1943
ANNUAL TECHNICAL REPORT

WINNIPEG LABORATORY
FOREST INSECT INVESTIGATIONS

1943

ANNUAL TECHNICAL REPORT

Prepared
by the

FOREST INSECT LABORATORY, WINNIPEG, MANITOBA.

Division of Entomology, Science Service.

Submitted to Ottawa May 17, 1944.

SUBJECT INDEX

SUBJECT INDEX (CONTINUED)

Page

SUBJECT INDEX (CONTINUED)

SUBJECT INDEX (CONTINUED)

SUBJECT INDEX (CONTINUED)

SPECIES INDEX

SPECIES INDEX CONTINUED

SEVENTH ANNUAL REPORT

Forest Insect Investigations Winnipeg Laboratory

For the Year
-1943-

I. INTRODUCTION

The year 1943 was one in which war-time conditions again handicapped work to a marked degree. Only two men were available for field work--H.A. Richmond and R.R. Lejeune--and one man was available for full time laboratory work--D.N. Smith. Supplementing these was F.B. Rabkin, who was hired for two months in the field and two girls assisting in the laboratory. (A resume of personnel is given under the next section).

Three main phases of work were undertaken: (1) Budworm investigations, (2) wood borers and timber salvage in northern Saskatchewan and (3) Forest Insect Survey.

The budworm investigations were restricted to the Hawk Lake, Ontario, field station, with aerial and ground reconnaissance being made throughout the budworm regions of Manitoba, Ontario and Saskatchewan. Budworm research included the following major phases: A survey of pupal parasites over 8 widely separated regions, including both the Jack pine and the spruce budworm; larval parasitism at Hawk Lake, Ontario; population studies; studies of growth and development of budworm larvae as influenced by a pollen diet; egg survey; sample plot examinations; and general reconnaissance. The timber salvage and wood borer problem was investigated by Messrs. Richmond and Lejeune in the Carrot River country of northern Saskatchewan and at the mill of The Pas Lumber Company at The Pas, Manitoba. The forest insect survey operated under the direction of Mr. D.N. Smith at the Winnipeg Laboratory.

During the year, the laboratory cooperated with the Saskatchewan Department of Natural Resources in providing instruction on forest insects at their ranger school held at Torch River. A resume of the wood borer problem was presented before the Central Pulpwood Association in Winnipeg and Mr. Richmond attended a meeting of the Advisory Committee on Forest Entomology, Woodlands Section, Canadian Pulp & Paper Association, held in Montreal October 15, 1943.

A post-war program was prepared and submitted to Ottawa in February, 1944, details of which are included in this report.

During the year, some changes came about in the staff of the laboratory. Mr. Victor Taylor, janitor, died April 7, 1943, and his position was filled by Mr. Charles Gibson, working on a similar part-time basis. Mr. Donald Smith was transferred to Victoria, B.C., leaving Winnipeg January 4, 1944. Mr. W.C. McGuffin was transferred from Ottawa to fill the vacancy left by Mr. Smith and reported for work at this laboratory January 5, 1944.

It was not possible to complete the analyses of all field data collected during the summer months. Additional to personnel shortage, these analyses were interrupted to a considerable extent by calls upon the staff for the completion of other work. Such work included a publication on the forest insect survey for 1943, a publication on wood borers and timber salvage as recorded during 1942 and 1943, and a program of post-war forest insect investigation for central Canada. Despite the handicaps of the day, it is felt that the laboratory successfully carried out a heavy program, the details and results of which are respectfully submitted in the pages that follow.

H. A. RICHMOND,
Assistant Entomologist, in charge
Winnipeg Laboratory.

May 17, 1944.

II. ORGANIZATION

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H.A. Richmond	SSE 281 - Assistant Entomologist, in charge. (April 1, 1943 to March 31, 1944.)
R.R. Lejeune	SSE 283M - Agricultural Assistant, Grade 11. (April 1, 1943, to March 31, 1944.)
W.C. McGuffin	SSE ~~3013~~ 258M - Agricultural Assistant, Grade 11. (April 1, 1943, to March 31, 1944. Absent on active service June 7 to October 12, 1943. Transferred from Ottawa to Winnipeg January 5, 1944.)
Mrs. E. Caplan	SSE 3147 - Stenographer, Grade 2. (April 1, 1943, to March 31, 1944.)
Mrs. W. Barker	Extra Labour Laboratory Assistant. (May 17, 1943, to March 31, 1944.)
C. Gibson	Extra Labour Janitor. (April 22, 1943, to March 31, 1944.)
D.N. Smith	SSE 3045 - Agricultural Assistant, Grade 11. (April 1, 1943, to March 31, 1944. Transferred from Winnipeg to Victoria January 4, 1944.)
F.B. Rabkin	SSE 3038 - Agricultural Assistant, Grade 8. (June 26, 1943, to August 24, 1943.)
Miss Lenore Mustard	Extra Labour Laboratory Assistant. (May 17, 1943, to August 14, 1943.)
V. Taylor	Extra Labour Janitor. (April 1, 1943, to April 7, 1943 -- deceased.)

III. SUMMARY ACCOUNT OF WORK

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The following major projects were undertaken by the Winnipeg Laboratory during the year 1943.

A. Budworm Studies (*Cacoecia fumiferana* Clem.)

The budworm work was of necessity restricted to a degree whereby two men could handle it. The principal phases of the work are outlined below.

1. Reconnaissance & Mapping

A complete survey of the budworm was undertaken throughout its range and the extent of its depredations was recorded and mapped from a point east of Geraldton, Ontario, west throughout all of northwestern Ontario, Manitoba and the La Corne Forest in northern Saskatchewan. Details of conditions as observed and mapped appear in this report.

2. Food Transfer Studies

Original Host	Transferred to	Year of Transfer	Stage Transferred	No. of Cages
White Spruce	White Spruce	1942	Larvae	1
Jack Pine	White Spruce	1942	Larvae	1
Jack Pine	Jack Pine	1943	Eggs	2
Jack Pine	Black Spruce	1943	Eggs	2
Jack Pine	White Spruce	1943	Larvae	3
Jack Pine	Balsam	1943	Larvae	2
White Spruce	White Spruce	1943	Eggs	2
White Spruce	Black Spruce	1943	Eggs	2
White Spruce	White Spruce	1943	Larvae	2
White Spruce	Balsam	1943	Larvae	2
Balsam	White Spruce	1943	Eggs	1
Balsam	Jack Pine	1943	Eggs	2

These transfers were carried through using brass mesh cages over living branches. All data pertinent to their development were recorded and the resulting eggs were allowed to hatch and the larvae to hibernate for future development on their new host. Conclusions thus far are: The highest survival of larvae, the largest pupae and the greatest quantity of eggs were obtained from spruce budworm transfers on to balsam. The lowest survival of the spruce budworm transfers occurred on black spruce. Jack pine budworm showed the highest survival when transferred to Jack pine and black spruce. Fecundity of the spruce budworm on spruce was much higher than when transferred to Jack pine, but the latter was practically the same as the Jack pine budworm on Jack pine. This study is one requiring several years to complete and, while no results can be expected in its first year, a good and satisfactory technique has been developed for its continuation.

3. Budworm Parasitism

A survey of pupal parasites throughout the budworm region was continued again during 1943. Samples of budworm pupae were collected in 8 separate regions, 3 contributing budworm from spruce and balsam, and 5 contributing budworm from Jack pine. A total of 11,650 pupae was collected. These areas, together with the percentage parasitism, follow:

Sandilands	17.91%
Spruce Woods	14.39%
Riding Mountain National Park ...	23.24%
Hawk Lake, Ontario	11.71%
Hudson	11.52%
Dryden	24.33%
Eva Lake	25.0 %
Geraldton	10.28%

Parasitism by Phaeogenes and Chalcids was markedly lower on the spruce budworm. Ephialtes was reared in approximately the same numbers from spruce and Jack pine budworm. Diptera were higher on the spruce budworm. Disregarding hosts and considering parasitism over a period of years, dipterous parasites appear more abundant in the prairie forests (Riding Mountains and Spruce Woods, Manitoba, and La Corne, Saskatchewan) than in Ontario. Parasitism was recorded as to sex of host and sex ratios of parasites were ascertained.

Larval parasitism as determined through dissections gave an average of 22.3% at Hawk Lake, Ontario. The only larval parasite reared was Apanteles fumiferanae. Dipterous parasitism was negligible. Parasitic larvae were found in the host from the 2nd to the 6th instar but in 97% the parasite emerged before the host reached the 6th instar.

4. Growth & Development as Influenced by Food

This phase of the work represents a conclusion to the study that has been in progress over the past two years. Through systematic collections of larvae taken at two-day intervals from staminate flowers, non-staminate twigs on staminate trees and from twigs on trees void of all staminate flowers, it was possible to measure the influence of pollen in the diet as reflected in larval growth and migratory movements. It was found that larvae of the same sex fed on staminate flowers exceed terminal-fed individuals by a small amount in reaching pupation; that male larvae on the same food exceed females in pupation; that the more rapidly developing staminate-fed females reach pupation at about the same time as male non-staminate-fed individuals; that a variation of growth ratios occurs between instars even in larvae of the same sex fed on the same diet, and that no one ratio derived from two consecutive instars will give a true standard ratio as derived by Dyar's Law; that a marked uniformity occurs between the mean ratios for both 1942 and 1943 data, this mean being different for each sex but apparently uninfluenced by food; that from the standpoint of the final size and the mean growth ratio of 7th instar larvae, sex appears of greater significance than food; from the standpoint of instar development, comparing one instar with the next, the presence of a pollen diet does show its influence in all instars, being most pronounced in the 4th, dropping as larvae reach their 7th instar. Parasitism resulted in a reduction in mean head capsule size, pronounced in the 3rd, 4th and 5th instars. It was evident that early migration takes the larvae to staminate flowers, which appears the cause for wind drifting in early spring. Populations show a marked increase on staminate flowers until after pollen-shed, after which the movement is toward young developing shoots. Much work is yet required before the data on hand can be finally analyzed.

5. Population Studies

Population counts were of necessity restricted to one series taken on June 29th. This count showed an average population of 22.8 larvae per 100 terminals, as compared to 4.24 and 7.39 in 1941 and 1942 respectively, all of which were recorded during corresponding seasonal periods.

6. Egg Survey

An annual egg survey was again conducted, giving an average of 54.5 eggs per cluster, 3.3% parasitism, 12.9% developmental failures and an incubation of 84.6%. Oviposition averaged 148 eggs per 100 terminals, compared to 214 in 1942 and 31 in 1941.

7. Sample Plots

An analysis of budworm sample plots was again undertaken but only those located in northwestern Ontario were worked. Sandilands plots had to be omitted due to shortage of time available. The extent of 1943 defoliation, mortality with its contributory causes and general condition of the trees tagged were recorded. Thirteen quarter-acre plots were so examined, with 6 reproduction plots being omitted for the season.

B. European Larch Sawfly

During the year, this work was confined exclusively to general reconnaissance and a cocoon collection in the Riding Mountain National Park. The following regions were visited in the course of reconnaissance work: Riding Mountain, Duck Mountain, Inter-lake country and Riverton, all in Manitoba. Cocoons collected were shipped to Belleville for winter storage and subsequent rearing.

C. Wood Borers

A study of wood borers in northern Saskatchewan and the relation of injury to timber salvage was further investigated during 1943. The principal borer was Monochamus scutellatus Say., with Tetropium sp. associated with it. It was found that salvage during this second winter, following the heavy burn of 1942, will permit utilization of infested timber prior to the maximum borer damage, especially in the more lightly burned timber. The five burn classes described in 1942 were again separable in this second year by the habits of the wood borers and the extent of damage produced. Burn types were found to be of much value in considering the chronological sequence of borer attack, on which penetrations at a given date depend. Populations per square foot of log surface were also correlated to burn type, an important point in delayed salvage, for it was found that logs of heaviest populations were attacked the latest and hence may suffer the shallowest penetration one year after the fire but, in due time, will experience the greatest degree of borer damage. Fourteen months after the fire, classification of logs by burn type still enabled one to segregate logs of varying degrees of borer penetration according to these burn types. The actual speed of borer penetration is the same in all types, the difference in depth being due only to the difference in date of initial attack. The average depth of completed tunnels was 3½ inches, the maximum 7 inches, and the minimum 1¾ inches. Borings are seldom completed in the first year and emergence of young adults was very light by the end of the second season and was correlated closely with burn type. Borings in most of the timber extend through 2 years; in much, it will continue into the third year and possibly the fourth in some instances. The infestation of burned trees extends throughout the summer, with some trees experiencing their initial attack the second summer after the fire. Larval mortality, due probably to winter killing, showed a direct correlation to burn type, which reflects the depth of larval penetration by the end of the first season's activities. Mortality decreased with an increase in penetration. Mill studies showed what type of log has suffered the greatest over-all damage and what types are producing the best lumber in salvaging these logs. The results of this work were compiled for publication and submitted to Ottawa in February, 1944.

D. Forest Insect Survey

The forest insect survey was conducted in the Winnipeg Laboratory throughout the season. During the year, 390 boxes of specimens were received. From these, 11,653 budworm pupae were obtained, the rearing of which has given a fairly comprehensive picture of pupal parasitism. 94 fully determined species and as many undetermined species were secured. War-time conditions have caused great changes in forest service personnel, which has hindered greatly co-operative work of this kind, especially in Manitoba and Saskatchewan. The Annual Summary Report was submitted to Ottawa for publication in January, 1944.

E. Post-War Organization

A proposal for post-war work was prepared for the provinces of Manitoba, Saskatchewan and Alberta, the suggestions being included in this report.

F. Tree Injections

At the request of the Montreal meeting of the Pulpwood Association, a report was prepared on the methods and reputed results of tree injection experiments as advocated by Mr. Alexander White of Port Arthur, details of this also being included among the following pages.

IV. BUDWORM INVESTIGATIONS

PLATE I

Spruce regeneration in Jack pine forest at Fisher Bay, Lake Winnipeg, Manitoba, November 17, 194[illegible].

PLATE II

Spruce regeneration in Jack pine forest at Fisher Bay, Lake Winnipeg, Manitoba, November 17, 1943.

PLATE III

Spruce regeneration in Jack pine forest at Fisher Bay, Lake Winnipeg, Manitoba. November 17, 1943.

PLATE IV

Damaged regeneration caused
by browsing of Moose.

Fisher Bay, Lake Winnipeg,
Manitoba.

IV. BUDWORM INVESTIGATIONS (*Cacoecia fumiferana* Clem.)

A. Budworm Reconnaissance & Mapping

During the season of 1943, the greater part of the budworm country throughout central Canada was mapped and recorded. The status of the budworm on Jack pine and the budworm on spruce and balsam as observed is given below.

1. Jack Pine Budworm

The range of the Jack pine budworm in central Canada now extends from northern Saskatchewan through Manitoba and northwestern Ontario east to a point some one hundred miles beyond Lake Nipigon. Throughout its entire extent, the only area of new attack occurred in the Nipigon country, where its eastward spread was accompanied by considerable defoliation in areas previously free of attack. In most of the older infested country from Port Arthur, Ontario, west through Manitoba and Saskatchewan, there was a general improvement, with the intensity of attack lighter than recorded for several years. There were two exceptions to this, however, one in the Kenora district of Ontario and one in southeastern Manitoba, where two extremely severe attacks occurred. A summary of the general situation is outlined below.

Saskatchewan. The budworm in this province is still restricted to the one area, Fort a la Corne Provincial Forest. The infestation showed a marked decline in intensity, with defoliation very light. In certain parts of this forest, it has completely disappeared.

Manitoba. The budworm in Manitoba varied from very light to extremely heavy in certain parts of the province. The Riding Mountain infestation showed a marked decline, especially along the Norgate Road, where its greatest activity had occurred in previous years. The most active area was the Lake Katherine vicinity but even this was not heavy. Northwest of Riverton, an infestation of some years' standing was again active in a moderate degree. Some top killing has resulted from several years of attack. A heavy attack occurred from Moosehorn to Fairford and again at Buchan. Considerable budworm activity was recorded on the southeast shore of Lake Winnipeg in the region of Grand Beach and Elk Island. This infestation, as mapped and reported by Mr. J. Kokindovich, forest ranger at Pine Falls, shows varying degrees from light to heavy, widely scattered from Stead north through Jackfish Lake, Belair, Victoria Beach to the northern end of Elk Island. This represents an infested area of increasing importance.

In southeastern Manitoba on the Sandilands Forest Reserve, the budworm showed a rather startling increase. Its severity was generally greater than any previously recorded since 1937. Heavy defoliation occurred in the vicinity of the forest service headquarters and south a distance of some 8 miles. North and east, it was present generally in varying degrees of intensity over most of the reserve. The infestation appeared its heaviest in the more southerly portion of this forest in the vicinity of Badger and Sprague. The principal infested areas occurred four miles north of Badger and extended generally throughout the Jack pine stands south to Wampum. North and east of Sprague, including the Whitemouth Lake area, the budworm appeared in a very light degree with no notable defoliation.

In the more easterly part of the province, it was moderate at West Hawk Lake and extended eastward into Ontario.

Ontario. The Jack pine budworm situation in northwestern Ontario showed considerable improvement over much of the older infested regions during 1943. This general improved condition was offset, however, by the increased activity of this insect in the Nipigon-Geraldton country north of Lake Superior and by its heavy attack in parts of the Kenora district. Proceeding east from Kenora, the budworm was evident north of Dogtooth Lake extending southeast through Hawk Lake to Dryberry Lake in moderate intensity; west of Dogtooth to Andy Lake and the Heenan Highway, it was heavy; southwest and east of Dryberry Lake, light; at Tadpole Lake southward through Rowan Lake andinto the Fort Frances district, very heavy. Eastward, it reached the Manitou Lakes and extended northward to Eagle Lake in moderate intensity. Its eastern limit in this area appeared to be a line running due south from Osborne Bay on Eagle Lake through the Lower Manitou. Continuing north and west of Eagle Lake, it was generally light to moderate, the heaviest of this region being at Vermilion Bay and at McIntosh on the C.N.R. It was of light intensity along the Wabigoon and English Rivers and through the Sand Lake and Minaki country. Much of the above noted region has been subject to budworm infestation in previous years and, in parts, considerable mortality has occurred. Such stands would be located roughly as follows: South of Dogtooth to Andy Lake and eastward to Dryberry Lake; between Atikwa and Dryberry Lakes; north of Daniels Lake; south of Grassy Narrows; south of Lount Lake; between Separation Bay on the English River and Sand Lake.

In the Ignace region, the budworm showed a marked decline by comparison with previous years. This decline is especially noticeable at White Otter and the Upper and Lower Scotch Lakes. During 1943, the main infestation occurred at English River west for three miles in moderate intensity, thence to Ignace in a very light degree, with scattered spots of moderate intensity in the Ignace vicinity. Between Raleigh Falls and Revel River, it was moderate; Dryden for two miles west, moderate to heavy; between Eagle River and Vermilion Bay, moderate to heavy; Vermilion Bay to Hawk Lake, light.

The Sioux Lookout district experienced much less budworm attack than in the year previous. An infestation of moderate degree occurred north of Lac Seul in the Wapest Bay area and again west of Root River from Deadhead Creek, Lynx Portage and north to Root Bay. North of Lake St. Joseph and Pickle Lake and south across Lindbey Lake, Marchington River, Lake of Bays and Wintering Lake, there was no budworm evident.

In the Fort Frances district, the heavy infestation of the past three years has disappeared for the most part. In only four areas was the infestation of noticeable degree, these being around Eva Lake; Beaverhouse to Rainy Lakes; south of Seine Bay on Rainy Lake and east of Sabaskong peninsula on the Lake of the Woods. All of these were moderate in intensity.

North and west of Port Arthur, the budworm again was much lighter than in recent years. The most marked attack occurred at English River eastward 6 miles, of moderate degree; between Niblock and Fire Steel River, moderate; at Oskondaja, moderate over a small area; and at Kaministikwia, light. This latter area was extremely heavy in 1941.

Northeast of Port Arthur in the Nipigon region, the Jack pine budworm showed considerable activity during the year and infestations of varying degree occurred throughout the Nipigon-Geraldton country in areas previously free of marked attack. In some sections, the Jack pine budworm was intermixed with the spruce budworm on spruce and balsam. Areas of special note follow. An attack of moderate intensity occurred along the Nonwatin River near Camp 10 where it was of moderate intensity in the mature Jack pine. West of Garden Lake, it was moderate; North of Chief Bay, Lake Nipigon, to Obonga Lake, light to moderate; from Obonga Lake, extending around the north end of Lake Nipigon, south to Jellicoe and east to Geraldton, it was generally light, except for such areas as indicated below. A heavy attack occurred on young growth 15 miles south of Jellicoe on the Trans-Canada Highway which appeared most severe between Jackpine and Jellicoe and continued beyond the latter point as far as Geraldton in diminishing intensity. At Geraldton, it was active on young growth of Jack pine. A heavy attack occurred southwest of Twin Lakes at Mollison, Eaton, Dodds and Altitude Lakes, extending southward to Wintering Lake. This represents the north and south extensions of the infestation, as previously mentioned, on the highway at Jellicoe. East of Geraldton, it was recorded 7.4 miles east of Long Lac on the highway and at Camp 19, Pulpwood Supply, on Seagram Road. In both of the latter places, the budworm was extremely light. Other records of its presence were obtained from Pays Plat, Schreiber, south of McKay Lake and south of Pagwachuan Lake, all of which areas were very lightly attacked.

2. Spruce Budworm

The budworm on spruce and balsam has shown a decided increase during the year. This increase is most noticeable south and west of Lake Nipigon extending eastward to Geraldton and it appears westward as far as Sioux Lookout. The main areas affected are summarized below.

Sioux Lookout Region. An extremely active infestation occurs on the peninsula of land north of Italian Bay on Lost Lake midway between Sioux Lookout and Hudson, Ontario.

Lake Nipigon-Geraldton Region. Infestations of considerable magnitude and of increasing activity have developed in parts of this region and, during 1943, reached proportions justifying considerable alarm. The principal infestation on spruce and balsam extends around the south and west sides of Lake Nipigon in the following manner: McDiarmid to Frazer Lake, light; Frazer and Nonwatin Lakes, moderate; Little Sturge and Black Sturgeon Lakes, heavy; Chief Bay, heavy; Chief Bay east, moderate; westward from Lake Nipigon as far as Garden Lake, moderate to light with diminishing intensity westward. East of Lake Nipigon, it occurs in heavy intensity along the Trans-Canada Highway over a 10-mile course immediately southwest of Beardmore, and again heavy 29 miles west of Geraldton extending over a 6-mile course where young trees are undergoing attack. In this area, it appears in conjunction with budworm on Jack pine. It again appears in moderate intensity within the townsite of Geraldton. In the more easterly portion of this region, it was recorded in a light intensity south of White Lake, extending in a northeasterly direction as far as the vicinity of Hornpayne.

A few records of minor activity of the budworm on balsam fir reveal its presence in such scattered parts as Hawk Lake, near Kenora and at Pays Plat on Lake Superior. It seems possible that its activities may cover a considerable portion of this section of country but that as yet it is noticeable only through intensive searching.

The accompanying map delineates the major infested areas in northwestern Ontario as recorded during 1943 by aerial and ground reconnaissance.

3. History of the Budworm in Northwestern Ontario 1937-1943 inclusive

The first intensive budworm attack was reported in northwestern Ontario in 1936. In that year, severe defoliation occurred in the Kenora district at Andy Lake, Willard Lake and Beaubien Lake. Infestations of a milder nature probably were active in other areas, but it is doubtful if they reached epidemic proportions.

In 1937, when the present work on this insect pest was initiated, all of northwestern Ontario as far east as Dryden experienced medium to heavy defoliation.

The outbreak became more widespread than ever in 1938, extending eastward to the Port Arthur district and southward through the Fort Frances district into Minnesota. Areas of decidedly severe defoliation occurred as follows: The Turtle River-Pekagonina Lake area, 3 townships west of Lake Manitou, Hawk Lake, Dryden and Ignace in the Kenora district; at Kawnipi Lake in Fort Frances and in the Northern Lights area in Port Arthur.

By 1939, the infestation covered all of northwestern Ontario in varying degrees of intensity. The most marked increase was recorded in the Thunder Bay region where the infestation advanced about 50 miles. A minor infestation in Corman township in 1938 extended its coverage northward in 1939. Heaviest infestation was observed in newly attacked areas to the east of former centres. Prominent among these was Dog Lake.

Areas of older infestation in the Kenora and Fort Frances districts exhibited a diminished attack and mortality was less than anticipated, averaging less than 15%. In these districts, the heavier infestations moved eastward to Ignace, Manitou Lake and South of Dryden. In a belt of timber extending from Andy Lake northward beyond Beaubien Lake, about 50% of the trees were dead in 1939 as a result of heavy defoliations dating back to 1936.

The intensity of attack in older areas of infestation subsided in 1940, while new areas were few in number and small in sige. It was reported that the eastern limit of south of Garden Lake stopped at the line of change from the prevailing spruce-Jack pine mixture to a preponderance of spruce. However, north of Garden Lake, the spruce-Jack pine mixture extended eastward and here severe browning was reported. Small areas limited to a few acres were found east of the main line of advance and some of these subsequently developed into severe outbreaks. Occasional records of budworm were received from Phillip's Creek east of Heron Bay and on the Pic River north of Heron Bay.

In the Port Arthur District, the area south and west of the Canadian National Railways was practically free of damage. A local area of a few square miles at Kakabeka was heavily attacked, as was an area south of Pakashkan Lake and another north of Mac. Severe defoliation occurred on the boundary between the Port Arthur and Kenora districts at English River.

In the Sioux Lookout District, the infestation was light, with no severe defoliation observed or reported.

The infestation in the Kenora District was lighter than in previous years. In the western and northern portions, defoliation was patchy and light. No severe damage was observed elsewhere although a new area of moderate intensity appeared on the north end of Manitou Lake.

In the Fort Frances area, it appears that heaviest defoliation occurred about Burke Lake, Lake La Croix and Sturgeon Narrows.

The situation continued to improve in 1941 although large areas were again infested. The entire eastern portions of the Kenora and Fort Frances districts experienced an epidemic varying in degree of intensity from light to heavy, the heaviest in general occurring towards the eastern district limits. Severe defoliation was observed in three relatively small areas; namely, Beaverhouse Lake, Sturgeon Narrows and Eagle Rock Lake. The entire southwest portion of Quetico Park also received a medium attack extending across the border into Minnesota. In the vicinity of Ignace in the Kenora District, severe defoliation of isolated trees or groups of trees was observed. With these exceptions, the infestation elsewhere in this general area was light.

The area thus far considered appeared to be the focal point of the infestation in northwestern Ontario, having contracted eastward in the Kenora and Fort Frances Districts and westward from Port Arthur. The territory including Hawk Lake, Vermilion Bay and Dryden, the scene of heavy outbreaks from 1937-40, revealed only a trace of budworm in 1941. Northwest of the town of Kenora, a fairly large area bounded on the north by the English River was covered with a light to medium infestation.

In the Port Arthur District, the outbreak declined markedly, with four comparatively small areas of medium infestation being recorded. These were located: (1) west of Black Sturgeon Lake, (2) west of Lake des Iles, (3) an eastward extension of the Quetico Park infestation in the south and (4) in the north, the territory northwest of Lake Seseganga.

Northwestern Ontario, particularly the Kenora District, witnessed a general resurgence of the infestation in 1942. The range of the budworm was also extended northward into the Sioux Lookout region and eastward into the Geraldton District. On the whole, defoliation was patchy, with severe injury being restricted to several relatively small areas.

In the Kenora District, heavy outbreaks occurred at Mahree Lake, east of Hawk Lake, for a distance of 12 miles, east of Ignace for a distance of 18 miles, especially at Gull River, and for a distance of 26 miles west of Ignace. East and south of Eagle Lake to the eastern district boundary, budworm was generally present in medium intensity. The western portion west of Hawk Lake was almost free of budworm.

In the Fort Frances District, defoliation was general over the entire district east of the sixth meridian. On the whole, the infestation was light, with centres of medium outbreak prevailing in several areas.

Budworm extended its range well into the Sioux Lookout District during 1942. Generally speaking, the northern limits ran from Goldpines east to the southern tip of Wapesi Lake, thence in a northeasterly direction to Miniss Lake at the district boundary.

Of particular significance was the discovery of an attack by the budworm on spruce and balsam just north of the C.N.R. track 4 miles east of Hudson. This was the first record of an invasion of this part of the country by the budworm on spruce and balsam, an insect which has caused immeasurable damage in eastern Canada. This new infestation covered approximately 100 square miles.

In the Port Arthur District, it appeared that the infestation was moving eastward, several outbreaks occurring in the Geraldton District. This was apparently the forerunner of severe outbreaks in that area in 1943.

B. Biological Control of *Cacoecia fumiferana* Clem.

1. The Budworm Pupal Survey

(a) Introduction

Various factors peculiar to wartime conditions made further inroads into both the extent and quantity of budworm pupal collections obtained in 1943. For the most part, cooperators who had previously contributed so generously were unable to do so in the past year due to reduction in personnel and the burden of added duties. As a result, collections in all but two of the areas sampled were made by the staff of the Winnipeg Laboratory.

(b) Areas Contributing

The number of study areas represented was reduced from 13 to 8. Fortunately, it was possible to maintain collections from such important centres as the Sandilands Forest Reserve, Spruce Woods Forest Reserve, Riding Mountain National Park, Hawk Lake and Dryden. The scarcity of pupae was responsible for the absence of samples from Ignace and Fort Frances.

Spruce budworm pupae were received from three areas in 1943. The most important of these is Geraldton, situated in a region of a new widespread and severe outbreak on spruce and balsam. The second area, at Hudson near Sioux Lookout, is experiencing a moderate infestation of limited distribution while the third, at Spruce Woods Forest Reserve, has been active for several years. Jack pine budworm pupae were received from all other areas.

Table 1 indicates the source and number of pupae received in 1943.

TABLE 1

SOURCE & NUMBER OF PUPAE RECEIVED IN THE 1943 BUDWORM PARASITE SURVEY

LOCALITY	COLLECTOR	SERVICE OR COMPANY	NO. OF COLLECTIONS	NO. OF PUPAE
MANITOBA				
Sandilands Forest Reserve	F.B.Rabkin	Forest Insect Investigations	1	586
Spruce Woods Forest Reserve*	H.A.Richmond & F.B.Rabkin	Forest Insect Investigations	1	1529
Riding Mt. National Park	F.B.Rabkin	Forest Insect Investigations	1	185
ONTARIO				
Hawk Lake	R.R.Lejeune & F.B.Rabkin	Forest Insect Investigations	20	1981
Dryden	O. Jackson	Dryden Paper Company	7	1788
Hudson*	R.R.Lejeune & F.B.Rabkin	Forest Insect Investigations	7	1406
Eva Lake	R.R.Lejeune	Forest Insect Investigations	1	44
Geraldton*	H.A.Richmond & K.Montgomery	Forest Insect Investigations & Ont.Dept. Lands & Forests	4	4133
TOTALS			42	11652

* Spruce budworm.

(c) Organization

No changes in methods of handling and rearing were introduced during 1943.

(d) Analysis of Data

(i) Parasites reared. The following is a list of parasites reared from budworm pupae in 1943. The species are listed in the order of occurrence, the most abundant appearing at the top of the list.

HYMENOPTERA

Ephialtes conquisitor Say.
Phaeogenes hariolus Cress.
Amblymerus verditor Nort.
Amblymerus tortricis Br.
Brachymeria compsilurae Cwfd.

DIPTERA

Zenillia caesar Ald.
Nemorilla pyste Wlk.
Phyrse pecosensis (TT.)
Madremyia saundersii (Will.)
Actia interrupta Curr.
Pseudosarcophaga affinis (Fall.)
Ceromasia sp.

A curious development during the last two years has been the gradual disappearance of several species of miscellaneous hymenopterous parasites. While these never occurred in abundance, they at times added considerably to pupal mortality. *Atrometus* sp., the one most frequently reared in this group, was entirely absent this year. This was also true of the chalcids, *Tetrastichus* sp. and *Syntomosphyrum* sp. In all, 5 species of Hymenoptera were obtained in 1943, compared to 10 for the preceding year and a total of 18 since the inception of the pupal survey in 1939.

(ii) Pupal parasitism for 1943. Methods used for determining degree of parasitism and other mortality are the same as those described in the 1942 Annual Report, Page 26. Table 2 shows the degree of parasitism for all areas in 1943. Parasitism is based on the total number of pupae received minus those dead from other causes as 100%. As usual, Diptera are grouped under one heading. The chalcids are made up entirely of *Amblymerus* sp.

TABLE 2

PERCENTAGE MORTALITY OF PUPAE FROM THE 1943 BUDWORM SURVEY

AREA	DIPTERA	EPHIALTES CONQUISITOR	PHAEOGENES HARIOLUS	CHALCIDS	MISCELLANEOUS HYMENOPTERA	TOTAL
MANITOBA						
Sandilands Forest Reserve	1.69	1.88	6.58	9.59	0.00	19.74
Riding Mt. National Park	18.06	2.58	3.87	1.94	1.29	27.74
Spruce Woods Forest Reserve*	16.69	2.16	0.00	0.17	0.00	19.03
ONTARIO						
Hawk Lake						
Top ½ Jack pine	1.11	2.70	6.66	1.11	0.00	11.58
Bottom ½ Jack pine	.82	7.97	3.30	2.47	0.00	14.57
Average for Hawk Lake	.96	5.34	4.98	1.79	0.00	13.08
Dryden	4.75	9.15	13.83	2.98	0.14	30.85
Eva Lake	2.70	10.81	16.22	0.00	0.00	29.73
Hudson*	5.29	5.93	3.28	0.18	0.09	14.78
Geraldton*	5.43	5.13	1.68	0.29	0.00	12.53

*Spruce budworm.

The preceding table, while indicating the percentage of pupae parasitized by chalcids, does not show the actual number emerging. This information, plus the average number per pupa, appears in Table 3.

TABLE 3

AMBLYMERUS SP.* REARED FROM 1943 BUDWORM PUPAL COLLECTIONS

AREA	NUMBER OF CHALCIDS	AVERAGE NUMBER PER PUPA
Sandilands Forest Reserve	687	13.5
Riding Mt. National Park	50	16.7
Spruce Woods For. Reserve	15	7.5
Hawk Lake	419	12.3
Dryden	492	11.7
Eva Lake	0	0
Hudson	30	15.0
Geraldton	103	10.3

*All chalcids reared in 1943 were *Amblymerus* sp., mainly *A. verditor* with a few *A. tortricis*.

On the whole, parasitism showed no great changes over 1942, although there are some points of special interest. In 1942, chalcid parasitism reached a new high and it seemed that chalcids might be on the increase. However, in 1943, they generally occurred again in their usual abundance. *Ephialtes* decreased markedly, particularly at Hawk Lake, Sandilands and Spruce Woods. Diptera gained considerably at Spruce Woods and maintained their position as the dominant group in Riding Mountain National Park. Elsewhere, they were much the same. The prevalence of *Phaeogenes* approximated that of the preceding year.

In one respect the 1943 data are exceedingly interesting in that they afford a comparison of the parasite complex between three areas of spruce budworm and five of Jack pine budworm. The difference between the two is not as great as might be expected but some definite variations are apparent. The most striking is the usual absence of *Phaeogenes hariolus* in Spruce Woods material, a condition which has obtained since the inception of investigations in that area. On the other hand, this species was recovered from spruce budworm at Hudson and Geraldton but it is noteworthy that the average parasitism for these two areas is much lower than the average of the five Jack pine areas (2.5%

compared to 9.1%). Chalcid parasitism by *Amblymerus* sp. is also less in evidence on the spruce budworm. *Ephialtes conquisitor* in 1943 and in previous years has been reared in approximately equal numbers from both forms of budworm. Diptera appear to be the only group causing a greater mortality on the spruce budworm. In 1943, the average parasitism of spruce budworm by Diptera was 9.14% as compared to 5.63% on the Jack pine budworm.

Disregarding the question of hosts, dipterous parasitism has been consistently higher over a period of years in such areas as Riding Mountain National Park, Spruce Woods and Fort a la Corne, the average being 10.67%, 8.09% and 8.74% respectively, as compared with a mean of 3.65% for all areas since 1939. That this condition occurs with such regularity in the areas mentioned (2 of them Jack pine budworm), must be due to some inherent difference in the environment.

(iii) Natural mortality of pupae. Every year a percentage of pupae received in Winnipeg dies from causes which are not readily apparent. Moreover, this number is not constant but exhibits considerable variation between areas, some collections showing a consistently higher or lower mortality than the average. Unsuccessful attempts have been made to determine the underlying causes by analyzing the data. It is certain that some mortality is due to the feeding habits of the parasites *Ephialtes* and *Phaeogenes* but it is also equally certain that collecting, shipping and rearing must result in additional mortality.

In an effort to throw some light on this question, a simple experiment in which pupae received three different treatments was conducted at Hawk Lake in 1943. Treatments were as follows:

(1) An actual count was made in the field to determine the proportion of emerged to dead pupae present on the trees after emergence was completed.
(2) A series of pupae collected from Jack pine at Hawk Lake was carefully picked, handled and counted. Then the collections were divided into two lots, one being retained at Hawk Lake and reared through until emergence was completed.
(3) The other lot was packed in soft moss in Forest Insect Survey boxes, stored in a cool place until transportation was available and then shipped to Winnipeg. There they were reared through in the same type of cage used for the pupae at Hawk Lake. The treatment received by

pupae in (2) and (3) is the general procedure by which pupae from other areas reach Winnipeg. In this experiment, however, unusual precautions were taken to reduce the injury from collecting and shipping to a minimum and it is unfortunate that such ideal conditions do not always prevail.

Table 4 shows the results of these rearings.

TABLE 4

COMPARISON OF NATURAL MORTALITY OF HAWK LAKE PUPAE UNDER DIFFERENT TREATMENTS

TREATMENT	TOTAL PUPAE	NATURAL DEAD	% NATURAL DEAD
Field count at Hawk Lake	430	20	4.6
Reared in cages at Hawk Lake	594	55	10.8
Shipped to Winnipeg for rearing	627	75	12.0

It is readily perceived that mortality of pupae in the field is appreciably less than that of pupae reared in cages. This field mortality of 4.6% may be attributed mainly to the feeding habits of the parasites, inherent weakness and weather conditions. There is a surprisingly small variance in mortality of pupae reared at Hawk Lake and those shipped to Winnipeg. This additional mortality was incurred through packaging, transportation to Winnipeg and handling by postal authorities. In view of the numerous potential lethal factors inherent in such a trip, the mortality is remarkably small. The greatest injury appears to have been caused by collecting and counting and it would seem that careful handling during the pre-shipping period is most essential. The high mortality of pupae received from some areas is no doubt due in a large measure to lack of sufficient care in this respect. On the other hand, the pupae shipped in this experiment underwent a relatively short and rapid journey compared to those from other areas. The fact that such ideal conditions do not always obtain would tend to further increase this "natural" mortality.

The natural mortality of pupae received in 1943 is shown in Table 5.

TABLE 5

NATURAL MORTALITY OF PUPAE RECEIVED IN 1943

AREA	% NATURAL DEAD	AREA	% NATURAL DEAD
Sandilands	9.21	Hudson	22.05
Spruce Woods	24.39	Dryden	21.14
Riding Mt. National Park	16.21	Eva Lake	15.91
Hawk Lake	13.12	Geraldton	17.96

(iv) Other host-parasite relations. Herein are again included a number of tables dealing with various aspects of pupal parasitism. Similar data appear in all previous annual reports since the inception of the project in 1939. There is a definite need arising for correlation of all the data accumulated since the beginning of the survey into a comprehensive report. Unfortunately, time is a limiting factor and, to date, this has not been possible.

