American Poplar Leaf Beetle (Phytodecta americana Schffr.)

Light infestations of this beetle were found to be widespread on the trembling aspen in two districts of Manitoba.

In the inter-lake district, several collections were made in the Gimli, Riverton, and Arborg areas, where the insect was quite prevalent. However, in only two places was the defoliation noticeable (5 to 10 per cent) and, in each case, the damage was confined to a very few trees. These infestations were in sec. 20, tp. 24, rge. 4, E.P. mer. and in sec. 21, tp. 19, rge. 3, E.P. mer.

In the Duck Mountain Forest Reserve district, minor infestations were discovered near Renwer in sec. 6, tp. 36, rge. 24, W.P. mer., and in the Bield area throughout the northern half of tp. 26, rge. 26, W.P. mer.

Samples were collected at other points in Manitoba, but no defoliation was evident when inspections were made.

(j) Leaf Chafer (Dichelonyx sp.)

Two infestations of this insect were discovered in Manitoba this year, both in the inter-lake area.

One, on trembling aspen, was limited to about one acre in sec. 22, tp. 23, rge. 2, E.P. mer. At the time of examination, the trees had suffered 5 to 10 per cent defoliation and were still thick with leaf chafer adults. Beetles were quite common in the surrounding district, but no other "pockets" of heavy defoliation were discovered.

The other infestation was in sections 7 and 18, tp. 31, rge. 9, W.P. mer., near the Fairford Settlement, where leaf chafers caused severe defoliation on white birch and hazel. The infested area covered about 4 acres of a predominantly jack pine stand.

In other districts, leaf chafers were collected from saskatoon and hazel-nut, but were not numerous enough to cause noticeable damage.

(k) Pitch Pine Nodule Maker (Petrova albicapitana Busck.)

This insect was found to be very common on young jack pine throughout Manitoba. Pine plantations appeared particularly vulnerable to attacks, which resulted in killing or damaging branches of young trees.

In a plantation 5½ miles east of Douglas on highway No. 1, 20 per cent of the jack pine and Scots pine trees were found to have ~~two~~ or more branches attacked by the nodule maker. In many cases, the part of the branch between the nodule and the terminal had been killed.

A plantation near Camp Hughes in the Spruce Woods Forest Reserve contained jack pine and Scots pine, five per cent of which were attacked by the nodule maker.

Another plantation in the same area, about 9 miles east of Douglas on highway No. 1, was found, on thorough examination, to be almost untouched by the insect. Young pine seedlings at the Shilo nursery were severely attacked by this pest.

(l) The Spruce Sawflies (Pikonema alaskensis Roh. and Pikonema dimmockii Cress.)

These insects were again found throughout Manitoba, but no serious damage by them was observed. Collections were made in eastern, central and western Manitoba from Sundown in the south to The Pas in the north.

3. Special Investigations

In October of 1947, forest insect rangers L. L. McDowall, H.A.J. Edmunds, and E.F. Bridgman worked for 5 days in the Sandilands Forest Reserve mapping jack pine budworm damage, in co-operation with the Manitoba Forest Service.

The purpose of this survey was to record the distribution and intensity of budworm defoliation throughout the reserve, as well as to indicate the areas of jack pine containing a high percentage of dead tops.

In making the survey, practicially all traversable trails were covered by truck. At half-mile intervals, an estimate of total defoliation on jack pine was made in each of three diameter (D.B.H.) classes: 5 inches and under, over 5 inches to 10 inches, and over 10 inches. To arrive at this estimate, 10 trees in each class represented were chosen at random within a radius of some 10 to 15 yards. The average defoliation was then determined after assessing each of the 10 trees.

At every inspection point where dead tops were observed, the percentage of dead-topped trees in each diameter class represented in the stand was calculated. This was based on a count of 100 trees in each diameter class. The number of dead trees visible at each point was also recorded. Descriptive remarks about the stand were included for most inspection points.

Table 3 (pages 229 to 237) contains the data used in preparing a map of the jack pine budworm damage in the Sandilands Forest Reserve. This is reproduced on page 240A. The map legend is quite clear if it is kept in mind that the defoliation referred to is the accumulated result of past years' insect and other defoliating factors, assuming that budworm has been the chief one. The shaded areas are necessarily approximate, inasmuch as intensities of defoliation within relatively short distances may vary considerably and as some fairly large inaccessible areas were not surveyed.

As the map indicates, areas of moderate and heavy damage were confined to the southern part of the reserve. Symbols indicating budworm-killed tops in the northern part of the reserve mark former areas of severe infestation which are now only lightly infested.

A large scale copy of the map was sent to the Manitoba Forest Service in December 1947. It is to be used by them as a guide to cutting operations in the reserve. Some cutting operations are already in progress. It is thought that some control of the jack pine budworm will be effected through extensive cutting in areas which appear to be "pockets" of budworm activity and where budworm damage has been most severe.

Although a complete analysis of the data of Table 3 has not been attempted, some observations may be made from them.

A total of only 16 dead trees were recorded at 228 inspection points and in most cases the cause of death could not be definitely attributed to jack pine budworm. It should also be noted that defoliation estimates for trees over 10 inches D.B.H. were made in only three areas because there were not sufficient trees of this size elsewhere to make estaimates. Only two estimates of dead tops in this diameter class were made for the same reason. Damage to trees over 10 inches D.B.H. was negligible.

Table 3A summarizes the estimated percentage of defoliation and of dead tops for trees 5 inches and under and for trees over 5 inches to 10 inches. It also shows the number of inspection points where these estimates could be made. Both diameter classes were represented at a high percentage of the inspection points.

The maximum defoliation (average of 10 trees) observed in any area was 75 per cent. It occurred in trees in the D.B.H. class '5 inches and under'. The average defoliation in this D.B.H. class for 193 inspection points was 13 per cent. The maximum defoliation of trees in the D.B.H. class 'over 5 inches to 10 inches' observed in any area was 65 per cent and the average defoliation for 208 inspection points was 14 per cent.

If the two parts of the Reserve lying north and south of the boundary line between townships 6 and 7 are considered separately, it will be observed that defoliation is much heavier in the southern part. The average defoliation of trees at inspection points in the D.B.H. class '5 inches and under' was 16 per cent in the south and only 2 per cent in the north. For trees in the D.B.H. class 'over 5 inches to 10 inches', defoliations were respectively 18 per cent and 3 per cent.

As would be expected, dead tops were more frequently observed among trees in the 'over 5 inches to 10 inches' class than in smaller trees. Over the entire reserve, the former average 6 per cent and the latter less than one per cent; the maximum percentage of dead tops observed in any area was 90 per cent for the former and 50 per cent for the latter.

No dead-topped trees of the D.B.H. class '5 inches and under' were observed in the northern part of the reserve. This type of damage was confined to trees 'over 5 inches to 10 inches'. These, as mentioned before, are located in areas of former severe infestation which are now only light infested.

Large numbers of dead-topped trees in the '5 inches and under' D.B.H. class were observed at only two locations. In NE sec. 28, tp. 5, rge. 10, E.P. mer., 50 per cent of the trees in this class were dead-topped. This was a severely defoliated area. In NW sec. 10, tp. 6, rge. 10, E.P. mer., 30 per cent of the trees were dead-topped, although the defoliation here was recorded as light. In all other areas where high counts of dead tops were recorded, they were on trees in the 'over 5 inches to 10 inches' D.B.H. class.

In the southern part of the reserve, there were only a few observation points at which no defoliation was observed, confirming that the infestation was general throughout this part of the reserve. Dead-topped trees, on the other hand, were present at comparatively few points (67 out of 168) occurring in the main where defoliation was severe.

It is difficult to generalize about the characteristics of heavily-infested stands from the data of Table 3 since descriptions are incomplete. However, many of these stands were open-growing ones in which trees over 5 inches D.B.H. had suffered heavier defoliation than smaller trees. In general, jack pine in the northern part of the reserve, where infestations are light, grows more densely than in the south where infestations are much heavier.

It is planned to continue this survey in the Sandilands Forest Reserve as long as necessary to determine the effect of the cutting program on budworm populations.

No other special investigations were carried out this year by the writer. However, it may be noted here that a larch sawfly survey was conducted to determine the extent of the outbreak in Manitoba. Results of the survey are recorded under "Insect Conditions" in this report.

During July, two separate mass collections of pine tortoise scale were made in the Sandilands Forest Reserve and forwarded to Dr. S. G. Smith at Laniel, Quebec.

Mass collections of the large aspen tortrix were made in early June from the western part of theDuck Mountain Forest Reserve. These were mailed to the Winnipeg Laboratory for a biological study by Mrs. R. S. Barker.

4. Permanent Sample Plots

Between September 9 and October 4, 1947, sixteen permanent sample plots were established in the Whiteshell, Sandilands and Spruce Woods Forest Reserves of Manitoba.

Thirteen of the plots vary from 6 to 10 chains in length by half a chain in width. However, three of them had to be laid out as 1 x 4 chain plots, owing to local forest conditions.

In each plot, ten trees of each species, which constituted at least 20 per cent of the total number of trees in the plot, were marked for detailed records during the next five years.

Thus, in the Sandilands Forest Reserve there are seven plots containing jack pine sample trees and one plot, just outside the reserve, with ten larch trees and ten black spruce marked as sample trees. In the Spruce Woods Forest Reserve, three white spruce plots were laid out. In the Whiteshell Forest Reserve, one white spruce, one jack pine and one trembling aspen plot were established, as well as one of jack pine and white spruce, and one of white spruce and balsam.

The methods by which these sample plots were laid out are explained in detail in the report of the Chief Forest Insect Ranger, V. Hildahl.

Two plots were set up by R. R. Lejeune and V. Hildahl, six by H.A.J. Edmunds and A. F. Bridgman, and the balance by Edmunds, Bridgman, and R. C. Purse.

Table 1.

1947 Manitoba Larch Sawfly Survey

DATE 1947	AREA	LOCATION	GROUND COVER	MOIS-TURE	% AV. DEFOL-IATION	REMARKS
July 23	Whitemouth	sec.15, tp.13, rge. 11, E.P.M.	moss & litter	wet	75	Reached by car and on foot--¼ mile.
July 24	Pine Falls	sec.21, tp.17, rge. 11, E.P.M.	moss & long grass	wet	50	Reached by car.
July 24	Ft. Alexander Indian Res.	tp.19, rge.9, E.P.M.	moss & Labrador tea	dry	80	Reached by car and foot.
July 26	Lac du Bonnet	secs.19-20, tp. 15, rge.11, E.P.M.	moss & grass	dry	75	Reached by car.
July 26	Lac du Bonnet	secs.29,30,31, tp. 15, rge.11, E.P.M.	moss & grass	dry	75-80	Reached by car.
July 26	Seddon's Corner	sec.8, tp.13, rge. 9, E.P.M.	moss & Labrador tea	wet	70	Reached by car and foot.
July 31	Sundown	sec.3, tp.2, rge. 10, E.P.M.	moss, grass & needle litter	very dry	20	Reached by car.
Aug. 1	Sprague	sec.11, tp.1, rge. 14, E.P.M.	moss & grass, humus & litter	moist	15	Reached by car. Some trees 50-75% defoliated.
Aug. 1	Sprague	sec.7-8, tp.1, rge. 15, E.P.M.	mostly humus, litter & grass	moist	5-10	Reached by car. Large trees show no sign of defoliation.
Aug. 1	Middlebro	sec.4,5,8,9, tp.1, rge.16, E.P.M.	moss & litter	wet	5	Reached by car. Defoliation will probably be much worse later on.
Aug. 1	Sprague	sec.17,tp.1, rge. 14, E.P.M.	moss, grass, Labrador tea	wet	15	Reached by car. Infestation here is spotty.
Aug. 1	Sprague	sec.21, tp.1, rge. 13, E.P.M.	heavy moss and Labrador tea	very wet	50	Reached by car.
Aug. 1	Vassar	sec.32, tp.2, rge. 13, E.P.M.	thin moss & grass	very wet	80	Reached by car. Predatorized cocoons very numerous.

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Larch Sawfly Survey (Continued)

DATE 1947	AREA	LOCATION	GROUND COVER	MOIS-TURE	% AV. DEFOL-IATION	REMARKS
Aug. 2	St. Labre	sec.22, tp.4, rge. 11, E.P.M.	long grass & humus	quite wet	35	Reached by car.
Aug. 11	Ethelbert	sec.14, tp.30, rge. 22, W.P.M.	moss, grass heavy loam	dry	--	Very little current defoliation; very poor foliage production; few signs of larch sawfly.
Aug. 12	Birch River	sec.22, tp.39, rge. 26, W.P.M.	deep moss & Labrador tea	dry	20-25	Reached by car.
Aug. 12 & 13	39 N. of Mafeking	tp.49, rge.25, W.P.M.	moss & grass	dry	30	Reached by car on Highway #10
Aug. 18	Novra	sec.2, tp.38, rge. 28, W.P.M.	moss, humus & litter	moist	60-70	Reached by car and on foot.
Aug. 18	Bowsman	sec.2, tp.38, rge. 26, W.P.M.	moss & litter	moist	80-85	Reached by car.
Sept.3	Riverton	sec.32, tp.23, rge. 4, E.P.M.	deep moss,humus grass,Lab tea	moist	10	---
Sept. 4	Hodgson	sec.24, tp.23, rge. 2, W.P.M.	humus grass moss	wet	5-10	---
Sept. 4	Hodgson	sec.35, tp.25, rge. 2, W.P.M.	moss grass Labrador tea	moist	5	---
Sept. 5	Ashern	sec.11, tp.25, rge. 8, W.P.M.	thin moss, grass, humus	wet	50-55	---
Sept. 5	Fairford	sec.12, tp.31, rge. 10, W.P.M.	litter moss	dry	10-15	Reached by car. Poor foliage production here.