TABLE 6

PERCENTAGE MORTALITY OF MALE PUPAE IN 1943

AREA	EPHIALTES CONQUISITOR	PHAEOGENES HARIOLUS	DIPTERA	CHALCIDS	MISCELLANEOUS	TOTAL PARASITISM	NATURAL DEAD	TOTAL MORTALITY
Sandilands	1.35	3.38	1.01	12.84	0.00	18.58	6.76	25.34
Spruce Woods	1.82	0.00	16.28	0.10	0.00	18.20	20.98	39.17
Riding Mt. National Pk.	1.30	5.20	9.10	2.60	1.30	19.48	15.59	35.07
Hawk Lake	6.51	4.26	0.78	2.36	0.00	13.91	13.91	27.82
Hudson	6.23	3.11	3.11	0.19	0.00	12.65	16.93	29.58
Dryden	5.97	15.10	4.87	2.56	0.24	28.74	22.41	51.16
Eva Lake	6.90	17.24	3.45	0.00	0.00	27.58	17.24	44.82
Geraldton	3.68	2.04	2.37	0.53	0.00	8.62	6.78	15.39

TABLE 7

PERCENTAGE MORTALITY OF FEMALE PUPAE IN 1943

AREA	EPHIALTES CONQUISITOR	PHAEOGENES HARIOLUS	DIPTERA	CHALCIDS	MISCELLANEOUS	TOTAL PARASITISM	NATURAL DEAD	TOTAL MORTALITY
Sandilands	2.07	8.62	2.07	4.48	0.00	17.24	11.72	28.96
Spruce Woods	1.24	0.00	4.74	0.21	0.00	6.19	31.75	37.94
Riding Mt. National Pk.	2.78	1.85	19.44	0.92	0.92	25.92	16.67	42.59
Hawk Lake	4.22	3.67	0.82	1.19	0.00	9.91	12.48	22.38
Hudson	3.70	2.24	4.71	0.11	0.11	10.87	25.00	35.87
Dryden	8.27	7.34	2.79	2.17	0.00	20.58	20.06	40.64
Eva Lake	13.33	6.67	0.00	0.00	0.00	20.00	13.33	33.33
Geraldton	4.52	1.00	5.66	0.08	0.00	11.25	24.45	35.70

TABLE 8

PERCENTAGE MORTALITY OF ALL PUPAE IN 1943

AREA	EPHIALTES CONQUISITOR	PHAEOGENES HARIOLUS	DIPTERA	CHALCIDS	MISCELLANEOUS	TOTAL PARASITISM	NATURAL DEAD	TOTAL MORTALITY
Sandilands	1.70	5.97	1.53	8.70	0.00	17.91	9.21	27.12
Spruce Woods	1.63	0.00	12.62	0.13	0.00	14.39	24.39	38.78
Riding Mt. National Pk.	2.16	3.24	15.13	1.62	1.08	23.24	16.21	39.46
Hawk Lake	5.25	3.94	0.81	1.72	0.00	11.71	13.12	24.84
Hudson	4.62	2.56	4.12	0.14	0.07	11.52	22.05	33.57
Dryden	7.21	10.91	3.75	2.35	0.11	24.33	21.14	45.47
Eva Lake	9.09	13.64	2.27	0.00	0.00	25.00	15.91	40.91
Geraldton	4.21	1.37	4.45	0.24	0.00	10.28	17.96	28.24

Table 9 shows the sex ratios of Cacoecia fumiferana pupae, Phaeogenes hariolus and Ephialtes conquisitor in 1943. Natural dead pupae were excluded from the computations.

TABLE 9

SEX RATIOS OF CACOECIA FUMIFERANA, EPHIALTES CONQUISITOR AND PHAEOGENES HARIOLUS FOR THE 1943 PUPAL SURVEY

AREA	SEX RATIO OF CACOECIA FUMIFERANA	SEX RATIO OF EPHIALTES CONQUISITOR	SEX RATIO OF PHAEOGENES HARIOLUS
Sandilands	.481	.600	.914
Spruce Woods	.286	.440	None
Riding Mt. National Park	.581	.250	.500
Hawk Lake	.554	.615	.513
Hudson	.610	.446	.694
Dryden	.548	.659	.533
Eva Lake	.351	.750	.333
Geraldton	.582	.511	.456
TOTALS	.533	.559	.562

TABLE 10

SEX RATIOS OF EPHIALTES CONQUISITOR AND PHAEOGENES HARIOLUS REARED FROM MALE AND FEMALE PUPAE OF CACOECIA FUMIFERANA

AREA	MALE PUPAE		FEMALE PUPAE	
	Ephialtes conquisitor	Phaeogenes hariolus	Ephialtes conquisitor	Phaeogenes hariolus
Sandilands	.500	.700	.667	1.000
Spruce Woods	.316	.833	None	None
Riding Mt. National Park	.000	.250	.333	1.000
Hawk Lake	.414	.184	.870	.825
Hudson	.375	.562	.515	.800
Dryden	.469	.395	.775	.775
Eva Lake	.500	.200	1.000	1.000
Geraldton	.339	.387	.593	.538
TOTALS	.394	.377	.684	.789

(e) Summary

Some 11,650 pupae were received from three study areas of spruce budworm and five of Jack pine budworm in 1943. The following parasites were reared from the material submitted:

HYMENOPTERA

Ephialtes conquisitor Say.
Phaeogenes hariolus Cress.
Amblymerus verditor Nort.
Amblymerus tortricis Br.
Brachymeria compsilurae Cwfd.

DIPTERA

Zenillia caesar Ald.
Nemorilla pyste Wlk.
Phyrse pecosensis (TT.)
Madremyia saundersii (Will.)
Actia interrupta Curr.
Pseudosarcophaga affinis (Fall.)
Ceromasia sp.

During the last two years, there has been a gradual decline and disappearance of such common miscellaneous Hymenoptera as *Atrometus* sp., *Tetrastichus* sp. and *Syntomosphyrum* sp.

Pupal mortality from parasitism and natural causes in the eight areas sampled is listed below:

AREA	% PARASITISM	% NATURAL MORTALITY	% TOTAL MORTALITY
Sandilands	17.91	9.21	27.12
Spruce Woods	14.39	24.39	38.78
Riding Mt. Park	23.24	16.21	39.46
Hawk Lake	11.71	13.12	28.84 ?
Hudson	11.52	22.05	33.57
Dryden	24.33	21.14	45.47
Eva Lake	25.00	15.91	40.91
Geraldton	10.28	17.96	28.24

No outstanding changes in parasitism took place in 1943 but data procured permit an interesting comparison between the parasite complex on the spruce and Jack pine budworms. Parasitism by Phaeogenes hariolus and chalcids was markedly lower on the spruce budworm. Ephialtes conquisitor was reared in approximately equal numbers from the two, whereas Diptera were more abundant on the spruce budworm. Disregarding hosts, long term trends show a much higher average dipterous parasitism in Riding Mountain National Park, Spruce Woods and Fort a la Corne.

The major part of the natural mortality in collections from Hawk Lake was experimentally traced to collecting, counting and caging. Natural mortality due to shipping was very light in this instance.

The usual tables showing mortality of male and female pupae and host-parasite sex ratio relations are included in the report.

2. Budworm Larval Parasites

(a) Methods

A quantitative study of larval parasites at Hawk Lake in 1943 was conducted by two new methods which gave more accurate results than those employed in previous years. In the past, the usual procedure has been to collect, cage and rear a known number of larvae in the 3rd and 4th instars until pupation and the emergence of moths and parasites was completed. The adult parasites were collected and the percentage parasitism determined. The one great disadvantage of this method was that a heavy rearing mortality invariably nullified the accuracy of the data.

To overcome this difficulty, the two methods described below were followed in 1943. The first entails a count of budworm larvae and parasite cocoons in the field after parasite emergence from the host is completed. The best time to make these counts is usually when budworm larvae are in the 6th and 7th instars. The parasite cocoons are quite conspicuous and easily detected. The second method, the most accurate of all, requires the dissection of larvae after parasitism is completed and before parasite emergence from the host begins. This was accomplished in 1943 in conjunction with the budworm larval growth study completed during the winter of 1943-44. In addition to this, for purposes of identification a supplementary series of larvae should be reared through for adult parasites.

(b) Results Obtained

The only hymenopterous parasite reared from budworm larvae in 1943 was Apanteles fumiferanae Vier. A very small number of budworm larvae was found to contain Diptera but, for practical purposes, they may be disregarded.

The first series of results to be presented was obtained from counts of parasite cocoons in the field. Cocoons first appeared on July 5th, at which time most normal larvae were in the 6th instar, while parasitized larvae were still in the 5th. The number of individuals (hosts and parasites) and parasites counted on July 5th, 7th and 10th on staminate cones, terminals on staminate trees and terminals on non-staminate trees is shown in Table 11. The percentage parasitism for each category is also listed.

TABLE 11
LARVAL PARASITISM IN FIELD COUNTS AT HAWK LAKE IN 1943

DATE	STAMINATE CONES		TERMINALS ON STAMINATE TREES		TERMINALS ON NON-STAMINATE TREES	
	Larvae	Parasitized	Larvae	Parasitized	Larvae	Parasitized
July 5	70	7	49	1	23	1
July 7	25	4	37	2	38	1
July 10	21	5	22	2	30	0
TOTALS	116	16	108	5	91	2
% PARASITISM		13.8		4.6		2.2

The data as they appear above would seem to indicate that parasitism is much higher on larvae developing on staminate cones. While larval dissections indicate a slightly higher parasitism on cones, the reason for the wide variation in Table 11 is that by July 5th most of the normal larvae in cones had migrated to terminal buds while the parasites were emerging from their hosts before migration could take place. Even in the method used above, the true parasitism is greatly underestimated, as revealed by data from larval dissections in Table 12. Here, the parasitism of larvae all through the season to July 10th is shown for staminate cones and terminal collections made for a study on budworm growth and development.

TABLE 12

PARASITISM IN 1943 AS REVEALED BY LARVAL DISSECTIONS

DATE	STAMINATE CONES			TERMINAL BUDS			TOTALS		
	Larvae	Parasitized	%	Larvae	Parasitized	%	Larvae	Parasitized	%
June 5	35	5	14.3	20	0	0.0	55	5	9.1
10	32	2	6.2	30	0	0.0	62	2	3.2
14	36	6	16.7	19	0	0.0	55	6	10.9
17	33	3	9.1	31	1	3.2	64	4	6.2
19	33	3	9.1	32	2	6.2	65	5	7.7
21	34	4	11.8	37	7	18.9	71	11	15.5
23	44	14	31.8	34	4	11.8	78	18	23.1
25	41	11	26.8	36	6	16.7	77	17	22.1
28	39	9	23.1	41	11	26.8	80	20	25.0
30	41	11	26.8	38	8	21.0	79	19	24.0
July 3	38	8	21.0	42	12	28.6	80	20	25.0
5	44	14	31.8	41	11	26.8	85	25	29.4
7	35	5	14.3	37	7	18.9	72	12	16.7
10	33	3	9.1	34	4	11.8	67	7	10.4
TOTAL June 5-21	203	23	12.3	169	10	5.9	372	33	8.9
TOTAL June 23-July 10	315	75	23.8	303	63	20.8	618	138	22.3
GRAND TOTAL	518	98	18.9	472	73	15.5	990	171	17.3

Parasitism in the above table has been divided into two periods, one from June 5-21, when parasitism of larvae was apparently still in progress, and the other from June 23-July 10, the period when parasitism was completed. This second phase is the one which gives the most accurate picture of degree of parasitism. It is to be noted that for this period parasitism on staminate cones amounted to 23.8% while parasitism of terminal-fed larvae was 20.8%, not a very big variation. In the period from June 5-21, however, the difference between the two would appear to be significant, 12.3% for staminate cones, 5.9% for terminals. It may be that the adult parasites prefer the more rapidly developing staminate larvae as hosts in the early part of the season and later, as the terminal larvae develop in size, parasitism becomes more indiscriminate.

It appears that parasitism was generally completed around June 21-25 as, from then on to July 5th, the level of parasitism was fairly high and constant. On July 5th, the parasitic larvae began to emerge from their hosts and spin cocoons, the result being a sudden drop in the percentage parasitism (See Table 12, July 7th and 10th).

It is of interest to note that dissections disclosed 11 second instar larvae to contain hymenopterous larvae (probably Apanteles). The appearance of the parasitic larvae coincides with that described in Sweetman's "The Biological Control of Insects," P. 242 as the hibernating first stage larva of Apanteles lacteicolor Vier. and is apparently common to all species of Apanteles. From Sweetman's discussion, it would seem therefore that Apanteles fumiferanae may attack first instar budworm larvae in the fall and overwinter as a parasitic larva in the host. Whether parasitism by A. fumiferanae is normally completed at this time is unknown, but, unless the results of our larval dissections are unreliable, it appears that additional parasitism occurs in the more advanced instars of the following season.

Parasitism by Apanteles fumiferanae influences the growth and development of budworm larvae in several ways. The most apparent effect is the retarded rate of development, especially noticeable in the 5th instar. The last parasitized 5th instar larvae were collected on July 10th, at which time 71.4% of the parasitized larvae were in this stage. On July 5th (5 days earlier), 10% of the normal larvae were in the 5th instar, the remainder being in the 6th and 7th while, at the same time, 100% of the parasitized larvae were still in the 5th instar.

Parasitism also influences the size of the larvae as reflected in head capsule widths, this again being most apparent in the 5th instar. Below are listed the average head capsule widths of some 1,000 normal larvae and 171 parasitized larvae collected at Hawk Lake in 1943.

TABLE 13

HEAD CAPSULE WIDTHS IN MM. OF NORMAL AND PARASITIZED LARVAE

INSTAR	WIDTH OF NORMAL LARVAE	WIDTH OF PARASITIZED LARVAE	DIFFERENCE
2	.264	.263	.001
3	.383	.373	.010
4	.565	.530	.035
5	.822	.739	.083
6	1.218	None	
7	1.892	None	

Both parasitized and non-parasitized larvae are approximately the same size in the 2nd instar, the difference between the two becoming progressively larger with each succeeding instar until the 5th is reached. At that time, normal larvae are 10% larger than parasitized larvae.

Parasitic larvae emerged from the 5th instar host in 97% of those examined, only 3% of the parasitized larvae surviving to the 6th instar and none to the 7th. The emergence of the parasite is apparently fatal to the host.

A point of considerable interest is that, in all the 171 parasitized larvae examined, there was in no case positive evidence of male gonads in any of the hosts. Positive identification of the hosts as females is more difficult, however, and it is not possible to state therefore that all parasitized larvae were females. It would seem rather improbable that the ovipositing parasite could distinguish between male and female 1st and 2nd instar host larvae. A more tenable explanation is a possible inhibitory effect on the development of testes by the parasitic larva or actual destruction of the testes by feeding.

(c) Summary

The most accurate method of determining larval parasitism is by dissection. This technique disclosed a parasitism of 22.3% on a random series collected June 23rd to July 10th. Parasitism was slightly higher on larvae collected from staminate cones. Apanteles fumiferanae was the only hymenopterous species obtained in 1943, while dipterous parasitism was negligible.

Parasites have been found in budworm larvae from the 2nd to the 6th instar inclusive. In 97% of those examined, parasites emerged from the host prior to the 6th instar while, in the remainder, the host survived to the 6th instar. Parasitized larvae, especially in the 5th instar, were noticeably retarded in rate of development. The head capsule widths of 5th instar parasitized larvae also averaged 10% smaller than normal larvae.

It is rather curious that no male gonads were found in the 171 parasitized larvae examined. However, it is impossible to say definitely if all parasitized larvae were females, as positive identification of this sex is more difficult.

3. Budworm Egg Survey

(a) Methods

Sample branches were removed from the top and bottom of 20 trees in the vicinity of the Hawk Lake camp and the usual records obtained. These include a count of the number of terminal buds and egg clusters per branch and information on the height, crown class, staminate cones and density of foliage of the trees. Originally, egg clusters from half of the branches examined were preserved in Frehling's solution for a count of eggs per cluster, while the remainder were incubated for an estimate of larval emergence and egg parasitism. Subsequent analysis of data, however, revealed a higher incidence of parasitism in the preserved clusters. Nevertheless, data from the two sources are first tabulated separately and then a final compilation made of the two.

(b) Results obtained

(i) Preserved egg clusters.

Branches examined	20
Terminal buds	7159
Egg clusters	206
Eggs	11721
Parasitized eggs	430

(ii) Incubated eggs.

Branches examined	18
Terminal buds	7292
Egg clusters	186
Sound eggs	8168
Parasitized eggs	278
Unhatched eggs	1206
Total eggs	9652

(iii) Below is presented a compilation of data from the two sources above. In some cases, only data from one source are of use and, in others, the two are applicable. In all instances, the source is indicated.

		Source
Trees examined	20	(i)&(ii)
Branches examined	38	(i)&(ii)
Terminal buds	14451	(i)&(ii)
Egg clusters	392	(i)&(ii)
Eggs	21373	(i)&(ii)
Eggs destroyed by parasites	3.31%	(i)&(ii)
Sound eggs	84.62%	(ii)
Infertile eggs	12.94%	(ii)
Eggs per cluster	54.5	(i)&(ii)
Eggs per branch	562.4	(i)&(ii)
Egg clusters per branch	15.2	(i)&(ii)
Eggs per 100 terminals	148	(i)&(ii)

In 1943, egg parasitism(by Trichogramma minutum) was again relatively low but infertility was much higher than in previous years, amounting to 12.9% as compared to .8% for 1942. There was a decrease in the number of eggs deposited from 214 per 100 terminals in 1942 to 148 per 100 terminals in 1943. This is rather encouraging in view of the fact that an alarming increase in the budworm was anticipated for 1943. While some of the anticipated increase did actually occur, the damage sustained by the trees was not severe due to an exceptionally favourable growing season.

(c) Summary

The egg survey at Hawk Lake yielded 392 egg clusters, with an average of 54.5 eggs per cluster. Parasitism destroyed 3.3% of these; 12.9% failed to hatch; and 84.6% were sound. Terminal buds counted numbered 14,451, with an average population of 148 eggs per 100 terminals. This compares with 214 in 1942 and 31 in 1941.

4. Directions for the Budworm Pupal Parasite Survey

The following is a complete compilation of procedures and techniques developed over a period of five years in handling material received for the budworm pupal parasite survey. Directions are given in chronological order, beginning with the opening of the boxes and concluding with the cleaning and dismantling of the rearing cages. As an aid to those not familiar with the budworm and its parasites, a section on identifications is appended.

STEP ONE

RECEIVING AND SORTING MATERIAL

1. The box is opened in a bell jar laid on its side and the entire contents removed, finding the enclosure slip.
2 Make a note of date received on the determination sheet, also Forest Insect Survey and box numbers.
3. The material is carefully examined, segregating budworm pupae from packing material.
4. The packing material is then carefully checked and discarded. At this time, the box may also be discarded.
5. Living adult material, such as budworm moths and parasites, is killed and labelled. Budworm pupae and the pupae or cocoons and larvae of parasites are placed in petri dishes. Eventually, the budworm pupae will be placed in cages and included with them will be all the dipterous larvae and cocoons. Before caging, however, the following is done.
6. Pupae are segregated according to sex--male and female--and emerged pupal cases placed in a separate category. If possible, parasitized cases from which dipterous larvae came and also from which Hymenoptera emerged are segregated and an attempt made to balance the number of cases against the number of parasites found. Pupal skins with one to many small holes the size of a pin head have been parasitized by chalcids, while Ichneumons leave a more or less jagged circular hole anteriorly on the host pupae. Pupae from which Diptera have emerged are usually badly damaged; the emergence hole is normally large and irregular and may occur on any part of the pupal skin.
7. For emerged budworm material, balance the number of empty pupal skins against emerged moths and record the excess skins as directed on the determination sheet.

STEP TWO

FILLING IN DETERMINATION SHEET

1. The determination sheet is stapled on to the enclosure slip. The date received has already been entered. This date applies to the date the box is actually received.

2. The F.I.S. number is given. Check sheet for Record No., Date and Box No.

3. The first entry is in column (1) and comprises sound pupae. These consist of sexed material, male and female and total.

4. In column (2), enter the pupal skins from which dipterous larvae have emerged, segregated according to sex. If this is not possible, follow procedure suggested in item 6 below. These will be put in the rearing cage with sound budworm pupae.

5. Column (3) contains parasitized pupal skins from which Hymenoptera, both Ichneumons and Chalcids, have emerged. These will also be put in the rearing cage with sound budworm pupae.

6. Column (4) shows any parasites in excess of the parasitized skins. Include larval, pupal and adult forms. The excess parasites are distributed arbitrarily between male and female pupae, corresponding to the number of pupae received; i.e., if there are twice as many males as females, the parasites would be distributed two-thirds from males and one-third from females. If no excess parasites occur, no entry is necessary in column (4). Chalcids are <u>not</u> included in this column.

7. Total columns (1), (2), (3) and (4) and enter in column (5).

8. Column (6) contains the number of emerged moths found in the box. These are killed and, after being recorded, may be discarded.

9. Count and sex the budworm pupal cases and, if there is any excess of skins over the emerged moths, enter the number in column (7). These emerged skins may then also be discarded.

10. Column (8) shows the total of emerged moths by adding together columns (6) and (7).

11. The grand total, column (9), shows the original number of pupae in the collection before parasitism and emergence of moths commenced. It is obtained by adding columns (5) and (8) and is regarded as the total number of pupae received in the box.

12. Free adult Chalcids are not entered on the determination sheet but are killed and layered, then entered on the emergence sheet as a normal record for that date.

13. All other adult parasites should be segregated according to the headings on the emergence sheet and entered on that sheet as a normal emergence for that date. The number of Diptera and Ichneumons entered on the emergence sheet should correspond with the total of columns (2), (3) and (4) less larvae and cocoons of Diptera and pupae parasitized by Chalcids.

14. Miscellaneous material not related to the pupal survey proper may be noted on the bottom of the determination sheet and then transferred to the Forest Insect Survey.

15. Check determination sheet.

STEP THREE

FILLING IN ACCESSION SHEET

1. The accession sheet is filled in when the determination sheet is completed.

2. On the accession sheet are listed the main area from which the collection was taken and, where applicable, subsidiary areas. Where the area is a composite with several localities contributing, and where all the material is reared in one box, the subsidiary areas are listed on the same accession sheet under the appropriate heading. Entries are made from columns (5), (8) and (9) of each determination sheet and represent the total number of pupae received in that sample. The F.I.S. number on the determination sheet is also entered on the accession sheet. Thus, a ready reference to the original enclosure slip for any one entry on the accession sheet is possible. One accession sheet is used for each main area.

3. Check accession sheet against determination sheet and prepare the material for the cages.

STEP FOUR

PLACING MATERIAL IN REARING CAGES

1. The material that was recorded on the determination and accession sheets is introduced into the pupal parasite rearing cages.

2. It is advisable to load the top tray of the cage first. At the beginning of the Survey, it will be possible to remove the front of the cage to do this. Later, due to emerged material in the cage, it will require special means.

3. In loading the trays, it is essential to see that the pupae are properly distributed and that no clumping or piling up of pupae occurs. It is also advisable not to handle the pupae more than is absolutely necessary. To do this, it is sometimes possible to merely flip the contents out of the dish in which the pupae are contained, thus evenly distributing them over the wire trays.

4. Where emergence has proceeded, the front of the cage cannot be readily removed. At this time, it might be possible to introduce pupae into the cage by means of a long paper cone inserted through the jar opening in the front of the cage. By moving the cone about, pupae may be evenly distributed on the second and bottom compartments of the cage.

5. Parasitized pupal skins and immature Diptera that have been classified under columns (2) and (3) on the determination sheet are introduced into the cage.

6. Any material that escapes while the cage is being loaded is traced, if possible, and killed. Identification is the essential feature and a note is made on the emergence sheet of anything that has escaped. Parasites like *Ephialtes* and *Phaeogenes* which can be positively identified and sexed may be left free and alive.

7. In rearing the material in the insectary, it is sometimes advisable to air out the cage or else maintain some suitable humidity by means of clean water sprayed into the cage. A change of air may be accomplished by removing the sealer from the front of the cage and substituting a disc of finely-meshed wire, carefully fitted into the sealer ring. This may be left on overnight, if necessary.

8. 2 cages are allotted for each area contributing. The cages are labelled with the area and male or female designation. For purposes of record and standardization, the male cage is referred to as "A" and the female cage as "B." The appropriate material is introduced into each cage, as outlined.

STEP FIVE

REMOVING EMERGED MATERIAL FROM THE CAGES

1. The emergence of material from the rearing cages may be taken throughout the day, whenever convenient, and need not be restricted to any definite time. If possible, at least daily collections are maintained.

2. A suitable procedure of taking the emergence consists of having a clean jar at hand, also a glass jar top. The jar on the cage is carefully removed and the jar top quickly placed on the jar and the fresh jar inserted in its place.

3. A small square of paper, or cardboard preferably, with the area name and male or female designation is placed at this time in the removed jar. This will eliminate any confusion that might arise and the tag can then follow the material through its various stages, anaesthetizing or killing.

4. A small wad of cotton on the end of a string of suitable length is moistened with ether and introduced into the removed jar. Additional jars may be removed and cotton wads of ether introduced. In this manner, it is not necessary to wait for the material in the jar to be anaesthetized.

5. When all movement in the jar has ceased, the contents of that jar are then carefully examined. This may be facilitated by dumping all the contents on to a sheet of paper.

6. Moths are examined as to sex and the numbers recorded as to male and female. Parasite material is segregated into species and sex, if possible.

7. Unless instructed otherwise, kill all the emerged moths and adult parasites.

8. After the material has been killed and recorded, the moths may be discarded. All parasite material is kept for layering. In some cases, instructions may be given

to discard certain parasites.

9. Where live material is required, the anaesthetized insects may be returned to a fresh jar, or a parasite shipping can, and allowed to revive. In this respect, it is essential that proper identification of the parasites be made.

10. Do not immediately re-use sealers which have just been etherized. Set them aside for 5 minutes and use a clean sealer from a supply kept for that purpose. If lack of sealers will not permit this, swish the etherized jar through the air until no odor of ether remains before replacing.

11. Layer emerged and killed material between cellucotton, placing a label beside them bearing record number, cage number, sex of budworm, and date of emergence. Be sure to place the labels so that there is no confusion as to which specimens they refer to. Store in cardboard boxes or other containers which may be provided. Chalcids are best stored between layers of cellucotton in small cardboard pill boxes.

12. Any insects that escape while the emergence is being taken are identified, if possible. Moths are located and killed. Parasites, if no doubt exists as to their identity, are allowed to escape. For purposes of record, escaped material is entered as an ordinary emergence and need not be placed under a separate category.

13. The emergence is entered on an insectary emergence sheet in the insectary at the time the emergence is taken.

STEP SIX

EMERGENCE RECORDS

1. The daily insectary emergence sheet should be used in the insectary and these daily records transferred to the permanent emergence form. Records for several areas or several records for one area may appear on the one insectary emergence sheet.

2. Under the category of emerged moths, the checked material from the jars is entered. If any discrepancy has occurred, that is, if a male moth has been recovered from a female cage or vice versa, the procedure is to record the number of such moths in parentheses in the column referring to that cage from which they were removed. This figure then forms part of the total number of moths under the proper category. For example: If 2 male moths are recovered from a female

cage, the figure "2" is recorded in parentheses under the female cage column and does not form part of the total number of moths in that column. The "2" appears in the total number of moths under the male column without any further designation. Adult parasites are entered under their proper category. If any doubt exists as to identification, material is killed and layered and entered under miscellaneous parasites or Ichneumonids, etc. Adult Diptera are all killed and layered and entered as the total number of Diptera. Similarly, chalcids. The miscellaneous parasites are killed and layered and entered under the miscellaneous column.

3. Emergence sheet: The sex of the pupae, area of collection, F.I.S. numbers and all the material which emerges in the cage are recorded here. This is the permanent record of emergence and includes entries of emerged adult material from the determination sheet and the daily insectary emergence sheet. The "date" column refers to the actual date when emergence was taken or, if the figure is taken from the determination sheet, the emergence date is taken as that day on which the box was opened. One emergence sheet is used for each cage being reared.

a. Moths: The number of moths recorded on the insectary emergence sheets is entered here. In cases where any discrepancy in sex has occurred (male moths present in female cages or vice versa), enter the data as recorded on the insectary emergence sheet (See item 2 on preceding page). Any emerged moths in the F.I.S. box when it was opened are also recorded here at the time the determination sheet is filled in. The total in column (8) of the determination sheet is the figure used for emergence in the box.

b. Parasites: Emerged adult parasite material from the survey box is entered in the appropriate columns on the emergence sheet at the time the determination sheet is filled in. Do not include dipterous larvae or cocoons. However, all adult parasites, including chalcids, are entered. Records from the daily insectary emergence sheet are also transcribed to the emergence sheet. It is important that chalcids and all other material not identified to species be killed, clearly labelled and stored.

STEP SEVEN

CLEARING OUT THE CAGES

1. When all emergence has ceased, this final step is required to complete the data for analysis. For this purpose, the "Residual Cage Material" sheet is provided and should be filled in as completely as warranted by circumstances. The entreis made should serve as a check on all previously recorded data and will round out information on the emergence sheet by recording emerged budworm moths and parasites which, for various reasons, were never removed in the ordinary routine emergence.

2. The headings on this sheet are for the most part self-explanatory. Complete the entries for area, sex and F.I.S. numbers. Dead moths, dipterous adults, larvae and unemerged dipterous cocoons and all other adult parasites, after being entered on the residual cage material sheet, are transcribed to the permanent emergence sheet. It should be noted on the latter that the specimens were obtained when the cage was dismantled. All material except unemerged dipterous cocoons and larvae and unidentified adults may be discarded unless directed otherwise. The number of cocoons parasitized by Chalcids appearing on the residual cage sheet is the figure used for computing degree of parasitism by this group.

SUMMARY

First step:	Empty boxes and segregate material.
Second step:	Fill in determination sheet.
Third step:	Fill in accession sheet and transcribe records of emerged adults to permanent emergence sheet.
Fourth step:	Introduce material into rearing cages.
Fifth step:	Remove and segregate moths and parasites emerging in the cages.
Sixth step:	Record emergence on daily insectary emergence sheet. Then transfer records to permanent emergence sheet. The latter should also contain records from (a) the determination sheet and (b) records from the residual cage material sheet.
Last step:	When emergence has ceased, clear out cages and fill in residual cage material sheet.

5. Identification of Budworm & Parasite Material

(a) Budworm

(i) Sexing pupae. Male pupae have five free abdominal segments visible ventrally posterior to the wing pads; the last spiracle is on the penultimate or second last segment.

Female pupae have only four free abdominal segments visible ventrally posterior to the wing pads; the last spiracle occurs on the last segment. Female pupae are usually larger and more robust than males and often contain green pigment in the wing pad region (Colouring applies to Jack pine budworm only).

(ii) Parasitized pupae. These descriptions refer to empty budworm pupae from which parasites have emerged.

Diptera: Pupae from which Diptera have emerged are usually badly damaged. The emergence hole is normally large and irregular and may occur on any part of the pupal skin. Determining the sex of such pupae is often not possible.

Ichneumons: Ichneumons such as Ephialtes and Phaeogenes leave a more or less clean jagged circular hole anteriorly in the empty host pupae.

Chalcids: Pupal skins with one to many small holes about the size of a pin head have been parasitized by Chalcids.

(b) Parasites

The detail of these descriptions does not go beyond that necessary to separate parasites into the headings listed on the emergence sheet.

(i) Diptera. The larval, pupal and adult forms of Diptera may be encountered.

Larva. Dipterous larvae are commonly known as maggots. they are almost white in colour, headless and legless. They are often found free in pupal collections, having emerged from the host pupae. They have limited powers of locomotion, whereas the parasitic hymenopterous larvae have none.

Pupa. Dipterous pupae are known as puparia. The puparia are small, hard, oval to barrel-shaped, light to dark brown in colour and from one-half to three-quarters of a millimeter in length.

Adult. The adults are two-winged flies resembling in appearance the common house-fly. The great majority belong to the family Tachinidae.

(ii) Ichneumons.

Ephialtes conquisitor. The basic colour of males and females is black with a thin white transverse line on the posterior dorsal edge of each abdominal segment. The tibiae and tarsi of the middle and hind legs are marked with alternate black and white rings. The female is distinguished from the male by having a conspicuous needle-like ovipositor one-eighth to one-quarter of an inch in length.

Phaeogenes hariolus. The males and females are quite different. Males are generally black but occasionally there may be a thin transverse red line on the dorsum of each abdominal segment. The "face" below the antennae is white. The fore and middle legs are light brown, while the hind legs are a smoky brown. The females have a white annulus or ring around the middle of each antenna. The dorsal region of the first two to all the abdominal segments may be almost completely red in colour.

Larvae: Free larvae andpupae of the above species are rarely encountered, as their entire development takes place within the host. It is only through accidental breakage of parasitized budworm pupae that they will be seen. Once removed from the host, they inevitably die. For this reason, even when breakage does occur, the immature stages of the parasite usually remain in that part of the host skin which was not removed by the injury. Diptera, on the other hand, as a rule leave the host voluntarily. Budworm pupae containing full-grown Ichneumon larvae or pupae are distended, elongated and brittle. The mature parasitic larvae and prepupae have a more conspicuously developed cephalic region than the Diptera.

(iii) Chalcids (adults). Adult Chalcids are very small in size, compared to the Diptera and Ichneumons. They are four-winged insects with the wing venation greatly reduced. The front wing normally has a single large compound vein, there being no closed cells. They may be black as in Tetrastichus sp. or metallic blue-green as in Amblymerus, and usually appear in swarms in the emergence jars.

(iv) Miscellaneous (adults). All other parasites which do not fall into any of the preceding categories are entered in the miscellaneous column on the emergence sheet.

C. Population Studies

1. Introduction

Population counts at Hawk Lake were of necessity severely curtailed in 1943. Unfortunately, a large series of counts made for the budworm growth and migration project are of such a nature that they cannot be incorporated into the method of annual population estimates employed in previous years. However, a relatively small series of counts was made on June 29th. Chronologically, this corresponds with the count made in 1942 from June 30th to July 7th and serves as an estimate of the final larval population before pupation. The same method of calculation (1942 Annual Report, P. 44) and the same ratio of staminate to non-staminate trees (1942 Annual Report, P. 46) used in 1942 were used again this year.

2. Results

A summary of the larval counts made on June 29th appears on the following page.

TABLE 14

HAWK LAKE LARVAL COUNTS JUNE 29, 1943.

Tree No.	Staminate Cones	Location of Sample	No. of Staminate Cones	Larvae	Terminal Buds	Larvae	Total Terminals	Total Larvae	Larvae per 100 Terminals
1	Light	Top	7	5	65	31	72	36	50.00
1	Light	Bottom	1	1	103	16	104	17	16.35
2	None	Top	0	0	112	19	112	19	16.96
2	None	Bottom	0	0	184	32	184	32	17.39
3	Light	Top	1	0	150	33	151	33	21.85
3	Light	Bottom	0	0	212	34	212	34	16.04
4	Heavy	Top	52	12	211	143	263	155	58.94
4	Heavy	Bottom	0	0	193	46	193	46	23.83
5	Heavy	Top	8	2	136	101	144	103	71.53
5	Heavy	Bottom	1	0	163	75	164	75	45.73

Average per 100 terminals for non-staminate - 17.17
Average per 100 terminals for lightly staminate - 26.06
Average per 100 terminals for heavily staminate - 50.01

In 1942, the proportion of staminate to non-staminate trees in the vicinity of Hawk Lake was determined as follows:

Heavily staminate 12.86%
Lightly staminate 16.34%
Non-staminate 70.81%

Now, utilizing the formula mentioned in the introduction and the figures given above, the average field population of larvae for June 29, 1943, at Hawk Lake may be computed; i.e.,

$$\frac{(12.86 \times 50.01) + (16.34 \times 26.06) + (70.81 \times 17.17)}{100} = 22.85$$

This gives a population of 22.85 larvae per 100 terminals as compared to 7.39 for the corresponding period in 1942 and 4.24 in 1941.

According to the budworm egg survey conducted in the fall of 1942, a seven-fold increase was predicted for the budworm in 1943. According to the larval population counts, the increase was only three-fold, the larvae apparently having suffered a considerably higher mortality than in 1942.

3. Summary

Population counts were of necessity limited to one series on June 29th. This count showed an average population of 22.8 larvae per 100 terminals. In 1941 and 1942 for the corresponding seasonal periods, larvae averaged 4.24 and 7.39 per 100 terminals respectively.

D. Larval Growth & Development

An important problem in the biology and epidemiology of the Jack pine budworm is the question of the influence of pollen on larval size, rate of growth, migration and sex ratios. Since 1938, the problem has been investigated from several angles, each of which has made some contribution towards a final solution. The latest work was undertaken in 1943, when the project was designed in such a way as to fill in the few gaps and corroborate evidence gathered in previous data. An attempt is made here to summarize the more important findings from all this work, of necessity omitting a large series of complicated tables and graphs used to analyze the data. However, where such occur, their presence and, if possible, the source have been indicated.

1. Migration of Larvae as Influenced by Pollen

The preferred site for the young developing budworm larvae has been found to be the staminate flowers and the early movement of larvae immediately after hibernation appears to be designed for the location of such sites. By this, it is not meant that terminals cannot support larvae but certainly the preferred spot is on staminate flowers. Counts of staminate flower clusters and terminals throughout the season of larval growth tend to prove this point.

(a) 1938 Data

Periodic examinations made from May 29th to July 2nd in 1938 showed that of 2,768 terminal buds examined 35.7% were infested with budworm larvae. Corresponding examinations of 446 staminate flower clusters showed that 71.4% were infested when averaged for the season, although in the early days of June, 100% contained larvae.

That a considerable amount of migration occurs is quite evident to anyone working with this insect, particularly during the early larval life. The dropping of 2nd instar larvae on webbing and blowing in the wind is particularly noticeable in a year of a heavy infestation. Records from the field show noticeable quantities floating over the entire surface of Hawk Lake, an area of several square miles. Since these movements and wind migration may be prompted by an instinctive desire to wander in search of suitable food, it is possible that such movements may have a profound effect upon the trend of the infestation, particularly in so far as the spread of the infestation is concerned. Due to the early heavy larval population in the staminate cones, it is possible that, facilitated by wind, these larvae drift in hopes of eventually coming to rest on a suitable staminate cone. That pollen is a preferred food in early life, is borne out by the abundance of cones infested and by the apparent trend to migrate from them as the season progresses and the pollen supply ceases. This trend is borne out in the 1938 counts when, from June 1st to June 17th, 217 staminate flower clusters were examined and were found to be 92.8% infested while, during the same period, 1,191 terminal buds were examined and found to be 28% infested. The further trend of these larvae as pollen disappears is shown in further counts made between June 18th and July 2nd. During this period, 207 staminate clusters showed only 30% infested while 1,455 buds were 41% infested.

Tables summarizing these data may be found in a special file on budworm growth and development under the designation "A."

(b) 1939 Data & 1940 Data

The early preference for pollen with a subsequent migration to buds later on as the pollen supply disappears led to a further approach to the subject in 1940 (1941 Annual Report, Pp. 126-131). In this work, 100 staminate cones were examined in each sample and the percentage infestation was compared to a similar number of terminal buds, as follows:

DATE	AVERAGE NUMBER OF LARVAE PER 100 SAMPLES	
	Cones	Terminals
June 3	93	18
June 10	107	10
June 20	71	12
June 26	67	15
July 3	52	16
July 8	19	18

These figures originate from the 1941 Annual Report, P. 128.

From this sampling, much the same results were obtained, a peak of staminate population occurring on June 10th, diminishing to July 8th, with a slight increase in terminal populations from June 10th to July 8th. Late counts on July 8th show relatively little difference between terminal or staminate clusters.

These preliminary observations indicate that pollen is a desired food in the early life of budworm larvae and that a considerable movement of larvae to staminate flowers occurs in the early season. As pollen shedding is completed, such locations no longer hold attraction and the young terminal growth from then on is perhaps preferred.

Thus, from preliminary records, it would appear that pollen may influence to some considerable extent the future development and vigor of the strain. The study therefore is one of growth and development as influenced by the presence or absence of pollen.

(c) 1943 Data

The foregoing results indicate that larval migration definitely occurs and that a very high percentage of the larvae is involved. However, certain weaknesses in the data such as lack of uniformity in dates of collection or too small samples to a certain extent invalidate the reliability of the conclusions. Accordingly, in 1943 counts were made of staminate cones, terminal buds on staminate trees and terminal buds on non-staminate trees at regular intervals throughout the larval season. The general picture of larval abundance throughout this period may be seen in the following tabulation wherein the populations are averaged for each four-day interval. Counts were made on June 5th, 10th, 14th, 17th, 19th 21st, 23rd, 25th, 28th, 30th, July 3rd, 5th, 7th and 10th. For each count, 50 staminate cones, 100 terminals on staminate trees and 200 terminals on non-staminate trees were examined.

TABLE 15

AVERAGE LARVAL POPULATIONS FOR PERIOD INDICATED PER 100 SAMPLES EXAMINED

PERIOD OF MONTH	STAMINATE FLOWERS	TERMINALS ON STAMINATE TREES	TERMINALS ON NON-STAMINATE TREES
June 1- 5	130 (0)	7.3 (0)	24.5 (0)
5-10	172 (0)	10.9 (0)	26.9 (.5)
10-14	228 (0)	5.5 (0)	21 (2)
14-19	191 (2)	5.8 (1.1)	11.5 (1.7)
19-23	193 (0)	8.9 (2.3)	11.7 (3.7)
23-28	95 (23)	62.3 (3.7)	9.1 (1.9)
28-J.3	60 (51)	53.0 (12.5)	12.0 (4.2)
July 3- 7	48 (55)	41.0 (31.7)	13.5 (17.1)
7-10	32 (64)	20.0 (66)	15.0 (16)

NOTE: Bracketed figures are abandoned webs.

These data of populations according to site averaged for the noted interval indicate, in what seems to be a fairly accurate way, the trends of larvae in relation to their habits of feeding. The following points will be evident:

(1) Staminate flowers harbor by far the greater part of the larval population up to June 23rd, although the numbers decrease from June 14th on. In other words, in the middle of June a gradual migration commenced away from the staminate

flowers. This was climaxed by a sudden general exodus from staminate cones between June 23rd to June 28th. Records show that this large-scale migration actually started on June 25th, at which time the peak occurrence of the 4th instar had been reached and transformation to the 5th was under way. At the termination of migration on June 28th, 5th instar larvae predominated. This whole movement from June 14th on coincided with the general disappearance of pollen from the staminate clusters.

(2) Simultaneously with the above, a slight increase occurred on the terminal growth of staminate trees on June 14th, which increase continued, reaching its greatest peak from June 23rd to 28th, the period of maximum migration away from staminate cones.