Table 2.

1947 Manitoba Larch Sawfly Survey
Riding Mountain National Park

DATE 1947	AREA	LOCATION	GROUND COVER	MOISTURE	% AV. DEFOLIATION	REMARKS
Aug. 24	½ mi. S. of Norgate Road on Rolling River Road	tp.19, rge.17	thick moss & grass	very wet(water level just under moss)	60	Accessible by car; an all-weather road; high water level here but lots of moss cover.
Aug. 24	2½ miles S. of Norgate Road on Rolling River Warden Stn.Rd.		thick moss & grass & litter with Lab. tea	dry	75-90	It is probable here that high defoliation is due to poor foliage production. Accessible by car.
Aug. 24	5½ miles south of Norgate Road	sec.2, tp.19, rge.17	moss & long grass	wet	45-50	Accessible by car.
Aug. 25	1 mile north of Russell Warden Station	sec.3, tp.22, rge.25	moss & grass	very wet(some surface water)	5	Lack of cover and high water level probably reason for little defoliation. Reached by car on rough trail.
Aug. 24	mile 10, Norggte Road	sec.33, tp.19, rge.17	grass & Lab. tea	moist	75-95	Appeared to be ideal cover conditions for larch sawfly here. Reached by car.
Aug. 25	Near Russell Warden Stn. in deep lake area	sec.14, tp.22, rge.25	grass & humus & deep moss	very wet	75	Accessible by car on rough trail.
Aug. 25	southeast ¼	sec.15, tp.22, rge.25	grass, moss, Lab. tea	very wet(some surface water here)	50-60	Accessible by car on rough trail.
Aug. 25		sec.28, tp.22, rge.25	thin moss, humus, grass	moist	20	Cover conditions seem favorable for larch sawfly. Swamp reached by car.
Aug. 26	½ mile east of Russell Warden Station	sec.1, tp.22, rge.25	moss & humus	very wet	50-60	Reached by car.

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Larch Sawfly Survey (continued)

DATE 1947	AREA	LOCATION	GROUND COVER	MOISTURE	% AV. DEFOL-IATION	REMARKS
Aug. 26		sec.19, tp.22, rge.24	moss & grass	very wet	70-85	Reached on horseback. Some dead trees here.
Aug. 9	mi. 19 Audy Lake Road	sec.12, tp.21, rge.20, W.P.M.	moss, grass & litter	very wet	35-40	Accessible by car; an all-weather road.
Aug. 9	Audy Lake Road	sec.3, tp.21, rge.20, W.P.M.	moss & grass	very wet	75-80	Accessible by car. Larch bordered creek.
Aug. 9	NW side of Audy Lake Road	sec.36, tp.20, rge.21, W.P.M.	moss & long grass	very wet(surface water)	75-80	Swamp reached on foot or by boat from Warden's station.
Aug. 21		sec.18, tp.23, rge.25	grass & humus	very wet(water level high)	1-2	Swamp reached by car on rough trail from Grandview Warden Station.
Aug. 21		sec.18, tp.23, rge.24	moss & Lab. tea, grass & humus	very wet	80-85	Same as above. Numerous dead branches & some dead trees due to sawfly damage in past years.
Aug. 22	[illegible]	sec.4, tp.23, rge.24, W.P.M.	moss, litter, grass, humus	moist	75-80	Reached on horseback from Grandview Warden station.
Aug. 22		sec.4, tp.23, rge.24, W.P.M.	moss, marsh grass, humus	very wet	30	Reached on horseback from Grandview Warden station.
Aug. 22		sec.34, tp.22, rge.24, W.P.M.	marsh grass	very wet(water level high)	25-30	Larch are at north end of Crescent Lake. Reached by horseback as above.

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Larch Sawfly Survey (continued)

DATE 1947	AREA	LOCATION	GROUND COVER	MOISTURE	% AV. DEFOL-IATION	REMARKS
Aug. 22		sec.34, tp.22, rge.24, W.P.M.	grass, moss, humus	very wet	60-75	Larch at west side of Creascent Lake drier than above & more cover. Reached on horseback.
Aug. 22 sec		sec.31, tp.22, rge.24, W.P.M.	light to heavy moss & humus, Lab. tea	moist	75-100	Conditions appear favourable for sawfly development. Reached on horseback.
Aug. 23		sec.5, tp.22, rge.19, W.P.M.	moss & grass	very wet (surface water)	10-15	Accessible by car; located on east side of Hwy. ½ mile south of Moon Lake.
Aug. 23		sec.5, tp.22, rge.19, W.P.M.	moss & grass	moist	75-90	Same location as above, but on west side of Hwy. Better moisture & cover conditions.

Table 5.

Sandilands Forest Reserve
Survey of Damage by Jack pine Budworm
October 1947

LOCATION			% DEFOLIATION BY DIAMETER CLASS			% DEAD TOPS BY DIAMETER CLASS			NO. OF DEAD TREES	REMARKS
Sec.	Tp.	Age	5" and under	over 5" to 10"	over 10"	5" and under	over 5" to 10"	over 10"		
NE 35	4	9	28	22	-	0	1	-	1	
SE 35	4	9	5	4	-	0	0	-	0	
SE 34	4	9	10	10	-	0	0	-	0	Fairly dense; medium size
Centre 34	4	9	20	2	-	1	0	-	0	Fairly dense; medium size
NE 34	4	9	5	10	-	0	1	-	0	Fairly dense; under 5"
NE 28	4	10	20	20	-	0	0	-	0	Dense jack pine
NW 28	4	10	4	3	-	1	0	-	0	Dense jack pine
SW 33	4	10	2	-	-	0	-	-	0	Dense jack pine all under 5"
NW 33	4	10	3	-	-	0	-	-	0	All under 5"
NW 27	4	10	30	15	-	0	0	-	0	Open-growing; medium size
Centre 27	4	10	10	10	-	0	0	-	0	Fairly open; mostly 5" trees
Centre 28	4	10	2	3	-	0	0	-	0	Fairly dense; medium size
[illegible] 29	4	10	25	-	-	0	-	-	0	Dense; mostly under 5"
Centre 29	4	10	5	5	-	0	0	-	0	Open-growing; medium size
NE 30	4	10	10	5	-	0	5	-	0	Open-growing; new 2nd growth (cutting operations)
SE 31	4	10	-	0	-	-	1	-	0	Fairly dense; medium size
Centre 31	4	10	30	25	-	0	0	-	0	Open-growing; medium size; past scale
NE 32	4	10	-	5	-	-	0	-	0	Medium size; fairly dense
NW 32	4	10	2	2	-	0	2	-	0	Medium size; dense; average 5"
NW 34	4	10	-	10	-	-	1	-	0	Open-growing; large; old scale
NE 26	4	10	-	10	-	-	0	-	0	Fairly dense; medium growth
SW 34	4	10	15	-	-	0	-	-	0	Fairly dense; all under 5"
NE 34	4	10	15	-	-	0	-	-	0	Fairly dense; all under 5"

(continued on next page)

Survey of Damage by Jack Pine Budworm (continued)

LOCATION			% DEFOLIATION BY DIAMETER CLASS			% DEAD TOPS BY DIAMETER CLASS			NO. OF DEAD TREES	REMARKS
Sec.	Tp.	Rge	5" and under	over 5" to 10"	over 10"	5" and under	over 5" to 10"	over 10"		
NE 26	5	9	7	4	4	0	0	0	1	
SW 26	5	9	23	6	-	0	2	-	0	All trees under 10" D.B.H.
NW 23	5	9	30	3	-	0	10	-	0	All trees under 10" D.B.H.
SE 22	5	9	9	5	-	0	20	-	0	All trees under 10" D.B.H.
SE 15	5	9	8	1	-	0	0	-	0	All trees under 10" D.B.H.
SE 22	5	9	8	3	-	0	0	-	0	All trees under 10" D.B.H.
NE 26	5	9	20	15	-	0	0	-	0	All trees under 10" D.B.H.
NE 26	5	9	30	10	-	0	0	-	0	All trees under 10" D.B.H.
SW 25	5	9	30	20	-	0	15	-	0	All trees under 10" D.B.H.
NE 24	5	9	10	-	-	0	-	-	0	Old scale damage
NE 1	5	9	25	-	-	0	-	-	1	All under 2-3"
NE 1	5	9	30	25	-	0	0	-	0	Open-growing; under 10"
SW 1	5	9	5	3	-	0	0	-	0	Mostly prairie
NW 24	5	9	15	12	-	0	0	-	0	Medium density
SW 24	5	9	-	2	-	-	-	-	0	Mostly between 5-10"
SW 23	5	9	4	12	-	0	1	-	1	Some birch
SW 23	5	9	20	12	-	0	5	-	0	Open-growing with poplar
SW 15 (on boundary)	5	9	18	15	-	1	0	-	0	Medium density
SW 15 (on boundary)	5	9	5	3	-	1	0	-	0	Medium density
SW 10	5	9	4	-	-	0	-	-	0	Mostly under 5"
SW 10	5	9	6	12	-	0	10	-	0	Fairly open here
SW 11	5	9	5	15	-	0	0	-	0	Fairly dense; small size
SW 11	5	9	20	8	-	0	5	-	0	Fairly dense
SW 13	5	9	15	55	-	0	0	-	0	Mostly large (5-10") trees
SW 13	5	9	18	30	-	0	0	-	0	Mostly under 2"
SW 18	5	9	20	-	-	0	-	-	0	Mostly under 2"
SW 36	5	9	30	15	-	0	50	-	0	
SW 36	5	9	15	20	-	0	3	-	0	Near larch swamp

(continued on next page)

Survey of Damage by Jack Pine Budworm (continued)

LOCATION				% DEFOLIATION BY DIAMETER CLASS			% DEAD TOPS BY DIAMETER CLASS			NO. OF DEAD TREES	REMARKS
Sec.	[illegible]	Tp.	Rge	5" and under	over 5" to 10"	over 10"	5" and under	over 5" to 10"	over 10"		
SW 12		5	9	40	40	-	0	0	-	0	Dense, most under 5"
NE 35		5	9	0	5	-	0	0	-	0	Fairly dense, mixed with poplar
NE 24		5	9	35	45	-	0	0	-	0	Mostly 5-10"; heavy defoliation.
NE 1		5	9	45	65	-	0	0	-	0	Old scale; open large; dense small.
Centre 3		5	9	5	10	-	0	2	-	0	Mostly over 5".
SE 3		5	9	20	30	-	0	10	-	0	Fairly dense, heavy, over 5".
SW 2		5	9	30	40	-	0	2	-	0	Fairly open. Old cutting.
NE 2		5	9	25	35	-	0	0	-	0	Fairly dense, mostly medium size.
SW 19		5	10	12	[illegible]	-	0	0	-	1	Open growing under 5".
NW 18		5	10	15	-	-	0	-	-	0	Past scale damage.
SW 18		5	10	10	-	-	0	-	-	0	Mostly under 2" D.B.H.
NW 7		5	10	20	-	-	0	-	-	0	All under 5" D.B.H.
SW 4		5	10	15	10	-	0	0	-	0	Dense, mostly under 4" D.B.H.
NW 4		5	10	12	3	-	0	0	-	0	Dense, mostly under 4"
SW 9		5	10	40	30	-	0	0	-	4	Several trees nearly dead.
NE 9		5	10	28	45	-	0	12	-	0	Dense
NE 9		5	10	25	39	-	0	0	-	0	Medium size, dense, good cutting.
NE 10		5	10	15	18	-	0	2	-	1	Medium size, dense.
NE 15		5	10	20	25	-	0	0	-	0	Mostly small trees.
SE 8		5	10	6	18	-	1	0	-	0	Quite dense.
NW 8		5	10	5	2	-	0	0	-	0	Fairly dense, past scale damage.
SE 18		5	10	8	2	-	0	0	-	0	Medium density.
NE 18		5	10	-	8	-	-	0	-	0	Mostly under 2".
SE 20		5	10	40	25	-	0	0	-	0	Mostly over 5".
SE 20		5	10	8	25	-	0	5	-	0	Mostly over 6".
NW 20		5	10	[illegible]	30	-	0	5	-	0	
NW 30		5	10	5	15	-	0	2	-	0	

(continued on next page)

Survey of Damage by Jack pine Budworm (continued)

LOCATION			% DEFOLIATION BY DIAMETER CLASS			% DEAD TOPS BY DIAMETER CLASS			NO. OF DEAD TREES	REMARKS
Sec.	Tp.	Rge.	5" and under	over 5" to 10"	over 10"	5" and under	over 5" to 10"	over 10"		
NW 30	5	10	15	20	-	5	15	-	0	
NW 31	5	10	18	25	-	0	0	-	0	
NW 19	5	10	20	10	-	0	0	-	0	Mostly under 6"
NE 19	5	10	10	8	-	0	12	-	0	
SW 29	5	10	10	60	-	0	4	-	0	Tall PJ mostly over 5"
Centre 29	5	10	15	55	-	0	50	-	0	Mostly over 15"
NE 29	5	10	-	20	-	-	1	-	0	All over 5"
SW 33	5	10	15	15	-	0	4	-	0	Mostly young 2nd growth
Centre 33	5	10	5	10	-	0	30	-	0	Mostly young 2nd growth
NW 33	5	10	15	25	-	0	10	-	0	Mostly over 5"; open-growing
W½-28	5	10	10	15	-	3	0	-	0	Open-growing; large trees and young growth
SE 28	5	10	10	20	-	0	0	-	0	Mostly 2nd growth
Centre 28	5	10	30	60	-	0	80	-	0	Fairly open; mostly over 5"
NE 28	5	10	50	60	-	50	75	-	0	Open-growing; mostly over 5"; young growth
SE 28	5	10	15	50	-	0	75	-	0	Past scale damage in all of 28
NE 21	5	10	5	35	-	0	50	-	0	Dense new 2nd growth
Centre 21	5	10	10	10	-	0	2	-	0	Fairly dense; young
W½-22	5	10	20	45	-	0	2	-	0	Fairly open (cutting op. last winter)
NE 22	5	10	15	25	-	0	10	-	0	Fairly dense
SW.15	5	10	15	10	-	0	0	-	0	Fairly dense
SE 16	5	10	-	40	-	-	60	-	0	Open-growing over 5"
SW 16	5	10	30	20	-	3	5	-	0	Dense; over 5" D.B.H.
SE 17	5	10	10	50	-	0	2	-	0	Open-growing over 5"; old timber scale
NE 17	5	10	7	10	-	0	0	-	0	Dense; old scale damage; young growth
NE 18	5	10	10	10	-	0	0	-	0	Old scale damage
E½-7	5	10	15	30	-	0	0	-	0	Fairly dense; over 4"; old scale
NE 6	5	10	15	15	-	0	0	-	0	Dense; over 5" D.B.H.

(continued on next page)

Survey of Damage by Jack pine Budworm (continued)

LOCATION			% DEFOLIATION BY DIAMETER CLASS			% DEAD TOPS BY DIAMETER CLASS			NO. OF DEAD TREES	REMARKS
Sec.	Tp.	Rge	5" and under	over 5" to 10"	over 10"	5" and under	over 5" to 10"	over 10"		
Centre 6	5	10	15	-	-	1	-	-	0	Dense; under 5"
NW 6	5	10	25	35	-	1	0	-	1	Open-growing large; dense small
SE 6	5	10	5	5	-	0	0	-	0	Fairly dense; medium size
(On Sec. line) 5 & 6	5	10	10	10	-	0	0	-	0	Fairly dense; under 5"; old scale
N½-5	5	10	5	10	-	0	0	-	0	Fairly dense; medium growth
SE 5	5	10	-	5	-	-	0	-	0	Fairly dense; mostly over 5"
S½-4	5	10	-	0	-	-	0	-	0	Medium size; fairly dense
SE 3	5	10	40	40	-	-	75	-	0	Medium density; average is 4"
SW 10	5	10	40	40	-	-	50	-	0	Fairly open; medium size
Centre 10	5	10	50	50	-	0	75	-	0	Fairly dense; medium size
NE 10	5	10	0	0	-	0	0	-	0	Fairly dense; average 5"
N½-11	5	10	2	2	-	0	0	-	0	Fairly dense; medium growth
S½-11	5	10	-	10	-	-	3	-	0	Open-growing; medium size
NE 2	5	10	15	10	-	0	0	-	0	Fairly dense; medium size
SE 2	5	10	0	0	-	0	0	-	0	Fairly dense; medium size
SW 1	6	9	10	10	-	0	0	-	0	Dense; medium size
Centre 1	6	9	15	15	-	0	0	-	0	Fairly open; medium size
NE 1	6	9	20	10	-	0	0	-	0	Fairly dense; mostly under 5"
SE 12	6	9	15	10	-	0	0	-	1	Fairly dense; medium growth
SE 4	6	10	20	30	-	5	0	-	0	Predominantly young growth
NE 4	6	10	5	15	-	0	0	-	0	Young thick growth
NW 3	6	10	75	50	-	1	0	-	0	Fairly dense
Centre 10	6	10	10	15	-	5	0	-	0	Open-growing; mostly 5" and over
NE 10	6	10	2	10	-	0	1	-	0	Young 2nd growth; open-growing
SE 15	6	10	3	30	-	10	0	-	0	Mostly over 5"; open-growing
SW 15	6	10	5	5	-	0	0	-	0	Dense young growth
NW 15	6	10	-	30	-	-	0	-	0	Mostly over 5"
Intersection 9,10,15,16	6	10	5	10	-	10	0	-	0	Medium size; open-growth
NW 10	6	10	10	15	-	30	0	-	0	Open-growing

(continued on next page)

Survey of Damage by Jack pine Budworm (continued)

LOCATION			% DEFOLIATION BY DIAMETER CLASS			% DEAD TOPS BY DIAMETER CLASS			NO. OF DEAD TREES	REMARKS
Sec.	Tp.	Rge.	5" and under	over 5" to 10"	over 10"	5" and under	over 5" to 10"	over 10"		
Centre 10	6	10	15	30	-	3	0	-	1	Open-growing
NE 3	6	10	10	15	-	0	0	-	0	Mixture of thick, birch, spruce and Pj
SW 11	6	10	-	-	-	-	-	-	0	Open-growing
SE 11	6	10	-	-	-	-	0	-	0	Fairly open
SW 5	6	10	25	20	-	5	0	-	0	Medium dense
W½-7	6	10	25	35	-	0	0	-	0	Fairly dense; medium growth; under 5"
W½-6	6	10	20	40	-	0	50	-	2	Open-growing; large trees
Centre 6	6	10	15	10	-	0	40	-	0	Dense small trees
SW 5	6	10	30	-	-	0	-	-	0	Mostly small
NE 7	6	10	15	30	-	0	0	-	0	Fairly sparse
NE 7	6	10	15	30	-	0	0	-	0	Fairly sparse
SE 18	6	10	5	10	-	0	0	-	0	Fairly dense; medium growth
NW 17	6	10	5	10	-	0	0	-	0	Fairly dense; medium growth
SE 20	6	10	10	10	-	0	0	-	0	Medium density and growth
NE 20	6	10	5	10	-	0	0	-	0	Dense; medium sized trees over 5"
SW 28	6	10	10	5	-	0	0	-	0	
Centre 28	6	10	20	10	-	0	0	-	0	Swampy; fairly dense
NW 28	6	10	10	15	-	0	0	-	0	Medium density
NE 28	6	10	20	10	-	0	5	-	0	Fairly dense; medium size
SW 34	6	10	5	5	-	0	0	-	0	
Centre 34	6	10	15	10	-	0	0	-	0	
NE 34	6	10	10	10	-	0	0	-	0	Dense; medium size
NW 35	6	10	5	10	-	0	0	-	0	
NW 36	6	10	25	20	-	0	1	-	0	Dense; medium size, average 5"
NE 36	6	10	25	20	-	0	0	-	0	Fairly dense
E½-36	6	10	20	40	-	0	50	-	0	Fairly dense; medium growth
S½-36	6	10	20	15	-	0	0	-	0	Fairly dense; medium size

(continued on next page)

Survey of Damage by Jack pine Budworm (continued)

LOCATION			% DEFOLIATION BY DIAMETER CLASS			% DEAD TOPS BY DIAMETER CLASS			NO. OF DEAD TREES	REMARKS
Sec.	Tp.	Rge.	5" and under	over 5" to 10"	over 10"	5" and under	over 5" to 10"	over 10"		
S½-35	6	10	25	25	-	0	0	-	0	Medium dense; medium size
Centre 26	6	10	25	25	-	0	0	-	0	
NW 34	6	11	20	20	-	0	10	-	0	Dense; medium size
W½-34	6	11	10	10	-	0	25	-	0	
SE 33	6	11	20	20	-	0	5	-	0	
SE 34	6	11	-	5	-	-	10	-	0	
SW 35	6	11	-	5	-	-	15	-	0	Medium density; all tall Pj
SE 35	6	11	5	5	-	15	15	-	0	Medium density; all tall Pj
S½-2	7	10	5	10	-	0	5	-	0	
E½-2	7	10	10	10	-	0	1	-	0	
E½-1	7	10	10	15	-	0	0	-	0	Open-growing
NE 25	7	10	3	0	-	0	5	-	0	
N½-25	7	10	3	5	-	0	0	-	0	
SW 36	7	10	3	-	-	0	-	-	0	
SE 36	7	10	0	0	-	0	0	-	0	
Centre 35	7	10	3	3	-	0	0	-	0	
E½-34	7	10	0	-	0	0	-	-	0	
Centre 34	7	10	0	0	-	0	0	-	0	
SW 34	7	10	-	4	-	-	0	-	0	Large size Pj
NW 27	7	10	0	4	0	0	0	1	0	
SE 28	7	10	0	0	-	0	0	-	0	
N½-33	7	10	0	0	-	0	0	-	0	Pj and Sw stand
W½-31	7	10	0	0	-	0	0	-	0	Spruce and poplar
Centre 6	7	11	5	5	-	0	0	-	0	
SE 6	7	11	5	5	-	0	20	-	0	
Centre 5	7	11	5	-	-	0	-	-	0	All small trees
SW 4	7	11	15	25	-	0	75	-	0	Mostly small trees
W½-4	7	11	-	5	-	-	50	-	0	
NW 3	7	11	5	5	-	0	10	-	0	

(continued on next page)

Survey of Damage by Jack pine Budworm (continued)

LOCATION			% DEFOLIATION BY DIAMETER CLASS			% DEAD TOPS BY DIAMETER CLASS			NO. OF DEAD TREES	REMARKS
S Sec.	Tp.	Rge.	5" and under	over 5" to 10"	over 10"	5" and under	over 5" to 10"	over 10"		
N½-4	7	11	0	0	-	0	0	-	0	Dense; medium size
SW 9	7	11	10	5	-	0	0	-	0	
NE 8	7	11	0	0	-	0	0	-	0	
SW 17	7	11	-	0	-	-	5	-	0	
NE 18	7	11	0	0	-	0	0	-	0	
Centre 19	7	11	0	-	-	0	-	-	0	
N½-19	7	11	0	-	-	0	-	-	0	
SW 30	7	11	-	5	-	-	2	-	0	
SW 31	7	11	-	0	-	-	0	-	0	
SE 31	7	11	-	0	-	-	2	-	0	
E½-32	7	11	-	5	-	-	0	-	0	
NW 32	7	11	-	3	-	-	0	-	1	
SW 3	7	11	-	3	-	-	0	-	0	
NE 3	7	11	0	0	-	0	0	-	0	
NW 30	7	11	4	4	-	0	0	-	0	
E½-30	7	11	0	0	-	0	0	-	0	
SE 29	7	11	0	0	-	0	0	-	0	
W½-21	7	11	-	2	-	-	0	-	0	
NW 5	8	10	0	0	-	0	0	-	0	
SE 7	8	10	-	5	-	-	2	-	0	
W½-7	8	10	0	0	-	0	0	-	0	
SW 7	8	10	-	5	0	-	1	-	1	
W½-6	8	10	0	0	-	0	0	-	0	All small PJ
SW 6	8	10	0	0	-	0	0	-	0	
NW 7	8	10	0	0	-	0	0	-	0	
SE 18	8	10	0	0	-	0	0	-	0	
SW 17	8	10	0	2	-	0	0	-	0	
NE 17	8	10	0	0	-	0	0	-	0	

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Survey of Damage by Jack pine Budworm (continued)

LOCATION			% DEFOLIATION BY DIAMETER CLASS			% DEAD TOPS BY DIAMETER CLASS			NO. OF DEAD TREES	REMARKS
Sec.	Tp.	Rge.	5" and under	over 5" to 10"	over 10"	5" and under	over 5" to 10"	over 10"		
NW 2	8	11	0	0	-	0	0	-	0	
N½-2	8	11	0	0	-	0	0	-	0	
SW 12	8	11	-	5	-	-	1	-	0	
Centre 12	8	11	0	0	-	0	0	-	0	
NW 12	8	11	5	8	-	0	0	-	0	
N½-12	8	11	-	10	-	-	0	-	0	
SW 13	8	11	0	0	-	0	0	-	0	
Centre 14	8	11	-	5	-	-	0	-	0	
E½-15	8	11	-	8	-	-	0	-	0	
Centre 15	8	11	-	3	-	-	0	-	0	
E½-16	8	11	-	3	-	-	0	-	0	

Table 4.

Sandilands Forest Reserve
Jack pine Budworm Damage

Summary of Estimated Defoliation and Dead-Tops

(a) Trees 5" and Under

	TOTAL NO. OF INSPECTION POINTS	DEFOLIATION ESTIMATES			DEAD-TOP ESTIMATES		
		No. of Inspection Points	Average Defoliation %	Maximum Defoliation Observed %	No. of Inspection Points	Average Dead Tops %	Maximum Dead Tops %
Entire Reserve	228	193	13%	75%	191	< 1%	50%
Reserve south of boundary between tps. 6 and 7	168	151	16%	75%	149	< 1%	50%
Reserve north of boundary between tps. 6 and 7	60	42	2%	15%	42	0%	0%

(b) Trees Over 5" to 10"

Entire Reserve	228	208	14%	65%	207	6%	90%
Reserve south of boundary between tps. 6 and 7	168	153	18%	65%	152	7%	90%
Reserve north of boundary between tps. 6 and 7	60	55	3%	25%	55	3%	75%

Table 5.