(3) Both the staminate cone population and terminal population on staminate trees continued to drop from June 28th on to pupation. This was due no doubt to larval parasitism, the tendency of budworm larvae to wander during their later days and, in many instances, to fall and blow to adjoining regions (Illustrated in nursery counts).

(4) That this movement of larvae is initiated by food preferences is further supported in comparing the above noted trends, as observed on a staminate tree, with corresponding data derived from strictly terminal trees with no staminate flowers available. On purely non-staminate trees where there was no choice whatever of food, larvae were forced to eat terminal foliage or starve. Prior to the date of migration away from staminate flowers, the number of larvae per 100 terminals was consistently higher than among terminals on staminate trees. Upon migration from staminate flowers, the terminals on staminate trees rose rapidly in population whereas no such thing happened to the terminals on non-staminate trees.

There was a noticeable decline in their numbers after the first half of June. The drop may have been due to mortality and, to some extent no doubt, to dropping from these trees. Due to the absence of staminate flowers, however, there was no apparent population to migrate to these terminals after pollen shed, as in the case of the staminate trees.

To recapitulate, it seems that, where a choice is available, staminate flowers are the marked choice in the early season but that, where no choice is available, terminal growth is selected. Movement away from staminate flowers occurs as soon as the flowers begin to lose their pollen but not all are deserted. By late June, there seems little difference in site where both food types occur on the same tree. By the end of June and early July, food has become of little concern and the dropping of 7th instar larvae and wanderings may be due to a selection of suitable pupation sites as much as or perhaps more than a selection of food.

By observing the abandoned webs, this same trend is noted. It will be further observed, however, how much greater the number of abandoned webs found in the terminals of staminate trees is as compared to the terminals of non-staminate trees. This appears perhaps to be due to the matter of population numbers for there is a marked difference in the number of larvae feeding on terminals of the staminate trees than on the non-staminate trees.

This movement of larvae seems due primarily to the influence of food, pollen or its absence. As is shown on Pages 69 & 71 of the growth study, there is a marked difference in size of staminate-fed larvae as compared to terminal-fed larvae. This difference became most apparent in 1943 in the 4th instar of both males and females. In this instar, specimens of both sexes were over 12% larger. The average date of the 4th instar of staminate-fed males was June 22nd and females, June 23rd. It will be noted in the above table that the main migration away from staminate flowers occurred between June 23rd and 28th and, at the same time, there occurred the main increase of larvae on terminals. This seems to substantiate quite well the influence of pollen on the growth of these larvae and also the relationship of migratory trends. After this date, the pollen is gone, terminal food becomes more popular and the difference in head capsule widths diminishes as between the terminal- and staminate-fed larvae.

2. Rate of Growth as Influenced by Pollen

In 1940, a series of 9 field collections of larvae from staminate cones and terminal buds was made throughout the season. Subsequently, these were microscopically examined and divided into instars. Generally speaking, there was a distinct lag in development of instars on terminal growth, when compared to staminate food. Although evident in all the data, the collections were made at too irregular intervals throughout the season to set forth a graph showing the seasonal development of instars from day to day. In all, 1,095 larvae were included in the collections made on the 9 different dates from June 3rd to July 10th. These larvae, after being segregated according to sex and instar, showed that staminate larvae, both males and females, are considerably more advanced in development than terminal-fed larvae. Third instar staminate larvae were found by June 3rd, while terminal larvae did not reach their 3rd instar until almost mid-June, at a time when staminate larvae were generally in the 4th instar (See 1941 Annual Report, P. 135, for data).

The study was repeated in 1943, care being taken to make collections of larvae at regular intervals throughout the season. Accordingly, these were made on June 5th, 10th, 14th, 17th, 19th, 21st, 23rd, 25th, 28th, 30th, July 3rd, 5th, 7th and 10th--14 in all. For analysis, 30 larvae were taken from each of the staminate and terminal collections for each date and segregated according to instars and sex. Following this, the average dates of instar occurrence were determined. By this average date is meant the figure derived by multiplying the date by the frequency at which the larval instar occurred and then dividing by the frequency, or the number of larvae.

These average dates are shown in the following table.

TABLE 16

AVERAGE DATES OF OCCURRENCE OF INSTARS ACCORDING TO FOOD & SEX (1943)

	MALE			FEMALE			ALL LARVAE		
	STAMINATE	TERMINAL	DIFFERENCE (DAYS)	STAMINATE	TERMINAL	DIFFERENCE (DAYS)	STAMINATE	TERMINAL	DIFFERENCE (DAYS)
2	Spring			Spring			Spring		
3	June 16.3	June 19.5	3.2	June 17.2	June 19.9	2.7	June 16.8	June 19.7	2.9
4	June 22.3	June 24.9	2.6	June 23.3	June 25.6	2.3	June 22.9	June 25.2	2.3
5	June 28.2	June 29.8	1.6	June 28.8	June 30.0	1.2	June 28.6	June 30.0	1.4
6	July 1	July 3.4	2.4	July 3.1	July 5.1	2.0	July 1.9	July 4.4	2.5
7	July 8	July 9.9	1.9	July 10.6	July12.2	1.6	July 9.5	July 11.3	1.8

It seems that the influence of pollen on the rate of growth is most noticeable on the 2nd instar, as thepeak occurrence of terminal-fed 3rd instar larvae was later than that of staminate-fed larvae by 3.2 days for males, 2.7 days for females and 2.9 days for all larvae. In succeeding instars, however, this difference was in all instances smaller than for the 3rd instar, indicating that beyond the 3rd instar the rate of growth was either approximately the same or slightly more rapid in terminal-fed larvae. Thus, in the 7th instar, the lag in terminal-fed larvae was reduced to 1.9 days for males, 1.6 days for females and 1.8 days for all larvae. Second instar larvae, therefore, appear to be the only stage advanced in rate of growth by pollen.

Considering next sexual differences, it will be noted that the female lags slightly behind the male throughout its larval growth and male pupation exceeds the female. It will be further noted that, despite the earlier development of male pupae, terminal-fed males are about equal to staminate-fed females. This growth difference is best visualized by a series of graphs which has been prepared but is not incorporated in this discussion.

3. Influence of Pollen on Size

(a) Mathematical Expressions of Growth

It follows from the preceding sections that pollen--its presence or absence--in the larval diet would probably have a marked influence on the size of the larvae. One of the most generally accepted methods of comparing growth rates in Arthropods is based on the assumption that growth between instars takes the form of a discontinuous geometric progression. This was found to be the case in head capsule widths of the budworm.

First, however, it is necessary to make the larval measurements and classify them into their proper instars. In the case of the budworm, it was found that, with the aid of the general appearance of the larvae and segregation as to food type and sex, the head capsule widths fell into frequency distributions which clearly indicated the presence of 7 instars, the first of which occurs in the fall and the remaining 6 in the following year. As the first spring emergents are 2nd instar larvae, this study deals only with head capsule sizes of 2nd to 7th instar larvae.

Following the proper classification of larvae into instars, the average actual widths for each instar according to food type and sex are calculated.

The final step requires the calculation of theoretical growth ratios or coefficients to make possible comparison of the influence on growth of the factors under consideration; namely, food, sex and, in 1943, parasitism.

Four methods of calculating theoretical growth rates have been used, the advantages and disadvantages of each being discussed below. For illustrative purposes, the actual mean head capsule widths of the 1943 male staminate larvae have been selected and a growth ratio worked out by each method. These actual widths are as follows:

INSTAR	HEAD CAPSULE WIDTH IN MM.
2	.261
3	.396
4	.599
5	.811
6	1.129
7	1.775

(1) Dyar's growth ratio. This was originally intended by Dyar to predict the number and size of instars of insects, provided the actual widths of the first two instars were known. In this instance, all the instars are known so Dyar's method was examined chiefly for the possibility of providing a theoretical growth rate of sufficient accuracy for comparative purposes. In our data, Dyar's growth ratio is the quotient obtained by dividing the mean head capsule width of the 3rd instar into the mean width of the second. This ratio is then divided into the actual width of the second to obtain the theoretical third, then into the theoretical third to obtain the theoretical fourth, and so on. The use of Dyar's method gave the poorest fit of all between the observed and calculated widths.

Example of Dyar's growth ratio:-

Given: Head capsule width of 2nd instar = .261 mm.
Head capsule width of 3rd instar = .396 mm.

Then divide 2nd instar width by the 3rd instar width or

$$\frac{.261}{.396} = \underline{\underline{.659}}$$

The quotient, .659, is Dyar's growth ratio. The following tabulation shows how it is used to calculate theoretical head capsule widths for all instars and compares them with the observed widths.

INSTAR	METHOD		THEORETICAL WIDTHS (MM.)	OBSERVED WIDTHS (MM.)
2	Theoretical width same as observed	=	.261	.261
3	Divide .261 by the ratio .659	=	.396	.396
4	Divide .396 by the ratio .659	=	.601	.599
5	Divide .601 by the ratio .659	=	.912	.811
6	Divide .912 by the ratio .659	=	1.384	1.129
7	Divide 1.384 by the ratio .659	=	2.100	1.775

(ii) Average growth coefficient. This is an adaptation of Dyar's law whereby a growth ratio is calculated as above but between each instar from the 2nd to the 7th, then all the growth ratios are totalled and averaged. This method is almost as accurate as linear regression, the most accurate of all.

Example of average growth coefficient:-

Given: Head capsule widths of all instars; i.e., 2nd = .261, 3rd = .396, 4th = .599, 5th = .811, 6th = 1.129, 7th = 1.775. Then, using the same method as Dyar, determine a ratio between each instar.

Between 2nd & 3rd ratio is $\frac{.261}{.396} = .659$

Between 3rd and 4th ratio is $\frac{.396}{.599} = .661$

Continue this process until ratios have been worked out between all the instars. Add all the ratios together and divide by 5 to get a mean ratio. For this example, this is $\frac{3.412}{5} = .682$

Now, this average growth ratio, .682, is used in exactly the same way as Dyar's ratio for calculating theoretical head capsule widths. Using this average growth ratio, the theoretical head capsule widths compare with the actual widths as follows:

INSTAR	THEORETICAL WIDTHS	ACTUAL WIDTHS
2	.261	.261
3	.383	.396
4	.562	.599
5	.824	.811
6	1.208	1.129
7	1.771	1.775

(iii) Linear regression: This is one of the most valuable and commonly used techniques in statistical work. Essentially, by this method a theoretical growth rate is calculated such that the sum of the squares of the deviations from the observed values is a minimum. It requires more calculation than any of the other methods but has the advantage of being the most accurate.

The regression coefficient expresses the increase or decrease in the dependent variable (head capsule width) for one unit of increase in the independent variable (instars). From the regression coefficient can be set up a regression equation which can be used to make predictions and also defines a straight line known as the regression line. The actual head capsule widths when plotted against instars form a curve but, by transposing actual values into logarithms, they become a straight line. It is therefore necessary to use log values in computing the regression coefficient, transposing the final calculated head capsules back into ordinary numbers.

The regression equation is: $y = a + bx$
where
- y is the calculated head capsule width,
- a is a constant calculated from the data,
- b is the regression coefficient, and
- x is the instar for which the theoretical head capsule width is required.

Following is the procedure for determining the regression coefficient and solving the equation.

ACTUAL WIDTHS IN WHOLE UNITS (NOT MM.) y variates	LOG OF y	INSTARS x variates
261	2.41664	2
396	2.59770	3
599	2.77743	4
811	2.90902	5
1129	3.05270	6
1775	3.24919	7

List x and y variates as follows:

x	2	3	4	5	6	7
Log y	2.41664	2.59770	2.77743	2.90902	3.05270	3.24919

$T_x = 2 + 3 \ldots\ldots\ldots + 7 = 27$ $T_y = 2.41664 + 2.59770 \ldots\ldots + 3.24919 = 17.00268$

Proceed as follows:

$\Sigma xy = (2x2.41664) + (3x2.59770) \ldots\ldots\ldots + (7x3.24919) = 79.34173$

$T_xT_y/N = 27x79.34173/6 = 76.51206$

$\text{Difference} = \Sigma(y-\bar{y})(x-\bar{x}) = 2.82967$

$\Sigma x^2 = 2^2 + 3^2 \ldots\ldots\ldots\ldots + 7^2 = 139$

$Tx^2/N = 27^2/6 = 121.5$

$\text{Difference} = \Sigma(x-\bar{x})^2 = 17.5$

b_{yx} = regression coefficient = 2.82967/17.5 = .1617

$\bar{x} = T_x/N = 27/6 = 4.5$

$\bar{y} = T_y/N = 17.00268/6 = 2.83376$

$a = \bar{y}-b\bar{x} = 2.83376 - (.1617x4.5) = 2.10611$

Now calculate the log of thehead capsule width of each instar by the formula

$$\text{Log } y = a + bx$$

INSTAR	CALCULATIONS	CALCULATED LOG OF WIDTH	CALCULATED WIDTH IN ORIGINAL NO.
2	Log y = 2.1061 + (.1617x2)=	2.4295	.269
3	Log y = 2.1061 + (.1617x3)=	2.5912	.390
4	Log y = 2.1061 + (.1617x4)=	2.7529	.566
5	Log y = 2.1061 + (.1617x5)=	2.9146	.821
6	Log y = 2.1061 + (.1617x6)=	3.0763	1.192
7	Log y = 2.1061 + (.1617x7)=	3.2380	1.730

The calculated and actual head capsule widths are compared below:

INSTAR	CALCULATED	ACTUAL
2	.269	.261
3	.390	.396
4	.566	.599
5	.821	.811
6	1.192	1.129
7	1.730	1.775

(iv) Logarithms. Here the geometric growth rate is computed by means of logarithms, using actual widths for the 2nd and 7th instars. The growth ratio obtained is almost identical to the average growth coefficient of (ii) preceding.

Briefly, it is calculated as follows:

(1) Change actual average widths of the 2nd and 7th instars into logarithms.
(2) Subtract log of 2nd from log of 7th.
(3) Divide the answer by 5.
(4) Change quotient back into a whole number. This will be the growth coefficient. To obtain the calculated head capsule widths, multiply the average width of the 2nd instar by the coefficient to give the calculated 3rd and multiply this by the coefficient to obtain the calculated 4th, etc.

Example:-

Given: The actual average head capsule width of the 2nd and 7th instars (.261 mm. and 1.775 mm.).

Transpose actual widths with the decimal removed into logarithms.

Log 261 = 2.41664
Log 1775 = 3.24919

Subtract log of 2nd from log of 7th.

3.24919 - 2.41664 = .83255

Divide .83255 by 5 = .16651

Convert .16651 back into a whole number = 1.4672

This number, 1.4672, is the growth coefficient.

The calculated head capsule widths are determined as follows:

INSTAR	CALCULATIONS		CALCULATED WIDTH	ACTUAL WIDTH
2	Same as actual	=	.261	.261
3	.261 x 1.4672	=	.383	.396
4	.383 x 1.4672	=	.562	.599
5	.562 x 1.4672	=	.824	.811
6	.824 x 1.4672	=	1.209	1.129
7	1.209 x 1.4672	=	1.774	1.775

These results are equally as accurate as the average growth coefficient. The following table shows the standard error of the estimate of these four methods applied to four sets of data.

TABLE 17

STANDARD ERROR OF GROWTH RATES BASED ON DIFFERENT METHODS

SET OF DATA	STANDARD ERROR IN MM.			
	Dyar's Law	Average Coefficient	Logarithms	Linear Regression
1	.204	.052	.050	.050
2	.239	.027	.029	.022
3	.147	.031	.032	.028
4	.062	.042	.043	.040

For the above, see designation "G" in special budworm file.

The use of logarithms accomplishes exactly the same end as Dyar's law in (1), with the following advantages:

It is much more accurate, as noted in the above table, and would seem to be superior when used in predicting the number and average size of instars.

Since widths of the first and last instars are required, instead of the first two, as in Dyar's method, the work of sexing the larger larvae and measuring is greatly simplified.

Dyar's law assumes a uniform rate of growth in all instars, which is definitely not the case in the budworm. The logarithm method, on the other hand, averages the rate of growth from the 2nd instar to the 7th, taking into consideration all the factors that influence growth in between.

(b) Factors Influencing Growth of Budworm Larvae

In the following pages, the influence of diet is considered as reflected by larval growth measured in terms of head capsule size. Data were procured in two years, on 1,095 larvae in 1940 and 1,171 larvae in 1943. In both instances, field collections of larvae were made at regular intervals throughout the season from staminate cones and terminal buds. The data procured commence with the first spring emergents, which represent the second instar.

In the following, the head capsule measurements have been made from larvae of known instars. No growth ratio was used in segregating instars as suggested through Dyar's law. However, for comparative purposes, the theoretical growth rates were calculated according to the method of average growth coefficients outlined in section (a)(ii), P. 63.

Measurements of head capsule widths for each instar are set forth in the following table, the figures shown being the mean for the instar.

TABLE 18

MEAN HEAD CAPSULE MEASUREMENTS OF MALE & FEMALE LARVAE SEGREGATED BY FOOD TYPES

	S T A M I N A T E						T E R M I N A L					
	MALE			FEMALE			MALE			FEMALE		
	Mean	Ratio	Diff.	Mean	Ratio	Diff.	Mean	Ratio	Diff.	Mean	Ratio	Diff.
						1940						
2	.268			.270			.265			.262		
3	.388	.691		.391	.690		.362	.732		.372	.704	
4	.603	.643		.594	.658		.543	.666		.530	.702	
5	.934	.645		.858	.692		.818	.664		.805	.658	
6	1.219	.766		1.316	.652		1.156	.707		1.239	.650	
7	1.778	.686		2.051	.642		1.776	.651		1.977	.627	
MEAN	.865	.686		.913	.667		.820	.684		.864	.668	
						1943						
2	.261			.265			.262			.261		
3	.396	.659		.392	.676		.377	.695		.366	.713	
4	.599	.661	.002	.590	.664	.012	.542	.695	0.000	.532	.688	.025
5	.811	.738	.077	.870	.678	.014	.802	.676	.019	.807	.659	.029
6	1.129	.718	.020	1.340	.649	.029	1.119	.717	.041	1.286	.527	.132
7	1.775	.636	.082	2.016	.664	.015	1.786	.626	.091	1.989	.646	.119
MEAN		.6824	.452		.6662	.017		.6818	.377		.6466	.762

The above tabulations, based on two years' larval collections and calculated by two independent sources, give a rather interesting account of head capsule development. Firstly, attention should be directed to the mean growth ratio. Despite the marked variations of ratio that occur between individual instars, there is an interesting similarity in the mean ratios of the same sex, regardless of food. These mean ratios are:

	1940	1943
Male staminate-fed	.686	.682
Male terminal-fed	.684	.682
Female staminate-fed	.667	.666
Female terminal-fed	.668	.650

It seems evident that the mean ratio for a given sex is much the same regardless of whether or not pollen was available but that these ratios are not the same for each sex. It will be further evident how great the variation is between some of the more extreme ratios calculated for individual instars and these means. The significance of this is further testified by the fact that the measurements were made by individuals independent of one another and in two different years.

One other point in this regard is seen in the comparison of the relative sizes of 7th instar larvae. It will be observed that the male is invariably smaller than the female, with staminate-fed individuals showing a slight advantage over the terminal-fed ones, thus:

	1940	1943
Male staminate-fed	1.778	1.775
Male terminal-fed	1.776	1.786
Female staminate-fed	2.051	2.016
Female terminal-fed	1.977	1.989

Thus far, it would appear that sex and not food is a factor of most importance in relation to growth ratios, that sex likewise is of more importance than food in so far as total development is concerned but that the presence of pollen does influence to a small degree the size of individuals of the same sex.

The variation in growth ratios between individual instars does suggest that development is not particularly uniform as the larval development progresses. Through an examination of these instar sizes, some evidence may be obtained of variations between instars.

In the following tabulation, the percentage difference in size between the staminate- and terminal-fed larvae is set forth, the figures being derived from the tabulation on P. 69. It should be remembered that the percentage refers to the degree by which the staminate larvae exceed the terminal-fed individuals.

TABLE 19

PERCENTAGE INCREASE IN SIZE OF HEAD CAPSULES OF STAMINATE- AS COMPARED TO TERMINAL-FED LARVAE

INSTAR	MALES		FEMALES	
	1940	1943	1940	1943
2	1.1	0.0	3.1	1.532
3	7.2	5.039	5.1	7.103
4	11.0	10.516	12.1	10.902
5	14.2	1.122	6.6	7.806
6	5.4	.893	6.2	4.199
7	0.1	.616	3.7	1.357
MEAN	5.4	3.637	5.6	5.483

It will be observed that an increase in the mean head capsule width occurred in every instar (except the 2nd, males, 1943) and that the same general trend was common in all, namely that the most appreciable difference occurred in the 4th and, in one instance, the 5th instar. It seems that pollen as an influencing factor in instar development becomes most noticeable in the 4th instar. In general, it would seem that growth of larvae on staminate cones is larger while pollen is available, as the maximum difference in size between staminate- and terminal-fed larvae was reached prior to migration of larvae from staminate cones. After migration from cones has taken place, the individual instar growth ratios of terminal-fed larvae become larger. Both males and females on cones disclosed a notable decrease in growth ratio between the 4th and 5th instar, the period of migration. This was most conspicuous in the males. It appears that the influence of pollen both on size and rate of growth is most effective in the early instars. However, this influence is apparently not cumulative or permanent, but rather disappears with the exhaustion of the pollen supply. On the other hand, physiological reactions such as fecundity, fertility, vigour, etc. may be permanently changed by diet, a question which remains to be settled.

4. Sex Ratios in Relation to Pollen & Migration

Analysis of the 1943 data shows no apparent correlation between sex ratios of larvae sampled on different dates and taken from different foods. Further, there is no indication of a correlation between sex ratios of instars and food. The only point of significance is an increase in the sex ratio of the 5th instar of terminal- and staminate-fed larvae as noted in the tabulation below. This was followed by a decrease in the 6th instar. This may be due to some male larvae transforming directly from the 4th into the penultimate instar. In the data, these are classified as 6th instar larvae. If this actually occurs, many of the males would not appear in 5th instar sex ratio. Hence, the excess of males over females.

TABLE 20
SEX RATIOS ACCORDING TO INSTARS

INSTAR	STAMINATE-FED			TERMINAL-FED			ALL LARVAE		
	♂	♀	S.R.	♂	♀	S.R.	♂	♀	S.R.
2	23	38	.623	45	43	.489	68	81	.544
3	38	50	.568	33	49	.598	71	99	.582
4	38	42	.525	27	32	.542	65	74	.532
5	13	43	.768	21	35	.625	34	78	.696
6	25	40	.615	36	36	.500	61	76	.555
7	42	49	.538	27	55	.671	69	104	.601
PUPAE	35	34	.493	26	24	.480	61	58	.487

5. Larval Parasitism

In the course of dissections for sex determinations on 1943 larvae, the incidence of larval parasitism was recorded according to the presence or otherwise of the parasitic larva. The following table sets for the percentage of larvae parasitized according to instars.

TABLE 21
PERCENTAGE OF LARVAE PARASITIZED ACCORDING TO INSTARS

INSTAR	TOTAL LARVAE DISSECTED	TOTAL LARVAE PARASITIZED	PERCENTAGE LARVAL PARASITISM
2	159	11	6.92
3	202	22	10.89
4	190	51	26.84
5	195	80	41.02
6	141	4	2.84
7	172	1	0.58

This progression of percentage parasitism seems to indicate an increase in oviposition by the parasites up to the 5th instar. If this increase in percentage parasitism occurs, the question that arises is: What is the duration of the parasite larval life. Apparently, most parasitized larvae die in their 5th instar, as indicated by the preceding table and as seen in the field. If parasitism is not accomplished for the most part at the same period of the year, why does the host's death occur at one given time? If it is accomplished at one set portion of the summer, the completion of the parasite's larval growth and death of the host would be fairly uniform, as indicated in the preceding table. If so, why is not the percentage of parasitized larvae more uniform? Why the progression of 6.9%, 10.9%, 26.8%, 41.0%, 2.8%, 0.6% parasitism according to the instars, 2, 3, 4 and 5? It may be that early parasitized larvae die in the early stages of the 5th instar, while late parasitized larvae have a prolonged duration of the 5th.

It appears that parasitized larvae lag behind the unparasitized individuals in their development. This is most pronounced in the 5th instar. Parasitized larvae in each instar were not procured in sufficient abundance to permit a complete analysis in their comparative developmental rates, but some detailed consideration of 5th instar larvae serves to illustrate this lag in development. The following table sets forth the percentage of larvae that was in the 5th instar on the various dates given:

TABLE 22

PERCENTAGE LARVAE IN 5TH INSTAR ON DATES INDICATED

DATE	STAMINATE	TERMINAL	PARASITIZED
June 23	6%	0%	11%
25	36	10	6
28	66	63	50
30	47	67	53
July 3	27	30	95
5	3	17	100
7	0	0	66
10	0	0	71

Beyond the 5th instar, parasitized larvae practically disappeared, there being only 5 individuals found among 315 larvae dissected in instars 6 and 7.

It will be observed in the preceding tabulation how parasitized 5th instar larvae extend on to June 10th whereas non-parasitized ones had all completed their 5th instar by July 5th.

To give a more complete picture of the development of non-parasitized larvae beyond the 5th instar, the following table sets forth the percentage of larvae in various instars for the dates indicated.

TABLE 23

PERCENTAGE OF LARVAE OF EACH TYPE (STAMINATE, TERMINAL & PARASITIZED) OCCURRING IN THE 5TH, 6TH & 7TH INSTARS ON THE DATES INDICATED

DATE	5TH INSTAR			6TH INSTAR			7TH INSTAR		
	S	T	P	S	T	P	S	T	P
June 23	6	--	11	7	--	--	--	--	--
25	36	10	6	7	--	--	--	--	--
28	66	63	50	30	17	--	--	--	--
30	47	67	53	43	13	--	--	--	--
July 3	27	30	95	66	63	--	--	3	--
5	3	17	100	50	73	--	47	10	--
7	--	--	66	10	63	25	90	37	--
10	--	--	71	3	10	14	90	90	14
13	--	--	--	--	--	--	46	93	--
16	--	--	--	--	--	--	23	33	--
19	--	--	--	--	--	--	7	7	--

NOTE: S = staminate
T = terminal
P = parasitized

The absence of parasitized larvae after the 5th instar is especially significant. The lag in development of parasitized larvae in the 5th instar is also noticeable. For example, on July 5th 100% of the parasitized larvae (25 in number) were in their 5th instar while both staminate and terminal larvae were well advanced into their 6th and 7th instars. The appearance of parasitized larvae in the 6th and 7th instars was recorded only rarely and tends to indicate that some parasitized larvae do occasionally carry over to the 6th and 7th instars.

In view of this lag in development, it is interesting to observe the reflection of larval parasitism on head capsule development. The following table sets forth the mean head capsule width of normal and parasitized larvae of staminate- and terminal-fed individuals. The difference in mean size between the normal and parasitized larvae is shown in a percentage.

TABLE 24

MEAN HEAD CAPSULE MEASUREMENTS & PERCENTAGE DIFFERENCE OF NORMAL AND PARASITIZED BUDWORM LARVAE

INSTAR	STAMINATE-FED			TERMINAL-FED			ALL LARVAE (MEAN)		
	Normal	Parasitized	% Difference	Normal	Parasitized	% Difference	Normal	Parasitized	% Difference
2	.263	(9) .259	1.54	.262	(3) .268		.262	.263	
3	.394	(10) .386	2.07	.372	(13) .360	3.22	.383	.371*	3.23
4	.594	(26) .562	5.69	.537	(23) .498	7.63	.566	.531*	4.70
5	.840	(47) .747	12.45	.804	(33) .731	9.08	.822	.740*	11.08

* Weighted averages.

NOTE:
Bracketed figures represent number of measurements.

These percentages are calculated on the parasitized larvae measurements; i.e., the percentages show how much larger the normal larva is than the parasitized. This is for the sake of uniformity to be compared with previous growth rate percentages of staminate- and terminal-fed larvae.

It was previously shown how staminate larvae exceed terminal ones in mean head capsule width.

The preceding table indicates something of the disturbing factors that enter into the matter of head capsule determinations from random selections of field larvae. Several points are of interest.

The mean head capsule width is very much influenced by parasitism, especially in the 5th instar, where a difference of as much as 12% occurs in the staminate-fed individuals, 9% for terminal-fed, or an average of 11% for field run larvae. This difference is much less significant in the smaller instars and it is felt that in the 2nd the difference noted is due chiefly to sampline and field variations in size. Actually, too small numbers of parasitized larvae are available in the 2nd instar to make for accuracy.

The importance of this variation is, however, found in the 5th instar and also the 4th, but to a lesser degree, which indicates something of the nature of parasitism as a factor in upsetting any smooth geometric progression in head capsule growth from field run larvae.

There are, accordingly, three distinct factors that may influence uniformity in head capsule growth within an instar. These are sex, food (terminal or staminate), and parasitism. To summarize these differences, the male appears to be generally greater in size than thefemale up to the 5th instar, after which the female exceeds the male, with a mean growth ratio of the female in excess of the mean growth ratio of the male. The staminate-fed individuals as compared to the terminal-fed larvae of the same sex are generally larger up to the 4th or 5th instar, but the mean growth ratio is fairly uniform. Parasitism results in a reduced head capsule mean measurement in instars 3, 4 and 5. The culmination of these disturbing factors markedly influences the matter of an even progression of growth from one instar to the next. The influence of this when considering miscellaneous field run larvae, disregarding sex, food and parasitism, is most striking when comparing those of greatest growth (normal staminate-fed larvae) with the most retarded (parasitized terminal-fed larvae). This difference is shown below for the 3rd, 4th and 5th instars, where such differences are most pronounced.

PERCENTAGE DIFFERENCE BETWEEN THE LARGEST (NORMAL STAMINATE-FED) AND THE SMALLEST (PARASITIZED TERMINAL-FED) LARVAE, DISREGARDING SEX

Instar	% Difference
3	9.44
4	19.277
5	14.911

A point of interest in regard to larval parasitism is that not one of the parasitized larvae contained gonads. However, it is not possible to say definitely that all parasitized larvae are females because positive identification of that sex is more difficult.

6. General Summary

(a) Migration

The preferred site for young developing larvae was found to be the staminate flowers. Upon the exhaustion of the pollen supply, usually when larvae are in the 4th and 5th instars, they migrate to terminal growth. This statement is supported by evidence procured at Hawk Lake in 1938, 1940 and 1943.

(b) Rate of Growth

The rate of growth as influenced by pollen is most noticeable in the second instar, there being a lag of 2.9 days for the average date of occurrence of 3rd instar terminal-fed larvae (1943 data). Beyond the 2nd instar, the rate of growth is approximately the same, regardless of food type. The female, whether on terminals or staminate cones, lags slightly behind the male throughout its larval growth. This lag becomes most conspicuous in the 6th and 7th instars. The more rapidly developing staminate females are about the same as terminal males in reaching pupation.

(c) Size as influenced by Food and Sex

(1) Mathematical expressions of growth. Measurements on a large series of budworm larvae in 1940 and 1943 by different investigators show an amazing degree of uniformity. This would seem to indicate a constant rate of growth in the budworm, the limits of which could be defined mathematically.

By measuring head capsule widths and segregating them according to sex, food type and parasitism, the measurements fall into frequency distributions which show the presence of 7 larval instars.

Four mathematical methods to determine the growth rate of the budworm have been tested. These are: (a) Dyar's Law, (b) the average growth coefficient, a modification of Dyar's Law, (c) logarithmic geometric growth rate and (d) linear regression. The last was the most accurate, followed closely by the average growth coefficient and the logarithm growth rate. Dyar's Law was relatively inaccurate in predicting theoretical head capsule widths. In this study, the average growth coefficient has generally been used.

Dyar's Law applied to all instars shows that a variation in growth ratios occurs between instars even of the same sex, fed on the same diet, and that no one ratio derived from two consecutive instars will give a true standard ratio for all instars.

(ii) Size relations reflected in head capsule measurements. A marked uniformity occurred between the mean ratio for both 1940 and 1943 data, this mean being different for each sex but apparently uninfluenced by food (i.e., males--.68, females--.66).

Larval growth is shown to be influenced by sex, parasitism and food.

Comparing individual instars with one another, the presence of staminate food does show its influence in all instars, but is most pronounced in the 4th and 5th instars. This diet effect is apparent in both sexes. In the mid instars, head capsule size appears to be from 10% to 14% larger in staminate larvae, this difference dropping to an unappreciable amount following migration from staminate flowers. In the final instar, the average widths, regardless of food, are practically the same, as is the average growth ratio for all instars.

From the standpoint of completed size and mean growth ratios, sex appears to be of greater significance than food type. In the early instars, males averaged larger than females but, in the later instars, female head capsules averaged considerably larger. The average growth rate for females (all instars) is also significantly larger than for males.

The influence of parasitism on size is discussed under (e) below.

(d) Sex Ratios in relation to Pollen and Migration

Analysis of the 1943 data shows no apparent correlation between sex ratios of dates of sampling and food or between sex ratios of instar and food. Fluctuations in the ratio of the 4th, 5th and 6th instars are such as to indicate the possible transformation of some 4th instar males directly into the penultimate instar.

(e) Larval Parasitism (1943 data)

Parasitism results in a reduced head capsule mean measurement in instars 3, 4 and 5, the difference reaching its maximum in the 5th instar where, considering all larvae, the normal are 11% larger than the parasitized.

Most parasitized larvae succumb in the 5th instar, only a few surviving to the 6th and 7th instars.

Parasitism produces a lag in rate of development which is most evident in the 5th instar. On July 5, 1943, 93% of the normal staminate larvae and 83% of the normal terminal larvae were in the 6th and 7th instars, whereas 100% of the parasitized larvae were still in the 5th.

Incidence of larval parasitism showed a progressive increase throughout the season to a maximum of 41% in the 5th instar.

Parasitic larvae began to emerge from the host on July 5th.

No parasitized larvae contained male gonads, although they could not be positively identified as females.

7. Some General Considerations & Problems

This study shows that the head capsule size of budworm larvae is influenced by sex, food and parasitism. Therefore, any attempt to segregate field run larvae into instars by measurements or efforts to formulate mathematical expressions of growth <u>must</u> take these factors into consideration.

Further work could be done in applying the statistical "t" test to determine where significant differences occur in each instar for male and female larvae fed on pollen or terminal buds.

It might be less confusing if, instead of working out the average growth ratio by dividing the succeeding into the preceding instar, the reverse procedure were followed. In its present form, the magnitude of the ratio is inversely proportional to the rate of growth, whereas, with the reverse procedure, it would be directly proportional. It would also have greater similarity to ratios calculated by logarithms or linear regression.

There is evidence that some male larvae (both staminate- and terminal-fed) may skip the 5th instar, changing directly from the 4th to the penultimate instar. This evidence is indicated in (1) the simultaneous appearance of 5th and 6th instar staminate males in the field, (2) the occurrence of 2 peaks in the frequency distribution of 6th instar males on the two food types, and (3) an increase in the sex ratio of the 5th instar, preceded and succeeded by lower ratios in the 4th and 6th.

The series of measurements taken in 1940 and 1943 show such close agreement it appears that there may be a constant size and rate of growth in the budworm, regardless of the year under consideration. If that is the case, fiducial limits, taking into account sex and food, could be determined within which in all probability the true values of budworm growth fall.

Controlled studies by F.B. Rabkin definitely show the presence of 7 instars, the range of the head widths corresponding very closely to segregated widths of field run larvae.

The conclusions and observations contained herein are derived chiefly from a large series of tables, graphs and summaries. Some of these appear in the Annual Report while others are retained in a special file on budworm growth and development. As an aid to future reference to this work, the following lists of source material have been prepared.

TABLES AND SUMMARIES NOT APPEARING IN ANNUAL REPORTS

Table designations given in the left hand margin correspond with those appearing in red crayon on the tables.

1938 data:

A Complete list of counts made on terminals and staminate cones at Willard Lake in 1938.

1939-1940 data:

B Complete series of tables showing mean head capsule widths and growth ratios on all instars for material reared in 1939 and 1940 and field samples collected in 1940. Some discussion is also included. Reference is made to the 1940-41 Annual Report, Pp. 242, 252 and 256, and Table 15.

C A review of the above data by H.A. Richmond.

D Frequency tables of male and female terminal-fed larvae for the 1940 collections from Hawk Lake.

E Graphs showing these frequency distributions segregated and combined as to sex and food.

F A complete list of all actual head capsule widths of the 1940 larvae transposed into logarithms.

G A discussion by R.R. Lejeune on the use of logs to calculate growth rates.

1943 data:

H 2 sets of tables showing original measurements of the 1943 collections, one for terminal-fed and one staminate-fed. These include parasitized larvae.

I A table of class limits and mid-points based on logs prepared for frequency distribution of the above larvae.

J Three sets of tables showing frequency distributions of these larvae.

K Table showing occurrence of instars and sexes according to food types and date. An accompanying table gives the same data with the two sexes combined.

L Graph illustrating the distribution of instars as listed in the preceding paragraph.

M A series of tables accompanied by graphs in which the average dates of occurrence of staminate males and females, terminal males and females, all staminate larvae and all terminal larvae are calculated.

N A summary of larval counts for migration.

O A series of tables on head capsules giving (a) average, minimum and maximum head capsule widths, (b) difference in widths between terminal- and staminate-fed, (c) standard deviations of mean head capsule widths,

(d) comparison of parasitized larval widths with normal larvae and (e) a list of various growth ratios calculated from the data.

P A table and graph comparing growth ratios between instars.

Q A tabulation of sex ratios according to (a) dates and (b) instars, both segregated according to food type.

REFERENCES TO LARVAL GROWTH AND DEVELOPMENT IN THE ANNUAL REPORTS

E. Permanent Sample Plots

Sixteen permanent sample plots (Jack pine) were examined in the fall of 1943, 6 at Hawk Lake, 6 at Willard Lake and 4 at Raven Lake. The object was to record death and defoliation of trees resulting from budworm activity in 1943 and preceding years. In the Hawk Lake area, which includes Willard Lake, only sample plots containing tagged trees were examined. Regeneration in these plots, the purely regeneration plots, and untagged second growth Jack pine plots were omitted. The inspection of the permanent sample plots in the Sandilands Forest Reserve was of necessity postponed until the spring of 1944.

Information recorded includes mortality, total and current defoliation and condition of trees. A summary of the average total and current defoliation per plot, trees dying in 1943 and total number of dead trees appears on the following page. Defoliation is given in sixteenths, the average defoliation being based only on live Jack pine. Again, only Jack pine are recorded in the two dead trees columns. In the "Total dead trees" column, all dead Jack pine are included, whether they died prior to or after the establishment of the plot.

PLOT NO.	AREA	AVERAGE TOTAL DEF.	AVERAGE CURRENT DEFOLIATION	TREES DYING IN 1943	TOTAL DEAD TREES
1	Hawk L.	2.67	2.61	0	0
4	Hawk L.	4.49	3.49	0	7
6	Hawk L.	2.62	0.73	1	13
8	Hawk L.	3.01	1.10	5	63
9	Hawk L.	3.12	1.44	0	52
11	Hawk L.	3.04	0.77	1	24
1	Willard L.	2.93	0.76	0	21
3	Willard L.	3.68	0.94	0	32
4	Willard L.	1.36	0.11	2	17
5	Willard L.	2.29	0.39	0	9
6	Willard L.	2.93	0.10	0	75
7	Willard L.	4.35	1.74	0	84
1	Raven L.	1.26	0.00	0	17
2	Raven L.	1.77	0.00	4	39
3	Raven L.	1.28	0.00	1	46
4	Raven L.	1.61	0.00	1	18

F. Host Transfer Study

Investigations on this phase were continued in 1943 with the setting up of several new series of transfers. Other work originally started in 1942 was continued and completed in 1943 (See 1942 Annual Report, Pp. 62-71).

The 1942 study consisted of 8 cages of larvae transferred and reared as follows:

Budworm Strain	Transferred to:	Larvae Transferred
Spruce	White spruce	79
Spruce	Jack pine staminate cones	77
Spruce	Jack pine terminals	80
Spruce	Tamarack	76
Jack pine	Jack pine terminals	80
Jack pine	White spruce	80
Jack pine	Tamarack	80

Transferred larvae were reared through on living host material to the moth stage. Moths were then caged for oviposition on small seedlings of the same host on which larvae were reared, and progeny permitted to overwinter on the seedlings. Any larvae overwintered successfully were reared through in 1943 on the same host and the moths again caged for oviposition and overwintering of the young larvae. Thus, in successful transfers, 2 generations have been reared on the new host to the end of 1943.

The seedlings on which material reared through in 1942 was caged were examined in the spring of 1943 for egg clusters and larval emergence. The following tabulation summarizes the results obtained from efforts to overwinter the larvae.

RESULTS OF OVERWINTERED HOST TRANSFERS 1942-43

BUDWORM STRAIN	HOST	EGG CLUSTERS FALL OF 1942	LARVAE IN 1943	SEE NOTE BELOW TABLE
Spruce	Jack pine stam. cones	0	0	1
Spruce	Jack pine terminals	2	0	1
Spruce	White spruce	?	36	2
Spruce	Tamarack	?	4	3
Jack pine	White spruce	1	10/	4
Jack pine	Jack pine	?	Many	5
Jack pine	Tamarack	0	0	6

Note:

1. Apparently spruce budworm moths reared on Jack pine were capable of some oviposition. However, no larvae were recovered in 1943 for two probable reasons; first, the terminal buds on the seedling were all chewed off during the winter and, secondly, surviving larvae probably emerged long before the unexpanded terminals were suitable for food.