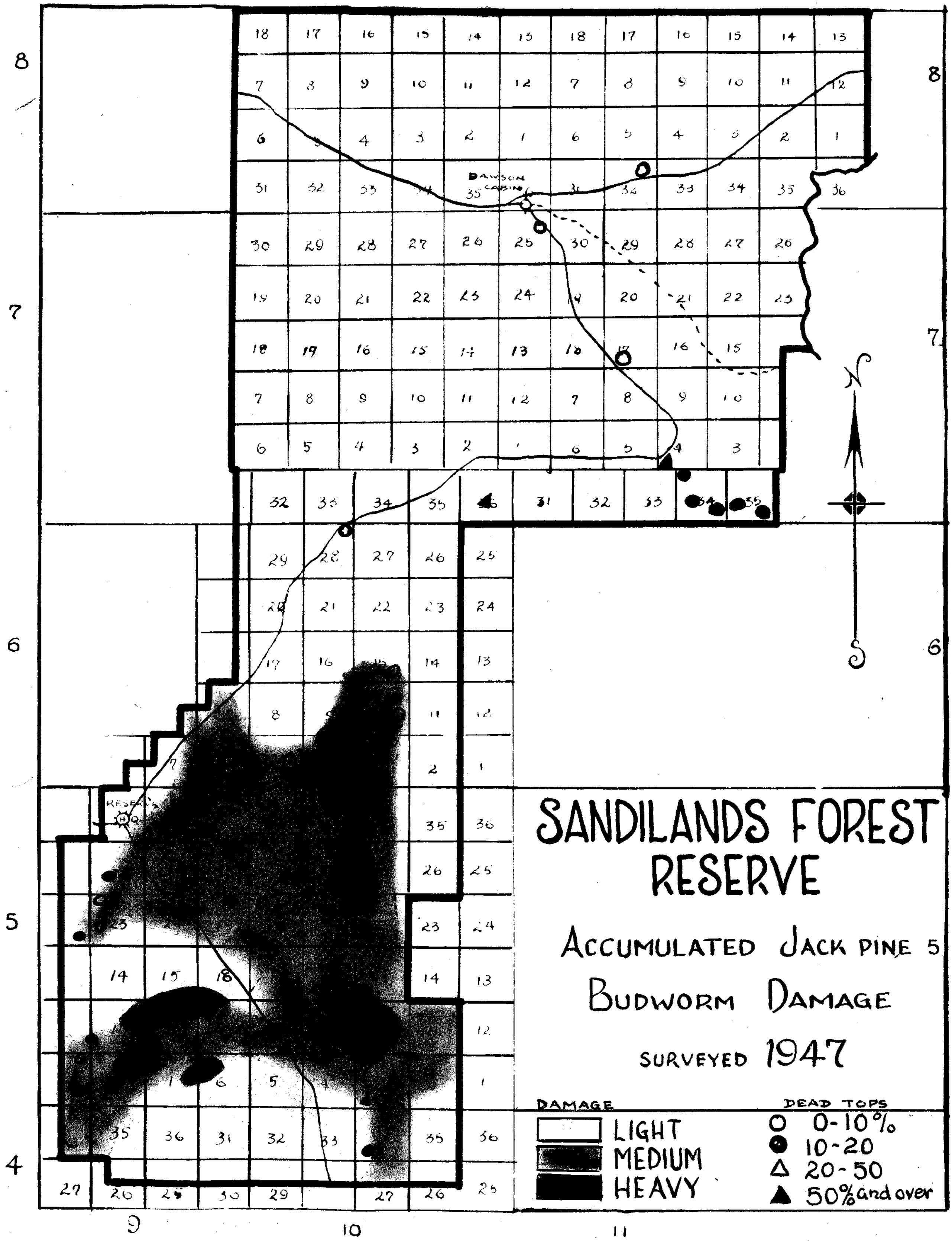
5. Personnel Contacted

NAME	TITLE	PLACE	DEMONSTRATION OF SAMPLING
J. H. Vicars	Forest Ranger	Turtle Mtn. For. Res.	no
F. J. Brodie	Supervisory Park Warden	Riding Mtn. Nat. Park	no
D. B. Bingley	Park Warden	Riding Mtn. Nat. Park	yes
R. McKinnon	Park Warden	Riding Mtn. Nat. Park	yes
J. Ryska	Park Warden	Riding Mtn. Nat. Park	yes
K. A. Koons	District Forester	Dauphin	no
B. Balchen	Senior Ranger	Dauphin	no
Bell	Senior Ranger	Dauphin	no
W. Presloski	Forest Ranger	Bield	yes
A. Machuk	Forest Ranger	Grandview	yes
Chas. Dunlop	Forest Ranger	Shell River Station	yes
J. Kokindovich	Senior Ranger	Swan River	no
W. F. Mawdsley	Forest Ranger	Birch River	yes
R. H. Ross	Forest Ranger	Mafeking	no
W. Templeton	Fire Ranger	Mafeking	no
R. Harvey	District Forester	The Pas	no
G. H. Bates	Forest Ranger	The Pas	no
J. Reader	Game Warden	Reader Lake	yes
H. Olee	Forest Ranger	Minitonas	no
J. B. Norman	Forest Ranger	Garland	no
T. B. Vermilyea	District Forester	Winnipeg	no
D. E. Cooper	Forest Ranger	Sandilands For. Res.	no
E. Polkowski	Forest Ranger	Sandilands For. Res.	yes
G. Emes	Forest Ranger	Sandilands For. Res.	no
deBelley	Forest Ranger	Spruce Woods For. Res.	no
J. J. Wright	Forest Ranger	Carberry	no
J. H. Inkster	Forest Ranger	Whiteshell For. Res.	
E. A. Braine	District Forester	Ashern	no
E. Campbell	Forest Ranger	Ashern	yes
E. Marner	Forest Ranger	Riverton	no
J. L. Stanlake	Forest Ranger	Hodgson	yes
C. H. Patterson	Senior Ranger	Lac du Bonnet	no
J. Nespor	Forest Ranger	Lac du Bonnet	no
W. D. Wardrop	Forest Ranger	Pine Falls	yes
B. R. Gilmore	Forest Ranger	Pine Falls	no
R. L. Kendrick	Forest Ranger	Whitemouth	no
B. Kuryk	Fire Ranger	Bissett	yes
J. E. Harrison	Forest Ranger	Sprague	no

Table 6.

6. Negative Reports

DATE 1947	HOST	LOCALITY
May 27	W. poplar	Turtle Mountain, near Max Lake
May 27	W. birch	Turtle Mountain, near Max Lake
May 29	W. poplar	Spruce Woods For. Res. near Camp Hughes
June 2	W. poplar	Elphinstone
June 4	Larch	N.W. of Dauphin, sec. 25, tp. 24, rge. 21, W.P. mer.
June 11	W. poplar	Duck Mountain For. Res., Singoosh Lake
June 11	W. spruce	Duck Mountain For. Res., Singoosh Lake
June 13	Larch	Spruce Woods For. Res., Epinette Swamp
June 20	Larch	S. of Hodgson, sec. 19, tp. 25, rge. 1, E.P. mer.
June 27	Scrub Oak	Lundar
July 28	Balsam Fir	Near St. George, sec. 3, tp. 18, rge. 10, E.P. mer.
Aug. 17	W. spruce	Mile 55 on The Pas Highway
Aug. 20	W. poplar	9 miles north of Grandview


SANDILANDS FOREST RESERVE
ACCUMULATED JACK PINE BUDWORM DAMAGE
SURVEYED 1947
DAMAGE
LIGHT
MEDIUM
HEAVY
DEAD TOPS
0-10%
10-20
20-50
50% and over
DAWSON CABIN
N
S

C. L. L. McDowell

1. Introduction

The Forest Insect Survey field work for the province of Saskatchewan was carried out in 1947 by forest insect rangers D. H. McKay and L. L. McDowall.

Leaving Winnipeg headquarters in the latter part of May, the rangers travelled to Prince Albert and from there began their summer activities.

During the first part of June, two reported bark beetle infestations were investigated; both of these were in the Pasquia Provincial Forest. The latter part of June was spent in the Madge Lake area of the Duck Mountain Provincial Park. An extensive infestation of the large aspen tortrix in this area was completely mapped.

The month of July was taken up in a general reconnaissance of the forested areas of central and eastern Saskatchewan. A few days were also spent in the liberation of yellow-headed spruce sawfly parasites.

In August, two more shipments of yellow-headed spruce sawfly parasites were released. Some time was spent during August in mapping the distribution of larch sawfly in Saskatchewan. Every effort was made to cover all accessible areas of tamarack but, owing to the great amount of territory to be traversed, some of the outlying districts had to be omitted for the 1947 season.

The greater part of the month of September was spent in establishing permanent forest insect survey sample plots. Several days at the end of the month were used to obtain fire-killed jack pine logs in the Fort a la Corne Provincial Forest, where a study of wood borer damage in fire-killed timber had been made during August by members of the staff of the Winnipeg laboratory. These infested logs were taken to the laboratory for storage to obtain emergence of adult specimens. The end of September brought to a close field activities in Saskatchewan.

2. Insect Conditions

(a) Larch Sawfly (*Pristiphora erichsonii* Htg.)

Larch sawfly has now become one of the foremost forest insect pests of Saskatchewan. In 1947, it was found in almost all tamarack swamps in the central and eastern forested areas of the province.

Collections were made in 1947 as far west as the Big River Provincial Forest (sec. 24, tp. 56, rge. 8, W. 3rd mer.). No defoliation was noted in this area.

Two collections of larch sawfly were made in Prince Albert National Park but no infestations were encountered. One collection was made in sec. 7, tp. 53, rge. 1, W. 3rd mer., where the sawfly had been found in 1946. At this location, 1½ miles north of the Park gate, there is a small stand of tamarack. The other collection was made in a much larger area of tamarack about 10 miles south of Waskesiu (sec. 6, tp. 56, rge. 1, W. 3rd mer.). No trace of larch sawfly had been found in this area in 1946. No defoliation was noted in either place this year.

Most of the tamarack swamps in the vicinity of Prince Albert bore some signs of defoliation. The most severe infestation was found in a tamarack stand of approximately 5 acres, located in sec. 8, tp. 49, rge. 26, W. 2nd mer., 1 mile north of Prince Albert. Defoliation in this area ranged from 15 to 40 per cent. Light defoliation was noticed in two small swamps 15 miles west of Prince Albert in sections 23 and 27, tp. 49, rge. 1, W. 3rd mer., Four miles south of MacDowall, along highway no. 12, light defoliation was noted in a small tamarack stand. This stand is located in sec. 26, tp. 46, rge. 1, W. 2nd mer.

In townships 50 and 51, rge. 11, W. 2nd mer., north-east of Carrot River, very light defoliation was observed. Field Officer C. A. Otterbein stated that the infestation was no heavier than last year's in this area. Two small infestations were discovered north of Nipawin. The first one is located in tp. 52, rge. 7, W. 2nd mer., 3 miles north of Nipawin and the second in tp. 53, rge. 15, W. 2nd mer., 5 miles north of Nipawin. In both cases, defoliation was very light. One small collection of larvae was made in Greenwater Lake Provincial Park in sec. 12, tp. 41, rge. 11, W. 2nd mer. No defoliation was noted in this area.

Numerous small swamps, from Hudson Bay south to Sturgis, were found to be lightly infested. In this area, light infestations occurred in sec. 15, tp. 44, rge. 5, W. 2nd mer., 5 miles south of Hudson Bay and in sec. 22, tp. 40, rge. 5, W. 2nd mer., one mile south of Reserve. Defoliation in both places ranged from 20 to 30 per cent.

Severe damage was seen in a large tamarack stand west of Pelly. This stand is located 2 1/2 miles west of Pelly along highway no. 49 (sec. 24, tp. 33, rge. 1, W. 2nd mer.). Defoliation ranged from 25 to 60 per cent. The heavy infestation of 1946 in tp. 35, rge. 31, W. 1st mer., 17 miles north of Pelly, showed no sign of diminishing. Defoliation in this area ranged from 50 to 60 per cent.

Two small tamarack stands north of Pelly were examined and larch sawfly was found to be quite active in both. The first is located in sec. 22, tp. 34, rge. 32, W. 1st mer., 6 miles north of Pelly and the second in sec. 34, tp. 34, rge. 32, W. 1st mer., 8 miles north of Pelly. Defoliation ranged from 30 to 40 per cent.

Throughout the Madge Lake area of the Duck Mountain Provincial Park, larch sawfly was found to be quite generally distributed. Defoliation for the most part appeared to be very light. Three areas showing medium defoliation were sections 26, 27, and 36, tp. 30, rge. 30, W. 1st mer.

Table 1, on page 250 provides additional information about the areas visited during the larch sawfly survey.

(b) Yellow-headed Spruce Sawfly (<u>Pikonema alaskensis</u> Roh.)