2. On the normal host of the budworm, 36 larvae were recovered in 1943. Of these, 28 were reared to moths, which were again caged on a seedling.

3. Spruce budworm larvae were reared on tamarack but the moths caged on spruce, as tamarack needles are deciduous. Due to unfavourable conditions in the cage, the spruce seedling did not overwinter well, with the result that only 4 larvae survived.

4. Of this transfer, approximately 20 larvae survived and became established in terminal buds in the spring of 1943. Ten of these were removed from the seedling and reared individually in jelly jars, 4 larvae maturing to the moth stage. The other larvae were left on the seedling for rearing. Two pair of male and female moths were finally available for oviposition. These deposited 6 egg clusters which were caged on the same white spruce seedling for overwintering. It is interesting to note that the young emergents in the spring did not mine the old needles, as is the habit of the spruce budworm, but apparently occupied the terminal buds immediately. The later emergence of the Jack pine budworm at a time when the terminals are suitable for habitation by the young larvae may be responsible.

5. Many larvae emerged from this cage in the spring of 1943. These were transferred to a more vigorous branch of Jack pine but, unfortunately, the rearing and emergence records on this particular cage were not continued.

6. Only one male moth completed development in 1942; hence no progeny were produced.

A more ambitious program of larval transfers was undertaken in 1943. Larvae of both the spruce and Jack pine budworm were reared on white spruce, black spruce, balsam and Jack pine. Replicate cages were used for the transfer of each budworm strain to each host, with 50 larvae per cage. Fine 60-mesh to the inch bronze screen cages were again employed and larvae reared on live branches to the pupal stage.

At that time, the cages were brought into the insectary and rearing completed. As pupae formed, they were sexed, the length and width measured and they were confined in glass vials for emergence of moths. Five male and female moths were confined in screen oviposition cages on live branches, the resulting egg clusters counted and placed in bronze screen incubation "vials." These "vials" were suspended for overwintering on seedlings of the same species as those on which the larvae were reared. The seedlings were covered with unbleached cotton until incubation was over and, in the early spring of 1944, they will be recovered before the larval emergents appear.

To prevent confusion, a system of nomenclature was devised to identify the various transfers and generations. The following designations were adopted:

G_0 - generation; G_1 - 1st generation; G_2 - 2nd generation.
Sw - white spruce
Sb - black spruce
Pj - Jack pine
Ab - balsam

Examples of the use of this system follow:

Sw - Pj --- Transfer of larvae from white spruce to Jack pine. The first host indicated is the original from which the larvae were taken.

Sw - Pj 1942 G_0 --- Larvae were transferred from white spruce to Jack pine in 1942.

Sw - Pj 1942 G_1 --- The first generation that has been produced from these 1942 transfers. The year 1942 always appears, showing when the original transfer was made. Obviously, G_1 must have occurred in 1943 and G_2 in 1944, but it is the 1942 transfer date that should show beside the transfer symbols.

Individual cages were recorded by number; i.e., 1,2, 3 etc. and so mentioned in the record books. On each cage, however, there was a tag indicating what it was (Sw-Pj 1943 G_0) etc. Each cage was recorded in a separate record book. Oviposition cages and overwintering cages also received number and content designations.

Although sufficient time was not available for a complete analysis of the 1943 G_0 transfers, it has been possible to summarize some of the data in a general way. The two tables which follow are a condensation of the rearing data for the spruce and Jack pine budworm transfers.

TABLE 25
JACK PINE BUDWORM TRANSFERS

DETAIL OF TRANSFERS	CAGE NUMBERS								
	16	20	21	22	23	24	25	26	27
Transferred to:	Sw	Sw	Sw	Sb	Sb	Ab	Ab	Pj	Pj
Source of larvae	Hawk L.	Hawk L.	Hawk L.	Hawk L.	Hawk L.	Hawk L.	Hawk L.	Hawk L.	Hawk L.
Date of transfer	June 7	June 15	June 15	June 16	June 16	June 18	June 18	June 18	June 18
Instar when transferred	2nd	3rd	3rd	3rd	3rd	3rd	3rd	3rd	3rd
No. of larvae transferred	50	50	50	50	50	50	50	50	50
Pupae obtained:									
Male	12	12	17	17	15	13	13	22	19
Female	8	15	5	13	22	8	13	21	12
Total	20	27	22	30	37	21	26	43	31
Days of development from June 15 to last pupa	Not comparable	38	34	34	34	38	39	34	38
Females caged for oviposition	24			20		13		20	
Egg clusters per female	1.5			0.8		2.9		3.9	
Eggs per female	55.5			22.4		96.0		191.5	

TABLE 26

SPRUCE BUDWORM TRANSFERS

DETAIL OF TRANSFERS	CAGE NUMBERS								
	10	11	12	13	14	15	17	18	19
Transferred to:	Sw	Sw	Sb	Sb	Ab	Ab	Pj	Pj	Sw as a check on 17 & 18
Source of larvae	Spruce Woods	Spruce Woods	Spruce Woods	Spruce Woods	Spruce Woods	Spruce Woods	Hudson	Hudson	Hudson
Date of transfer	May 26	May 26	May 27	May 27	June 5	June 5	June 10	June 10	June 10
Instar when transferred	3rd	3rd	3rd	3rd	4th	4th	3rd&4th	3rd&4th	3rd&4th
No. of larvae transferred	50	50	50	50	50	50	50	50	50
Pupae obtained:									
Male	14	10	7	10	24	19	13	7	20
Female	13	19	6	10	18	17	10	0	15
Total	27	29	13	20	42	36	23	7	35
Days of development from May 26 to:									
First pupa	28	28	31	31	33	33	27	27	22
Last pupa	42	42	42	45	45	42	39	39	30
Females caged for oviposition	25		10		30		9		9
Egg clusters per female	5.5		3.0		7.0		3.0		5.5
Eggs per female	66		45.6		110.0		44.7		127.1

All egg clusters obtained were caged on small seedlings at Hawk Lake for incubation and overwintering, as follows:

CAGE NO.	SEEDLING	DESIGNATION	LOCATIONS
16, 20, 21	Sw	Pj-Sw G_0 1943	At truck parking space
22, 23	Sb	Pj-Sb G_0 1943	Near sample plot 1
24, 25	Ab	Pj-Ab G_0 1943	75 ft. south of old ranger's cabin
26, 27	Pj	Pj-Pj G_0 1943	Near tree 27, plot 1.
10, 11	Sw	Sw-Sw G_0 1943	Near tree 23, plot 1.
12, 13	Sb	Sw-Sb G_0 1943	Near plot 1, Hawk Lake
14, 15	Ab	Sw-Ab G_0 1943	75 ft. south of old ranger's cabin
17, 18	Pj	Sw-Pj G_0 1943	Near tree 27, plot 1.
19	Sw	Sw-Pj G_0 1943	At truck parking space

Each seedling is marked with 3 stakes in the form of a triangle and another stake bearing the appropriate designation.

An analysis of the average width of spruce and Jack pine budworm pupae from all transfers was made. All pupae, as they formed in cages 10 to 27 inclusive, were measured at their widest point (the caudad area of the wing pad region) with calipers calibrated to 0.01 mm. Pupae were measured from the ventral side. The following tables show the average pupal widths in mm. for males and females reared in duplicate cages.

SPRUCE BUDWORM TRANSFERS TO:

	Replicate	White spruce	Black spruce	Balsam	Jack pine
MALES	1	.434	.366	.398	.334
	2	.428	.391	.422	.304
FEMALES	1	.454	.435	.455	.385
	2	.476	.446	.475	.402

JACK PINE BUDWORM TRANSFERS TO:

	Replicate	Jack pine	White spruce	Balsam	Black spruce
MALES	1	.324	.322	.304	.335
	2	.351	.338	.315	.330
FEMALES	1	.349	.358	.332	.369
	2	.386	.360	.338	.375

Statistical treatment by analysis of variance shows significant differences in size of the spruce budworm transfers. The table shows this is due mainly to the much smaller size of pupae reared on Jack pine and, to a lesser extent, those reared on black spruce. Moths reared from these two hosts deposited a much smaller number of eggs than those reared on white spruce or balsam.

Host made no significant difference on the size of Jack pine budworm transfers. However, it is noteworthy that the smallest Jack pine pupae, both males and females, were obtained from balsam.

Other points of interest arising out of this analysis are:

(1) The larger average size of spruce budworm pupae as compared with Jack pine budworm when reared on their normal host; i.e.,

	JACK PINE BUDWORM	SPRUCE BUDWORM	PERCENTAGE DIFFERENCE
MALES	.338	.431	28
FEMALES	.368	.465	26

(2) Although it is probably well known that females are generally larger than males, these measurements show the magnitude of these differences as follows:

	JACK PINE BUDWORM (ALL TRANSFERS)	SPRUCE BUDWORM (ALL TRANSFERS)
MALES	.384	.327
FEMALES	.441	.358
% DIFFERENCE	15	9.5

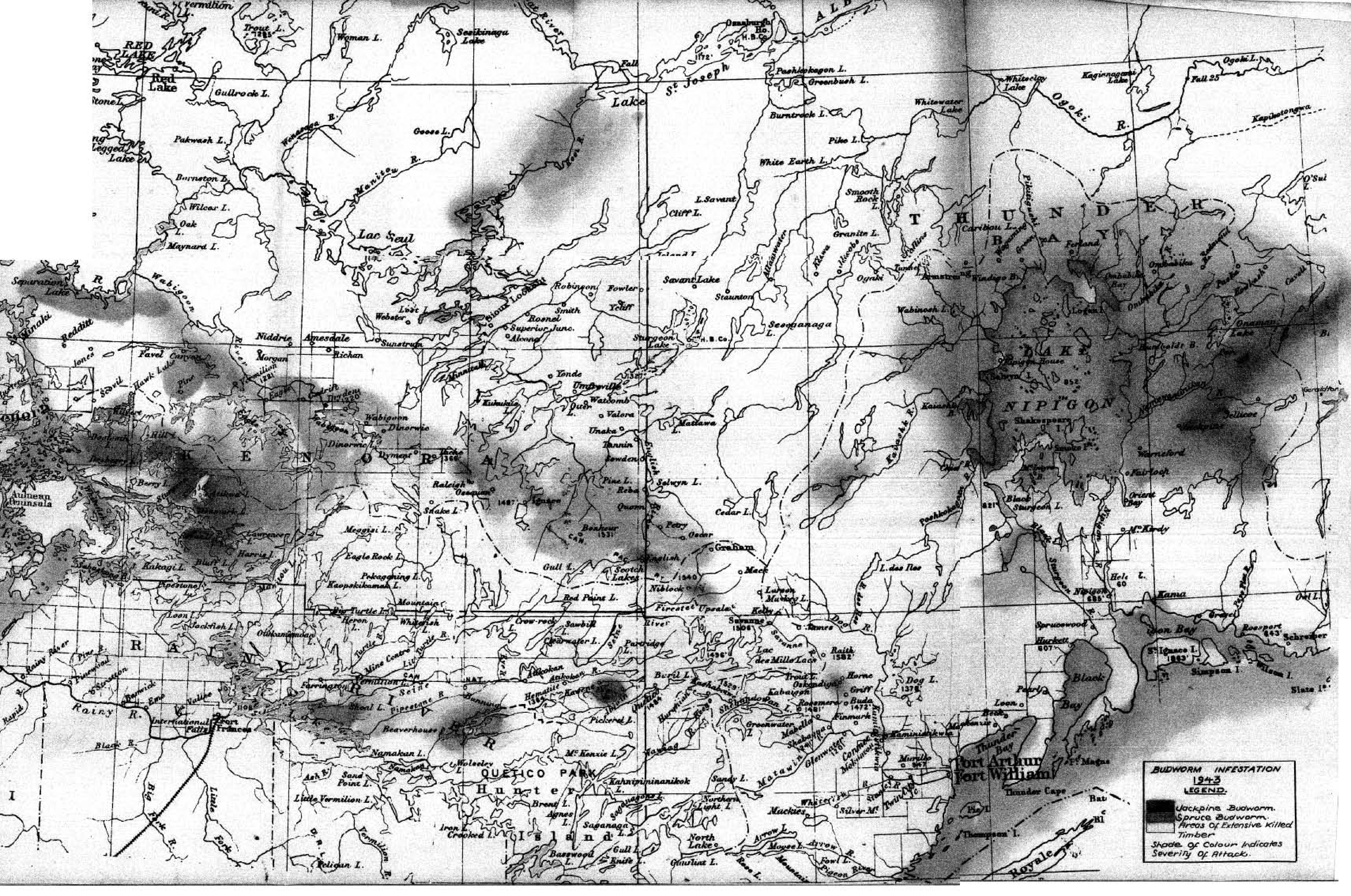
BUDWORM INFESTATION
1943
LEGEND.
Jackpine Budworm.
Spruce Budworm.
Areas Of Extensive Killed Timber
Shade Of Colour Indicates Severity Of Attack.
K E N O R A
R A I N Y
R I V E R
T H U N D E R
B A Y
LAKE NIPIGON
Lac Seul
Lake St Joseph
Red Lake
QUETICO PARK
Hunter Island
Fort Arthur
Fort William
Thunder Bay
Black Bay
Nipigon Bay
Thunder Cape
Royale
Rainy R.
International Falls
Fort Frances
Sioux Lookout
Savant Lake
Sturgeon Lake
Wabigoon
Dinorwic
Ignace
Graham
Savanne
Upsala
Schreiber
Rossport
Jellicoe
Geraldton
Ogoki R.
Kapikotongwa
Osnaburgh Ho.
Ombabika Bay
Nipigon House
Wabinosh L.
Armstrong
Orient Bay
McKirdy
Kama
Hurkett
Dorion
Red Rock
Minaki
Separation Lake
Wabigoon R.
Manitou R.
English R.
Gull L.
Pipestone L.
Kakagi L.
Namakan L.
Sand Point L.
Little Vermilion L.
Crooked L.
Basswood L.
Saganaga L.
North Lake
Mine Centre
Atikokan
Kashabowie
Shebandowan L.
Kaministikwia
Murillo
Dog L.
Pigeon River
Pie I.
Thompson I.
Simpson I.
St Ignace I.
Slate Is.
Big Fork R.
Little Fork
Vermilion R.
Pelican L.

PLATE V

Establishing the summer field station at Hawk Lake, Ontario, April, 1943.

Unloading

Transporting equipment across the ice to the campsite.

PLATE VI

Equipment on the beach at the campsite.

View of the camp the following day.

PLATE VII

View of beach adjacent to
the camp after a heavy
snowstorm.

V. EUROPEAN LARCH SAWFLY

V. EUROPEAN LARCH SAWFLY
(*Pristiphora erichsonii* Htg.)

A. Reconnaissance

This insect appears to be more prevalent annually, especially in parts of Manitoba. Within the latter, two areas are under severe attack. The first of these is of long standing--the Riding Mountain National Park. The second area is in the northeast section of Manitoba's inter-lake district, and full information is not yet available as to the exact extent and severity of this attack.

1. Riding Mountain National Park

The European larch sawfly was again active in the larch stands throughout the park. Destructive defoliation, however, was limited to certain specific areas. Most noticeable of these, as in past years, was the townsite of Wasagaming and at Mile 7 on the Norgate Road. There is some doubt as to whether the sparseness of foliage in these areas is due entirely to sawfly or in part to a general weakening of the trees from past sawfly attack. Such might result in the tree's inability to make normal needle growth this year. Cocoon collections from these two areas revealed a rather light crop as compared with previous years.

Cocoons from the Mile 7 Norgate Road area showed double the *Mesoleius tenthredinis* Morley parasitism in 1942 that obtained in 1941; accordingly, some 2,200 cocoons were collected and shipped to the Belleville Laboratory to provide further information on this trend.

In the western half of the park, beginning just west of Lake Audy, the tamarack was described as pretty well stripped in all townships westward from Lake Audy to the west end of the park but, by August 10th, trees were described as putting forth new needles.

The following list places the location of samples and reports from this section of the park.

Sec.	Twp.	Rge. W.P.M.
2	22	25
28	20	20
25	21	21
31	21	20
2	22	25
16	20	19
15	22	25
19	22	25
6	22	24
5	22	23

2. Interlake Area

Reports have come in of a more or less heavy evidence of tamarack defoliation inside a perimeter extending from Riverton on the east, to Hodgson and thence westward to Lake Winnipegosis and northeast to the series of southern bays on Lake Winnipeg.

Field reports and samples have been received from the Riverton and Hodgson areas, indicating the following situation:

In the early part of the season, the infestation appeared widespread but the subsequent defoliation was somewhat lighter than originally anticipated. Thus, at one time 50% of the new growth appeared destroyed at Riverton, and 80% of smaller trees in the Hodgson area. In the latter area, however, the larger trees seemed relatively unaffected. By the end of the season, a figure of 30% for the Riverton area obtained, with a small patch on the N½ Sec. 29 and S.E. 1/4 of Sec. 32, Twp. 23, Rge. 4E, bearing 50 to 60% defoliation.

Scattered and light attack was indicated in the remainder of the province. A few ornamental larch on home grounds in Charleswood, reported infested in 1942, are still harboring a few of the pests. The insect was discovered in light population at Buchan (Sec. 9, Twp. 13, Rge. 9E) and some defoliation was also evident from a point midway between Roblin and Swan River, on the west slopes of the Duck Mountains. The localized population is still extant in the nursery of the Turtle Mountain Forest Reserve. A few larvae were again found on ornamental larch on the grounds of the University, Fort Garry. A small collection was likewise noted at Belair.

3. Saskatchewan

The Director of Forests initiated a survey for this insect in the Meadow Lake, Prince Albert and Hudson Bay Junction districts of the province. Fortunately, all subsequent reports were of a negative nature. A large colony was located in the McConnell Creek section of the upper Carrot River valley in 1939 by the junior writer, but this has apparently disappeared.

4. Ontario

Only four reports were received from this province. A local infestation occurred on ornamentals at the Kenora Headquarters of the Forest Service, but spray treatment was undertaken and proved efficacious. The other three points of collection were Wabigoon (light), 28 miles east of Kenora (light), and at Graham (also light).

B. Parasites

A further attempt was made during the year to procure a representative sample of sawfly cocoons from the Riding Mountain National Park for further determinations of sawfly parasitism by Mesoleius tenthredinis. Accordingly, R.R. Lejeune and D.N. Smith, assisted by two park wardens, J. Allen and B. Campbell, spent three days in collecting cocoons, September 27th to 29th inclusive. Collections were made at Mile 7, Norgate Road, where a total of 2,200 sound cocoons was gathered and shipped to Belleville for rearing. At the time of this writing, no results have been received but previous figures on parasitism are listed below.

SUMMARY OF COCOON COLLECTIONS & PARASITISM BY MESOLEIUS

Year	No. of Cocoons	% Parasitism
1943	2,200	?
1942	10,000	4.34
1941	23,003	5.0

Additional to the above parasitism for 1942, there was a recovery of Bessa selecta amounting to 0.20% and the recovery of 5 specimens of Euceros decorus, 2 of Eclytes perennis and 1 unidentified cryptine.

PLATE VIII

Larch sawfly sample plot photographs at Riding Mountain National Park, Manitoba. These plots are photographed every year from the same spot.

Mile 13 Audy Lake Road

Golfcourse at Wasagaming

PLATE IX

Mile 7 Norgate Road. The larch trees showing in this photograph are almost 100% defoliated.

Wasagaming townsite

VI. WOOD BORERS

VI. WOOD BORERS

A. Introduction

During the early summer of 1942, disastrous fires swept over extensive stands of white spruce in northern Saskatchewan and Manitoba, leaving thousands of burned, scorched and dying trees. The estimated damage in Saskatchewan amounted to over 60 million feet of saw timber and almost 200 thousand cords of pulpwood. Losses in Manitoba were less. Due to wartime demands, utilization of a good percentage was possible, provided it could be cut while still in a usable condition. As the principal source of immediate deterioration lay in wood borer damage, this insect assumed primary importance in relation to any salvage program. In view of these circumstances, this paper is largely confined to an analysis of the injury produced by round-headed borers, the principal being Monochamus scutellatus Say, also known as the pine sawyer or long-horned borer due to its extremely long antennae. In certain types of burn, another round-headed borer, Tetropium sp., was in abundance associated with Monochamus. Although a round-headed borer, Tetropium, as recorded by Craighead (1923), restricts its mining entirely under the bark. pupating in a small cell in the outer sapwood or bark. It was the writer's experience that Tetropium larvae enter the wood much as Monochamus do, but are shallow borers. The average depth of penetration for 76 tunnels measured was 3/4 inch, with a maximum of 2 inches. The tunnels parallel the log's surface and may extend as much as 3 inches in length, terminating in a small pupal cell (Fig. 9). From such cells, newly transformed adults were collected and subsequently identified. Being a shallow borer, Tetropium is of much less importance than Monochamus but, due to similarity of external engravings and mode of entering the wood, some confusion might arise, particularly in the early stages when entrance holes are small. Illustrations Nos. 10 and 11 indicate the most obvious differences between the two. In this paper, the two species are dealt with for the most part together, as a single complex. Bark beetles and flat-headed borers, while present in varying degrees of intensity, were of minor importance in the immediate problem and therefore are eliminated from the main discussion.

The life history of Monochamus scutellatus has been recorded in detail in various publications (Graham, 1939; Craighead, 1923; and others). The eggs are deposited singly in narrow slits cut in the bark by the female adult.

Upon hatching, the larva bores into the sapwood where it feeds for a time between the wood and the bark, resulting in the characteristic engraving on the outer surface of the wood. Eventually, the larva penetrates the sap and heart wood, increasing the diameter of its tunnel constantly as it grows in size. The completed tunnel is generally U-shaped and pupation occurs in a cell excavated at the far end of the tunnel near the surface of the log (Fig. 8). The newly transformed adult beetle escapes by chewing a round hole from the pupal cell to the outside. The period of development varies from one season to three years, according to temperature and moisture conditions.

While the literature on wood borers, especially Monochamus, is voluminous, this study in northern Saskatchewan has disclosed some apparently new information in relation to borers and fire-burned timber. Other published works are of direct application, however. Parmelee (1941) concluded that in Michigan fire-killed timber was of no greater attraction to borers than timber killed by other agencies, that Monochamus scutellatus caused the greatest damage and that borers do not, as a rule, re-infest trees from which they emerge. Morley (1939) found that logs are readily attacked throughout the season and that logs cut after August may be infested the following spring. Tothill (1924) reported that the heaviest attack occurs on logs cut in May, June and July and that later cut trees are less subject to infestation. Trägårdh (1940), studying storm-felled timber in Sweden, found that wholly dry trees were all infested by Monochamus sutor, while green-crowned trees were only 5.8% infested. This report is of special interest in view of the findings as recorded in the following pages.

The study as set forth was conducted in part in 1942 and again in 1943, on as intensive a scale as possible, but of necessity restricted to the immediate problem of salvage, due to the handicaps inherent in present day wartime conditions. It must be realized that the following data are intended only to set forth conditions of the fire-burned timber as they obtain at the present time. Under different weather conditions than those encountered or a different date of burning, many of the findings might be markedly altered.

Two representative and highly important areas were selected for study, Clemenceau and Carrot River, each representing a different type of burn. The Clemenceau region, in the vicinity of Hudson Bay Junction, had experienced extreme heat from what was predominately a crown fire and the majority of trees were burned and blackened from ground level to their tops, with only blackened stubs of branches remaining. They were generally of a small size, averaging around 12 inches D.B.H. The Carrot River country, on the other hand, had undergone all degrees of burn, from a light root burn to severe crown fire which left only blackened, branchless trunks. In general, the timber in this area was much larger than at Clemenceau, running from 2 to 3 feet D.B.H. Clemenceau and Carrot River were examined in 1942 between July 23rd and August 1st inclusive and, again, September 18th to October 1st inclusive. In 1943, a second examination was made in the Carrot River area, August 12th to 17th inclusive, and in the mill at The Pas, Manitoba, August 23rd and 24th.

B. Period of Wood Borer Attack

A question of prime importance from the standpoint of salvage concerns the period during which these logs are subject to attack, the lapse of time during which quality of the wood will progressively deteriorate from continued borings, and the extent of borings in such fire-damaged trees.

An indication of the period of attack is found in an examination of the following three areas:

(1) <u>1941 burn</u>, Carrot River, burned late June to July 15, 1941, examined July 25 and 26, 1941, and again July 25, 1942.

(2) <u>Logs cut in March, 1942</u>, Carrot River, examined July 26, 1942.

(3) <u>1942 burn</u>, Carrot River, burned June, 1942, examined July 23 to 27 inclusive, and again September 24 to 28 inclusive, 1942.

The first area, burned in 1941, was a very close duplicate of the 1942 Carrot River burn. It was primarily a ground fire with some scorching of tree trunks but, for the most part, the trees were standing and the branches were green. The first examination was made by the senior author the same month as the fire--July 25 and 26, 1941.

At this time, the cambium of the unburned bark was white and normal-looking, but was in the process of infestation by flat-headed borers. In no instance was a round-headed larva observed. One year later, July 25, 1942, an examination of the same trees (now wind-fallen) revealed a heavy attack by round heads. Of 39 tunnels measured, 5 went in to a depth of 4 inches each and 7 to a depth of 4½ inches each, the average for the 39 being 2.65 inches. Larvae were present and still in the course of tunnelling. Of special interest is the period of time during which this deterioration occurred. Further evidence given below indicates that the initial attack probably occurred during August, 1941, resulting in this condition, one year later.

The second area, logs cut in March, 1942, and left in the woods, was examined July 26th of the same year. A total of 39 square feet of bark was removed. Round-headed borers were entering the logs in 62% of the bark samples examined. The average population was 1.8 per square foot; the average depth of penetration, 1 1/10 inches; the minimum, 1/16 inch; and the maximum, 2½ inches. These logs were attacked in the spring prior to July 26th.

The following comparisons may be made in these two areas, both examined July 25 and 26, 1942.

	1941 Burn	1942 March-cut Logs
Maximum Penetration	4 1/2 inches	2 1/2 inches
Minimum Penetration	1 inch	1/16 inch
Average Penetration	2 5/8 inches	1 1/16 inches

The difference in wood borer penetration is quite striking and it seems quite evident that the July, 1941, burned timber must have been infested by roundheads during that summer subsequent to the writers' visit and hence that timber infested in late summer will continue to deteriorate during the following summer. This point is further shown in an examination of the third area.

The third area was the large 1942 burn at Carrot River with which the study is primarily concerned.

Thus far, it would seem evident that wood borer attack may be expected throughout most of the summer in northern Saskatchewan. As will be shown in more detail later, such borings are not necessarily completed in the year of initial attack nor are all of the logs infested to their maximum during the first season. The time and duration of this attack is dependent upon the period during which these logs become and remain favorable for borer infestation, a point considerably more involved than would appear on the surface.

1. Classification of Burn Types

That much variation occurred in relation to the date of attack following the burn was soon apparent. After some study, five distinct classes of burn were segregated, each with its own peculiarities in relation to borer behavior. Such characteristics seemed quite uniform both in Carrot River and Clemenceau and the burn types are set forth below. It should be understood that these descriptions apply immediately following the fire and refer only to trees with bark. While the condition will change with drying, the type of burn to which the tree was subjected is thus permanently recorded on it.

Burn Type 1 (Figs. 1 and 5). The most severe of all burn types. Bark burned thin, no scales or flakes remaining, brittle, fails to bend without breaking, entire patches of bark missing due either to having burned away or subsequently peeled off, cambium has been cooked, wood dry and brown. This type is usually encountered at the lower portion of the tree, where it has been subject to the greatest fire. In crown fires, it may occur over the greater portion of the tree.

Burn Type 2. (Figs. 2 and 7). A less severe burn than Type 1. Bark badly charred and may have small areas burned through to the wood, thin but pliable when first burned, can be peeled in a single sheet, cambium cooked in patches, giving a mottled appearance from tan to brown and is too dry to be sticky. On thick-barked trees, all bark scales should be burned off, while on smaller trees with thin bark, 50% of the scales should be burned.

Burn Type 3 (Figs. 3 and 6). This bark has been swept by flames and is therefore blackened but remains at its normal thickness, with bark scales still present. It is moist, pliable, and peels readily in one unbroken sheet. Bark has not burned through nor has cambium been cooked. Cambium a uniform creamy-tan in color without darkened areas caused by excessive heat, partly dried so as to be definitely sticky.

Burn Type 4 (Fig. 4). Found on partly burned trees. It has not been scorched or blackened by flames but has been subject to much heat from nearby fires. Externally, it looks quite normal. Cambium generally white, traces of discoloration developing, moist but shows signs of drying and, when peeled, is decidedly sticky. It is generally found on the log opposite to a burned side.

Burn Type 5. This type of tree has been injured only at the roots by ground fires, but the tree itself is entirely uninjured. It has not been subjected to heat and is normal in every respect. Peeled bark appears to be an exact duplication of bark peeled from a standing green healthy tree.

2. Susceptibility of Burn Types to Borer Attack

Considering burn types alone, disregarding all other factors, a marked difference will be noted in the average degree of infestation, as shown in the following table:

TABLE 27

PERCENTAGE SAMPLES ATTACKED AND POPULATION PER SQUARE FOOT SEGREGATED BY BURN TYPE*
CLEMENCEAU & CARROT RIVER, SEPTEMBER, 1942.

BURN TYPE	CLEMENCEAU		CARROT RIVER	
	% Samples Infested	Population Per Sq.Ft.	% Samples Infested	Population Per Sq.Ft.
1	Nil	Nil	Nil	Nil
2	30.8	1.12	20.0	1.00
3	87.5	3.01	63.6	1.80
4	94.1	3.48	82.6	3.06
5	76.5	3.08	78.6	5.15
MEAN	72.2	2.67	61.2	2.75

* Populations are per square foot for infested samples only.

It will be seen from the data obtained that Type 1 was immune from attack, Type 2 was subject to considerable infestation, while Types 3, 4 and 5 were the main areas of borer abundance. Conditions afforded borers by the various types of burn are not stationary, however, for, as drying progresses, a Type 5 bark will eventually approach a Type 4 in moisture content, with a corresponding change in all burn types. Burn types, therefore, are perhaps more valuable in considering the chronological order in which infestation may be expected to occur. This, in turn, governs to a large extent the depth of borer penetration at any given date during larval activity. As will be shown later, the penetration of borers is correlated with the sequence of attack, which is largely governed by the type of burn.

In examining the preceding table, it will be noted that in both areas Type 4 had a larger percentage of samples attacked than any other and that, in Carrot River, Type 5 had the greatest population per square foot in September. This point may be further illustrated by averaging the 1942 and 1943 data from Carrot River.

TABLE 28

BURN TYPES & BORER ATTACK, CARROT RIVER, AVERAGE FIGURES 1942-43.

BURN TYPE	% SAMPLES ATTACKED	POPULATION PER SQUARE FOOT
1	Nil	Nil
2	46.0	0.80
3	73.8	2.12
4	80.2	2.90
5	62.7	3.94

The order remains the same as shown in the preceding table based on 1942 data alone. It is much as would be expected for, as Types 2 and 3 dry, their attractiveness diminishes as they approach the Type 1 stage. Type 4 may actually improve as it approaches the level of Type 3. Type 5, however, appears to be unattractive at the outset but drops to the more attractive form as drying progresses. It was found that this change varies greatly, some trees of this type becoming infested within 6 weeks while others have remained immune to attack 12 months after burning. This variation of infestation among Type 5 trees has resulted in a lower percentage of samples being attacked than was encountered in the Type 3 and 4 burns. Those attacked in the Type 5 class, however, harbored a denser borer population per square foot. It appears possible that some of the Type 5 burn may remain alive and escape infestation, given favorable conditions. Once attacked, however, a Type 5 tree seems to absorb a greater population of borers per square foot than any other type. In contrast to this, Type 2 would seem to absorb the least. The type 5 tree, being the last to reach a favorable condition for infestation, becomes available when most of the others are past their most attractive stage and this may account for the greater influx of borers into it. Likewise, since the Type 2 is among the earliest favorable to borers and only slightly better than the Type 1, its attractiveness is short-lived and its population per square foot is small by comparison with the others.

3. Sequence of Attack

From the foregoing, it will be seen that the average percentage of samples attacked seems fairly well correlated with the type of burn. The sequence by which these types become infested is better shown by a consideration of the following. Data obtained from the Clemenceau area in July and again late September in the year of the fire, 1942, lend themselves toward indicating the sequence of borer infestation in these burn types. This sequence is of special significance since the depth of penetration at a given time will be dependent, to a large extent, on the length of time during which boring has been in progress.

TABLE 29

SEQUENCE OF ATTACK ON LOGS
CLEMENCEAU, 1942.

BURN TYPE	PERCENTAGE LOGS ATTACKED	
	July	September
1	Nil	Nil
2	21.2	30.8
3	82.8	87.5
4	50.0	94.1
5	Nil	76.5

The early attack of Types 2 and 3, with a relatively small increase in September, is indicated in this table. This, it appears, is the result of drying of these more severely burned logs, when the cambium soon drops below its optimum attractiveness for wood borers. After this early attack, further infestation of these two types practically ceases. In Clemenceau, this condition appears to have been reached in most logs within 2 months after the fire, for there was a relatively small increase in the number of logs attacked after that time. Logs of the Type 4 burn deteriorated sufficiently to permit an infestation of some 50% by July and 94% by September.

At the same time, the green trees of Type 5 were immune from borers in July but, by September had changed sufficiently that 76% of the logs were attacked.

C. Penetration of Wood-boring Larvae

1. Field Studies

In consideration of this sequence of attack, a direct correlation should be evident between burn type and average depth of penetration of borers at any given date during the period of their boring activities. The earliest favorable logs should normally carry the deepest tunnels until such time as borings in all burn types are completed. When that stage is reached, there will be a natural evening out of penetration depths. This is stating the problem in its simplest and most fundamental form, but the real problem should be approached from two viewpoints. The first is to give the general over-all condition as it actually exists, including all species of borers that produce holes, and, as well, mortality and other factors that influence penetrations. The second is to examine the destructive *Monochamus* species alone. Since we are primarily concerned here with the actual over-all condition as it exists at the present time, the former will be considered first. To this end, three sets of data are available: Clemenceau, September, 1942; Carrot River, September, 1942; and Carrot River, August, 1943.

TABLE 30

AVERAGE BORER PENETRATION IN INCHES
CLEMENCEAU & CARROT RIVER
(ALL SPECIES ROUND-HEADED BORERS)

BURN TYPE	CLEMENCEAU	CARROT RIVER	
	Sept., 1942.	Sept., 1942.	Aug., 1943.
1	Nil	Nil	Nil
2	---*	---*	2.9
3	2.0	2.6	2.8
4	1.9	1.7	1.9
5	1.2	1.0	1.1

*Insufficient data for true average.

The regular decrease in average depth suggests again the greater attractiveness and hence the earlier attack that occurred on the more heavily burned timber. It is evident, however, that the increase in average penetration at Carrot River in 1943, as compared to 1942, is not as great as might normally be expected. The true picture of damage to lumber in 1943 is masked by the presence of a shallow-boring species of *Tetropium* that attacked these logs in conjunction with *Monochamus* and, as well, by a progressively higher larval mortality in the lighter burn types (See Page 114). By eliminating from our data all measurements less than 1½ inches deep in August, 1943, we discard these above mentioned disturbing factors and have a truer picture of the destruction caused by the deep-boring *Monochamus* larva. On this basis, the penetrations on these same trees shown on the preceding page have been set forth in the following tabulation:

TABLE 31

AVERAGE BORER PENETRATION IN INCHES OF MONOCHAMUS LARVAE

BURN TYPE	CLEMENCEAU	CARROT RIVER	
	Sept., 1942.	Sept., 1942.	Aug., 1943.
1	Nil	Nil	Nil
2	----	3.08	3.06
3	2.65	2.82	3.33
4	2.47	2.46	3.01
5	2.02	2.14	2.72

The relationship between burn types and average penetration remains as before, with the earliest attacked suffering the greatest depth. It will be noted further that by the elimination of the shallower penetrations, the average depths show a considerably greater increase in 1943, except in Type 2. While some of these shallow tunnels which have been eliminated may have been young *Monochamus*, especially in Types 4 and 5, their elimination does give a more accurate picture in relation to current deterioration of timber, the main point with which we are concerned.

The average depth of penetration of completed *Monochamus* tunnels (those with pupal cells constructed) was 3½ inches, regardless of burn type. The maximum depth encountered was 7 inches, the minimum 1¾ inches. Types 2, 3 and 4 are shown above to be reaching this average in August, 1943. Since considerable variation occurs between the maximum and minimum depth of completed *Monochamus* tunnels, it is felt that a clearer indication of present conditions would be revealed if considered from the standpoint of the actual percentage of Monochamus larvae occurring at given depths. The following table sets forth these data, with shallow borings of less than 1½ inches eliminated. Type 2 has also been eliminated due to the fact that it was not possible to obtain sufficient samples in the time available for this work.

TABLE 32

PERCENTAGE MONOCHAMUS LARVAE OCCURRING AT VARIOUS DEPTHS FOR EACH BURN TYPE CARROT RIVER, 1942 and 1943.

PENETRATION	BURN 3		BURN 4		BURN 5	
	1942	1943	1942	1943	1942	1943
1-2 inches	100.0	100.0	100.0	100.0	100.0	100.0
2-3 inches	71.0	93.2	50.0	77.3	51.7	66.7
3-4 inches	25.8	44.1	16.7	38.6	00.0	16.7
4-5 inches	9.7	17.0	8.3	9.1		00.0
5-6 inches	3.2	3.4	00.0	2.3		
6-7 inches	1.6	00.0		00.0		
7+ inches	00.0					

Here may be seen at a glance the percentage of Monochamus borers that occurs at any given depth for any burn type. There is apparently a uniform decrease in penetrations in 1942 as we pass from Type 3 to Types 4 and 5, as underlined in the above table, which further testifies to the sequence by which burn types become infested. In 1943, similar trends are apparent to a lesser degree.

While these data add considerable significance to the matter of attractiveness, they also indicate something of the importance attached to burn types in salvaging fire-burned timber. Considering the 1943 damage (14 months after the fire), there still existed a marked variation in damage sustained as between burn types. The percentage of holes at a depth of 2-3 inches, for example, averaged for Type 3, 93.2%; Type 4, 77.3%; and Type 5, 66.7%. This variation may be observed throughout the table, although it is of significance that, in Type 4, deterioration on the whole is approaching the stage reached in Types 2 and 3. These figures, it should be noted, are derived from field measurements procured by chopping into logs. A further consideration of this matter is dealt with later, when measurements and counts were made within the mill where logs from this area were in the process of being cut.

Thus far, it seems evident that borer penetrations will be governed primarily by the type of burn. Those most susceptible soon after the fire may have a lighter population due to their attractiveness being short-lived, but probably the deepest penetration, due to their earlier attack. Eventually, however, as the later-attacking borers complete their tunnelling in the lighter burn types, the damage sustained should be much more severe. Populations per square foot, while not of special importance if salvage operations are to be proceeded with within a year of the burn, do become of particular significance in any delayed salvage operation. The table on Page 105 would indicate the much greater population that eventually attacked the lighter burned timber. While the future for such logs looked bad from external appearances, it should be pointed out that a good percentage of these larvae died before reaching an appreciable depth, as discussed later on, and that the infestation was a mixture of the shallow-boring <u>Tetropium</u> sp. and the destructive <u>Monochamus</u>. An appraisal of eventual borer damage based on external holes may be decidedly misleading when these holes are newly made and of a small size. Once they have reached a fairly large size in diameter, one may be more assured that the borer is in to considerable depth and, in all probability, will survive to complete its tunnelling.

2. Mill Studies

Mill studies were run as a check on field examinations primarily to determine the actual condition of boards as they come from the head saw and the final condition after edging has taken place. The method consisted of pulling aside all boards cut from one face of a log of a specific burn type, followed by measurements of the board and a count of borer holes. By the use of a straight edge, a line was drawn down either side of the board which would approximate the path of the edger and the boards were then analyzed for borer damage before and after edging. This method proved quite interesting, for it showed to what extent the shallower holes were eliminated as sawing and edging proceeded and, as well, afforded a comparison between data taken in the field and actual conditions in the mill. It may be expected to give a somewhat more accurate picture of conditions, for the final damage of borers on sawn timber may be affected by certain peculiarities of the borer that can scarcely be recorded from field examinations; for example, wood borers project their tunnels downward and outward, usually in a U-shape, but occasionally angle-shaped. Thus, one tunnel, when completed, may penetrate a board twice. Furthermore, a percentage of tunnels will parallel the sawkerf and hence may be eliminated by the saw or enter the edge of the board and thus not be seen as a hole on the board's surface. Other tunnels that for one reason or another do not go directly toward the centre of the log but remain on the outer sapwood area may be largely eliminated in edging. As opposed to the foregoing, field examinations consisted of chopping into logs, measuring the depth of penetration from the outside surface, disregarding from necessity how such holes would affect boards cut from the logs.

In view of the above and after much thought, it was felt that the best means of presenting this information would be to base it on the average number of holes occurring in a 16-foot board, 12 inches wide. Accordingly, the table below was prepared on this basis.

TABLE 33

AVERAGE NUMBER OF BORER HOLES PER BOARD OF DIMENSIONS 1"x12"x16' BEFORE AND AFTER EDGING

SLAB		BURN 3	BURN 4	BURN 5
1	Before edging	38.11	48.54	32.21
	After edging	OUTER	SLAB NO	EDGING
2	Before edging	23.09	54.42	40.37
	After edging	11.84	30.37	24.58
3	Before edging	20.37	20.00	15.00
	After edging	8.51	7.12	7.15
4	Before edging	8.24	4.29	7.04
	After edging	5.00	0.61	0.37

It will be noted first how much greater has been the damage in Type 3 logs at the lower levels than in any of the others (holes in Slab 4: Type 3---5.0, Type 4---0.61, Type 5---0.37). It will also be seen that at the shallower depths (Slabs land2) Types 4 and 5 have experienced by far the heaviest attack, especially before edging (54.42 and 40.37 holes per board). This, it would seem, falls in with previous statements that, despite the heavier attack of Type 5, net damage was less than anticipated, partly because of larval mortality in shallow tunnels and partly because many of the holes were of the current year's attack and were still sufficiently shallow to be removed by edging.

To summarize, mill data indicate that the number of borer holes in an edged board 16 feet long, 1 foot wide, and 1 inch thick will average as follows (the outer slab not included):

	BURN 3	BURN 4	BURN 5
1st board	11.84	30.37	24.58
2nd board	8.51	7.12	7.15
3rd board	5.0	0.61	0.37

These net figures represent a marked decrease in holes after edging has taken place. The percentage of holes removed by edging is tabulated below (excluding the outer slab).

TABLE 34

PERCENTAGE HOLES REMOVED BY EDGING*

	BURN 3	BURN 4	BURN 5
1st board	48.7	44.2	39.1
2nd board	58.2	64.4	52.3
3rd board	39.4	85.7	94.7

* Percentage based on the average number of holes occurring in a 1-inch board, 1'x16', at the given depth within the log. The outer slab not included.

These figures, when compared to our population per square foot recorded in the woods, as given on Page 104, indicate a somewhat lighter degree of damage. It is not felt that the two sets of data lend themselves to accurate comparisons, however, for the point of origin of the mill logs is not known and they had undergone considerable water travel before reaching the mill. Comparisons are interesting, however, for the mill results also indicate the greater damage in the Type 3 log and the better quality of Types 4 and 5.

It was apparent that checking of logs, particularly among the more severely burned types, had become a large factor in loss and may be more influential in limiting the time available for salvage than the wood borers.

D. Diameters & Heights in relation to Borer Attack

The possible existence of some correlation between diameters, heights and wood borer infestation was investigated with the intention of recommending some form of selective salvage if such existed. Careful analysis, however, failed to reveal any marked degree of correlation in either case.

E. Duration of Deterioration through Wood Borer Activities

A consideration of the time during which logs may be expected to deteriorate through wood borer activities is of prime importance from the standpoint of salvaging fire-burned timber. In this regard, there would appear to be three main considerations: (a) time during which logs are subject to attack by adult beetles, (b) mortality of larvae within the logs and (c) the period of emergence of young adult beetles, which naturally marks the termination of larval life.

1. Duration of Attack

It has been mentioned that infestation may be expected throughout most of the year (P.102) but that not all burn types are attractive simultaneously (P.104). Furthermore, the duration of attractiveness varies. Type 2, being the earliest, its susceptibility to attack was relatively short-lived, reaching a degree of immunity through drying within the first season. Similarly, drying slowly changes the character of the other burn types. In trees of a lightly burned type, such as Type 5, there appears to be an increase in attractiveness to borers as the tree dies. Some consideration must be given therefore to the period of susceptibility to infestation or, in other words, the duration of attack.

From a consideration of the percentage of trees attacked and the populations per square foot, it appears that the main attack is completed in the same season the burn takes place, but that some additional infestation continues into the second season. This conclusion is based on the increase in borers found in the outer inch of logs in 1943 as compared to 1942, summarized on the following page.

TABLE 35

INCREASE IN BORERS IN OUTER INCH OF LOGS IN AUGUST, 1943, AS COMPARED TO SEPTEMBER, 1942.

DEPTH	BURN 3	BURN 4	BURN 5
½ inch	7.0%	5.4%	31.9%
1 inch	4.3%	1.7%	16.4%

The marked increase in Type 5 is outstanding and much as would be expected. Beyond 1 inch, there was no increase evident and it therefore appears that the increase indicated originated in the second summer.

Further evidence in support of this comes from a consideration of larval mortality, discussed below. Briefly, it was found that the death rate decreased with added depth of penetration, except in the outer half inch of the log. In so far as this mortality seems attributable to winter killing, it would appear that the higher survival in the outer half inch of wood was due to the fact that many of these larvae are the result of 1943 oviposition and hence never experienced the winter temperatures. This is further discussed in the following.

2. Larval Mortality

As mentioned, evidence indicates that larvae of deeper penetrations survive to a greater extent than those in shallow locations and, since penetrations are so influenced by the duration of boring activities, this leads us back to the time of season attack occurred. The correlation between penetrations and burn types will be recalled (Pp. 108+109). The correlation between mortalities and burn types is shown in the following table:

TABLE 36

BURN TYPE	% DEAD LARVAE	% DEAD PLUS MISSING LARVAE
2	11.1	33.3
3	24.3	39.2
4	31.1	50.0
5	51.6	61.3
MEAN	29.5	46.0

Some confusion arose in defining tunnels in which the death of larvae had occurred. There were those actually containing the dead larva, while in others the larvae were missing. Since Monochamus larvae move in and out of their tunnels and may die outside, and since predators may consume them within their tunnels, there is the possibility that the occupants of abandoned tunnels may also be dead. For this reason, the two columns above have been prepared. While a considerable difference in percentage mortality occurs according to the interpretation of "dead" larvae, the order does not change in relation to burn types, the point of paramount interest in relation to salvage. Mortalities show an increase in the lighter burn types due, it is felt, to the greater percentage of shallow penetrations. To illustrate this point, the following table sets forth this percentage mortality as recorded at various depths in August, 1943.

TABLE 37

PERCENTAGE MORTALITY OF LARVAE BY DEPTH OF PENETRATION, AUGUST, 1943.

PENETRATION (INCHES)	% MORTALITY LARVAE
0 - ½	58.4
½ - 1	90.0
1 - 1½	84.2
1½ - 2	66.7
2 - 3	27.6
3 +	14.3

A marked decline is evident as the penetration depth increases, except in the 0 - ½ inch class. This, as mentioned on Page 114, would indicate further infestation in the current year.

These mortalities carry considerable significance in the appraisal of eventual damage based on external borer holes. For example, at the end of the first season, 1942, Type 5 trees carried by far the heaviest population, an average of 3.3 holes per square foot. It was predicted that this type would eventually undergo the greatest damage. This expectation was much modified in 1943 due to the fact that a great percentage were in to a shallow depth and experienced a high mortality (Percentage of larvae wintering at various depths as recorded September, 1942, was: ½"---48%; 1"---21%; 1½"---10%; 2"---8%; 2½"---10%; 3 +"---3%).

Mortality records are available for only one winter, 1942-43, and while pertinent to this problem, cannot be assumed to be typical of all years.

3. Emergence of Young Adults

The emergence of young adults marks a definite termination of larval activities and hence timber deterioration. Data on hand indicate a small emergence thus far and hence additional destruction during the third summer of 1944. Current winter mortality is of course an unknown factor. Emergence recorded in August, 1943, based on total borer tunnels, follows:

BURN TYPE	% EMERGENCE
2	9.0
3	6.5
4	2.5
5	Nil

Excluding the mortality already discussed, there still remains a large number of active borer larvae to enter the third season. Caged logs confined within the laboratory were producing young adults in January, 1944, and certainly much emergence is expected from this area in the summer of 1944. To what extent borers will terminate their work in that season is but a guess, but the paramount fact is that, to utilize this timber, particularly Types 4 and 5, during this second winter is to salvage it before the maximum of damage has been produced.

F. Summary

Investigations of wood borer damage to fire-killed white spruce in northern Saskatchewan and its relation to salvage operations were undertaken during parts of the two seasons, 1942 and 1943. The principal borer was Monochamus scutellatus Say, with Tetropium sp. associated with it. It was found that salvage during the second winter will permit utilization of infested timber prior to the maximum of borer damage, especially in the more lightly burned timber. Borer damage was not the same in all burned trees and 5 distinct types were segregated. Type 1 represents the heaviest burn type on which bark remains; Type 5, the least injured, suffering only from root burn caused by ground fires (All types are described on Pages 103 + 104).

Type 1 was found to be immune to borer attack; Type 2, the earliest attacked but of relatively short-lived attractiveness. The other types became susceptible in the order 3, 4 and 5. A direct correlation was found between the average depth of penetration and burn type. The deeper penetrations at a given date occurred in those logs attacked earliest and hence average penetration depths appear to diminish from Types 2 to 5. Burn types are of much value in considering the chronological sequence of borer attack on which penetrations at a given date depend.

Populations per square foot were also correlated with susceptibility to attack, the least number of borers per square foot being found in Type 2 logs, theearlier attacked, and the greatest populations in Type 5 logs, the latest attacked. The earliest attractive logs carry the lightest population due to the fact, it seems, that their appeal is relatively short-lived, but the deepest penetrations due to this earlier attack. Populations are of greatest significance in consideration of delayed salvage operations undertaken perhaps in the second winter following the fire. Burn types can be used to advantage in classifying trees in relation to borer damage in salvage operations. In August, 14 months following the fire, there still existed a marked difference between these types and the extent to which deterioration had developed as a result of borer activities.

The actual speed at which borers penetrate wood appears to be the same in all burn types, the depth of penetration varying only because of the difference in date at which the logs became infested. Borers were found to penetrate as much as $2\frac{1}{4}$ inches between spring activity and late July ; $4\frac{1}{2}$ inches in the course of 12 months. The average depth of completed tunnels was $3\frac{1}{2}$ inches, regardless of burn type. The maximum depth recorded was 7 inches, the minimum $1\frac{3}{4}$ inches. Borings are seldom completed within the first year. Emergence of young adult beetles, which marks the termination of larval activities, was very light by the end of the second season, the percentage emergence being 9, 6.5 and 2.5 for Types 2, 3 and 4 respectively. No emergence had occurred in any Type 5 logs. Larval activities will extend, for the most part, into the third season and some Type 5 trees will probably be undergoing further deterioration in the fourth year. While some of this type were attacked 6 weeks after the fire in 1942, some were undergoing initial attack in midsummer, 1943. Others were still free from infestation.

Borer attack was recorded throughout the season from spring through August. Trees burned in early summer appear to experience the main infestation the same season as burned,

PLATE X

Fig.1 (left). Type 1 Burn.
Bark burned thin, no flakes remaining, brittle, fails to bend without breaking, with entire patches eventually peeling off.

Fig.2 (right). Type 2 Burn.
Badly charred, small patches burned through to wood, pliable immediately after burn and will peel in unbroken sheet.

Fig. 3 (left). Type 3 Burn. Bark swept by flames and blackened but with bark scales still present. Moist, pliable and peels readily. Cambium definitely sticky.

Fig. 4 (right). Type 4 Burn. Unburned portion Type 4. Bark not burned or blackened, but has been subjected to much heat. Generally moist but becoming sticky on under side. Found on partly burned trees, as illustrated, or on trees burned at base.

PLATE XII

Fig. 5 (above).
Type 1 burn in
foreground; type 5
in background.

Fig. 6 (above).
Type 3 burn in
foreground; type 5
in background.

Fig. 7 (left).
A typical type 2
burn.

PLATE XIII

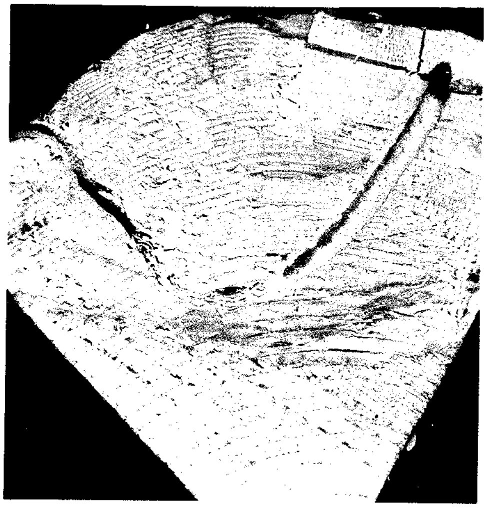

Fig. 8. Larval mine of *Monochamus scutellatus*. Note frass plug in centre and enlarged pupal cell at end of tunnel.

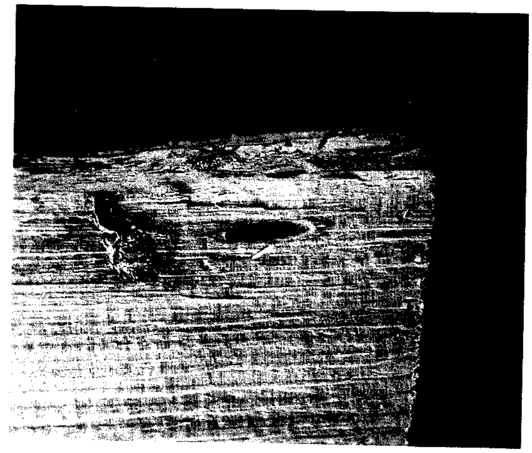

Fig. 9. Larval mine (left) and pupal cell (right) of *Tetropium* sp.

Fig. 10. Entrance hole, larval engraving and emergence hole of *Monochamus scutellatus*.

Fig. 11. Larval engraving and entrance hole of *Tetropium* sp. The entrance hole is more oval-shaped and enters the wood less obliquely than *Monochamus*.

PLATE XIV

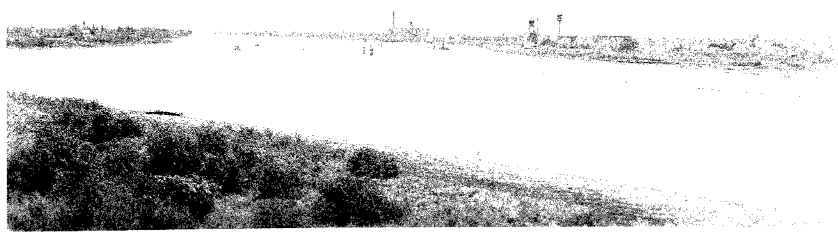

Fig. 12. The Pas Lumber Company Mill from across the Saskatchewan River. This mill has a daily capacity of 300,000 board feet.

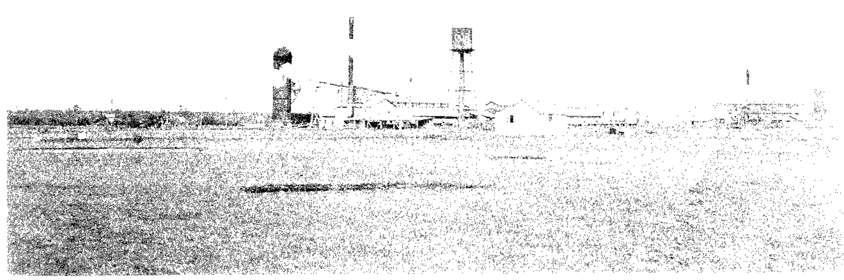

Fig. 13. The Pas Lumber Company mill viewed from the golf course.

with additional infestation developed in the second season, especially in the more lightly burned types. Type 5 increased 31% in this second season, as opposed to 4% for Type 4.

Larval mortality due, it is thought, to winter killing showed a direct correlation with burn types. The more recently attacked logs with a correspondingly higher percentage of shallow holes experienced the greatest death rate. Average mortalities based on depth of location showed that mortality decreased as deeper locations were reached.

Mill studies of logs sawed during the second summer after the fire showed a marked difference in borer penetration according to burn types. The greatest over-all damage was sustained by Type 3 logs, but Types 4 and 5 showed by far the greatest injury in the first outer board. The edging of boards from deeper cuts of Types 4 and 5 removed practically all holes.

Diameters and heights showed insufficient relation to borer attack to warrant any practical recommendations in this respect.

The salvaging of all types during the first winter following fire, and especially Types 4 and 5 during the second, will certainly ensure its utilization prior to the maximum of borer damage. The checking of logs, however, appears to be an important contributory factor in the deterioration of more severely burned logs, particularly in the second year following the fire.

VII. FOREST INSECT SURVEY

VII. FOREST INSECT SURVEY

A. Introduction

The area of service of the Winnipeg Laboratory, for the period covered in the report to follow, includes the forested areas of the provinces of Saskatchewan and Manitoba, together with northwestern Ontario eastwards as far as Heron Bay on Lake Superior, thence northward to James Bay.

The Forest Insect Survey has several objectives, some practical, some pure science, some immediate, some attainable only through the accumulation of knowledge over many successive years. These may be set forth in several ways but, underlying all arrangements of objectives, is the necessity for regarding the forest as a unit--trees, shrubs, herbs; soil, rocks, water; mammals, birds, insects; all operated upon by weather and climate and, when in adjustment, constitute the "balance of nature." These elements together form a community which we regard as the forest. It is to understand some of the fundamentals of this community that the Forest Insect Survey is organized and to use this increasing knowledge in the development and protection of our forests.

In specific terms, the objectives of the Survey are as listed below:

1. The location and delimiting of populations of highly dangerous forest insects, so that the maximum in forewarning of impending outbreak may be secured.

2. The annual sampling of these areas to reveal biological information relating to the status of such dangerous populations. Such information as relative proportion of males and females, the nature and incidence of parasitism, etc. being employed as yardsticks.

3. The reasonably accurate mapping of such populations to obtain a basis for graphic representation of increasing or decreasing infestation.

4. To broaden out and, eventually, catalogue completely knowledge of all forest insects in the areas concerned; dangerous, potentially dangerous, apparently innocuous, innocuous and beneficial. This is essential to full appreciation of the interplay of species in the same environment and for full knowledge of the parasite complex obtaining under any given set of conditions as found in the forest.

5. To increase the first-hand knowledge of those whose lives are spent in the woods, with respect to forest insects; their identification, significance, habits and all those peculiarities of life which set them apart one from another, and from other forest animals. To become familiar with common forest insects is as desirable as the knowledge of any other branch of woods lore.

Besides having objectives, the Survey has certain aims; these are highly practical, such as:

1. By the detection of new insect species in an area, to forewarn those concerned, if such are known to cause damage elsewhere.

2. Having forewarned, to assist in the preparations for salvage cuttings, modifications of management, or plans for silviculture, as indicated.

3. To provide the basic scientific information upon which a program of control by introduced parasitism, or by chemical means, may be founded.

4. To anticipate or perhaps predict future insect problems that may arise as a result of forest conditions or known outbreaks elsewhere, etc.

B. Resume of Methods

1. Field

To be fully effective in supplying information to those concerned with insect conditions, the Survey requires a constant seasonal supply of specimen material, reports, maps and reconnaissance collections and observations. As members of protection staff are becoming more acquainted with the simple procedures involved in cooperation, more material, good maps, and reports giving the area and severity of damage are coming in from the men in the field.

Field samplings may be direct, as when caterpillars are found feeding in a group, in which case the infested foliage is cut off and put directly into the box, or indirect, from the beating or brushing down of trees so that the insects they bear fall upon a tarp from which they are placed into a box with a portion of the foliage from the variety of tree concerned. A separate box should be used for the insects from each tree variety. A supply of fresh boxes is always available on request.

2. Laboratory

Upon arrival in the laboratory, the sample is opened, analyzed, recorded and set up for rearing in the insectary. Wherever possible, immature insects are reared through to adults. Adults may occur in the same season as larvae were collected, or development may only go so far and then cease, the insect becoming dormant and overwintering in that stage of growth. Such insects are placed outside in an overwintering box until the beginning of January, at which time they are brought into incubators and given an "artificial spring" which causes them to continue development to the adult condition.

In either case, it not uncommonly happens that a parasitic fly or wasp emerges where one's experience knows a moth or some other adult insect should have arisen. When this occurs, the value of the sample increases for a new, practical field of study at once opens up.

Quite often caterpillars, cocoons, etc. are submitted which are not known to us. In such cases, all that can be given immediately in the way of identification is the family to which the insect belongs. In this way, information gradually accumulates about obscure or unknown forest insects. When these family names are given, they may not convey very much to the person submitting the sample, but the vast majority of insects now coming in can be named and the person receiving such a name should consult the literature distributed by the Survey* for fuller information on the species. When these are not covered in the booklets, such information will be supplied on request.

It is hoped that what has gone before will serve to give a glimpse of the basic principles of the Forest Insect Survey.

C. Results

1. General

The number of samples received was still small by comparison with other districts, although the volume

* "Short Course of Instruction on Forest Insects"
"Canadian Forest Insects"

of budworm material received still remains high. It should be indicated here that Survey sampling throughout the Jack pine budworm infestation has contributed greatly toward an understanding of the nature of native parasites present in this territory. During the current year, a total of 11,653 budworm pupae was received and reared, from which a fairly comprehensive picture of the parasite complex, sex ratio, etc., has been obtained. Additional to the budworm, another 94 fully determined species of forest insects were secured, with at least that number of unidentified species. For the three years that the Survey has been operated by this laboratory, the following number of boxes have been received: 1941--389; 1942---379; 1943---390. The tremendous change in forest service personnel resulting from wartime conditions has been a serious but unavoidable handicap in any expansion of Survey work.

2. Major Pests of 1943

(a) Jack Pine Budworm

For details on distribution and intensity of infestations, see Section IV. Budworm Investigations, A. Reconnaissance and Mapping, Pp. 13 to 16.

(b) Spruce Budworm

For details on distribution and intensity of infestations, see Section IV. Budworm Investigations, A. Reconnaissance and Mapping, Pp. 16 and 17.

(c) European Larch Sawfly

For details see Pp. 95 to 97.

(d) Wood Borers

For details see Pp. 99 to 101.

(e) Forest Tent Caterpillar

Reports on this insect were meagre this season. The heavy infestation of the past three seasons north of Riding Mountain National Park (Gilbert Plains to Roblin) seems to have subsided. Only one sample was received from the same area that last season gave rise to a report of complete defoliation (Oatseed, Manitoba). East of Dauphin, however, the infestation increased its territory to Ste. Rose du Lac, some 30 miles away.

One epidemic of considerable size occurred in Manitoba this season, in an area hitherto unreported to this laboratory. The insect was reported rampant and completely stripping foliage between Ashern and Gypsumville, from the lakeshore to a depth of several miles. No samples were received, however, but in 1944 large collections in this area are desired.

(f) Jack Pine Tortoise Scale

This pest is still holding its own in the Sandilands Forest Reserve and this year it seems to have made some gain over last. From the Marchand Tower south and east to the outskirts of Piney, it is to be found, usually light and more or less patchy. An exception to this is a heavy area somewhat inside the southern boundary of the reserve and south of the Woodridge Ranger Station. This general area was likewise reported heavily affected in 1942.

A single female scale was sent in from Grandview Ranger Station. In acknowledging the sample, a request was made that a survey of the vicinity of the collection be made on the basis of the sooty appearance of trees affected by this insect. About 75% of between 500 and 600 trees were subsequently reported to bear this black fungus. It was also noted that in 1942 and 1943 "thousands" of wasps were about these trees. However, no further actual specimens were submitted and it must only be assumed that the scale was of infestation status in the area.

3. Minor Pests of 1943

(a) Yellow-headed Spruce Sawfly (*Pikonema alaskensis* Roh.)

This common spruce insect continues to be widely distributed and innocuous, except on the occasional ornamental tree.

Five samples were received from points in north central Saskatchewan (Meadow Lake, Endeavour, Torch River, Loon Lake) but none indicated that damage was arising from this insect.

Four Manitoba samples came in (Beresford Lake, Crawford Park, Fort Garry and Arnaud). A small seedling in the laboratory nursery provided some 25 larvae. Trees on the campus of the University of Manitoba have occasionally had large populations of this insect in years gone by. At Arnaud, ornamental spruce reportedly bore a fairly heavy population.

From Ontario, 27 samples were received (Rossport; Sioux Narrows; Kenora, Lake of Two Mountains; Wabigoon; Nestor Falls; Vermilion Bay; Kawene, French Lake; Graham; Flanders, Beaverhouse Lake; Malachi; Hurkett, Stirling Tower; Dryden; Redditt; Kawene, Eva Lake; Armstrong, Savant Lake; Beardmore; Suomi P.O., Whitefish Lake; Kashabowie). As is usual with this insect, notable infestation was upon ornamental trees. Thus, they are described as "increasing lately" at Hurkett, "quite numerous" at Malachi and Rossport, etc.

(b) Green-headed Spruce Sawfly (*Pikonema dimmockii* Cress.)

This insect is widely distributed but rarely attains the numbers of *P. alaskensis* Roh., although frequently associated with it.

One small sample from Saskatchewan (Loon Lake) came in and only four samples were received from Manitoba (Wanipigow River, Beresford Lake, Wabowden, Mafeking).

From Ontario, 9 samples were received (Kenora, Lake of Two Mountains; Hawk Lake; Ignace; Armstrong, Savant Lake; Kawene, Eva Lake; Beardmore; Sioux Lookout; Red Lake).

(c) Pine Needle Scale (*Phenacaspis pinifoliae* Fitch)

No reports from Saskatchewan were received concerning this insect. In the Spruce Woods Forest Reserve, Manitoba, there was a "widely prevalent population of medium abundance" in May. A heavy infestation of several years' standing of a stunting nature was reported on a blue spruce in Tuxedo and appropriate measures were suggested to control same. A sample was received from Moosehorn and two samples were received from Minitonas. In the latter case, Jack pine was the host and appeared to be overmature or decadent from the description provided.

Two samples were received from Ontario (Ignace, Scotch Lake; and Nestor Falls).

(d) Spruce Gall Aphid (*Adelges abietis* L.)

Only three samples were received of this usually common pest, there being one from each of the provinces (Manitoba, Saskatchewan and Ontario).

The Saskatchewan (Torch River) and Ontario (Vermilion Bay) reports indicated considerable abundance on white spruce. The Manitoba sample contained specimens of 1942 activity.

(e) Hemlock Looper (*Ellopia fiscellaria* Gn.)

No specimens of this insect were received from Saskatchewan, and only two arrived from Manitoba (English Brook, Crawford Park). From Ontario, 11 samples were received (Lost Bay, Uchi Lake; Jellicoe; Malachi; Minaki; Savant Lake, Sturgeon Lake; Armstrong; Savanne; Minataree; Graham; Hurkett, Stirling Tower).

At no point was the insect of infestation status.

(f) Marlatt's Larch Sawfly (*Anoplonyx laricis* Marl.)

One sample was received from Saskatchewan (Hudson Bay Junction), 10 from Manitoba (Buchan; Crawford Park; Rossburn; Hodgson; Riding Mountain National Park, Lake Katherine), and 9 from Ontario (Savanne; Graham; Suomi P.O., Whitefish Lake; Hurkett, Stirling Tower). Unusually large populations were found at Savanne and Graham and it will be of value to sample these same areas carefully in 1944 for comparative reasons.

(g) Green Larch Looper (*Semiothisa 6-maculata* Pack.)

No samples of this insect came in from Saskatchewan. Two samples were received from Manitoba (Belair; Riding Mountain National Park, Lake Katherine), and 8 from Ontario (Savanne; Graham; Suomi P.O., Whitefish Lake; Hurkett, Stirling Tower). Three unusually large samples were received from Savanne, totalling 129 larvae from 65 trees, or nearly 2 per tree. While this is not a significant average, it is of some interest to note that 65 trees provided this average, indicating a sizeable total population in the area. Because this area also produced a large population of Anoplonyx laricis Marl., it is doubly valuable to continue regular collections. While *Anoplonyx laricis* Marl. has not been a pest before, *S. 6-maculata* Pack. has at times caused heavy and extensive defoliation elsewhere. That these two species are abundant together might prove significant.

(h) Green Spruce Looper (*Semiothisa granitata* Gn.)

Only 3 samples were received, 2 from Ontario (Savanne, Graham) and 1 from Manitoba (Mafeking).

(i) Black-headed Budworm (*Peronea variana* Fern.)

No record was received from Saskatchewan and only 2 from Manitoba (Bissett, Long Lake; Manigotogan, English Brook). From Ontario, 20 samples were received, quite widely distributed as to locality (Rossport; Flanders, Beaverhouse Lake; Kenora; Nestor Falls; Hawk Lake; Jellicoe; Malachi; Ignace; Kawene; French Lake; Armstrong, Savant Lake; Sioux Lookout; Red Lake; Eva Lake; Vermilion Bay; Savanne). At Ignace, 22 larvae were recovered from one spruce tree 5" D.B.H., which is an unusually large population for the status of this pest in central Canada.

(j) Spruce Coneworm (Dioryctria reniculella Grt.)

No samples from Saskatchewan and but 1 from Manitoba (Bissett, Long Lake) were received, the insect being more abundant in Ontario, with 9 samples submitted from the following points: Pays Plat, Hudson, Jellicoe. This insect was of particular abundance at Pays Plat.

(k) Aspen Leaf Beetle (Chrysomela tremulae Fab.)

All samples of this insect originated in Ontario, 11 samples being received from the following points: Ignace (White Otter Lake); Garden Lake; Kawene (French Lake); Savant Lake (Sturgeon Lake); Wabigoon; Pakashkan Lake; Savanne; Graham; Armstrong (Caribou Lake). At Garden Lake, they were said to be "very thick" on small growth. The largest sample came from Pakashkan Lake, where they were said to be common in a dense stand of young poplar.

While a pest of aspen, this insect occurs on birch and occasionally is found on various species of conifers.

(l) Fir Sawfly (Neodiprion abietis Harris)

Ontario samples totalled 15. The following points supplied the material: Kawene (French Lake); Uchi Lake (Lost Bay); Kenora (Lake of Two Mountains); Nestor Falls; Graham; Pays Plat; Vermilion Bay; McIntosh; Malachi; Fort Frances (Sturgeon Lake); Minaki; Wabigoon; Kawene (Eva Lake); and 1 sample came in from Wabowden, Manitoba. At no point did this insect attain status other than that of an incidental.

(m) Red-headed Jack pine Sawfly (Neodiprion rugifrons Middleton)

One sample was received from Kawene (Eva Lake), Ontario, from Jack pine.

(n) Fir Tortrix (Tortrix packardiana Fern.)

From Manitoba, two samples were received (Spruce Woods Forest Reserve, mouth of Wanipigow River), while the Ontario collections numbered four (Geraldton; Pays Plat; Uchi Lake, Lost Bay; Minaki).

(o) Pitch Nodule Maker (Petrova albicapitana Busck.)

A sample was received from Spearhill, Manitoba, and from Geraldton, Ontario, but no report of extensive occurrence was received.

(p) White Pine Weevil (Pissodes strobi Peck.)

Two samples of this insect were received from Manitoba (Sprague, Moosehorn) and three from Ontario (Ignace, White Otter Lake; Uchi Lake, Lost Bay; Minataree). The Sprague sample indicated a population of 5 insects in the 1 shoot submitted, but no information was included which would indicate any marked local abundance of the pest.

(q) Fall Webworm (Hyphantria textor Harris)

Three samples were received, 2 from Ontario (Savant Lake, Sturgeon Lake; Wabigoon), and 1 from Manitoba (Riverton). The latter was a large one and represented an infestation on elm in the village of Riverton. Maple (Acer negundo) in the same areas was unaffected.

(r) Birch Leaf Skeletonizer (Bucculatrix canadensisella Chamb.)

Two samples of this insect were received, both from Ontario (Red Lake, Redditt). At the latter point, most of the birch in the district was unaffected. This insect, so widespread and epidemic in 1941, has apparently failed to attain the same status this past two seasons. However, it will be of value to watch this Redditt area in 1944 to see if it provides the focal point for the enlargement of infestation.

(s) False Hemlock Looper (Nepytia canosaria Wlk.)

Four samples were received, all from Ontario (Flanders, Beaverhouse Lake; Fort Frances, Russell Lake; Graham, Quorn; Kawene, Eva Lake).

(t) Leaf Beetles (Phytodecta sp.)

Two samples from north central Saskatchewan were accompanied by reports of extensive defoliations by these beetles. In the Cookson area, the report stated that defoliation has been intensive for the past 4 seasons and "several places have been noticed where trees are dead after having been stripped twice." In the Glaslyn area, small aspen were described as being denuded of leaves over an area one mile wide. One individual occurred in a sample of Altica from Pakashkan Lake, Ontario. The latter insect was in epidemic on alder throughout that district.

(u) Spruce Needle Rust (Chrysomyxa spp.)

This plant disease of spruce annually attracts considerable attention, particularly in areas traversed by air patrols where its presence is conspicuous and alarming.

During 1943, this disease, while restricted in extent, occurred on a large scale in Prince Albert National Park, westerly to Green Lake; north of the Torch River; and another smaller pocket occurred from Hudson Bay Junction south for a distance of some 10 miles along the highway. In Manitoba, it was reported very heavy and extensive in the Simonhouse Lake area northeast of the Pas, while, in Ontario, a localized infection centred on Wabigoon. It was present on foliage in a sample from 17 miles of Kenora, Trans-Canada Highway.

(v) Reddish-yellow Spruce Budworm (Zeiraphera ratzeburgiana Sax.)

One specimen was received from Pays Plat, Ontario.

(w) Grey Spruce Tussock Moth (Olene plagiata Wlk.)

Four samples of this insect were received, two from Manitoba (Stead; Manigotogan, Wanipigow River); and two from Ontario (Uchi Lake, Lost Bay; Mobert, White Lake).

D. Survey Summary Tables

The following tables summarize the foregoing in a manner, it is hoped, that will make for the greatest interest. The material deals first of all with the highly important insects and then with the species most frequently encountered. Lesser known or more seldom occurring species are not dealt with.

INSECT	LARVAL DESCRIPTION	STAGE CAUSING DAMAGE AND HOW CAUSED	TREE VARIETIES AFFECTED	OCCURRENCE	INTERVALS FOUND AS: LARVA	PUPA	ADULT	WINTER PASSED AS:	MANITOBA	NO.	SASKATCHEWAN	NO.	ONTARIO	NO.
Cacoecia Fumiferana Clem. Spruce Budworm	(Head black, area immediately (behind head black, separated (from head by light narrow (area (prothoracic shield). (Body color dark reddish-brown, (with two rows of cream spots, (each spot bearing a fine, (light-colored hair. Yellowish (stripes on lower sides. (Adult: Greyish.	Larval feeding separates needles close to their bases. Larva feeds inside a silken tube to which severed needles adhere. As these die, they give tree a scorched look.	White spruce Balsam fir Less commonly Black spruce	Uncommon in central Canada	Early May to early June	Late May to mid-June	Early June	Small larva on twigs	Sandilands Moosehorn Lac du Bonnet Buchan Whitemouth Richer Pine Falls Sprague Carberry Riverton Beresford Lake Total	1 2 1 1 1 1 2 1 1 1 1 13	None received.		Sioux Lookout Hudson Ignace Emo Flanders Kawene Wabigoon Nestor Falls Crow L. (Kenora) Vermilion Bay Graham Hurkett Rossport Beardmore Savanne Geraldton Armstrong McIntosh Minaki Dryden Suomi Kenora Ft. Frances Quetico Park Pt. Arthur Total	2 1 5 1 2 5 3 2 1 6 3 1 2 2 9 5 2 1 1 2 2 2 1 3 3 67
Jack pine Budworm	(Head reddish-brown; dark (shield as above; body color (olive-green to brownish- (green; cream spots as above; (stripes on sides more cream (than yellow. (Adult: Copperish.		Jack, Norway, White, Scotch pines; less commonly Black and White spruce. Sometimes found on Tamarac.	Common or epidemic over wide areas	Late May to early July	Late June to late July	Mid-July to early August	Small larva on twigs						

INSECT	LARVAL DESCRIPTION	STAGE CAUSING DAMAGE AND HOW CAUSED	TREE VARIETIES AFFECTED	OCCURRENCE	INTERVALS FOUND AS: LARVA	PUPA	ADULT	WINTER PASSED AS:	MANITOBA	NO.	SASKATCHEWAN	NO.	ONTARIO	NO.
<u>Pristiphora erichsonii</u> Htg. European Larch Sawfly	Head black; grey-green to neutral grey above in one broad band extending fully from behind head to end of body, and downwards on the sides to just above the level of the legs. Below, an off-white or dingy-cream color.	Larvae cause damage by eating needle-bundles, producing stunting or death. Adults cause "bishop's crooks" at twig ends.	Native Tamarack Imported or oriental tamarack (Siberian, European).	Widespread	June, July	August	May and June	**Cocoon in moss**	Riverton Winnipeg Charleswood Fort Garry Boissevain Hodgson Pine Falls Whitemouth Riding Mtn. National Park Total	2 1 1 1 1 3 1 1 10 21	None received. Negative reports for Meadow Lake District, Crooked River, Somme. May be present north of Pelly.		Kenora Wabigoon Graham Total	2 1 1 4
<u>Malacosoma disstria</u> Hbn. Forest Tent Caterpillar	Head blue-black, sides bright bluish with darker central area along back interrupted by diamond-shaped or exclamation mark-like white spots. Thin yellow lines also present on back. Very hairy. Become agitated when disturbed.	Larvae do not form tent. Are gregarious. Leave a trail of silk along ground and on tree trunks. Eat leaves entire.	Aspen, Elm, Birch, Willow, Maple, Oak, Ash, all small shrubs. Will not accept Black Poplar.	Widespread. Usually go in cycles often of 3 to 4 years' duration.	Late May to mid-June.	Mid-June to mid-July	Mid-July to Aug.	**Egg.** **In rings on top twigs of trees.**	Fort Garry Moosehorn Oatseed Total	1 1 1 3	None received.		None received.	
<u>Toumeyella</u> sp. Jack pine Tortoise Scale	Adult Male: Minute, winged, rarely seen, only lives a few days. Adult Female: Tortoise-shaped, waxy reddish-black in color. Permanently clings to twigs and branches. Young Scales: Exceedingly small at first; after settling down, become whitish in color, somewhat oblong in shape.	All, except adult male. The sucking of plant sap by the thousands of these scales often found on quite small trees weakens, stunts buds, etc.	Jack pine Scotch pine	Restricted to areas of high infestation, limited in number at present. Can spread rapidly.	Nymphal state lasts almost whole year, mature females appearing in mid-June and giving rise to a new nymphal population by early July. Males appear at time of greatest mature female scales. Males live 2-3 days.			**Nymphs, half-grown, fertilized females.**	Grandview Sandilands to Piney (Field report)	1	None received.		None received.	