The yellow-headed spruce sawfly caused a considerable amount of damage again this year to planted white spruce but was relatively unimportant on spruce growing under natural forest conditions.

A severe infestation on ornamental white spruce at Waskesiu, Prince Albert National Park, had not abated to any extent. In fact, defoliation appeared much heavier on some trees than in 1946. The area affected is approximately ½ of an acre and is located on the east side of the tennis courts in the townsite.

Two other small infestations of much lighter intensity are to be found at MacDowall and Holbein in the Nisbet Provincial Forest. At Holbein, a few white spruce adjacent to the ranger's cabin were lightly infested. A small plantation of white spruce, 6/10 of a mile north of the ranger's cabin at MacDowall, was also infested. Parasite liberations were made in the infested areas at MacDowall and at Waskesiu.

(c) White Pine Weevil (<u>Pissodes strobi</u> Peck.)

Damage by the white pine weevil, although comparatively light, appeared to be spreading in some areas in Prince Albert National Park. It is still to be found attacking jack pine along Hanging Heart road, 5 miles northwest of Waskesiu. New damage was observed at intervals up to 15 miles south of Waskesiu on jack pine and white spruce, along highway no. 2. In all places, timber was scattered and the number of trees suffering damage was relatively small.

In the Nisbet Provincial Forest, damage to a few trees in two separate areas was found on white spruce. One area was at MacDowall, ½ of a mile south of the ranger's cabin and the other at Holbein, adjacent to the ranger's cabin.

(d) Pitch Pine Nodule Maker (<u>Petrova albicapitana</u> Busck.)

Damage to jack pine by this pest appeared to be very light in the two areas where it was encountered in the Nisbet Provincial Forest.

The first area was in sec. 7, tp. 49, rge. 27, W. 2nd mer., 8 miles west of Prince Albert and the second in sec. 11, tp. 49, rge. 28, W. 2nd mer., 10 miles west of Prince Albert. Light regeneration covered these areas. In both cases, only 2 or 3 trees showed damage.

(e) Western Willow Leaf Beetle (<u>Galerucella decora</u> Say)

The rapid spread of this beetle over new areas became very apparent. It is now quite general over central and eastern Saskatchewan. In most areas where willow was examined, defoliation was severe and the foliage was skeletonized to a burned-over appearance. Heavy defoliation was seen this year on willow around Madge Lake in the Duck Mountain Provincial Park and also from Kamsack, north along highway no. 8, to Pelly. Extremely heavy defoliation occurred along highway no. 9, from Reserve north to Hudson Bay. Other districts still suffering damage by this beetle are Carrot River, Prince Albert, the Meadow Lake Provincial Forest, Glaslyn and the Jackfish Lake area.

(f) Aspen Tortrix (<u>Archips conflictana</u> Wlk.)

This poplar-feeding insect is still one of the foremost pests in the Duck Mountain Provincial Park. Large areas of trembling aspen, in the vicinity of Madge Lake, were attacked and heavily defoliated during 1947. The more mature trees appeared to suffer the greater injury but smaller trees also showed some defoliation.

The heaviest defoliation by this insect in the vicinity of Madge Lake occurred in the large aspen stands along the east and west sides of the lake. Light to moderate defoliation occurred along the south end of the lake. On the east side of Madge Lake, in sections 13, 25, and 26, tp. 31, rge. 30, W. 1st mer., defoliation was quite severe. Heavy damage was also noted in sec. 36, tp. 30, rge. 30, W. 1st mer. Trees in this area were between 10 and 12 inches D.B.H., and ranged from 30 to 60 feet in height. Defoliation appeared to be much lighter in sections 25, 26, 27, and 28, tp. 30, rge. 30, W. 1st mer. at the south end of the lake. In this area, trees were of the orchard type, between 3 and 5 inches D.B.H. and 15 to 20 feet high. On the west side of the lake, in sections 29 and 30, tp. 30, rge. 30, W. 1st mer., defoliation appeared quite heavy. Other sections in tp. 30, showing light to medium defoliation, were 17, 18, 31, and 32. An area of extremely heavy defoliation was encountered 2½ miles east of Ministik Beach in sec. 31, tp. 30, rge. 30, W. 1st mer. on the Manitoba-Saskatchewan boundary. Trees in the latter area were between 60 and 70 feet high and 12 to 18 inches D.B.H.

Further information about this insect is given under "Special Investigations". A map of the infestation appears on page 254A.

(g) American Poplar Leaf Beetle (Phytodecta americana Schffr.)

This leaf-eating beetle was quite active in the dense aspen stands of the Duck Mountain Provincial Park in 1947. The most severe damage occurred in the Madge Lake area, with trees between 5 and 20 feet high (2 to 4 inches D.B.H.) being the most heavily attacked. Defoliation by this beetle ranged from light to medium. Accurate estaimation of defoliation was almost impossible, owing to the fact that the trees had also suffered attack by the large aspen tortrix.

Light defoliation of aspen was noted at Pelly, Usherville and north along highway no. 9 to Hudson Bay. Last year's heavy infestation at Rabbit Cabin in Prince Albert National Park showed signs of decreasing. Defoliation this year was much lighter than in 1946.

(h) Bronze Birch Borer (Agrilus anxius Gory)

During August, the rangers spent 3 days examining birch stands for 'die-back' birch in Prince Albert National Park. Birch stands on sections 31 and 32, tp. 57, rge. 1, W. 3rd mer. were examined for tree mortality. Although no dead trees were seen, numerous dead tops were observed throughout this area. In the above area, south-east of Hanging Heart Lake, 10 trees were cut down and examined for evidence of borer activity. Of the 10 trees, 7 were damaged by borer tunnels. In the remaining 3 trees, no evidence of borer was observed.

(i) Mistletoe (Razoumofskya sp.)

This disease on jack pine in the Nisbet Provincial Forest showed no signs of diminishing in 1947. All jack pine in areas around Holbein and MacDowall was heavily attacked by mistletoe. Light to moderate outbreaks occurred in areas north and west of Prince Albert. Wherever possible, cutting operations were in progress in an effort to curb this serious menace.

3. Special Investigations

(a) Bark Beetles

During the early part of June, an attempt was made to investigate two reported bark beetle infestations.

The first one was located in sec. 18, tp. 51, rge. 7, W. 2nd mer. in the Pasquia Provincial Forest. This area consisted of approximately 12 acres of green spruce and was surrounded by a burn of a 1942origin. At the time of examination, cutting operations, which had been commenced during the winter of 1946-47, were still in progress. Most of the merchantable timber had been salvaged and all slash gathered and burned. Insect damage was quite noticeable in the remaining timber but, although an intensive search was made, no bark beetles were found. It appeared that the beetles which caused the damage had already migrated to other stands.

The second infestation was reported in sections 21, 22 and 27, tp. 48, rge. 8, W. 2nd mer., in the Pasquia Provincial Forest. This area could not be reached owing to heavy rains which made roads in the area impassable during early June. It is intended to re-visit this area next year and to attempt to reach the locations mentioned above.

(b) Large Aspen Tortrix (Archips conflictana Wlk.)

Between June 10th and 18th, a complete survey of aspen in the Madge Lake area of the Duck Mountain Provincial Park was carried out. The purpose of this survey was to determine the extent and severity of damage caused by the large aspen tortrix. The stand consisted generally of high crown trees, ranging in height from 30 to 60 feet. Trees of this type had to be cut down in order to be examined.

An interesting peculiarity observed throughout this infestation was the tendency of the aspen tortrix to attack high crown trees rather than trees with more foliage, or orchard type trees. Owing to the high crown feeding, it was exceedingly difficult to estimate damage accurately. Typical trees in each area were felled for close examination and estimates of defoliation. A map of the infestation was prepared.

(c) Parasite Releases

Three shipments of a parasite (Sturmia sp.) were received from the Dominion Parasite Laboratory, Belleville, Ontario for liberation in spruce stands infested with yellow-headed spruce sawfly.

The first shipment of 9 colonies was liberated in Prince Albert National Park in sec. 16, tp. 57, rge. 1, W. 3rd mer. on July 9, 1947.

Two other shipments, of 5 and 2 colonies respectively, were liberated in the Nisbet Provincial Forest on July 14 and August 7. Both of these were released in sec. 34, tp. 47, rge. 1, W. 3rd mer., six-tenths of a mile north of the ranger cabin at MacDowall. The yellow-headed spruce sawfly was found to be quite abundant in both these areas on ornamental spruce.

(d) Larch Sawfly Survey

A considerable amount of time was spent this year on a survey of the distribution of larch sawfly damage in the central and eastern parts of Saskatchewan. This survey was conducted for the purpose of determining the amount of defoliation and tree mortality throughout the larch stands in the area mentioned above.

While on the survey, the rangers spent approximately one week in the company of [illegible]. Fink and [illegible]. H. Fell who were gathering information on defoliation, tree mortality and swamp conditions and making cocoon collections. Tamarack in most of the swamps examined revealed some signs of defoliation by larch sawfly. Further information concerning this insect will be found under "Insect Conditions".

(e) Nursery Inspection

A request by Mr. E. J. Marshall, Director of Forests, Prince Albert, to investigate insect damage in the Big River nursery, was carried out during August.

It was found, upon examination, that nursery stock seedlings of one and two years of age had been damaged by insects. Injury to the seedlings consisted mainly of chewed roots. Most of the damage was to larch and jack pine. However, one bed of lodgepole pine seedlings suffered slight damage. Although no insects were found at the time of the examination, specimens sent in later by J. Cowie, Field Officer for Big River, have since been identified as larvae of a June beetle (<u>Phyllophaga</u> sp.).

Table 1.

1947 Saskatchewan Larch Sawfly Survey

DATE 1947	AREA	LOCATION	GROUND COVER	MOISTURE	DEFOLIATION	TREE MOR-TALITY	METHOD OF ACCESS
July 16	Big River F.F.	sec.24,tp.56,rge.6,W.3rd	moss	dry	nil	nil	car
July 17	Prince Albert N.P.	sec.7,tp.53,rge.1,W.3rd	grass & moss	dry	nil	nil	car
July 17	Prince Albert N.P.	sec.7,tp.53,rge.1,W.3rd	grass & moss	dry	nil	nil	car
July 21	Prince Albert city property	sec.6, tp.49,rge.26,W2nd	moss	wet	light to medium	nil	car
July 22	Nisbet F.F.	sec.23,tp.49,rge.1,W.3rd	moss	dry	light	nil	car
July 22	Nisbet F.F.	sec.27,tp.49,rge.1,W.3rd	moss	dry	light	nil	car
July 23	4 miles south of MacDowall	sec.26,tp.46,rge.1,W.2nd	moss & grass	wet	light	nil	car
July 24	Carrot River	tp.50 & 51,rge.11,W.2nd	moss	dry	light	nil	car
July 24	Nipawin	tp.52,rge.7,W.2nd	moss	dry	light	nil	car
July 24	Nipawin	tp.53,rge.15,W.2nd	moss	dry	light	nil	car
July 25	Porcupine F.F.	sec.15,tp.[illegible],rge.5,W.2nd	moss	wet	light	nil	car
July 25	Porcupine F.F.	sec.22,tp.[illegible],rge.5,W.2nd	moss	wet	light	nil	car
July 26	3 1/2 miles west of Pelly	sec.[illegible],tp.[illegible],rge.1,W.2nd	moss	wet	light to medium	nil	car
July 28	17 miles north of Pelly	tp.35,rge.31,W.1st	moss	dry	medium	nil	car
July 28	6 miles north of Pelly	sec.22,tp.34,rge.32,W.1st	moss	dry	light	nil	car
July 28	6 miles north of Pelly	sec.34,tp.34,rge.32,W.1st	moss	dry	light	nil	car
Aug. 1	Duck Mountain F.F.	sec.26,27,36,rge.30,W.1st	grass & moss	wet-open water	medium	nil	car
Aug. 4	Greenwater Lake F.F.	sec.12,tp.41,rge.11,W.2nd	grass & moss	dry	nil	nil	car

Table 2.

4. Negative Reports

DATE 1947	HOST	LOCATION
May 31	Spruce	½ mile northwest of Ranger Headquarters, MacDowall, tp. 46, rge. 1, W. 3rd. mer.
June 3	Spruce Larch	1 mile west of Summit Cabin, Pasqui Provincial Forest, tp. 49, rge. 7, W. 2nd mer.
June 6	Spruce Larch	3 miles south of Mistatim
June 10	Spruce	1½ miles east of Ranger Headquarters, Madge Lake, Duck Mountain Provincial Forest, tp. 30, rge. 30, W. 1st mer.
June 11	Spruce	1 mile east of Reserve boundary on highway, Duck Mountain Provincial Forest, tp. 30, rge. 30, W. 1st mer.
June 18	Spruce	½ mile south of Benito Beach, Duck Mountain Provincial Forest, tp. 31, rge. 30, W. 1st mer.
June 23	Jack pine spruce, larch	4 miles northwest of Waskesiu on Hanging Heart road, Prince Albert National Park, tp. 56, rge. 1, W. 3rd mer.
June 24	Spruce	2 miles north of Bittern Creek Cabin, Prince Albert National Park, tp. 56, rge. 27, W. 2nd mer.
June 30	Spruce	10 miles west of Prince Albert, tp. 49, rge. 27, Nisbet Provincial Forest, W. 2nd mer.
July 1	Larch	1 mile northeast of Red Rock boundary, Nisbet Provincial Forest, tp. 49, rge. 24, W. 2nd mer.
July 1	Jack pine	Area adjacent to Red Rock Cabin, Nisbet Provincial Forest, tp. 49, rge. 24, W. 2nd mer.
July 1	Spruce	2 miles northeast of Red Rock Cabin, tp. 49, rge. 24, W. 2nd mer.
July 2	Larch	3 miles north of Ranger Cabin, MacDowall, Nisbet Provincial Forest, tp. 46, rge. 1, W. 3rd mer.
July 3	Spruce	7 miles west of Prince Albert on highway, Nisbet Provincial Forest, tp. 49, rge. 27, W. 2nd mer.

(continued on next page)

Negative Reports (continued)

DATE 1947	HOST	LOCATION
July 4	Larch	½ mile east of Fort a la Corne Provincial Forest boundary, tp. 50, rge. 22, W. 2nd mer.
July 10	Spruce	1½ miles north of Park gate, Prince Albert National Park, tp. 53, rge. 1, W. 3rd mer.
July 11	Spruce	3 mil. north of Ranger Headquarters, MacDowall, Nisbet Provincial Forest, tp. 46, rge. 1, W. 3rd mer.
July 18	Jack pine	6 miles south of fire tower on highway, Meadow Lake Provincial Forest, tp. 56, rge. 16, W. 3rd mer.
July 18	Spruce	10 miles south of fire tower on highway, Meadow Lake Provincial Forest, tp. 55, rge. 16, W. 3rd mer.
July 23	Jack pine	4 miles south of Hudson Bay Junction, tp. 44, rge. 3, W. 2nd mer.
Aug. 7	Spruce	4 miles south of MacDowall on highway, tp. 45, rge. 2, W. 3rd mer.
Aug. 12	Spruce	8 miles south of Waskesiu on highway, Prince Albert National Park, tp. 56, rge. 1, W. 3rd mer.
Aug. 13	Jack pine	15 miles south of Waskesiu on highway, Prince Albert National Park, tp. 55, rge. 1, W. 3rd mer.

Table 3.

5. Personnel Contacted

NAME	RANK	PLACE SASKATCHEWAN	DEMONSTRATION OF SAMPLING
H.J. Feusi	Field Officer	Madge Lake D.M.P.F.	yes
J.L. Dobie	Field Officer	Pelly	no
L.F. Bryson	Field Officer	Usherville	no
F. Warburton	District Supt.	Hudson Bay Junction	no
O. Schell	Field Officer	Hudson Bay Junction	no
A.W. Benson	Forester 4	Hudson Bay Junction	no
R. Bacon	Field Officer	Prairie River	no
H.Abra	Field Officer	Chelan	no
C.A. Otterbein	Field Officer	Carrot River	yes
E.J. Marshall	District Forester	Prince Albert	no
O.G. Horncastle	District Supt.	Prince Albert	no
L.S. Horne	Field Officer	Nipawin	no
E. Bilquist	Field Officer 4	Love	no
B.H. Matheson	Field Officer	Prince Albert	yes
J.C. Callaghan	Field Officer	Kinistino	no
Ashum	Forester	Prince Albert	no
J.M. Brown	Field Officer	Prince Albert	yes
A. Johnson	Field Officer	Holbein	yes
J. Johnson	Field Officer	MacDowall	no
A. McDonald	Field Officer	Emma Lake	no
S.I.M. Strong	Park Supt.	Prince Albert N.P.	no
G. Davies	Warden	Prince Albert N.P.	yes
S. Pocock	Warden	Prince Albert N.P.	yes
R. Gange	Warden	Prince Albert N.P.	no
H.E. Harrison	Warden	Prince Albert N.P.	no
F. Beaudoin	Field Officer	Green Lake	yes
J. Cowie	Ass't Field Officer	Big River	no
J. Barnett	District Supt.	Meadow Lake	no
R. Turner	Ass't Field Officer	Meadow Lake	no
F. Mitchell	Field Officer	Meadow Lake	no
J. Holman	Farmer	Bannock	no

Table 4.

Intelligence

S - Satisfactory U - Unsatisfactory

PLACE	HOTELS		CAFES	
	Name	Grade	Name	Grade
Kamsack	King George	S	Club	S
Yorkton	Blackstone	S	Broadway	S
	Balmoral	S		
Hudson Bay Junction	Marcotte	S	Railway	S
Tisdale	Tisdale	S	Coffee Shop	S
Wynyard	Lewis	S		
Melfort	Winston	S	Coffee Shop	S
Prince Albert	Marlboro	S	Princess	S
	Avenue	S	Wings	S
Big River	Lakeview	S	Lakeview	S
Meadow Lake	Empire	S	Empire	S
Saskatoon	King George	S	Honey Dew	S
Pelly	Pelly	U		
Prince Albert N.P.	tent	S	Pleasant Inn	S
			Lakeview Inn	S
Stenen	King George	U		

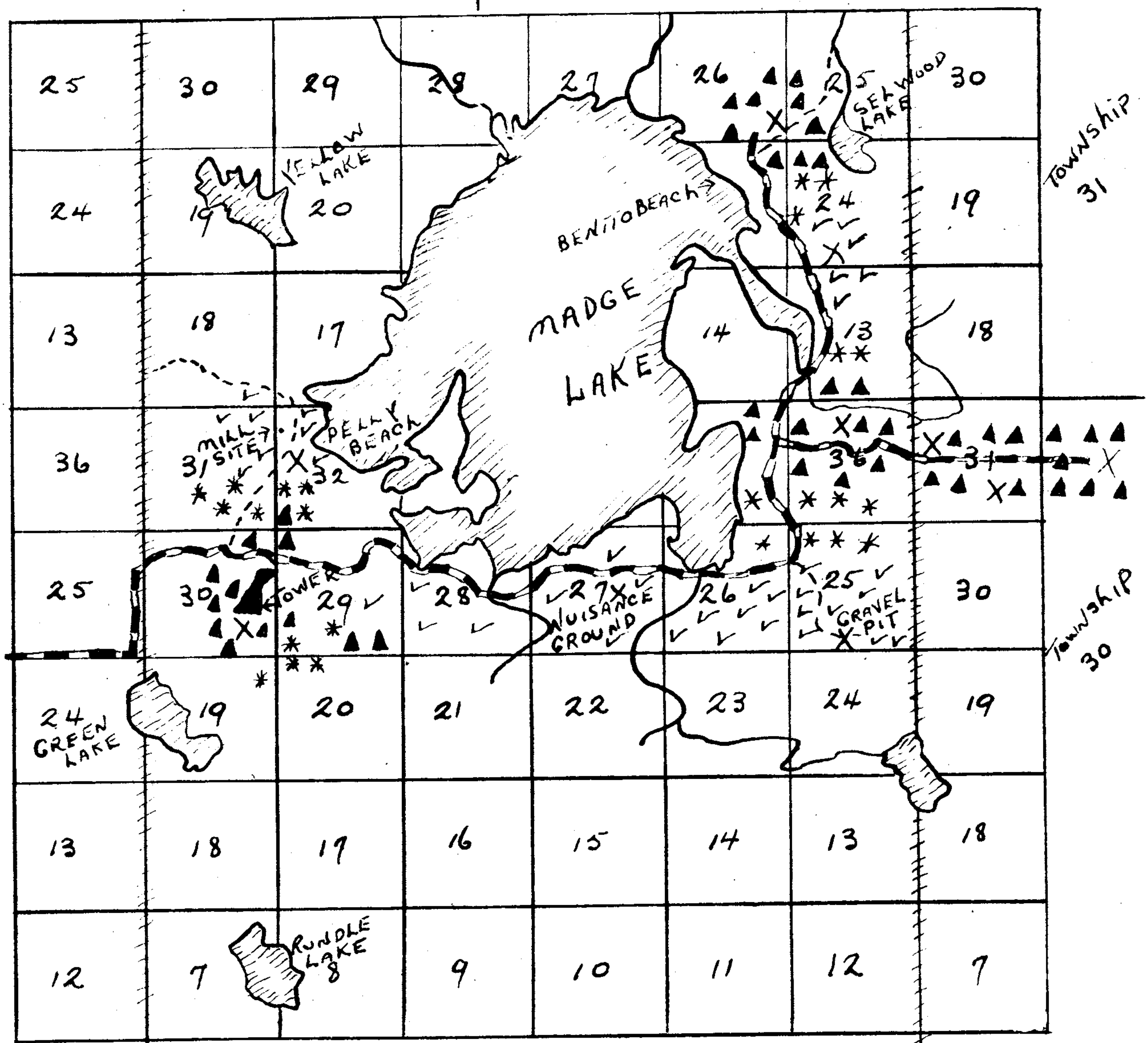
254 A

DUCK MOUNTAIN PROVINCIAL FOREST SASK

ASPEN TORTRIX INFESTATION 1947

SCALE 3/4 IN - 1 MILE

HIGHWAYS -
OTHER ROADS -
LIGHT - ✓
MEDIUM - - ✱
HEAVY - - ▲



RANGE 31

RANGE 30

RANGE 29

F.I.S. SAMPLES ---- X

D. A. E. Anderson and J. A. Drouin

1. Introduction

Forest Insect Survey sampling and observations were continued throughout the forested areas of Alberta from May 12 to October 14, 1947 by forest insect rangers A. E. Anderson and J. A. Drouin.

Work commenced on May 16 at Canmore, Alberta where an infestation of poplar borer was mapped. This infestation, reported in 1946 by forest ranger J. Kovach, was re-inspected to determine its progress. The rangers proceeded to the Coleman district, where sample plots established in 1946 were inspected. An infestation of the large aspen tortrix, reported in 1946, was inspected this year for possible enlargement and increased intensity. On completion of this inspection, the rangers proceeded to the Cypress Hills and thence to the Clearwater Forest Reserve.

On July 27, the rangers departed for Elk Island Park, where a considerable amount of general sampling was done. From Elk Island Park, they proceeded north to Embarras Portage via Lac La Biche and Waterways to conduct a bark beetle reconnaissance in that area.

After returning from Embarras Portage, they moved on to Slave Lake and district, where birch was examined to determine the extent of bronze birch borer infestation. The rangers returned to Edmonton on September 7 and from there proceeded to the Brazeau-Athabaska Forest Reserve to work on permanent sample plots until October 7.

Bark beetle reconnaissance was undertaken in the Clearwater Forest Reserve and at Embarras Portage as previously mentioned.

2. Insect Conditions

(a) Aspen Tortrix (*Archips conflictana* Wlk.)

The infestation of this insect in the Castle River District appeared to be more extensive in 1947 than in the previous year. During 1946, it was found in sections 29, 30, 31 and 32 of tp. 6, rge. 2, W. 5th mer. In 1947, it was active in the same area and also in the additional sections 12, 22, 23, 26, 27, 28, 33 and 34.

This infestation is located outside the Crowsnest-Bow River Forest Reserve and is confined to semi-agricultural and grazing land where aspen grows in small tuffs on open prairie. No map of this area was available so that the exact boundaries of the infestation could not be defined. At the time of examination early in June, aspen foliage was not fully developed. Defoliation was very slight since the larvae were in the early stages and heavy feeding had not started.

Collections were made 7 miles south of Burmis along the Castle River and also in the Coalfield school district. In the latter area, the infestation was of recent origin and was not very heavy.

(b) American Poplar Leaf Beetle (*Phytodecta americana* Schffr.)

The infestations of this insect reported in 1946 were inspected again in 1947. In the localities examined, a few scattered samples were taken but no heavy damage was encountered.

In the Cypress Hills of southern Alberta, this insect had practically disappeared and at Crimson Lake in the Clearwater Forest Reserve populations appeared to have declined considerably since 1946. At Saunders, in the Clearwater Forest Reserve, a moderate to heavy infestation was encountered by R. G. McLaughlin and C. E. Enwright, in their respective districts, which are separated by the North Saskatchewan River. They observed the infestation during the early summer when the larvae were feeding.

Part of this area was inspected by the forest insect rangers in mid July. At that time, only a few scattered adults were collected and the trees showed very little defoliation.

(c) Poplar Borer (*Saperda calcarata* Say)

An infestation, located on Deadman's Flats, 7 miles east of Canmore, was reported in 1946. When re-examined in 1947, it had not spread to any great extent. Definite boundaries of the infestation were established during this year's survey. The infested area was in sections 12 and 13, rge. 10, and sections 7 and 18, rge. 9. A light attack occurred in sec. 17 and extended into sec. 20, rge. 9 (all west of the 5th meridian). The estimated area affected in 1947 is approximately three-quarters of a section. The heaviest portion of the infestation occurred in sections 12 and 13, rge. 10 and sec. 18, rge. 9. In this area, numerous collections of larvae and pupae were made at the time of the survey in May.

Stands of pure aspen, with a light scattering of willow and lesser shrubs, suffered the heaviest borer attacks. These stands occur on a natural 'flat' which has a park-like appearance.

During the survey, 3 areas within the most heavily infested portion were selected for study. One hundred trees were examined in each place. These trees were selected at random and marked with a lumber crayon for later examination. The marked trees were felled and the trunk cut into sections which were then split. This work was done on a tarpaulin spread on the ground to prevent loss of any insects found in the wood. A record was kept of uninfested trees, living infested trees and dead infested trees.