INSECT	LARVAL DESCRIPTION	STAGE CAUSING DAMAGE AND HOW CAUSED	TREE VARIETIES AFFECTED	OCCURRENCE	INTERVALS FOUND AS: LARVA	PUPA	ADULT	WINTER PASSED AS:	MANITOBA	NO.	SASKATCHEWAN	NO.	ONTARIO	NO.
Pikonema alaskensis Roh. Yellow-headed Spruce Sawfly	Head reddish-yellow to deep tan color; body green or yellow-green with dark olive-green stripes along sides; a pair of thin central lines on back.	Larvae chew needles, feeding in colonies and methodically working from tips of twigs in.	Black and White Spruce	Widespread. Chiefly found on ornamental trees and transplants when doing damage.	June to Aug.	Mid-July to Sept. & overwinter.	May to June	Cocoon	Fort Garry Beresford Lake Arnaud Riding Mtn. National Park Total	1 1 1 1 4	Meadow Lake Torch River Endeavour Loon Lake Total	1 1 1 2 5	Rossport Sioux Narrows Kenora Wabigoon Vermilion Bay Kawene Flanders Malachi Hurkett Dryden Redditt Armstrong Beardmore Suomi Kashabowie Nestor Falls Total	3 1 1 2 1 8 2 1 1 1 1 1 1 1 1 1 27
Pikonema dimmockii Cress. Green-headed Spruce Sawfly	Head green with narrow greyish marking on each cheek. Body dark apple-green, two narrow white lines central on back, one white line, broader, on each side.	Larvae chew needles, feeding in colonies and methodically working from tips of twigs in.	Black and White Spruce	Widespread. Never abundant. Usually found with alaskensis in forest areas	June to Aug.	July to Sept. & overwinter	May to June	Cocoon	Lac du Bonnet Bissett Wabowden Mafeking Total	1 1 1 1 4	Loon Lake	1	Kenora Hawk Lake Ignace Armstrong Kawene Beardmore Sioux Lookout Red Lake Total	1 1 1 1 2 1 1 1 9

INSECT	LARVAL DESCRIPTION	STAGE CAUSING DAMAGE AND HOW CAUSED	TREE VARIETIES AFFECTED	OCCURRENCE	INTERVALS FOUND AS: LARVA	PUPA	ADULT	WINTER PASSED AS:	MANITOBA	NO.	SASKATCHEWAN	NO.	ONTARIO	NO.
Chrysomela tremulae Fab. Aspen Leaf Beetle	Shiny black head and shield; body tapers backward almost to a point. Body color a dull orange, bearing three rows of black, broad tubercles on the back and a row along each side. Pupae salmon color.	Larvae; reduce leaves to a ragged skeleton.	Aspen chiefly, occasionally Birch	Widespread, common and occasionally destructive.	June to July	July	July to Aug.	Egg(?)	None received.		None received.		Kawene Savant Lake Ignace Garden Lake Wabigoon Pakashkan Lake Savanne Armstrong Total	2 2 1 1 1 2 1 1 11
Adelges abietis L. Spruce Gall Aphid	Presence of insect noted more by pineapple-like gall it produces than by insects themselves. Young are insignificant, being minute and enclosed within the needle bases going to make up the gall. Early in season, gall is scarlet, later fading and finally becoming brown.	Gall causes distortion of needles affected. In heavy infestation, tree's vitality becomes drained.	White Spruce	Widespread, common.	Seasonal history complicated. Briefly, nymphs emerge in spring and mature females arise, lay eggs which hatch early in June and produce new nymphs. These settle on needles, causing them to swell. Eventually, swollen needles hide the nymphs. Nymphs feed until mature and females again present about end of July. From eggs laid by these, the overwintering nymphs arise.			Nymph in bud crevices	Grandview	1	Torch River	1	Vermilion Bay	1

INSECT	LARVAL DESCRIPTION	STAGE CAUSING DAMAGE AND HOW CAUSED	TREE VARIETIES AFFECTED	OCCURRENCE	INTERVALS FOUND AS: LARVA	PUPA	ADULT	WINTER PASSED AS:	MANITOBA	NO.	SASKATCHEWAN	NO.	ONTARIO	NO.
Petrova albicapitana Busck. Pitch Nodule Maker	Larva less often seen than evidence of injury. Injury manifests itself as a soft resinous swelling, more or less surrounding the main shoot or a strong side branch, frequently of young trees in transplant beds. May kill leader or branch from nodule outwards. Larva inside pitch nodule is of reddish color.		Pines	Widespread, common.	May to July	Presumably July		Larva	Spearhill Douglas Total	1 1 2	None received.		Geraldton	1
Neodiprion abietis Harris Fir Sawfly	Head black; body olive-green or sometimes (pine varieties) red-brown, with four dark stripes, two on back, one along each side.	Larva feeds on needles.	Spruces Balsam Pines	Widespread, common.	June to July	July	July to Sept.	Egg	Wabowden	1	None received.		Graham Rossport Malachi Minaki Kawene Uchi Lake Kenora Nestor Falls Vermilion Bay McIntosh Fort Frances Wabigoon Total	2 1 1 2 2 1 1 1 1 1 1 1 15
Neodiprion rugifrons Middleton Red-headed Jack pine Sawfly	Head brown; greyish-green body with conspicuous dark stripes on back and black spots on sides above the legs.	Larva eats needles.	Jack pine	More localized, uncommon.	July	Aug.	June	Cocoon	None received.		None received.		Kawene	1

INSECT	LARVAL DESCRIPTION	STAGE CAUSING DAMAGE AND HOW CAUSED	TREE VARIETIES AFFECTED	OCCURRENCE	INTERVALS FOUND AS: LARVA	PUPA	ADULT	WINTER PASSED AS:	MANITOBA	NO.	SASKATCHEWAN	NO.	ONTARIO	NO.
Tortrix packardiana Fern. Fir Tortrix	Head green with isolated brown or black markings; light green body color. Very active when disturbed.	Feed on needles, binding them with filmy silken thread.	Spruces Balsam	Fairly common	June	June to July	June to July	Larva	Spruce Woods Forest Reserve Wanipigow River Total	1 1 2	None received.		Geraldton Pays Plat Uchi Lake Minaki Total	1 1 1 1 4
Dioryctria reniculella Grt. Spruce Coneworm (foliage variety)	Head black-brown; body a dirty cream or grey-brown with two broad, black, longitudinal stripes. Similar form mines out cones.	Larva feeds on foliage, living amidst a nest of silk & frass.	Spruces	Widespread	June	July	July	Larva	Bissett	1	None received.		Pays Plat Hudson Jellicoe Total	6 1 2 9
Hyphantria textor Harris Northern Fall Webworm	Colors vary, but are mainly greenish or yellowish, intermixed with grey areas. Larva covered with long grey hairs which arise from black and orange-yellow tubercles. There is a dusky stripe down middle of back and a yellow one along each side.	Larvae feed in clusters inside a web. Completely strip all leaves inside web and then move on to fresh food supply.	Almost all shrubs and deciduous trees	Widespread	July to Aug.	Aug.	June to July	Pupa in silk cocoon	Riverton	1	None received.		Savant Lake Wabigoon Total	1 1 2

INSECT	LARVAL DESCRIPTION	STAGE CAUSING DAMAGE AND HOW CAUSED	TREE VARIETIES AFFECTED	OCCURRENCE	INTERVALS FOUND AS: LARVA	PUPA	ADULT	WINTER PASSED AS:	MANITOBA	NO.	SASKATCHEWAN	NO.	ONTARIO	NO.
Bucculatrix canadensisella Chamb. Birch Leaf Skeletonizer	Slender, yellowish-green in color, very active when disturbed. Drop on silken threads.	Eat green surface material. Affect under parts of leaves only. Expose veining showing leaf skeleton.	Birches	Widespread	Early Aug. to Sept.	Late Aug. to Sept.	July	Pupa	None received.		None received.		Red Lake Redditt Total	1 1 2
Zeiraphera ratzeburgiana Sax. Reddish-yellow Spruce Budworm	Head light reddish-brown, larva smallish, yellow or honey-color, with a broad band down the back of same color as head. Active.	Form a filmy web in new shoots, feeding on developing needles.	White Spruce	Widespread, common.	Early June	Late June	Early July	Larva	None received.		None received.		Rossport	1
Olene plagiata Wlk. Grey Spruce Tussock Moth	Larva has a flattish appearance due to the dense coat of long grey and black hairs, intermingled with white. Four conspicuous bushy tufts of grey arise immediately behind the head and long pencils of hair stick out above larva in front and behind.	Feeds on needles.	Spruces Pines Tamarack Some hardwoods	Widespread, not very common.	Spring to fall due to overlapping of generations	Mid-June to early July	June, July, Aug.	Larva	Stead Manigotogan Total	1 1 2	None received.		Uchi Lake Mobert Total	1 1 2

INSECT	LARVAL DESCRIPTION	STAGE CAUSING DAMAGE AND HOW CAUSED	TREE VARIETIES AFFECTED	OCCURRENCE	INTERVALS FOUND AS: LARVA	PUPA	ADULT	WINTER PASSED AS:	MANITOBA	NO.	SASKATCHEWAN	NO.	ONTARIO	NO.
Nepytia canosaria Wlk. False Hemlock Looper	Larva occurs in two color (or reddish brown) phases. Head green with pronounced black spots. Body color either green with well-marked dark and light lines and stripes; or yellowish with red-brown broad stripe on central back portion, two lateral red-brown stripes edged with black and a broad yellow stripe above legs along sides. Red phase occurs once in 5.	Larva eats needles. Not known to be serious.	Spruces Balsam Pine	Widespread	June to July	July to August	July to August	Egg	None received.		None received.		Flanders	1
													Fort Frances	1
													Graham	1
													Kawene	1
													Total	4
Peronea variana Fern. Black-headed Budworm	Head black or black-brown, margins of prothoracic shield of same color. Rest of body clear green.	Larva feeds on needles, especially of expanding buds. Feeds inside silk web.	Spruces Balsam	Not commonly received to date	June to July	July	July	Egg	Bissett	1	None received.		Rossport	1
									Manigotogan	1			Flanders	1
									Total	2			Kenora	1
													Nestor Falls	1
													Hawk Lake	2
													Malachi	1
													Ignace	1
													Kawene	2
													Savant Lake	1
													Sioux Lookout	1
													Red Lake	5
													Vermilion Bay	1
													Savanne	1
													Jellicoe	1
													Total	20

INSECT	LARVAL DESCRIPTION	STAGE CAUSING DAMAGE AND HOW CAUSED	TREE VARIETIES AFFECTED	OCCURRENCE	INTERVALS FOUND AS:			WINTER PASSED AS:	MANITOBA	NO.	SASKATCHEWAN	NO.	ONTARIO	NO.
					LARVA	PUPA	ADULT							
Anoplonyx laricis(Marl.) Marlatt's Larch Sawfly	Head light greenish-brown; body pale apple-green, faintly greener stripe on each side. Smallish size.	Larva eats needle, but at present inconsequential.	Larch	Widespread	June to July. Sometimes September.	July to Aug.	June	Cocoon in moss	Buchan Crawford Park Rossburn Hodgson Riding Mountain National Park Total	1 3 3 2 1 10	Hudson Bay Junction	1	Savanne Graham Suomi P.O. Hurkett Total	3 3 1 2 9
Semiothisa sexmaculata Pack. Green Larch Looper	Head green; body green with lateral stripes of darker green. A few larvae may be brownish in color.	Larvae eat needles.	Larch	Widespread.	June to Aug.	Aug.	May to June	Pupa in ground	Belair Riding Mountain National Park Total	1 1 2	None received.		Savanne Graham Suomi P.O. Hurkett Total	3 3 1 1 8
Semiothisa granitata Gn. Green Spruce Looper Differs from larch looper in brownish check markings.	Head green with dark brown mark on each side; body green with lateral stripes of darker green, occasionally black. A few larvae may be darker than the average.	Larvae eat needles.	Black and White Spruce. Sometimes Larch and Pines.	Widespread	June to Aug.	Aug. to Sept.	May to June	Pupa in ground	Mafeking	1	None received.		Savanne Graham Total	1 1 2
Ellopia fiscellaria Gn. Hemlock Looper	Head light ground-color, heavily spotted with black; body greyish or greyish-yellow, may be quite dark grey, bearing double row of black dots on back arranged to make groups of four.	Larva eats needles. Has been very destructive in past in some areas.	Spruces Pine. Aspen occasionally.	Widespread	June	July to Aug.	Aug. to Oct.	Egg	Manigotogan Crawford Park Total	1 1 2	None received.		Uchi Lake Jellicoe Malachi Minaki Savant Lake Savanne Minataree Graham Hurkett Total	1 1 1 1 2 1 1 1 2 11

INSECT	LARVAL DESCRIPTION	STAGE CAUSING DAMAGE AND HOW CAUSED	TREE VARIETIES AFFECTED	OCCURRENCE	INTERVALS FOUND AS: LARVA	PUPA	ADULT	WINTER PASSED AS:	MANITOBA	NO.	SASKATCHEWAN	NO.	ONTARIO	NO.
<u>Phenacaspis pinifoliae</u> Fitch Pine Needle Scale	Presence of insect noted by appearance on needles of white, oval or oblong flecks. Tree may be white with them in heavy cases.	Scale insects suck juices from needles and reduce thrift and vitality of trees.	Spruces Pines	Widespread over North America, common.	Eggs hatch in early June and nymphs settle on needles (This is the only time spraying is really effective). Nymphs develop into male or female scales about mid-August. Eggs laid late Aug. or Sept.			Egg	Spruce Woods Forest Reserve Tuxedo Moosehorn Minitonas Total	1 1 1 2 5	None received.		Ignace Nestor Falls Total	1 1 2
<u>Chrysomyxa rust</u> Spruce Needle Rust NOT AN INSECT	This fungus occurs all across the forested area of central Canada, attacking white and black spruce needles. From the air, during an epidemic, the picture presents an alarming pattern of infected spruce, as far as the eye can see. However, forest pathologists do not consider this a very serious disease unless it recurs frequently, since, although the infected needles will fall off, the buds and next year's growth are unaffected. Three species occur, each having one of the following alternative hosts: Labrador tea, sheep laurel and leather leaf.				Most visible in August.				Simonhouse Lake		Prince Albert National Park Green Lake Hudson Bay Junction		Wabigoon Kenora	
<u>Pissodes strobi</u> Peck. White Pine Weevil	Insect noted by characteristic damage. Inside injured shoots will be found plump, whitish grubs with yellowish heads. These are the larvae.	Eat out growing tissue of leaders and cause distortion of future trunk.	Pines Spruce	Widespread, common. Destructive in plantings and to ornamentals.	June to July	July	July to Sept.	Adult	Sprague Moosehorn Total	1 1 2	None received.		Ignace Uchi Lake Minataree Total	1 1 1 3

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
F. Mayson	Farlane via Redditt	June 16	74347	Spruces	1 larva of a moth, Lepidoptera sp.; 1 larva of a tiger moth, Arctiidae sp.; 1 larva of a climbing cutworm, Phalaenidae sp.; 6 adults of the 3-barred click beetle, Ludius triundulatus Rand.; 1 adult of the 2-barred click beetle, Ludius propola Lec.; 3 adults of the inky click beetle, Ludius appropinquans Rand.; 1 adult of a click beetle, Ludius splendens Zieg.; 2 adults of the polished click beetle, Ludius nitidulus Lec.; 2 adults of a very small click beetle, Elateridae sp.
James Peden	McIntosh Canyon L.	June 16	74346	Spruce	1 larva of a climbing cutworm, Phalaenidae sp.; 7 adults of the inky click beetle, Ludius appropinquans Rand.; 2 adults of the 2-barred click beetle, Ludius propola Lec.; 1 adult of a small click beetle, Limonius aeger Lec.; 2 adults of 2 different species of click beetles, Elateridae sp.; 1 adult of a firefly, Lucidota corrusca L.; 2 small adults of 2 different species of oil-beetles, Meloidae sp.;

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140

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30,1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
James Peden Cont'd					1 adult of the pine ladybird, Cleis picta Rand.; 1 adult of a flat-bug, Aradidae sp.
J. Yousans	Malachi Rudd Twp.	June 16	74440	Jack pine	3 adults of the inky click beetle, Ludius appropinquans Rand.; 2 adults of a click beetle, Ludius splendens Zieg.; 1 adult of the dun click beetle, Ludius medianus Germ.; 2 adults of two different species of click beetles, Elateridae sp.; 1 adult of a small ground beetle, Carabidae sp.; 1 adult of a weevil, Curculionidae sp.; 1 nymph of a plant bug, Hemiptera sp.
H. Stone	Minaki Townsite	June 17	74431	Jack pine	1 larva of a tiger moth, Arctiidae sp.; 4 adults of the 2-barred click beetle, Ludius propola Lec.; 1 adult of the 3-barred click beetle, Ludius triundulatus Rand.; 1 adult of a June-bug, Dichelonyx sp.; 1 adult of a darkling beetle, Tenebrionidae sp.; 1 large adult of a firefly, Pyractomena borealis Rand.; 2 small fireflies, Lampyridae sp.; 1 adult of a metallic borer, Dicerca sp.;

Cont'd

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
H. Stone Cont'd					1 adult of a larger metallic borer, Buprestidae sp.; 1 adult of a click beetle, probably Ampedus evansi Brown; 1 adult of a click beetle, Ludius splendens Zieg.; 3 adults of 3 species of click beetles, Elateridae sp.; 1 adult of a flat-bug, Aradidae sp.
A. King	Ignace White Otter Lake, Sandy.	June 21	74340	Jack pine	2 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 2 cocoons of a Jack pine sawfly, Neodiprion sp.; 1 larva of a looper, Geometridae sp.; 1 dead larva of a looper, Geometridae sp.; 1 larva of a leaf-roller, Tortricidae sp.; 2 adults of the aspen leaf beetle, Chrysomela tremulae Fab.; 1 adult of the white pine weevil, Pissodes strobi Peck.; several larvae of a ladybird beetle, Coccinellidae sp.; 1 larva of amother looper, Geometridae sp.

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
A. King	Ignace White Otter Lake, Sandy.	June 21	74339	Spruce:	1 larva of a climbing cutworm, Phalaenidae sp.; 1 larva of the dotted line geometer (looper), Protoboarmia porcelaria Gn.; 1 larva of a large looper, probably the pine measuring worm, Paraphia piniata Pack.; this larva bears two eggs of a parasite on its side; 2 larvae of another species of climbing cutworm, Phalaenidae sp.; 1 adult of the 2-barred click beetle, Ludius propola Lec.; 1 adult of the modest soldier bug, Podisus modestus Dall.
J. Jorgenson	Ignace Post, down Scotch R. 1 mi. N. Scotch Lake.	June 21	74698	Jack pine	3 adults of the 3-barred click beetle, Ludius triundulatus Rand.; 1 adult of a small ground beetle, Platynus sp.; 3 adults of the pine needle scale, Phenacaspis pinifoliae Fitch.
J. Jorgenson	Ignace Scotch Lake Post.	June 21	74326	Spruce	5 larvae of a climbing cutworm, Autographa sp.; 1 larva of another climbing cutworm, Phalaenidae sp.; 1 prepupa of a third climbing cut-worm, Phalaenidae sp.; 1 larva of the spruce budworm, Cacoecia fumiferana Clem.;

Cont'd

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Jorgenson Cont'd					1 larva of a leaf-roller, *Tortricidae* sp.; 2 larvae of a brown spruce looper, *Eupithecia* sp.; 1 larva of another looper, *Geometridae* sp.; 1 larva of another leaf-roller, *Tortricidae* sp.; 2 adults of the inky click beetle, *Ludius appropinquans* Rand.; 1 injured larva of a climbing cutworm, *Phalaenidae* sp.
A. Robson	Ignace 9 mi. W. of, Osaquan.	June 22	74001	Jack pine	A considerable number of needles showed signs of fungus (rust) infection. Some were dead from this cause. 2 adults of the splendid click beetle, *Ludius splendens* Zieg.; 1 dead larva of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 old pupa skin of same.
A. Robson	Ignace 3 mi. W. of, 22.	June 22	74002	Spruce	2 larvae of a climbing cutworm, *Autographa* sp.; 1 larva of a leaf-roller, *Tortricidae* sp.

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
E. Bohlin	Vermilion Bay Pine Tower	July 1	74100	Spruce Jack pine Poplar Birch	3 adults of the 2-barred click beetle, Ludius propola Lec.; 8 adults of the inky click beetle, Ludius appropinquans Rand.; 3 adults of a click beetle, Ludius splendens Zieg.; 1 adult of the polished click beetle, Ludius nitidulus (Lec.); 2 adults of the dun click beetle, Ludius medianus Germ.; 1 adult of a large click beetle, Elateridae sp.; 2 adults of a very small click beetle, Elateridae sp.; 1 adult of the forest ladybird, Cleis picta Rand.; 2 adults of the modest stink bug, Podisus modestus Dall.; 3 adults of a small leaf-beetle, Chrysomelidae sp.
Bert Knutson	Sioux Narrows Whitefish Bay, Twp. of Wellingdon	July 1	74600	White spruce	14 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 2 dead larvae of same, 1 parasitized by a small wasp, Braconidae sp.; 3 larvae of 3 species of aphid-eaters, Syrphidae sp.; 3 small oil-beetles, Meloidae sp.; 1 larger oil-beetle, Meloidae sp.

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
Bert Knutson	Sioux Narrows Whitefish, Twp. of Wellingdon	July 1	74691	White pine	4 larvae of an aphid-eater, Syrphidae sp.; several score plant lice, Aphidae sp.; 5 adults of an alder fly, Sialidae sp.
L. Kerr	Kenora Lake of Two Mountains, Forgie Twp.	July 2	74123	Spruce	1 larva of the spruce budworm, Cacoecia fumiferana Clem.; 12 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 2 larvae (1 parasitized) and 1 cocoon of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 4 larvae of the fir sawfly, Neodiprion abietis Harris; 1 larva of the webbing spruce leaf miner, Taniva albolineana Kft.; 1 pupa, probably of same; 2 larvae of the black-headed budworm, Peronea variana Fern.; 1 cocoon of a parasitic wasp, Braconidae sp.; 2 adults of the 2-barred click beetle, Ludius propola Lec.; 2 adults of the inky click beetle, Ludius appropinquans Rand.; 1 adult of another click beetle, Elateridae sp.;

146

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
L. Kerr	Kenora Lake of Two Mountains, Forgie Twp.	July 2	74122	Balsam	1 parasitized larva of a looper, *Geometridae* sp.; possibly *Eupithecia* sp.; 1 prepupa of a climbing cutworm, *Phalaenidae* sp.; 1 adult of the 2-barred click beetle, *Ludius propola* Lec.; 1 adult of the apple ladybird, *Anatis mali* Say; 1 adult of a blister beetle, *Meloidae* sp.; 1 adult of a beetle, *Coleoptera* sp.
W. Potts	Wabigoon Zealand Twp.	July 5	54880	Spruce	24 larvae of the yellow-headed spruce sawfly, *Pikonema alaskensis* Roh.; 1 larva of the spruce budworm, *Cacoecia fumiferana* Clem., parasitized by the grub of a very small wasp, *Chalcidae* sp.
J. Anderson	Wabigoon, vicinity of, Zealand Twp.	July 6	74678	Birch Poplar	1 adult of the aspen leaf-beetle, *Chrysomela tremulae* Fab.; 1 adult of a lace bug, *Tingidae* sp.
J. Anderson	Wabigoon, vicinity of,	July 6	74679	Jack pine	1 larva of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 cocoon of a small parasitic wasp, *Braconidae* sp., a parasite of the budworm.

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R.D. Kendall	Nestor Falls	July 7	74683	Jack pine	24 larvae and 7 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 larva of the red-striped spruce caterpillar, Feralia jocosa Gn.; 1 larva of the chameleon caterpillar, Anomogyna elimata Wlk.; 1 larva of a horntail, Sphingidae sp.; 2 larvae of the fir sawfly, Neodiprion abietis Harris; 1 larva of a tussock moth, Liparidae sp.; 1 larva of a climbing cutworm, Phalaenidae sp.; 1 dead larva of another species of climbing cutworm, Phalaenidae sp.; 1 adult of a tarnished plant bug, Miridae sp.
R.D. Kendall	Nestor Falls	July 7	74682	Spruce	13 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 2 dead larvae of same; 2 dead larvae of the spruce budworm, Cacoecia fumiferana Clem.; 1 larva of a climbing cutworm, Phalaenidae sp.; 5 larvae of the black-headed budworm, Peronea variana Fern.; 1 larva of another climbing cutworm, Phalaenidae sp.; 2 larvae of an aphid-eater, Syrphidae sp.; several female scales of the pine needle scale, Phenacaspis pinifoliae Fitch.

148

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
W. Coppard	Vermilion Bay, 3 mi. E. of, Wabigoon Twp.	July 9	74718	Jack pine	40 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 5 pupae of same; 21 larvae of same, parasitized by a fly maggot, Tachinidae sp.; 27 larvae of same, dead from other causes.
W. Coppard	Vermilion Bay, 2 mi. E. of, Wabigoon Twp.	July 9	74719	Jack pine	8 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 3 parasitized larvae of same; 3 cocoons of a small parasitic wasp, Braconidae sp., and 1 cocoon of a parasitic fly, Tachinidae sp., parasites of budworm larvae; 12 dead budworm larvae, probably diseased; 1 larva of a looper, Geometridae sp.; 1 larva of the pine amorbia, Amorbia humerosana Clem.; 1 adult of a true bug, Hemiptera sp.
W. Coppard	Vermilion Bay, 1 mi. N.E. of, Langton Twp.	July 9	74717	Spruce	7 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 2 dead larvae of same.
W. Coppard	Vermilion Bay, 1 mi. east of, Langton Twp.	July 9	75000	Spruce	Numerous galls caused by a plant louse-like insect, the spruce gall aphid, Adelges abietis L.

149

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Stanker	Crow Lake By Crow Lake Tower	July 9	74362	Pine	4 larvae and 4 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 5 parasitized larvae of same; 1 dead larva of same, apparently eaten by a predator; 1 adult of the inky click beetle, Ludius appropinquans Rand.; 2 adults of another click beetle, Ludius splendens Zieg.
W. Coppard	Vermilion Bay Mile 88 on C.P.R., Mutree Twp.	July 13	74724	Jack pine	75 larvae and 75 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 24 parasitized larvae of same; 1 larva and 15 cocoons of a parasitic fly, Tachinidae sp., from budworm larvae; 1 pupa of a parasitic wasp, Glypta sp., from a budworm larva; 25 dead larvae and 9 dead pupae of the budworm; 1 dead larva of the fir sawfly, Neodiprion abietis Harris; 2 adults of the 2-barred click beetle, Ludius propola Lec.; 1 adult of another click beetle, Elateridae sp.; 2 adults of a spittle-bug, Aphrophora sp.; 1 adult of the apple ladybird, Anatis mali Say.

150

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
W. Coppard	Vermillion Bay Mutrie Twp.	July 13	74725	Jack pine	29 larvae and 44 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 4 dead larvae of same; 7 larvae of same parasitized by a fly, Tachinidae sp.; 1 larva of same parasitized by a small wasp, Braconidae sp.; 1 larva of same parasitized by a larger wasp, Glypta sp.; 1 adult of a tarnished plant bug, Miridae sp.; numerous adults of the balsam twig aphid, Mindarus abietinus Koch; 1 larva of a shoot moth, Olethreutidae sp.
J. Foden	McIntosh Vicinity Canyon Lake	July 14	74343	Jack pine	14 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 6 larvae of same, parasitized by a fly, Tachinidae sp.; 1 dead larva and 1 injured pupa of the budworm; 2 living and 1 dead larvae of the fir sawfly, Neodiprion abietis Harris 1 larva of a looper, Geometridae sp.; 4 adults of a spittle bug, Aphrophora sp.; 1 adult of a climbing cutworm, Phalaenidae sp.; 3 adults of 3 forms of click beetle, Elateridae sp.;

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ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Peden Cont'd					1 adult of a long-horned borer, Cerambycidae sp.; several larvae (predacious) of a ladybird, probably the 2-spotted, Hyperaspis binotata Say.
A.W. Leman	Kenora	July 15	74093	White spruce	1 pupa of the spruce budworm, Cacoecia fumiferana Clem.; 1 larva of a false webworm, Cephalcia sp.
J. Youmans	Malachi	July 15	74441	Spruce	1 larva of the black-headed budworm, Peronea variana Fern.; 2 dead larvae of same; 2 larvae of the hemlock looper, Ellopia fiscellaria Gn.; 1 larva and 1 pupa of the fir sawfly, Neodiprion abietis Harris; 1 pupa of a small moth, Microlepidoptera sp.; 1 cocoon of a sawfly, probably the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 adult of the forest darkling beetle, Upis ceramboides L.; 1 adult of a caddice fly, Trichoptera sp.; 1 adult of a firefly, Lucidota corrusca L.; 1 small adult of an oil-beetle, Meloidae sp.

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
H. Stone	Minaki Townsite	July 17	74432	Spruce	2 adults of a larder beetle, Dermestidae sp.; 1 adult of an oil beetle, Meloidae sp.; 2 adults of a spittle bug, Aphrophora signorettii Fitch; 1 adult of a firefly, Lucidota corrusca L.; 1 adult of the modest stink bug, Podisus modestus Uhl.; 1 living and 1 dead larva and 1 cocoon of the yellow-headed spruce budworm, Cacoecia fumiferana Clem.; 3 living and 3 dead larvae of a race of the fir sawfly, Neodiprion abietis Harris; 1 larva of the hemlock looper, Ellopia fiscellaria Gn.; 1 parasitized larva of a looper, may be the saddled larch looper, Ectropis crepuscularia Schiff.?; 1 pupa (cocoon) of a climbing cutworm, Phalaenidae sp.; 1 larva of an unknown sawfly, Tenthredinidae sp.; 1 dead larva of a climbing cutworm, Anomogyna sp.; 1 dead larva of a sawfly, Tenthredinidae sp.; 1 adult of the 2-barred click beetle, Ludius propola Lec.

153

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Pencoff	Kenora	July 19	73588	Tamarack	25 larvae of the European larch sawfly, *Pristiphora erichsonii* Htg.; 20 dead larvae of same.
W. Lillian	Dryden Van Horne Twp.	July 19	74119	Jack pine	4 pupae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 4 cocoons of a small parasitic wasp, *Braconidae* sp.; 1 adult of a small click beetle, *Elateridae* sp.; 1 adult of a firefly, *Lucidota* sp.
W. Lillian	Dryden Van Horne Twp.	July 19	74120	Poplar	3 very small larvae of at least 2 species of a leaf-roller, *Tortricidae* sp.; 1 adult of a leaf-beetle, *Disonycha* sp.; 2 larvae of a leaf-beetle, probably of same species as above; 1 adult of a leaf-hopper, *Cicadellidae* sp.
W. Lillian	Dryden Van Horne Twp.	July 20	74121	White birch	6 dead nymphs of a leaf-hopper, *Cicadellidae* sp.
W. Lillian	Dryden Van Horne Twp.	July 20	74118	Spruce	3 larvae of the yellow-headed spruce sawfly, *Pikonema alaskensis* Roh.; 1 dead larva of same; 1 larva of the spruce budworm, *Cacoecia fumiferana* Clem.

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY JULY 1-31, 1943, REPORT

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
F. Sayson	Redditt Farlane	July 21	74348	Jack pine	1 larva of a climbing cutworm, Phalaenidae sp.; 1 larva of a parasitic fly, Tachinidae sp., from anotherlarva of above; 1 larva of the same Phalaenid, apparently parasitized; 1 adult of a climbing cutworm, Phalaenidae sp.; 4 adults of a larder beetle, Dermestidae sp.; 2 adults of the dun click beetle, Ludius medianus Germ.; 1 adult of a small click beetle, Elateridae sp.; 1 adult of a darkling beetle, Tenebrionidae sp.
A. Robson	Ignace, 3 and 9 mi. west of	July 22	74004	Jack pine	6 larvae, 1 parasitized prepupa and 40 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 3 dead larvae of same; 1 larva and 1 cocoon of a parasitic fly, Tachinidae sp., from budworm; 1 sickly larva of the pine amorbia, Amorbia humerosana Clem.; 5 larvae of a looper, Geometridae sp., (Paraphia-Eupithecia?); 6 cast nymphal skins of a cicada, Cicadidae sp.; 1 adult of a stink bug, Elasmostethus cruciatus Say.

155

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
A. Robson	Ignace Butler, Osaquan.	July 22	74003	Spruce	13 larvae of the black-headed budworm, Peronea variana Fern.; 8 dead larvae of same; 1 apparently parasitized larva of same; 2 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 pupa of the spruce budworm, Cacoecia fumiferana Clem.; 1 dead larva of same.
R. Mullan	Redditt	July 23	73552	Spruce	10 larvae and 2 cocoons of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 dead larva of a climbing cutworm, Phalaenidae sp., from which had emerged 14 cocoons of a small parasitic wasp, Braconidae sp.
J. Anderson	Wabigoon Zealand Twp.	July 28	74079	Balsam Tamarack Mountain ash	1 cocoon of a sawfly, probably the fir sawfly, Neodiprion abietis Harris; 1 larva of a sphinx-moth, Sphingidae sp.; 2 larvae of a swallowtail butterfly, probably the tiger swallowtail, Papilio glauca turnus.
N. Coppard	Vermilion Bay Alexander Bay, Indian Lake, Wabigoon Twp.	July 30	74720	Jack pine	2 sound and 1 injured pupae and 1 moth of the Jack pine budworm, Cacoecia fumiferana Clem.;

156

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
W. Coppard	Vermilion Bay Blue Lake, Wabigoon Twp.	July 30	74721	Jack pine	2 pupae and 1 moth of the Jack pine budworm, Cacoecia fumiferana Clem.; 3 nymphs and 1 adult of a stinkbug, Pentatomidae sp.

157

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Anderson	Wabigoon Zealand Twp.	Aug. 2	74676	Tamarack Spruce	5 larvae of the yellow-headed spruce sawfly, *Pikonema alaskensis* Roh.; 12 larvae of the European larch Sawfly, *Pristiphora erichsonii* Htg.
W. Wohlin	Vermillion Bay Pine	Aug. 3	74098	Spruce	4 pupae of a looper, probably the black-headed budworm, *Peronea variana* Fern.; 1 cocoon of the Cecropia moth, *Platysamia cecropia* L.; 1 adult of the forest soldier bug, *Podisus serieventris* Uhl.; 2 adults of the apple ladybird, *Anatis mali* Say.
J. Anderson	Wabigoon Zealand Twp.	Aug. 9	74681	Jack pine Poplar Willow	1 pupa of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 13 larvae of a leaf-beetle, *Altica* sp.; 1 larva of a climbing cutworm, *Phalaenidae* sp.; 2 larvae of a snout moth, *Pyralidae* sp.; 1 adult of a stink bug, *Pentatomidae* sp.

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
W. Wohlin	Vermilion Bay Pine	Aug. 11	74099	Birch	1 larva of a looper, Geometridae sp.; 1 larva of another looper, Geometridae sp.; 1 prepupa of a ladybird beetle, Coccinellidae sp.; 1 larva of a looper, Eupithecia sp.; 2 small nymphs and 2 adults of a stinkbug, Meadorus lateralis Say; 1 adult of a small leaf bug, Miridae sp.
A.W. Leman	Kenora N. side Trans-Canada Hwy.,17 mi. E. ofKenora.	Aug. 11	74355	Black spruce	1 larva of a looper, very small, may be the transverse-banded looper, Hydriomena divisaria Wlk.; 1 pupa of a looper, Geometridae sp.; several needles infected with the spruce needle rust, Chrysomyxa sp.
A.W. Leman	Kenora 28 mi. E. of, N. side Trans-Canada Hwy.	Aug. 11	74351	Eastern larch	21 larvae of the European larch sawfly, Pristiphora erichsonii Htg.
J. Anderson	Wabigoon Zealand Twp.	Aug. 12	18197	Poplar Birch	13 larvae of the fall webworm, Hyphantria textor Harris; 2 larvae of a sawfly, Tenthredinidae sp.

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
A.W. Leman	Kenora 10 mi. W. of Ignace on Trans-Canada Hwy.	Aug. 12	74354	Trembling Aspen	11 larvae of a snout moth, Meroptera pravella Grt.; 1 cocoon of a sawfly, may be the american elm sawfly, Cimbex americana Leach.
J. Youmans	Malachi N. of C.N.R. tracks, Rudd Twp.	Aug. 16	74437	Balsam	1 small, injured larva of a looper, Geometridae sp.; several nymphs of a plant louse, Aphidae sp.; 2 adults of a flat-headed borer, Buprestidae sp.; 1 adult firefly, Calopteron terminale Say.
J.E. Peden	McIntosh Vic. Canyon Lake	Aug. 17	74344	Red pine	1 larva of a looper, apparently Semiothisa sp.; 1 pupa of a moth, may be pine hairstreak, Incisalia niphon clarkii Frmn.; 1 adult of the 2-barred click beetle, Ludius propola Lec.; 1 adult of the polished click beetle, Ludius nitidulus Lec.; 1 adult of the apple ladybird, Anatis mali Say; 3 adults of the tiger ladybird, Neomysia subvittata Muls.; 1 adult of a very small ladybird, Coccinellidae sp.;

(Cont'd)

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J.E. Peden Cont'd					1 adult of a stink bug, Meadorus lateralis Say; 1 adult of the forest soldier bug, Podisus serieventris Uhl.; 1 adult of the modest soldier bug, Podisus modestus Dall.; 1 adult of a tiger moth, Lexis bicolor Say; 1 adult of a spittle bug, Aphrophora signoretii Fitch; 1 small adult of a nerve-winged fly, Hemerobiidae sp.
F. Mayson	Redditt Farlane	Aug. 18	74350	Poplar	1 larva of a climbing cutworm, Phalaenidae sp.; 1 larva of a sawfly, Tenthredinidae sp.; 1 larva of a looper, Geometridae sp.; 1 adult of the 2-barred click beetle, Ludius propola Lec.; 1 adult of the forest ladybird, Cleis picta Rand.; 2 adults of a small leaf-beetle, Chrysomelidae sp.; 2 adults of a firefly, Lucidota corrusca L.; 1 adult of a small beetle, Coleoptera sp.; 6 adults of a flat-bug, Aradidae sp.; 6 adults of a tree-hopper, Cicadellidae sp.;

(Cont'd)

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
F. Mayson Cont'd					1 adult of a tiger-moth, Lexis bicolor Grt.; 1 adult of Signoreti's spittle-bug, Aphrophora signoretii Fitch; 1 adult of another spittle-bug, Aphrophora sp.
A.W. Leman	Kenora 20 mi. W. of, S. of Hwy. No. 17.	Aug. 18	74352	White birch	4 larvae of 3 distinct forms of leaf-roller, Tortricidae sp.; 7 nymphs and 1 adult of the forest soldier bug, Podisus serieventris Uhl.
H. Stone	Minaki	Aug. 20	74430	Jack pine	1 larva of a leaf-roller, resembles strongly the fir tortrix, Tortrix packardiana Fern., but is quite late seasonally; 2 larvae of the fir sawfly, Neodiprion abietis Harris; 1 adult of a firefly, Lucidota corrusca L.; 1 adult of a small long-horned borer, Cerambycidae sp.
J. Anderson	Wabigoon Zealand Twp.	Aug. 23	54882	Balsam Black spruce	spruce needles infected with the spruce needle rust, Chrysomyxa sp.; several needles of balsam bearing needle galls of insect origin, produced as a result of the feeding of larvae of a small gall-fly, possibly Cecidomyia balsamicola.

162

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT SEPTEMBER 1-30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
W. Wohlin	Vermilion Bay Pine	Sept. 3	74363	Jack pine	3 dead and 2 living larvae, and 1 pupa of the pine amorbia, Amorbia humerosana Clem.; 2 larvae of a parasitic fly, Diptera sp., from dead larvae of above; 1 cocoon of a sawfly, Tenthredinidae sp.; 1 adult of a flat-headed borer, Dicerca tenebrosa Kirby; 1 adult of a click beetle, Ludius sp.; 2 adults of a ground beetle, Platynus sp.
R. Mullan	Redditt	Sept. 11	74426	Birch	20 larvae and 44 pupae of the birch leaf skeletonizer, Bucculatrix canadensisella Chamb.
F. Mayson	Redditt Farlane	Sept. 15	74349	Spruce	1 adult of the forest ladybird, Cleis picta Rand.; 1 adult of a ground beetle, Platynus sp.; 1 adult ant, Formicidae sp.; 1 adult of a large parasitic wasp, Ichneumonidae sp.; 3 adults of the 12-spotted ladybird, Anisocalvia 12-maculata Gebl.; 1 adult of a ladybird, Coccinellidae sp.

ONTARIO FORESTRY BRANCH - KENORA DISTRICT

FOREST INSECT SURVEY REPORT SEPTEMBER 1-30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Youmans	Malachi N. of C.N.R., Rudd Twp.	Sept. 15	74439	Poplar	10 adults of a leaf-hopper, Cicadellidae sp.; 1 adult of a leaf-beetle, Chrysomelidae sp.; 1 adult of a small weevil, Rhyncophora sp.
J.E. Peden	McIntosh Vic. Canyon Lake.	Sept. 16	74354	Poplar Birch	1 larva of a looper, probably the pine measuring worm, Paraphia piniata Pack.; 2 larvae of a lacewing fly, Chrysopidae sp.; 2 adults of the apple ladybird, Anatis mali Say; 1 adult of the 14-spotted ladybird, Anisocalvia 14-guttata L.; 6 adults of the 12-spotted ladybird, Anisocalvia 12-maculata Gebl.; 1 adult of aladybird, Hyperaspis binotata Say; 1 adult of a flat-headed borer, Dicerca sp.; 1 adult of a stinkbug, Pentatomidae sp.; 5 adults of a species of leafhopper, Cicadellidae sp.; 1 adult of a small leaf-beetle, Chrysomelidae sp.

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT

FOREST INSECT SURVEY REPORT UP TO JUNE 30,1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R.A. MacDonald	Savant Lake Sturgeon L., Thunder Bay.	June 19	74387	Poplar	4 adults of the aspen leaf beetle, Chrysomela tremulae Fab.; 4 adults of a leaf-beetle, Phyllodecta sp.; 1 adult of a firefly, Lucidota corrusca L.; 1 dead larva of a leaf-roller, Tortricidae sp.
R.A. MacDonald	Savant Lake Sturgeon L., Thunder Bay.	June 19	74386	Birch	11 nymphs of a leaf-hopper, Cicadellidae sp.
R.A. MacDonald	Savant Lake Sturgeon L., Thunder Bay.	June 19	67620	Balsam	1 adult of the forest ladybird, Cleis picta Rand.; 1 adult of the splendid click beetle, Ludius resplendens Esch.; 1 adult of a checkered beetle, Cleridae sp.
R.A. MacDonald	Savant Lake Sturgeon L., Thunder Bay.	June 19	73740	Spruce	1 dead larva of a leaf-roller, Tortricidae sp.; 1 adult of a ground-beetle, Carabidae sp.; 2 adults of a small leaf-beetle, Chrysomelidae sp.; 1 adult of a robber-fly, Asilidae sp.
K. Acheson	Sioux Lookout	June 21	74379	Manitoba maple	Several score larvae of the box elder gallfly, Cecidomyia negundinis Gill.