The percentage of infested trees and of dead trees at each location (based on a count of 100 trees) is shown on the following page.

AREA	% INFESTED TREES	% DEAD TREES
Sec. 12, rge. 10, W. 5th mer.	45%	nil
Sec. 13, rge. 10, W. 5th mer.	82%	11%
Sec. 18, rge. 9, W. 5th mer.	41%	5%
AVERAGE	56%	5.3%

Of the total of 300 trees tallied for borer activity, 168 or 56 per cent were infested and 16 or 5.3 per cent were dead. Tree mortality is thus quite low as yet.

Some evidence of damage other than that of insects was also found on the trees. The cause of this damage is not known with certainty but appeared to be due to the grazing of elk on the bark during the winter.

In sections 17 and 20, rge. 9, borer damage was very light. In this area spruce, Douglas fir, birch and poplar occur together; the poplar grows in small stands at the base of the mountain and the other species grow at higher elevations.

A sanitation cutting of the heavily infested area was recommended.

(d) Bronze Birch Borer (<u>Agrilus anxius</u> Gory)

An infestation of this insect, which had been reported in 1946, continued to attack scattered birch stands again in 1947 in the same area between Clyde and Kinuso in northern Alberta. These towns are situated on the Peace River Highway (No. 2). Clyde is 50 miles north of Edmonton and Kinuso is 150 miles north of Clyde.

This infestation is located in agricultural as well as forest areas. Extensive land clearing is now in progress throughout the entire agricultural area and logging operations are being conducted south of Lesser Slave Lake.

A survey of the region was conducted during early September in an effort to estimate, if possible, the amount of 'dieback' in birch. However, owing to an early fall, heavy frosts had already caused some discoloration of the foliage, and it was extremely difficult to detect borer damage on trees unless they were closely scrutinized. Those which had suffered relatively light attacks were especially hard to detect.

During the survey, the trees were scrutinized for dying tips of branches and leaders. Dead branches were cut off and the bark peeled to see if borers were present in the phloem layer. If borer channels were present, these were traced along the branch in an effort to find the larvae.

The terrain between Clyde and Smith is rolling, with sand and rock ridges and a light peat soil in the bottom lands. From Smith to Canyon Creek, the same terrain continues but the soil is mostly clay and there is a denser growth of trees and underbrush. Beyond Canyon Creek to Kinuso and Faust, more agricultural land is encountered. Here the terrain is fairly level and the soil mainly clay.

Examination of trees for borer damage was confined to those appearing unhealthy. In tp. 73, rge. 11, W. 5th mer., approximately 2 miles east of Faust, borers were evident in 75 per cent of the trees examined. In tp. 73, ranges 9 and 10, W. 5th mer., a number of unhealthy trees had borer channels in the wood but in others they were absent. In tp. 74, rge. 8, W. 5th mer., mature trees showed more 'dieback' than in the preceding area. Here borer damage was more evident in mature trees than in young growth. A cruise was conducted in tp. 72, rge. 11, W. 5th mer., but no signs of borer damage or 'dieback' were observed.

In the Rochester and Tawatinaw areas (townships 61 and 62, rge. 24, W. 5th mer.), both 'dieback' and borer activity were very pronounced and damage was severe in some small scattered stands. No larvae or adults of the bronze birch borer were found during the entire survey but empty borer channels indicated infestation previous to the time of the survey.

(e) Mistletoe (Razoumofskya sp.)

A heavy infestation of mistletoe, or witch's broom, which is believed to be Razoumofskya sp., was observed on jack pine in the vicinity of Nestow, 40 miles north of Edmonton, Alberta.

The infested area extends south from the townsite of Nestow, a distance of approximately 1 mile. In this area, most of the trees are covered with large growths of witch's broom. Thus far, tree mortality is low but tree growth has been greatly reduced.

North of Nestow, the jack pine stands are separated by a black spruce belt approximately one-half mile wide. Beyond this black spruce belt, the jack pine appeared fairly healthy and no evidence of the mistletoe was observed. This spruce belt may be a governing factor in the spread of the infestation.

A black spruce swamp in the vicinity of Mitsui, 7 miles south of Slave Lake, was examined for mistletoe. This swamp extends for 2 miles along both sides of the highway and is composed mainly of black spruce. Mistletoe was found to be relatively light but had become somewhat worse than it was in 1946.

3. Special Investigations

(a) Inspection for Bark Beetles at Embarras Portage

In 1946, it was reported that a bark beetle epidemic had developed at Embarras Portage on the Athabaska River, 150 miles north of Fort McMurray on sec. 30, tp. 107, rge. 9, W. 4th mer. Owing to its inaccessible location, this area was not investigated by the forest insect rangers until 1947. Between August 13 and August 25, a trip was made to the area. The rangers proceeded to Waterways and from there travelled down the Athabaska River via forestry craft to Embarras Portage. They were accompanied by forest ranger G. Brauti.

Owing to heavy snowfall during the winter of 1946-47, the water level of the Athabaska River had been exceedingly high in early spring. This condition was especially noticeable in and around Embarras Portage, where flood waters had caused a considerable amount of ice damage to the black and white spruce and the black poplar bordering the banks of the river.

Timber operations in and around the area reported as infested had been curtailed about four years previously and the mill site moved farther north. Slash and debris covered the ground and a deposit of silt from the flood waters was present beneath the trees and on the lower trunks. The water level had reached an approximate 4 foot height above ground level at the peak of the flood. The stand of white spruce and balsam fir covered a distance of ½ a mile along the river bank and extended east from the river about 1½ miles, ending in a swamp covered with black spruce and dense undergrowth. Most of the spruce in this area range from 15 to 20 inches D.B.H. These over-mature trees were found to be infected with heart-rot when the rangers tested them for soundness by tapping the trunks. According to information gathered locally, trees reaching this size are susceptible to heart-rot and it is quite prevalent throughout the district.

A number of collections of bark beetles were taken from dead, presumably over-mature, white spruce and balsam fir. A total of approximately 30 trees were examined. Bark beetles were not attacking green timber at the time of inspection. However, several conditions in the area favour the development of an outbreak--the presence of over-mature trees and of bark injuries caused by ice during the spring floods.

The entire district extending north to Lake Athabaska (approximately 55 miles) is low-lying and swampy. The area is appropriately called "The Delta". A survey along the Athabaska River, through Fletcher Channel and Graywavy Creek, to the Embarras River and along it to Lake Athabaska revealed no dead or dying trees. According to Mr. J. Sutter of the Northern Alberta Forest District, no great number of 'red tops' had been evident throughout his territory and none were present at the time this reconnaissance was conducted.

Adverse weather conditions and lack of time prevented an extensive investigation by the rangers. However, co-operators in the district have agreed to report any change in the bark beetle situation. Much valuable assistance was given by members of the Alberta Forest Service and other residents of the area. Some information was obtained from the Wood-Buffalo Park Warden, Mr. J. McColl, who takes periodic trips along the Slave River for protection against poachers, fires and any irregularities occurring along the eastern boundary of the Park from tp. 105 north to Fitzgerald.

(b) Inspection for Bark Beetles, Clearwater Forest Reserve-Banff National Park

At the request of Mr. J.R.H. Hall, Superintendent of the Clearwater Forest Reserve, a bark beetle reconnaissance of the major mountain passes between Banff National Park and the Clearwater Forest Reserve was made between June 30 and July 5.

This reconnaissance was conducted jointly by S.R. Farris, Chief Forest Insect Ranger from the Forest Insect Laboratory, Vernon, British Columbia and A. R. Anderson, forest insect ranger from the Forest Insect Laboratory, Winnipeg, Manitoba. Mr. Farris was well acquainted with this type of bark beetle inspection. Mr. C. Larson, of the Alberta Forest Service, accompanied the insect rangers on the trip and provided valuable assistance in guiding and information on the location of timber stands. Pack horses and riding stock for this trip were supplied by the Alberta Forest Service from the Red Deer Ranger Station.

Areas covered during the reconnaissance were the Panther River Basin and Pass, Dormer Pass, Brewster's Cut-off trail, Scalp Creek trail, the upper Clearwater River watershed, part of the James River trail and the James-Logan trail down Yara Creek.

Banff National Park was entered at two points, namely the Dormer Pass and the Panther Pass. An excellent view was obtained of those portions of Banff National Park which can be seen through the Red Deer River Pass and the Clearwater River Pass.

The forest in the mountain passes of this region consists of uniform stands of lodgepole pine on the higher ridges; in the valleys the dominant tree species is white spruce mixed with a few scattered stands of white poplar.

Bark beetle attack in epidemic stages was non-existent throughout the area described and traversed. A close watch was kept for other forest insects but no evidence of insects of either major or minor importance was encountered.

4. Permanent Sample Plots

During the latter part of September and the first part of October, 10 permanent sample plots were established in the Brazeau-Athabaska Forest Reserve in Alberta.

With the assistance of Mr. H. Parnall, Senior Ranger of the Leyland Ranger Station (now Timber Inspector), a survey of the Leyland district was made to ascertain the most suitable locations for the plots. The areas selected for establishing the sample plots were all on crown land and, therefore, are relatively free from interference.

The plots vary from 5 to 10 chains in length and are ½ chain in width with a compass line run through the center. Pure stands were selected for the sample plot sites. Two plots each of lodgepole pine, black spruce and white poplar and one each of white spruce, Engelmann spruce, larch and black poplar were established. A tally was made of all trees over 1" D.B.H. in the plot to determine the exact number of trees in each class. Ten trees were selected at random throughout the plot and marked. The marked trees will be used for detailed records of tree growth, defoliation by insects and other insect damage.

The plots were sufficiently scattered throughout the district to provide a representative coverage of the forest types therein.

5. Personnel Contacted

Attendance at Ranger School

Starting July 7, 1947, forest insect rangers Anderson and Drouin attended a three day Ranger School at Red Deer Ranger Station for personnel of the Alberta Forest Service in the area. The instruction at the school was given by the Director of Forestry for Alberta, Mr. T. F. Blefgen, assisted by Mr. J.R.H. Hall, Superintendent of the Clearwater Forest Reserve.

During the three day period, such subjects as administration, fire fighting, telephone repairs, forest pathology and forest entomology were discussed. Practical work in each subject was included.

The forest insect rangers, during this period, gave talks on the more important forest insects. Samples of the insects were exhibited and explained. A demonstration of the method of collecting insects by beating was given on the third day of the school.

The classes were concluded by a demonstration of the various types of fire pumps and fire fighting equipment given by Mr. J. Robbins of the Alberta Forest Service.

5. Personnel Contacted (continued)

NAME	TITLE	PLACE	DEMONSTR-ATION OF SAMPLING
T. F. Blefgen	Director of Forestry	Edmonton	yes
E. Heustis	Ass't Director of Forestry	Edmonton	no
J. L. Janssen	Chief Timber Inspector	Edmonton	no
T. Keats	Timber Auditor	Edmonton	no
A. Earnshaw	Radio Supt.	Edmonton	no
H. Holman	District Forest Officer	Calgary	no
J. F. Alexander	Superintendent	Calgary	no
F. C. Edgar	Ass't Superintendent	Calgary	no
J. McLennahan	Supt. Kananaskis Exp. Stn.	Seebe	no
J.R.H. Hall	Superintendent	Rocky Mtn. House	yes
J. D. Champion	Timber Inspector	Rocky Mtn. House	no
H. Edgecombe	Ranger	Rocky Mtn. House	yes
J. Robbins	Ranger	Rocky Mtn. House	yes
D. Buck	Superintendent	Edson	no
H. Farnall	Timber Inspector	Edson	no
G. Ramstead	Forest Ranger	Edson	no
M. Reap	Ranger	Edson	no
H. E. Noble	transferred to Ottawa		no
W. Wood	Timber Inspector	Slave Lake	no
P. Foley	Ranger	Slave Lake	yes
E. Weidman	Ranger	Slave Lake	no
R. Mackie	Forest Ranger	Thelma	no
B. Sturm	Ass't Ranger	Thelma	no
J. Kovach	Forest Ranger	Canmore	yes
W. Wallator	Ass't Ranger	Canmore	no
T. Frew	Forest Ranger	Coleman	no
W. Liddell	Ass't Ranger	Coleman	no
O. Larsen	Forest Ranger	Sundre	yes
J. Walker	Ass't Ranger	Sundre	yes
H. Balander	Ass't Ranger	Sundre	yes
H. Lyle	Lookout	Sundre	yes

(Continued)