165

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT

FOREST INSECT SURVEY REPORT UP TO JUNE 30,1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R.A. MacDonald	Savant Lake Sturgeon L., Thunder Bay.	June 22	74701	Birch	1 adult of the luna moth, Tropaea luna.
H. Areumdson	Red Lake	June 22	74476	Spruce & Birch	1 adult of a lacebug, Tingidae sp.; 1 nymph of a leaf-hopper, Cicadellidae sp.
C. Johnston	Red Lake	June 23	74484	Spruce	1 nymph of a true bug, Hemiptera sp.; 1 dead adult of a parasitic fly, Tachinidae sp.
H.J. Busak	Red Lake	June 23	74481	Spruce	1 pupa (empty) of an aphid-eater, Syrphidae sp.
Tom Keesic	Red Lake	June 23	73783	Spruce & Birch	1 larva of a climbing cutworm, Phalaenidae sp.; 1 adult of a very small weevil, Curculionidae sp.; 1 nymph of a true bug, Hemiptera sp.; 4 nymphs of a leaf-hopper, Cicadellidae sp.; 1 adult of the forest ladybird, Cleis picta Rand.
Roy Keesic	Red Lake	June 23	74499	Spruce & Birch	1 small looper, probably the transverse-banded looper, Hydriomena divisaria Wlk.;

Cont'd

166

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
Roy Keesic Cont'd					2 nymphs and 4 adults of a leaf-hopper, Cicadellidae sp.; 2 small adults of a tarnished plant-bug, Miridae sp.; 1 nymph of a true bug, Hemiptera sp.; 1 adult of the forest soldier bug, Podisus serieventris Uhl.; 1 larva of a sawfly, Tenthredinidae sp.; 1 larva of a climbing cutworm, Phalaenidae sp.
I.R. Keesic	Red Lake	June 23	74488	Spruce & Birch	4 nymphs and 2 adults of a leaf-hopper, Cicadellidae sp.; 1 small adult of a tarnished plant bug, Miridae sp.; 1 adult of a stink bug, Meadorus lateralis Say.
J.N. Keesic	Red Lake	June 23	74492	Spruce & Birch	2 nymphs and 2 adults of a leaf-hopper, Cicadellidae sp.; 1 adult of a lace-bug, Tingidae sp.; 1 adult of a true bug, Hemiptera sp.
J.W. Lyon	Sioux Lookout 10 mi. North of, 14 mi. North of Drayton.	June 26	73277	White pine	2 adults of the inky click beetle, Ludius appropinquans Rand.

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT

FOREST INSECT SURVEY REPORT TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J.W. Lyon	Sioux Lookout 10 mi. N. of, 14 mi. N. of Twp. of Drayton	June 26	73279	Jack pine	2 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 adult of the inky click beetle, Ludius appropinquans Rand.; 1 adult of a stonefly, Plecoptera, family Perlidae.
J.W. Lyon	Sioux Lookout 10 mi. N. of, 14 mi. N. of Twp. of Drayton	June 26	73278	Spruce	7 larvae and 3 pupae of the spruce budworm, Cacoecia fumiferana Clem.; 1 parasitized larva of same bearing several eggs of a small parasitic wasp.

168

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

ADDENDUM

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R. McNamara	Armstrong Savant Lake, Jutten Twp.	June 26	73720	Spruce	1 pupa of a moth, Lepidoptera sp.; 1 larva of a looper, likely Eupithecia sp.; 1 adult of the forest ladybird, Cleis picta Rand.; 1 dead larva of the chameleon caterpillar, Anomogyna elimata Wlk.
R. Berglund	Lost Bay, Uchi L. Perrigo Lake.	June 30	73724	Spruce	1 pupa of a small moth, Microlepidoptera sp.; 1 dead pupa of same; 4 adults of a lantern-bug, Epiptera sp.; 1 adult of a stinkbug, Meadorus lateralis Say; 2 adults of the forest lady-bird, Cleis picta Rand.; 1 adult of the 12-spotted ladybird, Anisocalvia 12-maculata Gebl.; 1 adult of the inky click beetle, Ludius appropinquans Rand.; 1 adult of a small click beetle, Elateridae sp.; 1 adult of a click beetle, Ampedus sp.;

(Cont'd)

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

ADDERDUM

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R. Berglund Cont'd					1 adult of an oil-beetle, Meloidae sp.; 1 larva of a ladybird, Coccinellidae sp.; 2 larvae of a lacewing fly, Chrysopidae sp.; 1 dead larva of a climbing cutworm, Autographa sp.; 1 larva of the grey spruce tussock moth, Olene plagiata Wlk.
H. Johnson	Lost Bay, Uchi Lake. Earngey Twp.	June 30	73727	Balsam	1 larva of a climbing cutworm, Phalaenidae sp.; 1 larva of a false webworm, Cephalcia sp.; 1 parasitized larva of a climbing cutworm, Phalaenidae sp.; 1 larva of the hemlock looper, Ellopia fiscellaria Gn.; 4 pupae of a small moth, Microlepidoptera sp.; 2 larvae of a looper, probably the fir-needle inchworm, Eupithecia luteata Pack.; 1 dead larva of same; 1 larva of the fir tortrix, Tortrix packardiana Fern.; 1 larva of the fir sawfly, Neodiprion abietis Harris;

(Cont'd)

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
H. Johnson Cont'd					7 adults of the 2-barred click beetle, Ludius triundulatus Rand.; 1 adult of the forest lady-bird, Cleis picta Rand.; 5 adults of a stink bug, Meadorus lateralis Say; 1 adult of a tree-hopper, Telamona sp.; 1 adult of an oil-beetle, Meloidae sp.; 1 adult of a small click beetle, Elateridae sp.; 1 adult of another small click beetle, Limonius aeger Lec.; 1 adult of a leaf-beetle, Syneta sp.; 2 adults of a leaf-hopper, Cicadellidae sp.
R. Berglund	Lost Bay, Uchi Lake.	June 30	73725	Jack pine	1 adult of the 3-barred click beetle, Ludius triundulatus Rand.; 1 adult of a large click beetle, Adelocera brevicornis Lec.; 1 adult of the polished click beetle, Ludius nitidulus (Lec.); 1 adult of the whitepine weevil, Pissodes strobi Peck.; 1 adult of a checkered-beetle, Cleridae sp.;

(Cont'd)

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

ADDENDUM

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R. Berglund Cont'd					2 adults of the 2-spotted ladybird, Hyperaspis binotata Say; 1 adult of a small beetle, Coleoptera sp.
O. Peterson	Lost Bay, Uchi Lake.	June 30	73726	Spruce	1 larva of a looper, probably the fir-needle inchworm, Eupithecia luteata Pack.; 7 pupae of a small moth, Microlepidoptera sp.; 2 adults of the forest ladybird, Cleis picta Rand.; 2 adults of the polished click beetle, Ludius nitidulus (Lec.); 2 small and 1 large adult of 2 species of click beetle, Elateridae; 1 adult of a metallic borer, Chrysobothris sp.; 1 adult click beetle, Ampedus sp.; 1 adult of a tiger-beetle, Cicindelidae sp.; 1 small adult of a parasitic fly, Tachinidae sp.; 2 larvae of 2 species of aphid-eaters, Syrphidae sp.; 2 mealybugs, Coccidae sp.;

(Cont'd)

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

ADDENDUM

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
O. Peterson Cont'd					Several nymphs of a plant louse, Aphiidae sp.; 1 larva of a lace-wing fly, Chrysopidae sp.; 1 larva of a ladybird, Coccinellidae sp.; 1 adult of a small leaf-beetle, Chrysomelidae sp.

173

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
F.M. Dodds & H.C. Anderson	Armstrong	July 4	74448	Jack pine	No insects found in this sample. However, the silken webbing is suggestive of Jack pine budworm (*Cacoecia fumiferana* Clem.) activity.
F.M. Dodds	Armstrong	July 13	74449	Jack pine	17 living and 1 dead larva of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 pupa of a snout moth, *Pyralidae* sp.
R.A. MacDonald	Savant Lake Sturgeon L.	July 23	47621	Birch Poplar Spruce Balsam	6 larvae and 1 prepupa of the hemlock looper, *Ellopia fiscellaria* Gn.; 1 larva of a climbing cutworm, *Phalaenidae* sp.; 1 dead larva of a climbing cutworm, *Phalaenidae* sp.; 1 abortive prepupa of a moth, *Lepidoptera* sp.; 1 adult of the inky click beetle, *Ludius appropinquans* Rand.; 2 adults of the polished click beetle, *Ludius nitidulus* (Lec.); 1 adult of the forest ladybird, *Cleis picta* Rand.; 3 adults of a small leaf-beetle, *Chrysomelidae* sp.

174

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R. McNamara	Armstrong Savant Lake, Poisson Twp.	July 24	73721	Spruce	5 larvae and 4 pupae of the black-headed budworm, Peronea variana Fern.; 3 dead larvae of same, 2 apparently parasitized by a small fly, Tachinidae sp.; 7 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 cocoon of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 larva of the hemlock looper, Ellopia fiscellaria Gn.; 1 adult of the inky click beetle, Ludius appropinquans Rand.
Peter Jarrow	Armstrong Caribou Lake	July 26	74730	Poplar	3 larvae and 13 adults of the aspen leaf-beetle, Chrysomela tremulae Fab.; 2 larvae of a leaf-folding sawfly, probably Pontania sp.; 1 larva of a snout moth, Pyralidae sp.; 1 larva and 1 pupa of a leaf-miner, Lithocolletis sp.; 1 adult of the modest soldier bug, Podisus modestus Dall.

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
Peter Jarrow	Armstrong Caribou Lake	July 26	74723	Jack pine	13 pupae and 2 moths of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 injured pupa of same; 7 cocoons and 2 adults of a small parasitic wasp, Braconidae sp.; 1 cocoon of a small parasitic wasp, Glypta sp.; 1 larva of the spruce needle worm, Herculia thymetusalis Wlk.
J.W. Lyon	Sioux Lookout, 10 mi. north of	July 27	73275	Balsam	1 larva of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 larva of a climbing cutworm, Autographa sp.
J.W. Lyon	Sioux Lookout, 10 mi. north of	July 27	73274	Balsam	2 larvae and 1 pupa of the black-headed budworm, Peronea variana Fern.; 1 cocoon, Hymenoptera sp.
J.W. Lyon	Sioux Lookout, 10 mi. north of	July 28	73276	Norway pine	2 adults of the 2-barred click beetle, Ludius propola Lec.; 1 adult of the tiger ladybird, Neomysia subvittata Muls.
Alex Keesic	Red Lake	July 29	73729	Spruce Jack pine	3 living and 2 diseased larvae of the black-headed budworm, Peronea variana Fern.; 1 possibly parasitized larva of same.

176

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
Isaac N. Keesic	Red Lake Slate Bay (N. of Forestry Post)	July 29	74469	Jack pine	No insects in this sample.
R.J. Williams	Red Lake Slate Bay (N. of Forestry Post)	July 29	73265	Spruce	3 larvae of the black-headed budworm, *Peronea variana* Fern.; 1 larva of the green-headed spruce sawfly, *Pikonema dimmockii* Cress.;
J.N. Keesic	Red Lake Slate Bay (N. of Forestry Post)	July 29	74493	Jack pine	1 adult of a ground beetle, *Carabidae* sp.
Roy Keesic	Red Lake Slate Bay (N. of Forestry Post)	July 29	74500	Jack pine	No insects in this sample.
H. Musak	Red Lake Slate Bay (N. of Forestry Post)	July 29	74482	Jack pine	No insects in this sample
F.M. Dodds	Armstrong, N. of	July 29	74450	Spruce	Needles are affected by the spruce needle rust, *Chrysomyxa* sp.

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
W. Skenes	Red Lake Slate Bay (N. of Forestry Post)	July 29	73730	Jack pine	1 larva and 1 pupa of the black-headed budworm, Peronea variana Fern.; 1 pupa of a moth, Lepidoptera sp.
W. Skenes	Red Lake Slate Bay (N. of Forestry Post)	July 29	73731		No insects in this sample.
C. Johnson	Red Lake Slate Bay (N. of Forestry Post)	July 29	74485	Spruce	2 larvae of the black-headed budworm, Peronea variana Fern.; 1 larva of a parasitic wasp, Braconidae sp., from a dead larva of the above.
K. Amundson	Red Lake Slate Bay (N. of Forestry Post)	July 29	74477	Spruce	1 living and 1 dead larva of the black-headed budworm, Peronea variana Fern.; 1 pupa of a moth, Lepidoptera sp.

178

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R. Berglund	Lost Bay, Uchi Lake. N. Bay of Confederation Lake, Agnew Twp.	Aug. 5	67729	Jack pine	No insects found in this sample.
R. Berglund	Lost Bay, Uchi Lake. N. Bay of Confederation Lake.	Aug. 5	67724	Jack pine	No insects found in this sample.
R.A. MacDonald	Savant Lake Sturgeon Lake, Thunder Bay.	Aug. 23	73302	Spruce Birch Poplar Balsam	1 larva of the fall webworm, *Hyphantria textor* Harris; 1 dead larva of a woolly bear, *Arctiidae* sp.; 3 adults of a leaf-beetle, *Chrysomelidae* sp.; 1 adult of a long-horned borer, *Cerambycidae* sp.; 1 adult of a firefly, *Lucidota corrusca* Say; 4 adults of a ground beetle, *Platynus sinuatus* Deq.; 1 adult of another ground beetle, *Carabidae* sp.

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
C. Johnson	Red Lake W. end of MacKenzie Is.	Aug. 24	67730	Birch Balsam	3 larvae of the birch leaf skeletonizer, _Bucculatrix canadensisella_ Chamb.; 1 adult of a very small weevil, _Curculionidae_ sp.
I. Keesic	Red Lake W. end of MacKenzie Is.	Aug. 24	67733	Birch Balsam	No insects found in this sample.
W. King	Red Lake W. end of MacKenzie Is.	Aug. 24	74487	Birch Balsam	No insects found in this sample.
D. Peters	Red Lake W. end of MacKenzie Is.	Aug. 24	73260	Spruce	No insects found in this sample.
H. Amundson	Red Lake W. end of MacKenzie Is.	Aug. 24	74478	Balsam	1 adult of a ground beetle, _Platynus_ sp.
R. Keesic	Red Lake W. end of MacKenzie Is.	Aug. 24	74479	Birch Balsam	No insects found in this sample.
A. Keesic	Red Lake W. end of MacKenzie Is.	Aug. 24	67731	Birch Balsam	No insects found in this sample.

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Keesic	Red Lake W. end of MacKenzie Is.	Aug. 24	67732	Birch	1 adult firefly, Lucidota corrusca Say; 1 adult of a tree-hopper, Telamona sp.
W. Skenes	Red Lake W. end of MacKenzie Is.	Aug. 24	67735	Birch	1 larva of a leaf-roller, Tortricidae sp.; 1 larva of a tiger moth, Arctiidae sp.
H. Husac	Red Lake W. end of MacKenzie Is.	Aug. 24	73251	Birch Balsam	No insects found in this sample.
G. King	Red Lake W. end of MacKenzie Is.	Aug. 24	74490	Balsam White birch	No insects found in this sample.

ONTARIO FORESTRY BRANCH - SIOUX LOOKOUT DISTRICT

FOREST INSECT SURVEY REPORT SEPTEMBER 1-30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
C. Johnson	Red Lake	Sept. 25	74486	Jack pine	1 adult of a small parasitic wasp, Braconidae sp.
I.N. Keesic	Red Lake	Sept. 25	74483	Spruce	No insects found in this sample.
R. Keesic	Red Lake	Sept. 25	74480	Spruce	3 adults of the forest lady-bird, Cleis picta Rand.
R. Berglund	Red Lake	Sept. 25	74498	Jack pine	No insects found in this sample.
R. Williams	Red Lake	Sept. 25	74497	Spruce	No insects found in this sample.
H. Keesic	Red Lake	Sept. 25	74496	Jack pine	No insects found in this sample.
H. Amundson	Red Lake	Sept. 25	74491	Spruce	No insects found in this sample.

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30,1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J.E. Rabb	Garden Lake	June 21	73393	Poplar	13 adults of the aspen leaf beetle, *Chrysomela tremulae* Fab.; 1 larva of a leaf-roller, *Tortricidae* sp.

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Rabb	Port Arthur Garden Lake	July 1	73394	Jack pine	11 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 dead larva of same.
J. Rabb	Port Arthur Garden Lake	July 1	73392	Jack pine	1 pupa of a looper, Geometridae sp.
J. Rabb	Port Arthur Garden Lake	July 5	74402	White birch	22 larvae of the western tent caterpillar, Malacosoma pluvialis Dyar.
Forest Rangers	Pakashkan L., via Port Arthur.	July 6	74255	Poplar	8 adults of the aspen leaf-beetle, Chrysomela tremulae Fab.; 4 larvae of an aphid-eater, Syrphidae sp.;
A.E. Zapfe	Suomi P.O. Round Lake, W. of Strange Twp.;	July 6	74457	Jack pine	1 pupa of the Jack pine budworm, Cacoecia fumiferana Clem.; 3 dead larvae of same; 2 cocoons and 2 adults of a parasitic fly, Diptera sp., from budworm larvae; 1 adult of a parasitic wasp, Meteorus sp., from budworm larvae; 2 adults of the inky click beetle, Ludius appropinquans Rand.; 3 dead nymphs of a spittle bug, Aphrophora sp.; 1 dead larva of a tussock moth, Liparidae sp.

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Deafey	Kashabowie N. side Lake Kashabowie.	July 6	74735	Birch	1 larva of a type of climbing cut-worm, Phalaenidae sp.; 1 larva of another type of climbing cutworm, Phalaenidae sp.; 5 larvae and 2 dead larvae of another type of climbing cutworm, Phalaenidae sp.; 1 prepupa and 1 parasitized larva of another type of climbing cutworm, Phalaenidae sp.; 1 larva of another type of climbing cutworm, Phalaenidae sp.; 1 larva of another type of climbing cutworm, Phalaenidae sp.; 1 larva of a sawfly, Tenthredinidae sp.
E.J. MacKinnon	Hurkett Stirling Twp.	July 7	74272	Spruce	2 larvae of the rusty tussock moth, Notolophus antiqua L.; 1 dead larva and 1 moth of the spruce budworm, Cacoecia fumiferana Clem.; 2 larvae of 2 species of climbing cutworms, Phalaenidae sp.
J.B. Tremblay	Graham Block No.5	July 9	74748	Jack pine 2nd growth	17 larvae and 4 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 115 dead and injured larvae of same; 9 larvae and 2 cocoons of the fir sawfly, Neodiprion abietis Harris; 3 dead larvae of same; 1 larva of a small parasitic fly, Tachinidae sp., from a larva of the above.

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Latreille	Peninsula	July 10	74254	Spruce	1 adult of a sphinx moth, apparently the twin-spot sphinx, Smerinthus jamaicensis geminatus --- .
E.D. Humphrey	Beardmore Summers Twp.	July 11	74263	White & Norway pine	2 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 3 egg sacs of a spider, Araneida sp.
T. Dowell	Savanne Niblock & vicinity	July 13	73418	Jack pine	34 larvae and 1 pupa of the Jack pine budworm, Cacoecia fumiferana Clem.; 3 apparently parasitized larvae of same; 1 dead larva of same; 1 larva of a climbing cutworm, Phalaenidae sp.
T. Dowell	Savanne Niblock & Joynt Twp.	July 13	73416	Poplar	22 adults of the aspen leaf-beetle, Chrysomela tremulae Fab.
E.J. MacKinnon	Hurkett Stirling Twp.	July 15	74271	Spruce	65 living and 8 dead larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 9 cocoons of same.
J.B. Tremblay	Graham Block No. 5	July 15	74745	Jack pine	1 adult of the aspen leaf-beetle, Chrysomela tremulae Fab.; 1 adult of a ladybird, Coccinellidae sp. 22 larvae, 4 prepupae and 43 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.;

Cont'd

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J.B. Tremblay Cont'd					5 parasitized larvae of same; 123 dead larvae of same; 3 cocoons of a parasitic fly, Tachinidae sp., from budworm larvae; 2 cocoons of a small parasitic wasp, Braconidae sp., from budworm larvae; 1 adult of a small parasitic wasp, Meteorus sp., from budworm larvae; 1 adult of a larger parasitic wasp, Glypta sp., from budworm larvae; 1 larva of a false webworm, Pamphiliidae sp.; 1 pupa of a snout-moth, Pyralidae sp; 1 living and 1 dead larva of the pine Amorbia, Amorbia humerosana Clem.; 1 larva of another false webworm, Pamphiliidae sp.
Forest Rangers	Pakashkan Lake Via Port Arthur	July 23	74256	Poplar	50 larvae, 15 prepupae and 8 adults of the aspen leaf-beetle, Chrysomela tremulae Fab.; 1 larva of a climbing cutworm, Phalaenidae sp.; 1 larva of an aphid-eater, Syrphidae sp.; 1 adult of a small click beetle, Elateridae sp.
J. Latreille	Peninsula	July 24	74253	Spruce	1 adult of a hornet, Vespinae sp.

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J.B. Tremblay	Graham Quorn	July 25	74746	Jack pine Tamarack	22 pupae and 1 moth of the Jack pine budworm, Cacoecia fumiferana Clem.; 2 dead and 1 apparently parasitized larva of same; 1 dead larva of the fir sawfly, Neodiprion abietis Harris; 1 prepupa of the false hemlock looper (green phase), Nepytia canosaria Wlk.
J. Latreille	Peninsula	July 25	74251	Spruce	1 dead adult of a hornet, Vespinae sp.
A.E. Zapfe	Suomi P.O. Whitefish L., Forestry Sta., W. of Strange Twp.	July 26	74456	Jack pine	8 dead adults of a climbing cutworm, Phalaenidae sp.
A.E. Zapfe	Suomi P.O. Whitefish L., Strange Twp.	July 27	74458	Tamarack	2 larvae and 1 cocoon of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 2 dead larvae of same; 1 larva of the green larch looper, Semiothisa sexmaculata Pack.; 1 larva of a looper, Geometridae sp.; nymphs and adults of a plant louse, Aphiidae sp; sporulating bodies of a fungus on twig. The fungus is one of the first stages in the reduction of this twig to complete decay and, eventually, to soil.

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
A.E. Zapfe	Suomi P.O. Whitefish L., Strange Twp.	July 27	74455	Spruce	1 larva and 1 pupa of the spruce budworm, Cacoecia fumiferana Clem.; 1 larva of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 larva of a looper, possibly Eupithecia sp.; 1 adult of the 2-barred click beetle, Ludius propola Lec.; 1 adult of a click beetle, Agriotes limosus Lec.
T. Dowell	Savanne Between Savanne & Upsala, Savanne & Joynt Twp.	July 28	74739	Tamarack	75 living and 7 dead larvae as well as 1 cocoon of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 1 larva of the hemlock looper, Ellopia fiscellaria Gn.; 12 larvae and 1 prepupa of the green larch looper, Semiothisa sexmaculata Pack.; 1 parasitized larva and 3 dead larvae of same; 1 larva and 1 prepupa of another looper, may be Owen's green looper, Semiothisa oweni Swett.; 1 larva of another looper, Geometridae sp.

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
Ed. Humphrey	Beardmore, vicinity of, Summers Twp.	July 28	74264	Tamarack spruce	1 pupa of the spruce budworm, Cacoecia fumiferana Clem.; 1 moth of the same; 4 living and 1 dead larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 larva of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 pupa of a moth, Lepidoptera sp.; 1 adult of a lantern fly, Epiptera sp.
J.B. Tremblay	Graham Block No. 5	July 28	74747	Tamarack	86 larvae and 10 cocoons of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 9 dead larvae of same; 2 living and 1 dead larva of the hemlock looper, Ellopia fiscellaria Gn.; 4 living and 2 dead larvae of the green larch looper, Semiothisa sexmaculata Pack.; 1 pupa of another looper, Geometridae sp.; 1 adult of the ladybird beetle, Coccinella monticola Muls.; 1 adult of a small oil beetle, Meloidae sp.; 2 adults of another beetle, Coleoptera sp.
A. Holinshead	Kashabowie	July 29	74736	Juniper White spruce	23 living and 3 dead larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
T. Dowell	Savanne Hwy. east of English River	July 29	74749	Jack pine 2nd growth	3 larvae, 114 pupae and 57 moths of the Jack pine budworm, Cacoecia fumiferana Clem.; 2 living and 1 dead parasitic larvae of a fly, Diptera sp., from the budworm; 2 cocoons of a small parasitic wasp, Braconidae sp., from the budworm.
Carl Elder	Macdiarmid Chiefs Bay	July 29	74465	Balsam	1 pupa of a looper, Geometridae sp.; 1 adult of the apple ladybird, Anatis mali Say; 1 nymph of a stinkbug, Pentatomidae sp.
E. MacKinnon	Hurkett	July 29	74269	Tamarack	1 living and 1 dead larva of Marlatts larch sawfly, Anoplonyx laricis Marl; 1 larva of the hemlock looper, Ellopia fiscellaria Gn.

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
T. Dowell	Savanne 5 mi. E. of English R.	Aug. 1	74750	Jack pine	3 larvae, 80 pupae and 7 moths of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 larva of same parasitized by a fly larva, Tachinidae sp.; 2 cocoons of a small parasitic wasp, Braconidae sp., from budworm; 1 larva of a small parasitic wasp, Braconidae sp., from budworm; 1 larva of a looper, Geometridae sp.
Forest Rangers	Pakashkan L., via Port Arthur.	Aug. 2	74258	Potato	7 adults of a blister beetle, Epicanta sp.
T. Dowell	Savanne E. of English River	Aug. 2	74743	Jack pine	3 larvae, 82 pupae and 3 moths of the Jack pine budworm, Cacoecia fumiferana Clem.; 3 cocoons of a small parasitic wasp, Braconidae sp., from budworm; 1 larva of a parasitic fly, Tachinidae sp., from budworm.
T. Dowell	Savanne E. of English River	Aug. 3	74744	Jack pine	7 larvae, 77 pupae and 2 moths of the Jack pine budworm, Cacoecia fumiferana Clem.; 8 dead larvae of same; 6 cocoons of a parasitic wasp, Braconidae sp., from budworm larvae; several small cocoons of a parasitic wasp, Chalcidae sp., from budworm pupae.

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
T. Dowell	Savanne E. of English River	Aug. 4	74741	Jack pine	4 larvae, apparently parasitized, 92 pupae and 2 moths of the Jack pine budworm, Cacoecia fumiferana Clem.; 3 dead larvae of same; 3 cocoons of a small parasitic wasp, Braconidae sp., from budworm larvae; 1 larva of a parasitic fly, Tachinidae sp., from budworm larvae.
M. Sauerbrei	Port Arthur Garden Lake	Aug. 4	73965	Jack pine	1 adult of a robber-fly, Asilidae sp.
Forest Rangers	Pakashkan Lake via Port Arthur.	Aug. 5	73414	Alder	246 larvae and 9 adults of a leaf-beetle, Altica sp., may be the alder leaf-beetle, Altica ambiens alni Harris; 1 adult of another leaf-beetle, Phytodecta sp.
T. Dowell	Savanne E. of English River	Aug. 9	53	Jack pine	3 larvae, 79 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 2 dead larvae of same; 3 cocoons and 1 adult of a parasitic wasp, Braconidae sp., from budworm larvae; several cocoons of a very small parasitic wasp, Chalcidae sp., from budworm pupa; 2 larvae of a snout moth, Pyralidae sp.; 7 nymphs of a soldier bug, Pentatomidae sp.; 1 adult of a bug, Hemiptera sp.

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
T. Dowell	Savanne Between Fire Steel R. & Niblock.	Aug. 10	74742	Tamarack	3 larvae and 1 cocoon of Marlatt's larch sawfly, *Anoplonyx laricis* Marl; 1 larva of the black-headed budworm, *Peronea variana* Fern.; 3 larvae of a looper, *Eupithecia* sp., probably *E. luteata* Pack.; 36 larvae, 3 pupae and 3 dead larvae of the green larch looper, *Semiothisa 6-maculata* Pack.; 1 prepupa of another looper, *Geometridae* sp.; 1 pupa of another looper, *Geometridae* sp.; 1 pupa of a leaf-roller, *Tortricidae* sp.; 1 larva of a snout-moth, *Pyralidae* sp.; 6 larvae of another looper, *Geometridae* sp.; 1 larva of a climbing cutworm, *Phalaenidae* sp.; 1 larva of another looper, *Geometridae* sp.; 1 larva of another looper type, *Geometridae* sp.; 1 cocoon of a parasitic wasp, *Braconidae* sp.

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT.

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J.B. Tremblay	Graham Reba, Block 6.	Aug. 10	73957	Tamarack	6 larvae and 1 cocoon of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 7 larvae, 4 pupae and 2 parasitized larvae of the green larch looper, Semiothisa 6-maculata Pack.; 2 cocoons of 2 species of parasitic wasps, Braconidae sp., probably from the above parasitized larvae; 1 larva of a tiger moth, Arctiidae sp.; 1 larva of a looper, Eupithecia sp., probably E. luteata Pack.; 1 larva (parasitized) of a tiger moth, Arctiidae sp.; 1 larva of a climbing cutworm, Phalaenidae sp.; 3 larvae of a looper, Geometridae sp., may be the dotted line geometer, Protoboarmia porcelaria Gn.; 2 cocoons of 2 species of parasitic wasps, Braconidae sp.; 1 dead larva of the European larch sawfly, Pristiphora erichsonii Htg.; 2 adults of a larder beetle, Dermestidae sp.; 1 adult of a spittle bug, Aphrophora sp.
J. Habb	Port Arthur	Aug. 10	73389	Raspberry	2 larvae of 2 species of tiger moths, Arctiidae sp.

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
E. MacKinnon	Hurkett Stirling & Hele Twps.	Aug. 10	74270	Tamarack	1 larva of the hemlock looper, Ellopia fiscellaria Gn.; 3 larvae of the green larch looper, Semiothisa sexmaculata Pack.; 1 larva, may be of Owen's green looper, Semiothisa oweni Swett.; 1 larva of another looper, Semiothisa sp.; 1 larva of another looper, Geometridae sp.; 1 larva of another looper type, Geometridae sp.; 1 larva of another looper type, Geometridae sp.; 1 larva of another looper, Eupithecia sp., probably E. luteata Pack.; 2 larvae of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 1 cocoon of a small parasitic wasp, Braconidae sp.; 1 adult of a caddice fly, Trichoptera sp.
T. Dowell	Savanne E. of English R.	Aug. 11	50	Jack pine	2 living and 1 dead larvae as well as 78 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 3 larvae of a parasitic fly, Diptera sp., from budworm larvae;

(Cont'd)

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
T. Dowell Cont'd					4 cocoons of a small parasitic wasp, Braconidae sp., from budworm larvae; 8 nymphs and 4 adults of a stinkbug, Pentatomidae sp.; 2 adults of a true bug, Hemiptera sp; 1 adult of a small beetle, Coleoptera sp.
Forest Rangers	Pakashkan L., via Port Arthur.	Aug. 14	74257	Balsam	Numerous nymphs and adults of a plant louse, Aphidae sp.
T. Dowell	Savanne, E. of English River.	Aug. 15	52	Jack pine	1 dead larva and 7 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 larva of a parasitic fly, probably from budworm larvae above; 1 larva of a leaf-roller, Tortricidae sp.; 1 parasitized and 2 living larvae of a snout-moth, Pyralidae sp.; 3 nymphs and 1 adult of a stinkbug, Meadorus lateralis Say.
J.B. Tremblay	Graham Hogarth Twp.	Aug. 20	73958	Tamarack	5 larvae of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 16 living and 8 dead larvae, and 1 prepupa of the green larch looper, Semiothisa 6-maculata Pack.;

(Cont'd)

197

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J.B. Tremblay Cont'd					6 cocoons of a small parasitic wasp, Braconidae sp., from above; 5 larvae of the green spruce looper, Semiothisa granitata Gn.; 1 dead larva of same; 1 larva of a looper, Geometridae sp.; 1 larva of another looper, Geometridae sp.; 1 larva of a looper, Eupithecia sp.; 1 larva of a climbing cutworm, Phalaenidae sp.; 1 larva of another climbing cutworm, Phalaenidae sp.; 1 larva of another climbing cutworm, Phalaenidae sp.; 1 adult of the forest ladybird, Cleis picta Rand.; 1 adult of a plant louse, Aphiidae sp.; 1 adult of a small click beetle, Elateridae sp.; 2 adults of a small leaf-beetle, Chrysomelidae sp.; 1 adult of a plant bug, Miridae sp.
T. Dowell	Savanne	Aug. 20	74740	Poplar	104 larvae of the red-humped apple worm, Schizura concina S.&A.; 2 dead larvae of same; 1 dead larva of a looper, Geometridae sp.

198

ONTARIO FORESTRY BRANCH - PORT ARTHUR DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
S. Sitch	Port Arthur Northern Light Lake	Aug. 20	74468	Jack pine	No insects found in this sample. 2 egg masses of a spider, Araneida sp., were enclosed.
T. Dowell	Savanne	Aug. 20	51	Tamarack	55 larvae, 1 prepupa, 4 pupae and 10 dead larvae of the green larch looper, Semiothisa sexmaculata Pack.; 7 larvae and 1 prepupa of the green spruce looper, Semiothisa granitata Gn.; 1 larva of a looper, Eupithecia sp.; 2 larvae of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 1 pupa of a looper, Geometridae sp.; 1 larva of a looper, probably Fero morrisonarius Hy. Edw.; 1 larva of a looper, Geometridae sp.; 1 larva of another looper, Geometridae sp.; 1 larva of yet another looper, Geometridae sp.; 1 larva of a parasitic wasp, Ichneumonidae sp.; 2 pupae of a parasite, not known.

199

ONTARIO FORESTRY BRANCH - FORT FRANCES DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
G.C. Buckingham	Fort Frances Cache Bay, Saganaga L., Quetico Park.	June 13-14	55889	White pine Red pine Jack pine	2 empty (1942) cases of a false webworm, Pamphiliidae sp.; 1 larva of a predacious ladybird, Hyperaspis binotata Say; several nymphs of a plant louse, Aphiidae sp.; 4 twigs bearing enlarged portions due to the activities of gall insects or fungous growth; 1 adult of an ambrosia beetle, Scolytidae sp.; 1 adult of an oil beetle, Meloidae sp.
C.J. Thornton	Fort Frances Sphene L., Devils Cascades.	June 15	74187	Jack pine	1 adult of the dun click beetle, Ludius medianus Germ.; 1 adult of a click beetle, Elateridae sp.; 1 adult of another species of click beetle, Elateridae sp.; 1 adult beetle, Coleoptera sp.
L. Rawn	Kawene French L., Quetico Prov. Park.	June 22	74576	Norway pine	2 adults of the aspen leaf beetle, Chrysomela tremulae Fab.; 1 adult of a small oil beetle, Meloidae sp.; several larvae of a sawfly, probably the fir sawfly, Neodiprion abietis Harris.

ONTARIO FORESTRY BRANCH - FORT FRANCES DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box no.	Host Tree	Contents
L. Hawn	Kawene French L., Quetico Prov. Park.	June 22	74577	Poplar	1 dead, parasitized larva of a looper, Geometridae sp.; 1 adult of the aspen leaf beetle, Chrysomela tremulae Fab.; 2 adults of a firefly, Lucidota corrusca L.; 4 adults of a leaf-beetle, probably Disonycha pennsylvanica (Ill.); 6 adults of another leaf-beetle, Phyllodecta sp.; 1 adult of a ground-beetle, Carabidae sp.; 1 larva of a leaf-roller, Tortricidae sp.;
G.C Buckingham	Fort Frances Cache Bay, Saganaga L., Quetico Prov. Park.	June 22	35978	Juniper	Several score larvae and pupae of a leaf-miner, possibly Recurvaria sp.

ONTARIO FORESTRY BRANCH - FORT FRANCES DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

ADDENDUM

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
L. Rawn	Kawene Pickerel Lake, Quetico Prov. Park.	June 29	74578	Jack pine	1 larva of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 cocoon of a small parasitic wasp, Meteorus sp., parasite of the budworm.
Dick Johnston	Beaverhouse Lake, Flanders.	June 30	73448	Several	1 larva and 1 pupa of the spruce budworm, Cacoecia fumiferana Clem.; Numerous adult plant lice, Cinara sp.; 1 larva of a climbing cutworm, Phalaenidae sp.; 1 larva of the black-headed budworm, Peronea variana Fern.; Numerous ants, Formicidae sp.
Fred Cooke	Emo Heenan Hwy., Potts Twp., Con.6, Lot 9.	June 30	73428	Norway pine	1 larva of a looper, Geometridae sp.; 1 adult of the apple ladybird, Anatis mali Say; 2 adults of a darkling beetle, Tenebrionidae sp.; 1 adult of a click beetle, Ludius splendens Zieg.; 1 adult of a metallic borer, Dicerca sp.; 2 adults of 2 different forms of click beetles, Elateridae sp.

ONTARIO FORESTRY BRANCH - PORT FRANCES DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

ADDENDUM

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
Fred Cooke	Emo Heenan Hwy., Mile 9.	June 30	67278	Jack pine	2 larvae of the Jack pine Budworm, *Cacoecia fumiferana* Clem.; 1 dead larva of same.

ONTARIO FORESTRY BRANCH - FORT FRANCES DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31,1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
L. Rawn	Kawene French Lake, Quetico Prov. Park.	July 6	74050	Spruce	1 larva and 1 pupa of the spruce budworm, <u>Cacoecia fumiferana</u> Clem.; 1 dead larva of same; 24 larvae and 7 cocoons of the yellow-headed spruce sawfly, <u>Pikonema alaskensis</u> Roh.; 19 dead larvae of the above; 1 adult of the apple ladybird, <u>Anatis mali</u> Say; 3 pupae of same; 1 adult of the 2-barred click beetle, <u>Ludius propola</u> Lec.
G.L. Armstrong	Flanders Island on Beaverhouse Lake	July 6&7	74509	White pine	2 larvae and 6 pupae of the Jack pine budworm, <u>Cacoecia fumiferana</u> Clem.; 2 dead larvae of same; 3 cocoons of 3 species of small parasitic wasps, <u>Braconidae</u> sp., at least 1 parasitic on the budworm; 2 larvae of the false hemlock looper, <u>Nepytia canosaria</u> Wlk.; 1 dead larva of the yellow-headed spruce sawfly, <u>Pikonema alaskensis</u> Roh.
G. Walsh	Fort Frances N. end of Sturgeon Lake, Quetico Park.	July 7	74320	Jackpine	12 pupae of the Jack pine budworm, <u>Cacoecia fumiferana</u> Clem.; 3 dead larvae of same; 6 cocoons of a parasitic fly, <u>Diptera</u> sp.; parasites of budworm larvae;

Cont'd

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
G. Walsh Cont'd					1 dead larva of a false webworm, Pamphiliidae sp.; 8 cocoons of a sawfly, probably the fir sawfly, Neodiprion abietis Harris; 5 dead larvae of same; 1 adult of the 2-barred click beetle, Ludius propola Lec.; 1 adult of the inky click beetle, Ludius appropinquans Rand.
G. Walsh	Fort Frances Sturgeon Lake, Quetico Park.	July 9	74332	Jack pine	42 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 2 living and 15 dead larvae of same; 12 cocoons of a parasitic fly, Tachinidae sp., from budworm larvae; 1 cocoon of a sawfly, Neodiprion sp.
C.J. Thornton	Fort Frances Sphene Lake	July 10	74180	Jack pine	8 larvae and 8 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 4 larvae of same, apparently parasitized; 22 dead larvae of the budworm; 1 cocoon of a small parasitic wasp, Braconidae sp., from a budworm larva.

ONTARIO FORESTRY BRANCH - FORT FRANCES DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
G. Walsh	Fort Frances Russell Lake	July 19	74330	Jack pine White pine spruce	22 male and 22 female pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 4 male and 10 female moths of same; 1 larva of a parasitic fly, Tachinidae sp.; 1 larva of the false hemlock looper, Nepytia canosaria Wlk.; 1 larva of a false webworm, Pamphiliidae sp.
L. Rawn	Kawene French Lake, Quetico Prov. Park.	July 20	74048	Jack pine	11 living and 12 dead larvae of the red-headed Jack pine sawfly, Neodiprion rugifrons Middleton; 1 adult of a pine sawfly, Neodiprion sp.
L. Rawn	Kawene French Lake, Quetico Prov. Park.	July 20	74588	Poplar	1 pupa of a climbing cutworm, Phalaenidae sp.; 1 adult dragonfly, Odonata sp.
L. Rawn	Kawene French Lake, Quetico Prov. Park.	July 20	74049	Spruce	1 larva, apparently parasitized, of the black-headed budworm, Peronea variana Fern.; 1 pupa of a small moth, Microlepidoptera sp.; 1 dead larva of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 pupa of the spruce budworm, Cacoecia fumiferana Clem.; 1 nymph of a stinkbug, Pentatomidae sp.

ONTARIO FORESTRY BRANCH - FORT FRANCES DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
L. Rawn	Kawene Eva Lake	July 23	74584	Spruce	44 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 pupa of the spruce budworm, Cacoecia fumiferana Clem.; 1 nymph of a stinkbug, Pentatomidae sp.
L. Rawn	Kawene Eva Lake, Quetico Prov. Park.	July 24	74582	Spruce	23 larvae and 1 cocoon of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 13 dead larvae of same; 1 larva of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 exceedingly small larva of a looper, Geometridae sp.
L. Rawn	Kawene Eva Lake, Quetico Prov. Park.	July 25	74583	Spruce	1 larva and 6 pupae of the spruce budworm, Cacoecia fumiferana Clem.; 1 dead larva and 1 moth of same; 1 cocoon of a parasitic wasp (presumably from dead larva), Braconidae sp.; 5 larvae and 2 cocoons of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 12 dead larvae of same; 2 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 dead larva of same; 1 adult of the apple ladybird, Anatis mali Say.