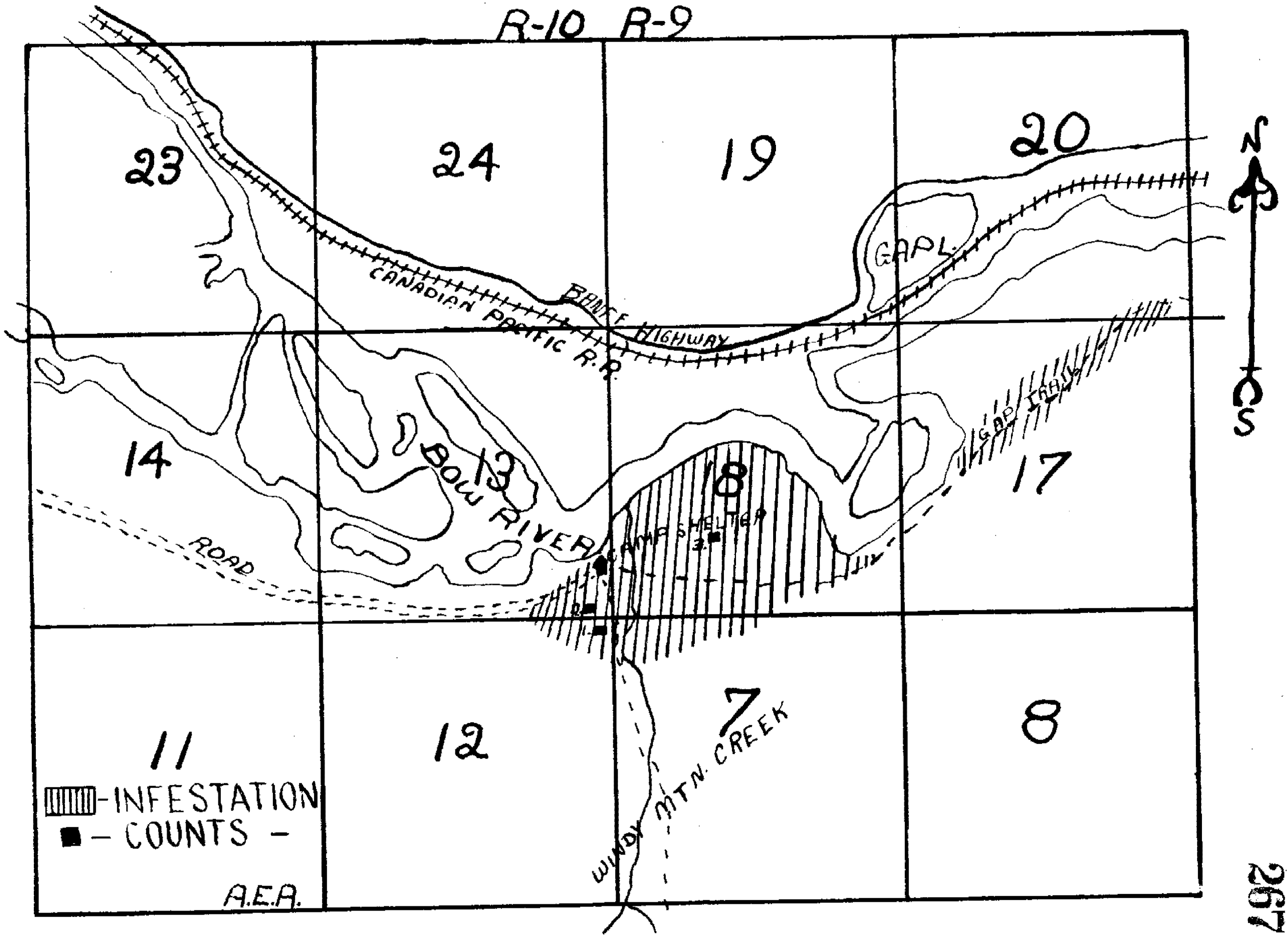
Personnel Contacted (Continued)

NAME	TITLE	PLACE	DEMONSTRATION OF SAMPLING
C. E. Enwright	Forest Ranger	Saunders	no
R. McLaughlin	Forest Ranger	Saunders	no
V. Higgins	Ass't Ranger	Saunders	no
J. Hause	Telephone Operator	Saunders	yes
M. Verhaeghe	Forest Ranger	Caroline	
J. Knight	Ass't Ranger	Caroline	yes
E. K. Stanley	Forest Ranger	Coalspur	
A. Dino	Ass't Ranger	Coalspur	no
P. Campbell	Ranger	Nordegg	yes
J. Sutter	Ranger	Embarras Portage	yes
G. Brauti	Ranger	Fort McMurray	yes
J. Booker	Ranger	Lac la Biche	no
A. Brown	Ranger	Smith	no
R. R. Stanley	Ranger	Leyland	no
N. Ponele	Ass't Ranger	Leyland	no
A. Clark	R.C.M.P., Game Warden	Leyland	no
A. Crawford	Ranger	Mountain Park	no
J. Bradshaw	Ass't Ranger	Mountain Park	no
B. J. Love	Superintendent	Elk Island Park	no
R. Jones	Warden	Elk Island Park	no
A. Roberts	Warden	Elk Island Park	no
J. McCall	Dominion Game Warden	Fort Chippewyan	no
C. Robson	R.C.M.P.	Fort Chippewyan	no

6. Negative Reports

DATE 1947	HOST	LOCATION
June 12	Lodgepole pine	Cypress Hills, sample plot #1, Nichol Springs
July 15	B. poplar	Saunders, Shunda Ranger Station
July 16	Lodgepole pine	Saunders, 2½ miles from Harlech Crossing
July 18	Willow	Saunders, 2½ miles
July 18	[illegible]. poplar	Nordegg, sec. 1, tp. 40, rge. 13, W. 5th mer.
July 24	W. poplar	5 miles east of Hinton, sec. 28, tp. 51, rge. 24, W.5th mer.
July 24	Lodgepole pine	Sample plot #2, sec. 7, tp. 53, rge. 19, W. 5th mer.
July 25	Lodgepole pine	Edson, sec. 34, tp. 52, rge. 18, W. 5th mer.
July 28	B. poplar	Elk Island Park, sec. 10, tp. 53, rge. 20, W. 4th mer.
Aug. 1	W. spruce	Elk Island Park, sec. 14, tp. 54, rge. 20, W. 4th mer.
Aug. 6	Jack pine	Slave Lake, sec. [illegible], tp. 72, rge. 5, W. 5th mer.
Aug. 6	Lodgepole pine	Slave Lake, east of plot
Aug. 29	W. spruce	Slave Lake, 6 miles west of Kinuso
Aug. 30	Balsam	Slave Lake, 1½ miles east of Wagner

POPLAR BORER INFESTATION



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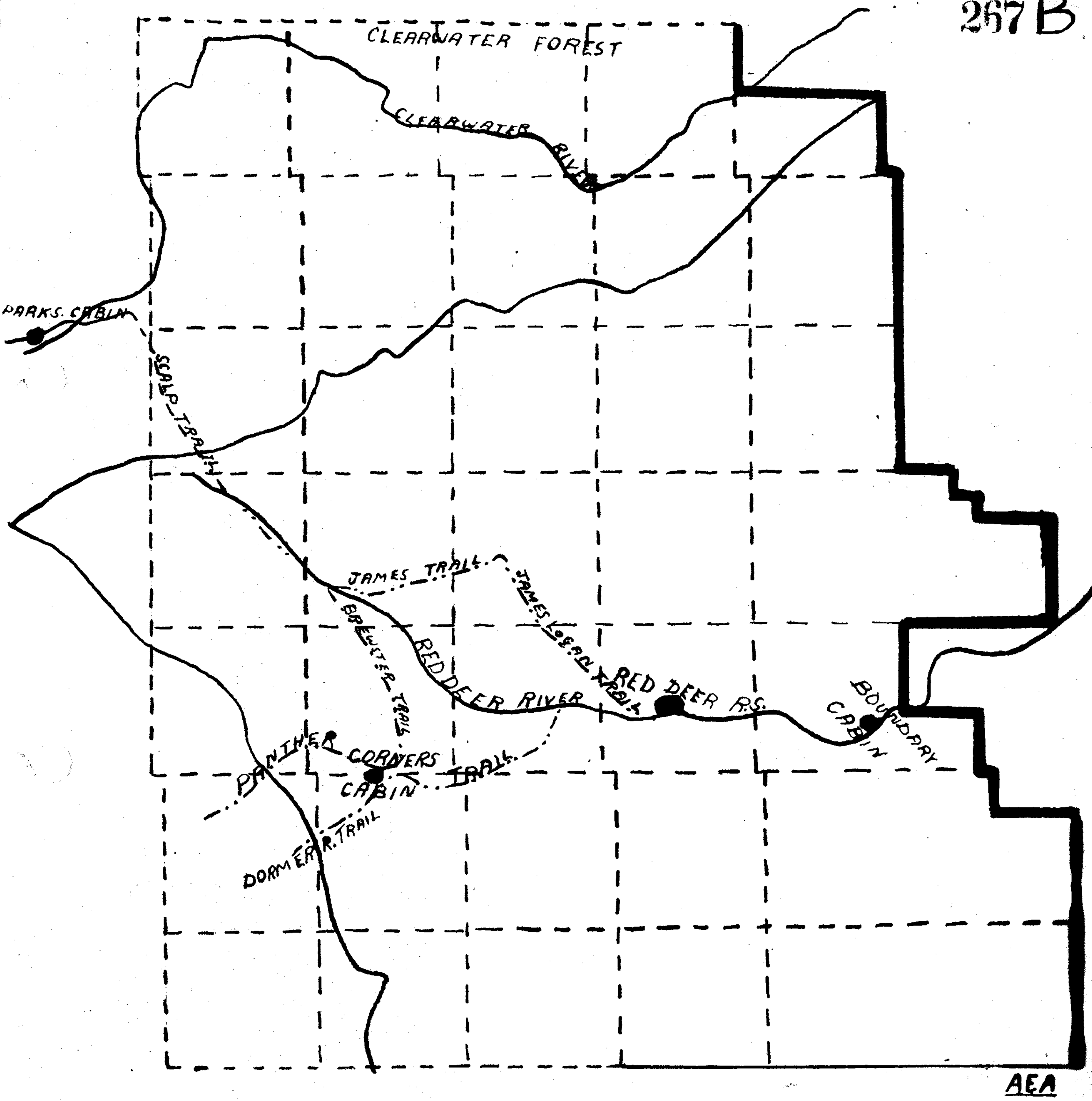

Bark Beetle Reconniassance - 1947

-..-.. Trails Traversed

Lejeune, R. R.
Status of the larch sawfly
(*Pristiphora erichsonii* Htg.)
In the Prairie Provinces. Can. Ent. in Press.

Mc Guffin, W. C. and Barker, R. B.
Annual report of the forest insect survey
(prairie provinces, forested area).
Div. of Ent., Forest Insect Investigations. 1946.

Barker, R. B. and Wong, H. R.
Annual report of the forest insect survey
(prairie provinces, forested area).
Div. of Ent., Forest Insect Investigations. 1947.

Contributions were made to the Bi-Monthly Progress Report, Forest Insect Investigations, at regular intervals by several members of the staff.

Several contributions were submitted for press release by the Publicity and Extension Service of the Department of Agriculture.

During the year, items on forest insects and the work of the Winnipeg Laboratory were noted in the local newspapers as follows:

(a) Sawfly menaces tamarac stands"
Winnipeg Tribune, February 12, 1947.
(b) Insects harm forests worse than all fires".
Winnipeg Free Press, September, 1947.
(c) Editorial on forest insects, Winnipeg
Free Press, September, 1947.
(d) News report on forest insect investigations,
Spruce Woods Forest Reserve, Carberry News-Express.
September, 1947.
(e) Information on larch sawfly investigations
contained in news report of sectional meeting of
the Canadian Society of Forest Engineers. Winnipeg
Free Press and Tribune. December 8-9, 1947.

It is quite possible that articles or news items appeared at other times in the local newspapers, out-of-town newspapers, or other publications, without being noticed, and there is, of course, no record available here on such material.

FINANCIAL STATEMENT 1947-48

	TOTAL	GENERAL ADMINI-STRATION	FOREST INSECT SURVEY	SPRUCE BUDWORM	JACK PINE BUDWORM	LARCH SAWFLY	LAB. MAINTENANCE	IMPROVE-MENTS	CAPITAL	Miscell. Projects
Buildings & Repairs	1,370.18	1,333.83					36.35			
Salaries: Permanent	1,695.00	1,695.00								
Temporary	31,929.86	2,756.00	20,666.75	2,496.79	2,378.53	2,972.39		205.00		454.40
Wages : Temporary	1,147.36		597.16		129.70		420.50			
Equipment: General: 4461.07 Scientific 804.86 Photograph 420.59	5,686.52								5,686.52	
Express, Freight & Cartage	144.12	24.72	51.86	11.72	3.62	7.55			44.65	
Miscellaneous	201.59	22.27				.85	178.47			
Supplies: General: 2150.14 Scient.: 417.50	2,567.64	45.62	605.10	288.44	420.43	321.57	75.56	318.44	472.15	20.33
Communications: Telegraph : 68.02 Telephone: 109.01 Postage: 139.32	316.35	173.20	91.37	14.92	18.44	18.42				
Travelling Expenses: General:	3,816.82	547.25	2,589.37	93.63	131.15	308.52				146.90
Maintenance:	4,095.72	611.43	2,046.77	537.84	495.11	404.57				
Pass.Car E-25 291.29 E-25A 281.94 Pass.Car E-26 334.08 Truck E-26A 70.49 Truck E-51 495.11 Truck E-80 593.32 Truck E-81 611.06 Truck E-82 350.85 Truck E-83 491.54 Pass.Car E-101 537.84 Motorboat 38.20										
TOTALS	$52,971.16	7,209.32	26,648.38	3,443.34	3,576.98	4033.87	710.88	523.44	6203.32	621.63

271

Northern 1947 Winnipeg Insect and Disease Species Index