ONTARIO FORESTRY BRANCH - FORT FRANCES DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
L. Rawn	Kawene Eva Lake, Quetico Prov. Park.	July 27	74585	Spruce	3 larvae and 6 cocoons of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 22 dead larvae of same; 1 cocoon of a small parasitic wasp, Braconidae sp., probably from the above; 1 pupa of a leaf-roller, Tortricidae sp., may be the black-headed budworm, Peronea variana Fern.
L. Rawn	Kawene Eva Lake, Quetico Prov. Park.	July 28	74586	Spruce	7 living and 4 dead larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 cocoon of a sawfly, likely the fir sawfly, Neodiprion abietis Harris; 1 pupa (red phase) of the false hemlock looper, Nepytia canosaria Wlk.; 1 nymph of a stinkbug, Pentatomidae sp.
P. Cooke	Rao Cedar Lake Portage on W. side of Burditt Lk.	July 29	74593	Jack pine	2 adults of a ladybird beetle, Hyperaspis binotata Say; 1 adult of a ground beetle, Carabidae sp.

ONTARIO FORESTRY BRANCH - FORT FRANCES DISTRICT

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
L. Hawn	Kawene Eva Lake, Quetico Prov. Park.	July 29	74587	Spruce	17 living and 1 dead larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 cocoon of a parasitic fly, Diptera sp., may be from the above.
G.L. Armstrong	Flanders Beaverhouse Cabin	July 31	74508	Norway pine	26 larvae of a false webworm, Pamphiliidae sp.
D.C. Baldwin	Mine Centre Bad Vermilion Lake	July 31	73434	Norway pine	No insects found in this sample, but cone bore signs of insect attack.

609

ONTARIO FORESTRY BRANCH - FORT FRANCES DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
L. Rawn	Kawene French Lake, Quetico Prov. Park.	Aug. 31	74581	----------	22 moths of a climbing cutworm, <u>Phalaenidae</u> sp.

ONTARIO FORESTRY BRANCH - GERALDTON DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
K. Montgomery	McLeod Mine, Geraldton, 3 mi. E. of Jellico on Hwy.	July 9	16028 67569 55463	Balsam fir	268 male and 1185 female pupae of the spruce budworm, <u>Cacoecia fumiferana</u> Clem.; 37 pupae and 26 larvae of a parasitic fly, <u>Tachinidae</u> sp., parasitic on the above; 4 larvae of a parasitic wasp, <u>Glypta</u> sp., parasitic on the above; <u>ADDITIONAL MATERIAL IN BOXES</u>: 10 larvae and 1 pupa of the spruce budworm, <u>Cacoecia fumiferana</u> Clem.; 13 pupae of a small parasitic wasp, <u>Braconidae</u> sp., from budworm larvae; 1 cocoon of a sawfly, <u>Neodiprion</u> sp.; 1 pupa of a very small moth, <u>Microlepidoptera</u> sp.; 2 larvae of a looper, probably the pine measuring worm, <u>Paraphia piniata</u> Wlk.; 1 larva of another looper, <u>Geometridae</u> sp.; 3 prepupae of a 3rd looper, <u>Geometridae</u> sp.
K. Montgomery &H.A.Richmond	McLeod Mine, Geraldton, On Hwy. near Jellico.	July 11	55875	Balsam fir	1 larva of the green-striped spruce caterpillar, <u>Feralia jocosa</u> Gn.; 2 pupae and 1 moth of the spruce budworm, <u>Cacoecia fumiferana</u> Clem.; 1 parasitized larva of same, parasitized by a small wasp, <u>Braconidae</u> sp.; 1 cocoon of a parasitic fly, <u>Diptera</u> sp., probably from budworm larva;

Cont'd

ONTARIO FORESTRY BRANCH - GERALDTON DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
K. Montgomery & H.A. Richmond Cont'd					1 pupa of the spruce cone worm, Dioryctria reniculella Grote; 2 larvae of a looper, Nyctobia limitaria Wlk.; 1 larva of the hemlock looper, Ellopia fiscellaria Gn.; 2 dead larvae of same; 2 larvae of the saddled larch looper, Ectropis crepuscularia Schiff.; 2 larvae of another looper, Eupithecia sp.; - 1 dead larva of same; 1 pupa of a looper, Geometridae sp.; 1 larva and 1 prepupa of the transverse-banded looper, Hydriomena divisaria Wlk.; 1 parasitized larva of a climbing cutworm, Phalaenidae sp.

ONTARIO FORESTRY BRANCH - GERALDTON DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31,1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
K. Montgomery	Macleod Mine, Geraldton. 3 mi. W. of Jellicoe, Leduc Twp.	Aug. 1	67107	Jack pine	5 pupae and 2 moths of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 larva of a parasitic fly, *Tachinidae* sp., from budworm; 1 larva of a false webworm, *Pamphiliidae* sp.
E. Assad	P.O. Box 1, Geraldton. 3 mi. W. of Jellicoe, Leduc Twp.	Aug. 1	71030	Jack pine	1 larva and 4 pupae and 8 moths of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 cocoon of a small parasitic wasp, probably *Meteorus* sp., from budworm larva.

ONTARIO FORESTRY BRANCH - GERALDTON DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

ADDENDUM

Collector	Locality	Date Collected	Box no.	Host Tree	Contents
K. Montgomery & H.A. Richmond	McLeod Mine, Geraldton. Trans Canada Hwy., 5 mi. E. of Jellico.	July 11	Parcel	Balsam fir	1217 male and 1323 female pupae of the spruce budworm, Cacoecia fumiferana Clem.; 51 pupae and 87 larvae of a parasitic fly, Tachinidae sp., parasitic on the above; 2 pupae, Hymenoptera sp., parasitic on the above; 31 pupae of a small parasitic wasp, Braconidae sp.; ADDITIONAL MATERIAL IN PARCEL: 6 larvae of the spruce budworm, Cacoecia fumiferana Clem.; 1 larva of the black-headed budworm, Peronea variana Fern.; 1 pupa of the spruce cone worm, Dioryctria reniculella Grote; 7 larvae and 1 prepupa of a looper, Eupithecia sp.; 2 larvae of an aphid-eater, Syrphidae sp.; 2 pupae of a small moth, Microlepidoptera sp.

1943 FOREST INSECT SURVEY REPORT

ONTARIO FORESTRY BRANCH - PROVINCIAL AIR SERVICE

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
C. MacMillan	Long Lake	c.June 5	73350	----------	1 larva of a climbing cutworm, Phalaenidae sp.; 1 larva of the black-headed budworm, Peronea variana Fern.
C. MacMillan	Pays Plat	June 19	73370	----------	1 dead larva of a leaf-roller, possibly Tortrix packardiana Fern.; 1 pupa of a leaf-roller, probably Tortrix packardiana Fern.; 1 adult of a bark beetle, Dendroctonus sp., possibly D. piceaperda.
C. MacMillan	Pays Plat	June 25	73369	Spruce	1 larva of the spruce cone worm, foliage form, Dioryctria reniculella Grt.; 2 larvae of a snout-moth, Pyralidae sp.
C. MacMillan	Pays Plat	June 28	73368	Spruce	5 larvae of the spruce cone worm, foliage form, Dioryctria reniculella Grt.; 5 extremely small larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 larva of an aphid-eater, Syrphidae sp.

1943 FOREST INSECT SURVEY REPORT

ONTARIO FORESTRY BRANCH - PROVINCIAL AIR SERVICE

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
C. MacMillan	Pays Plat	July 3	73366	Spruce	4 larvae of the spruce coneworm, foliage form, *Dioryctria reniculella* Grt., 1 of these apparently parasitized; 1 small larva of a shoot-moth, probably the spruce budmoth, *Zeiraphera ratzeburgiana* Sax.; 1 larva of a leaf-roller, probably the spruce needle worm, *Herculia thymetusalis* Wlk.
C. MacMillan	Pays Plat	July 4	73365	Spruce	1 larva and 1 pupa of the spruce coneworm, foliage form, *Dioryctria reniculella* Grt.
C. MacMillan	Pays Plat	July 7	73367	Spruce	34 larvae of the yellow-headed spruce sawfly, *Pikonema alaskensis* Roh.; 1 larva of a leaf-roller, probably the spruce needle worm, *Herculia thymetusalis* Wlk.
C. MacMillan	Pays Plat	July 10	74044	Spruce	1 larva of the spruce coneworm, *Dioryctria reniculella* Grt.; 1 small dead larva of the yellow-headed spruce sawfly, *Pikonema alaskensis* Roh.;

1943 FOREST INSECT SURVEY REPORT

ONTARIO FORESTRY BRANCH - PROVINCIAL AIR SERVICE

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
C. MacMillan	Pays Plat	July 10	51992	Balsam	1 larva and 1 pupa of the spruce budworm, Cacoecia fumiferana Clem.; 1 dead larva of same; 1 adult of a small click beetle, Limonius aeger Lec.
C. MacMillan	Pays Plat	July 10	74046	Spruce	2 small larvae and 1 pupa of the spruce coneworm, Dioryctria reniculella Grt.
C. MacMillan	Pays Plat	July 10	74045	Spruce	1 larva of the spruce budworm, Cacoecia fumiferana Clem.; 2 living and 1 dead larvae of the fir sawfly, Neodiprion abietis Harris.
C. MacMillan	Black Sturgeon Lake, Nipigon.	July 26	51990	Jack pine	Numerous nymphs and adults of a Jack pine plant louse, Aphiidae sp.; 2 larvae (predatory on the aphids) of a ladybird, Hyperaspis binotata Say; 8 larvae (predatory on the aphids) of an aphid-eater, Syrphidae sp.

MANITOBA FOREST SERVICE - SOUTHERN DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
F.R. de Delley	Box146, Douglas. Shilo Nurseries, Sec.18-10-16W, Plantation No. 5-38.	June 30	74621	Jack pine	Several nymphs and adults of a form of plant louse, Aphiidae sp.
B.C. Emes	Richer 36-7-10E	June 30	74608	----------	No insects found in this sample.
B.C. Emes	Richer 36-7-10E	June 30	74609	Small brush such as hazel & rose bushes	No insects found in this sample.

218

MANITOBA FOREST SERVICE - SOUTHERN DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
A. Bainbridge	Winnipeg Charleswood	July 3	74620	Tamarack	1 larva and several moulted skins of the European larch sawfly, Pristiphora erichsonii Htg., and oviposition-crooked twigs of tamarack.
B.C. Emes	Richer 36-7-10E	July 6	74611		2 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 nymph of a spittle bug, Aphrophora sp.
A. Bainbridge	Winnipeg S.E.11-16W (N.Cypress?)	July 10	74619	Jack pine	1 larva of the pine amorbia, Amorbia humerosana Clem.
J.J. Wright	Sprague 11-2-12E, Near Vassar.	July 10	74644	Jack pine	1 larva and 3 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 3 cocoons of a small parasitic wasp, Braconidae sp. These will have accounted for 3 larvae at any rate.
T.P. Williams	Carberry Spruce Woods For. Reserve (S. of Camp Hughes) S19-10-15W	July 15	74825	Spruce	1 living and 2 dead larvae, and several empty pupal skins of the spruce budworm, Cacoecia fumiferana Clem.; 3 cocoons of a small parasitic wasp, Braconidae sp., from budworm larvae; 1 adult of a small chalcid parasite of budworm pupae, Amblymerus tortricis Br.; 1 adult, an unusually marked specimen, of the black sawyer, Monochamus scutellatus Say.

MANITOBA FOREST SERVICE - SOUTHERN DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J.H. Vicars	Boissevain Nursery, Turtle Mt. For. Res., L.S. 16 of 25-1-21WPM.	July 15	74625	Larch (European)	3 living and 1 injured larvae of the European larch sawfly, *Pristiphora erichsonii* Htg.
J.J. Wright	Sprague N.E.1/4 22-1-12EPM, near Piney.	July 16	74647	Red pine	1 larva of a leaf-roller, *Tortricida* sp.
A. Bainbridge	Winnipeg N.W.18-10-16W	July 29	74617	Jack pine	Apparent work of a twig-borer.
T.P. Williams	Carberry Highway Plantation, near to Camp Hughes.	July 31	Special	Jack pine	No insects found on terminal. May have escaped in transit. Spider and her egg-mass present, together with much silk.

220

MANITOBA FOREST SERVICE - SOUTHERN DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J.J. Wright	Sprague W.1/2 24-1-12E. near Wampum.	Aug. 4	74646	Jack pine	3 living and 1 dead larvae of a snout moth, Pyralidae sp.; 1 nymph of a stinkbug, Pentatomidae sp.
J.J. Wright	Sprague N.E.4-4-14E.P.M., N. of Vassar & Sprague.	Aug. 4	74645	Jack pine	5 adults of the white pine weevil, Pissodes strobi Peck.; shoot injury caused by the above; 1 larva of a blueberry maggot, Diptera sp.
T.P. Williams	Carberry Sec.6-10-14W, Brandon Jctn., near Carberry.	Aug. 4	67910	Willow	Injury, the result of feeding by the larvae of leaf beetles. There were no larvae in this sample.
T.P. Williams	Carberry Sec.6-10-14W, Brandon Jctn., near Carberry.	Aug. 4	67911	Saskatoon	Leaves of Saskatoon infected with a rust fungus, Gymnosporangium sp.
J.H. Vicars	Boissevain 35-1-21, Turtle Mt. For. Res.	Aug. 13	74624	Poplar	Numerous nymphs and adults of a plant louse, Aphidae sp.; 15 larvae, comprising several forms of an aphid-eater, Syrphidae spp.
J.H. Vicars	Boissevain N.E.30-1-20, Turtle Mt. For. Res.	Aug. 17	74623	Scrub oak	2 leaves bearing greyish-brown dead areas at their tips affected by a fungous disease of the leaf-scorch type; 1 small yellow leaf-gall, caused by a gall wasp, probably Cynipoidea sp

221

MANITOBA FOREST SERVICE - SOUTHERN DISTRICT

FOREST INSECT SURVEY REPORT SEPTEMBER 1-30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
A. Bainbridge	Winnipeg Adt. site Sandilands Forest Res.	Sept. 19	74618	Scotch pine	5 hibernating larvae of a snout moth, Pyralidae sp., associated with damage and frass, together with cast pupal skins of the Jack pine budworm (Cacoecia fumiferana Clem.).
T.P. Williams	Box 247, Carberry.	Sept. 28	67912	Spruce	1 empty egg mass, apparently of the spruce budworm, Cacoecia fumiferana Clem.

MANITOBA FOREST SERVICE - NORTHERN DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
A. Sinclair	Cross Lake Twp. 65, R3WPM	June 29	74916	Spruce Birch Jack pine Poplar Balsam	1 pupa of a looper, Geometridae sp.

MANITOBA FOREST SERVICE - NORTHERN DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
A. Bowman	Island Lake	July 1	74546	Birch Spruce Balsam	1 adult of a snout beetle (weevil), Lepyrus palustris Scop.; 1 adult of a leaf-beetle, Syneta sp.; 1 adult of a click beetle, Ludius splendens Zieg.; 1 adult of an oil beetle, Meloidae sp.
J.A. Lundie	Mile 137, H.B. Rwy., Wabowden.	July 13	74575	Spruce	1 dead larva of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 4 dead larvae of the fir sawfly, Neodiprion abietis Harris; 2 adults of the large spruce weevil, Hypomolyx piceus DeG.; 1 adult of a small long-horned beetle, Cerambycidae sp.; 1 adult of a metallic borer, Buprestis nutalli var. consularis Gory; 2 adults of the polished click beetle, Ludius nitidulus (Lec.).
A. Sinclair	Cross Lake S29,T66, R2EPM.	July 28	74015	Spruce Poplar Balsam Tamarack Birch	5 adults of the 2-barred click beetle, Ludius propola Lec.; 2 adults of Signoret's spittle bug, Aphrophora signoretii Fitch; 3 adults of the polished click beetle, Ludius nitidulus Lec.; 2 adults of a caddice fly, Trichoptera sp.;

Cont'd

MANITOBA FOREST SERVICE - NORTHERN DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
A. Sinclair Cont'd					1 adult of a small click beetle, *Elateridae* sp.; 1 adult of a stink bug, *Meadorus lateralis* Say.

MANITOBA FOREST SERVICE - NORTHERN DISTRICT

FOREST INSECT SURVEY REPORT SEPTEMBER 1-30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
A. Sinclair	Cross Lake	Sept. 25	74526	Jack pine	3 adults of the forest soldier bug, Podisus serieventris Uhl.; 2 adults of the pine spittle bug, Aphrophora parallela Say.; 1 injured pupa of a small moth, Microlepidoptera sp.; 1 adult of a leaf-hopper, Cicadellidae sp.; 1 adult of a beetle, Coleoptera sp.

MANITOBA FOREST SERVICE - WESTERN DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
C. Dunlop	Deepdale S34,T30,R28WPM	May 19	74234	Jack pine	Enclosed twigs healthy. No insects found.

MANITOBA FOREST SERVICE - WESTERN DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
C.H. Patterson	Grandview S13-27-24W	July 19	74888	Spruce	1 gall (1942) of the spruce gall aphid, *Adelges abietis* L.; 2 adults of Signoret's spittle bug, *Aphrophora signoretii* Fitch; 1 adult of the 2-barred click beetle, *Ludius propola* Lec.; 2 moths, *Lepidoptera* sp.; 1 adult of a lantern bug, *Epiptera* sp.
C.H. Patterson	Grandview S13-27-24W	July 19	74886	Jack pine	1 female scale of the Jack pine tortoise scale, *Toumeyella* sp.; 1 adult of Signoret's spittle bug, *Aphrophora signoretii* Fitch; 1 adult of a plant bug, *Miridae* sp.

MANITOBA FOREST SERVICE - WESTERN DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R. Nelson	Winnipegosis Channel Is., Twp.47,R.21.	Aug. 3	74877	Spruce	Nothing found in this sample.
C.H. Patterson	Grandview Sec.13-27-24W	Aug. 21	55375	Scotch pine	1 adult of a flat-bug, Aradidae sp.; 1 adult of a gall-louse, Adelgidae sp.
C.H. Patterson	Grandview Sec.13-27-24W	Aug. 21	74869	Jack pine	Needles bearing a stickiness which usually accompanies the activity of scale insects; 1 adult of a small leaf-beetle, Chrysomelidae sp.; 1 adult of a leaf-bug, Miridae sp.
R. Nelson	Winnipegosis Shannon Is., Sec.5, Twp.48, R.21.	Aug. 27	74859	White spruce	No insects found in this sample.
F. Imrie	Mafeking	Aug. 31	67839	Jack pine	1 larva of the green spruce looper, Semiothisa granitata Gn.
J.W. Thompson	Mafeking Jack pine ridge, Twp.43, Sec.29,R.26W1.	Aug. 31	67826	Jack pine	1 larva of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 2 adults of a firefly, Lucidota corrusca Say.

MANITOBA FOREST SERVICE - WESTERN DISTRICT

FOREST INSECT SURVEY REPORT SEPTEMBER 1-30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
H. Clee	Minitonas Provincial land, Sec.2-36-23.	Sept. 21	74232	Jack pine	Buds enclosed did not look strong. Trees of this size will be overmature for most sites unless decidedly well-favored in other ways. A few female scales of the pine needle scale, *Phenacaspis pinifoliae* Fitch.
H. Clee	Minitonas Provincial land, Sec.2-36-23.	Sept. 21	74233	Spruce	Several female scales of the pine needle scale, *Phenacaspis pinifoliae* Fitch; 1 old gall of the spruce gall aphid, *Adelges* sp.; The blight mentioned might be due to the spruce needle rust, *Chrysomyxa* sp., but no infected needles were found in sample.

230

MANITOBA FOREST SERVICE - EASTERN DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
A. Malyk	Moosehorn St. Martin Dist., T31,R9W.	June 15	74854	Jack pine	1 1942 (empty) egg mass of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 dead "thousand-legged worm" (millepede), Diplopoda sp.; 1 adult of the 3-barred click beetle, Ludius triundulatus Rand.; 1 adult of a small firefly, Lampyridae sp.; 1 adult of a small weevil, Curculionidae sp.; 1 adult of a click beetle, Elateridae sp.; 1 adult of another click beetle, probably Ludius splendens Zieg.
J. Kokindovich	Pine Falls Catfish Creek, S13-17-9E; S.E.31-17-9E.	June 16	74411	Tamarack	5 adults of an ambrosia beetle, Scolytidae sp.; 2 adults of a bark beetle, Scolytidae sp.; 2 adults of a darkling beetle (scavengers), Tenebrionidae sp.
D. Cooper, G. Edmonds, W. Burns	Lac du Bonnet Long Lake, Twp.22-13, N. mouth Manigotagan R.	June 16	55465	White spruce	8 larvae of the black-headed budworm, Peronea variana Fern.; 1 cocoon of a small moth, Microlepidoptera sp.; 1 larva of the foliage variety of the spruce cone worm, Dioryctria reniculella Grt.; 1 prepupa of a climbing cutworm, Phalaenidae sp.;(May be Epizeuxis americalis Gn.) 1 larva of a leaf-roller, Tortricidae.

231

Manitoba Forest Service - EASTERN DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
M. Pocock	Winnipeg Spearhill	June 23	74855	Jack pine	1 incipient nodule, containing a larva of the pitch nodule-maker, Petrova albicapitana Busck.; 8 nymphs of one of the pine spittle bugs, Aphrophora sp.; shoot-killing of pines, particularly Jack, Scotch and lodgepole transplants is frequently caused by the above insect.
M. Pocock	Winnipeg 2 mi. South of Moosehorn	June 23	74858	Poplar	1 very small larva of a leaf-roller, Tortricidae sp.; 46 larvae and 3 prepupae (cocoons) of the forest tent caterpillar, Malacosoma disstria Hbn.
A. Malyk	Moosehorn St. Martin, 31-30 & 10W.	June 24	74853	Jack pine	39 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 8 dead larvae, very young, of same; 3 female scales of the pine needle scale, Phenacaspis pinifoliae Fitch;
D.E. Cooper	Lac du Bonnet English Brook Pulp Berth No. 28,S17-25-10E.	June 25	67831	White spruce	1 larva of the black-headed budworm, Peronea variana Fern.; 1 larva of a climbing cutworm, Phalaenidae sp.; 1 larva of the hemlock looper, Ellopia fiscellaria Gn.; 1 larva of the dotted line geometer, Protoboarmia porcelaria Gn.

232

MANITOBA FOREST SERVICE - EASTERN DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
D.E. Cooper	Lac du Bonnet Mouth of Wanipigow R., Twp.26-9E.	June 25	67832	White spruce	3 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 larva of the grey spruce tussock moth, Olene plagiata Wlk.; 1 prepupa of the fir tortrix, Tortrix packardiana Fern.; 6 larvae and 1 pupa of an aphid-eater, Syrphidae sp.; 2 adults of the 2-barred click beetle, Ludius propola Lec.; 1 adult of the forest ladybird, Cleis picta Rand.; 1 adult of a small leaf-beetle, Chrysomelidae sp.
Andy Bjork	Bissett P.O. S.W. of Beresford L. P.O., Twp.22.	June 26	74424	Balsam & Spruce Jack pine	3 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 2 adults of the 2-barred click beetle, Ludius propola Lec.; 1 adult of a very small click beetle, Elateridae sp.; 1 larva of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 prepupa of a looper, Geometridae sp.; 5 larvae of a looper, Geometridae sp. (may be several different kinds but require further feeding to be sure); 1 pupa of a moth, Macrolepidoptera sp.

MANITOBA FOREST SERVICE - EASTERN DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
W.D. Wardrop	Riverton Sec.29, Twp.23, Rge. 4E.	June 29	74301	Tamarack	1 adult of the European larch sawfly, *Pristiphora erichsonii* Htg.; 5 nymphs of a plant louse, *Aphiidae* sp.
M. Pocock	Winnipeg 36-13-9E.	June 29	67833	Jack pine	11 larvae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 9 dead larvae of same; 1 dead nymph of a spittle-bug, *Aphrophora* sp.; 1 prepupa of a climbing cutworm, *Phalaenidae* sp.
M. Pocock	Winnipeg S.9-13-9E., Buchan.	June 29	74404	Tamarack	1 larva of a looper, *Geometridae* sp.; 1 prepupa of a climbing cutworm, *Phalaenidae* sp.; 1 hairy larva of a climbing cutworm, *Phalaenidae* sp.; 1 larva of the European larch sawfly, *Pristiphora erichsonii* Htg.; 4 larvae of Marlatt's larch sawfly, *Anoplonyx laricis* Marl.
H.L. Kendrick	Whitemouth S34-12-9 S2-13-9E.	June 29	74417	Jack pine	2 larvae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 dead larva of same.
A. Malyk	Moosehorn Twp.26, R7&8W W.of Moosehorn	June 29	74852	Tamarack & Spruce	1 adult of the white pine weevil, *Pissodes strobi* Peck.; tamarack terminals affected by the egg-laying of the female European larch sawfly (*Pristiphora erichsonii* Htg.

MANITOBA FOREST SERVICE - EASTERN DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Kokindovich	Pine Falls Stead, S15-17-8E.	July 6	74409	Jack pine	28 larvae and 1 pupa of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 dead larva, 1 injured pupa and 1 abortive pupa of same; 2 larvae of a parasitic wasp, Itoplectis sp., larval parasites of the above; 35 dead nymphs of a spittle bug, Aphrophora sp.; 1 larva of a looper, Geometridae sp.; 1 larva of the grey spruce tussock moth, Olene plagiata Wlk.; 3 adults of the apple ladybird, Anatis mali Say; 2 nymphs of a true bug, Hemiptera sp.; 3 soft-bodied ticks, Argasidae sp.; These are uncommon and differ from the ordinary hard-bodied ticks (wood ticks) chiefly by not being flat, but globular in shape. May have dropped off a squirrel; 1 adult fishfly, Hexagenia sp.; 1 adult of a lacewing fly, Hemerobiidae sp.
J. Kokindovich	Pine Falls S9-17-8E	July 7	74410	Jack pine	22 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 5 injured larvae of same; 1 nymph of a spittle bug, Aphrophora sp.

MANITOBA FOREST SERVICE - EASTERN DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
W.D. Wardrop	Riverton S32-23-4E	July 16	74403	Tamarack	57 sound and 15 injured larvae of the European larch sawfly, Pristiphora erichsonii Htg.; 1 very small larva of the Jack pine-spruce budworm, Cacoecia fumiferana Clem.
J.H. Inkster	Hodgson S24,T25, R2WPM.	July 26	74418	Tamarack	101 larvae and 11 cocoons of the European larch sawfly, Pristiphora erichsonii Htg.; 3 larvae of Marlatt's larch sawfly, Anoplonyx laricis Marl.

236

MANITOBA FOREST SERVICE - EASTERN DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J.H. Inkster	Hodgson Sec.22-24-1W	Aug. 2	74420	Tamarack	105 larvae and 20 cocoons of the European larch sawfly, Pristiphora erichsonii Htg.; 1 dead larva of same; 1 larva of Marlatt's larch sawfly, Anoplonyx laricis Marl.
W.D. Wardrop	Riverton	Aug. 6	74401	Elm	A large sampling of larvae of the fall webworm, Hyphantria textor Harris; 1 larva of a looper, Geometridae sp.
J. Kokindovich	Pine Falls Belair	Aug. 10	74412	Tamarack Spruce	7 dead larvae and 1 cocoon of the European larch sawfly, Pristiphora erichsonii Htg.; 3 small larvae of the green larch looper, Semiothisa 6-maculata Pack.; 1 nymph and 1 adult of the modest soldier bug, (predacious), Podisus modestus Dall.; needles infested with the spruce needle rust, Chrysomyxa sp.
H.L. Kendrick	Whitemouth N.E. 1/4 36-12-9E	Aug. 14	74415	Tamarack	3 dead larvae and 1 cocoon of the European larch sawfly, Pristiphora erichsonii Htg.

MANITOBA FOREST SERVICE - EASTERN DISTRICT

FOREST INSECT SURVEY REPORT SEPTEMBER 1-30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J.H. Inkster	Hodgson Sec.11-29-1W.	Sept. 15	74419	Tamarack	121 sound cocoons of the European larch sawfly, *Pristiphora erichsonii* Htg.; 2 cocoons bearing emergence holes of a small parasitic wasp, *Chalcidae* sp.; 2 cocoons that had been eaten out by mice.

SASKATCHEWAN DEPARTMENT OF NATURAL RESOURCES - REGINA DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J.A. Sufferm	Yonker 27-42-27W3M	July 13	55831	Spruce	No insects found in this sample.

239

SASKATCHEWAN DEPARTMENT OF NATURAL RESOURCES - REGINA DISTRICT

FOREST INSECT SURVEY REPORT SEPTEMBER 1-30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
A.J. Colquhoun	Maple Creek	Sept. 1	Special	----------	1 adult female of a parasitic wasp, an ichneumon fly, Ichneumonidae sp.

240

SASKATCHEWAN DEPARTMENT OF NATURAL RESOURCES - PRINCE ALBERT DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
A.M. Howland	Torch River Grassy Lake Sta., L.S. 4 of 15-54-15-2.	July 14	67091	White spruce	Numerous adults and galls (caused by feeding of young) of a gall aphid, probably the spruce gall aphid, Adelges abietis L.; 2 dead larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.

SASKATCHEWAN DEPARTMENT OF NATURAL RESOURCES - HUDSON BAY JUNCTION DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
K.O. Sanders	Endeavour S4-39-5 2nd.	July 10	74787	Spruce	2 larvae of the yellow-headed spruce sawfly, *Pikonema alaskensis* Roh.; 1 larva of the pine hairstreak, *Incisalia niphon clarkii* Frmn.; 1 twig, bearing evidence of mining. No insects found.

242

SASKATCHEWAN DEPARTMENT OF NATURAL RESOURCES - HUDSON BAY JUNCTION DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
C.R. Christie	Hudson Bay Junction Twp.39,R5W3M, along No. 9 Hwy.	Aug. 21	67090	White spruce	Twigs infected with the spruce needle rust, *Chrysomyxa* sp.

SASKATCHEWAN DEPARTMENT OF NATURAL RESOURCES - HUDSON BAY JUNCTION DISTRICT

FOREST INSECT SURVEY REPORT SEPTEMBER 1-30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
T. N. Shannon	Hudson Bay Junction	Sept. 23	74783	Tamarack	11 dead larvae of Marlatt's larch sawfly, *Anoplonyx laricis* Marl.

SASKATCHEWAN DEPARTMENT OF NATURAL RESOURCES - MEADOW LAKE DISTRICT

FOREST INSECT SURVEY REPORT UP TO JUNE 30, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Barnett	Glaslyn Twp.51, R16, W3.	June 22	74909	White poplar	89 larvae of a leaf-beetle, probably *Phytodecta* sp.; 1 adult of same.

245

SASKATCHEWAN DEPARTMENT OF NATURAL RESOURCES - MEADOW LAKE DISTRICT

FOREST INSECT SURVEY REPORT JULY 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R.T. Pike	Meadow Lake	July 5	74365	White spruce	3 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.
R.T. Pike	Meadow Lake	July 12	74367	White spruce	Numerous adults of the balsam twig aphid, Mindarus abietinus Koch.
F. Mitchell	Loon Lake 11-59-22-3	July 16	74936	Jack pine	2 nymphs of a plant louse, Aphiidae sp.; numbers of needles showing fungous (rust) disease.
F. Mitchell	Loon Lake 14-59-22-3	July 17	74937	Spruce	4 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 dead larva of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.

SASKATCHEWAN DEPARTMENT OF NATURAL RESOURCES - MEADOW LAKE DISTRICT

FOREST INSECT SURVEY REPORT AUGUST 1-31, 1943.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R.C.Higman	Green Lake	Aug. 4	74926	White spruce	Needles affected by the spruce needle rust fungus, *Chrysomyxa* sp.

1943 FOREST INSECT SURVEY REPORT

WINNIPEG LABORATORY

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
H.A. Richmond & R.R. Lejeune	Hawk Lake, Ontario.	April 20	Special	White Spruce	1 larva of the dotted line geometer, Protoboarmia porcelaria Gn.
H.A. Richmond	McKay Lake, Ontario. (Near Geraldton)	May 27	55879	Balsam Fir	1 larva of the fir tortrix, Tortrix packardiana Fern.
H.A. Richmond	White Lake, Ontario. (P.O. Rossport) North of Heron Bay.	May 27	55874	Balsam	1 adult of a ladybird, Cleis picta Rand.; 1 dead larva, bearing the cocoon of a parasite (Ichneumonidae) which had emerged from it. The larva is the grey spruce tussock moth, Olene plagiata Wlk.
Dr. C.E.Atwood	White River, Ontario, 5 miles west of station.	May 30	Special	Jack pine	Sample of Jack pine bearing evidence of defoliation by Cacoecia fumiferana Clem. A few needles exhibited mining activity which may or may not have been due to the budworm larvae. Sample carried an old pupa skin of the budworm. A number of resin-inhabiting larvae of a moth, Microlepidoptera sp.; 2 pupae liberae of a moth, Microlepidoptera sp.

1943 FOREST INSECT SURVEY REPORT

WINNIPEG LABORATORY

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R. Barker & L. Mustard	Grounds	June 10	Special	Ornamental shrub	47 larvae of the forest tent caterpillar, Malacosoma disstria Hbn.
R. Barker & L. Mustard	Grounds	June 14	Special	Balsam	Numerous nymphs of a plant louse, Aphiidae sp.; 3 larvae of an aphid eater, Syrphidae sp.
R. Barker & L. Mustard	Grounds	June 17	Special	Ornamental shrub	1 male and 1 female of the yellow woolly bear, Diacrisia virginica Fab.
L. Mustard	Grounds	June 18	Special	Balsam	1 cocoon of a parasitic wasp, Braconidae sp.
L. Mustard	Grounds	June 19	Special	Oak	1 larva of a climbing cutworm, Phalaenidae sp.; 1 adult of a cranefly, Tipulidae sp.; 1 adult of a June-bug, Dichelonyx sp.; 2 nymphs of a leafhopper, Cicadellidae sp.
R. Barker	Grounds	June 22	Special	Oak, Poplar, Hazel	1 larva of a sawfly, Tenthredinidae sp.
L. Mustard	Grounds	June 22	Special	Balsam	1 larva of a leaf-roller, Tortricidae sp.

1943 FOREST INSECT SURVEY REPORT

WINNIPEG LABORATORY

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
H.A. Richmond	Sandilands, 5 miles up German Settlement Road	June 23	55876	Jack pine	A sample of Jack pine twigs bearing evidence of marked total defoliation of old needles. Sample contained a large number of needles exhibiting fruiting bodies of a needle fungus, and others apparently bearing immature fungal lesions.
H.A. Richmond	Headquarters, Sandilands For. Reserve	June 23	Special	Jack pine	A large number of larvae of the Jack pine budworm, _Cacoecia fumiferana_ Clem.
R. Barker	Grounds	June 24	Special	Oak	1 pupa of a leaf-roller, _Tortricidae_ sp.
R. Barker	Grounds	June 24	Special	---------	1 larva of a looper, _Geometridae_ sp.
R. Barker	Grounds	June 27	Special	Hazel	1 larva of a climbing cutworm, _Phalaenidae_ sp.
R. Barker	Grounds	June 27	Special	Oak	1 larva of a leaf-roller, _Tortricidae_ sp.
R. Barker	Grounds	June 28	Special	Poplar	1 larva of a climbing cutworm, _Phalaenidae_ sp.
H.A. Richmond & R.R. Lejeune	Hawk Lake, Ontario.	June 29	Special	Jack pine	1 larva of a shoot-moth, _Olethreutidae_ sp., may be the webbing spruce leaf-miner, _Tamia albolineana_ Kft.

1943 FOREST INSECT SURVEY REPORT

WINNIPEG LABORATORY

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
H.A. Richmond	Spruce Woods For. Reserve	July 2	55880	White Spruce	8 larvae of a wasp, Itoplectis sp., parasite on larvae of the spruce budworm, Cacoecia fumiferana Clem.; 1 cocoon of a small wasp, Braconidae sp., probably Meteorus sp.; 1 pupa of a leaf-roller, probably the fir tortrix, Tortrix packardiana Fern.; 2 twigs bearing unemerged galls, probably Phytophaga piceae Felt.
R. Barker & L. Mustard	Grounds	July 6	Special	---------	2 larvae of 2 species of looper, Geometridae sp.; 1 adult of a stink bug, Pentatomidae sp.
R.R. Lejeune & F.B. Rabkin	Mile 9 between Hudson & Sioux Lookout, Ont.	July 9	Special	Balsam Black Spruce	514 male and 892 female pupae of the spruce budworm, Cacoecia fumiferana Clem.; 28 pupae and 7 larvae of a parasitic fly, Tachinidae sp., parasitic on the above; ADDITIONAL MATERIAL INCLUDED: 1 larva and 4 pupae of a parasitic wasp, Glypta sp., ex C. fumiferana; 3 pupae of the spruce cone worm, Dioryctria reniculella Grote.
H.A. Richmond	Townsite McLeod Cockshutt Mine, Geraldton.	July 12	55878	Jack pine	2 larvae of the pitch nodule maker, Petrova albicapitana Busck.; Chlorosis due to smelter smoke not very extensive.

251

1943 FOREST INSECT SURVEY REPORT

WINNIPEG LABORATORY

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
H.A. Richmond	Townsite McLeod-Cockshutt Mine, Geraldton.	July 12	67570	Poplar	Primary cause: a gall-forming mite. Also present Marssonina? populi (Lib.) Magn., a leaf-spot.
F.B. Rabkin	Hawk Lake, Ontario.	July 13	Special	Spruce	3 larvae and 1 injured prepupa of the black-headed budworm, Peronea variana Fern.
F.B. Rabkin	Hawk Lake, Ontario.	July 14	Special	Balsam Black Spruce	3 larvae of the black-headed budworm, Peronea variana Fern.; 1 larva of a looper, Nyctobia limitaria Wlk.; 1 sickly larva and 7 cocoons of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 large dipterous cocoon, possibly a sarcophagid; 3 pupae of a small looper, Geometridae sp.; 1 adult of a tarnished plant bug, Miridae sp.
F.B. Rabkin	Hawk Lake, Ontario.	July 15	Special	Jack pine	137 male and 87 female pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 adult of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 pupa of a parasitic fly, Tachinidae sp., parasitic on the above.

<u>1943 FOREST INSECT SURVEY REPORT</u>

<u>WINNIPEG LABORATORY</u>

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R.R. Lejeune	Hawk Lake, Ontario.	July 15	Special	Jack pine	64 male and 36 female pupae of the Jack pine budworm, <u>Cacoecia fumiferana</u> Clem.
R.R. Lejeune	Basswood Lake, Bailey Bay.	July 16	Special	Jack pine	Needle change is the result of twig-borers; no fungus evident.
R. Barker	Lab. nursery	July 16	Special	White Spruce	25 larvae of the yellow-headed spruce sawfly, <u>Pikonema alaskensis</u> Roh.
F.B. Rabkin	Hawk Lake, Ontario.	July 17	Special	Jack pine	89 male pupae and 4 male adults, 78 female pupae and 1 female parasitized pupa of the Jack pine budworm, <u>Cacoecia fumiferana</u> Clem.
F.B. Rabkin	Hawk Lake, Ontario.	July 17	Special	Jack pine	66 male pupae, 6 male moths and 1 male parasitized pupa containing 1 dipterous larva of the Jack pine budworm, <u>Cacoecia fumiferana</u> Clem., and 70 female pupae, 1 female moth and 1 female pupa (bacterial) of the same; 1 larva of a crane-fly, <u>Tipulidae</u> sp.

1943 FOREST INSECT SURVEY REPORT

WINNIPEG LABORATORY

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R.R. Lejeune	Eva Lake, Ft. Frances Dist., Quetico Park.	July 17	Special	Jack pine	27 male pupae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 2 male adults of the above; 14 female pupae of the above; 1 female adult of the above.
R.R. Lejeune	Hawk Lake, Ontario.	July 17	Special	Jack pine	73 male and 70 female pupae of the Jack pine budworm, *Cacoecia fumiferana* Clem.
F.B. Rabkin	Hawk Lake, Ontario.	July 20	Special	Jack pine	93 male pupae and 12 male adults plus 1 dipterous male larva and 1 injured male pupa and 97 female pupae and 3 female adults of the Jack pine budworm, *Cacoecia fumiferana* Clem.
F.B. Rabkin	Hawk Lake, Ontario.	July 20	Special	Jack pine	36 male pupae, 10 male adults, 66 female pupae and 4 female adults of the Jack pine budworm, *Cacoecia fumiferana* Clem.
R.R. Lejeune	Hawk Lake, Ontario.	July 20	Special	Jack pine	46 male pupae and 73 female pupae of the Jack pine budworm, *Cacoecia fumiferana* Clem.
F.B. Rabkin	Hawk Lake, Ontario.	July 21	Special	Jack pine	84 male pupae and 17 male adults of the Jack pine budworm, *Cacoecia fumiferana* Clem.

1943 FOREST INSECT SURVEY REPORT

WINNIPEG LABORATORY

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
F.B. Rabkin	Hawk Lake, Ontario.	July 21	Special	Jack pine	135 female pupae, 21 female adults and 2 dipterous pupae of the Jack pine budworm, Cacoecia fumiferana Clem.
R. Barker & L. Mustard	Grounds	July 22	Special	Tamarack	2 larvae of the European larch saw-fly, Pristiphora erichsonii Htg.
R.R. Lejeune	Hawk Lake, Ontario.	July 22	Special	Jack pine	3 male pupae, 164 female pupae, 1 male adult and 15 female adults of the Jack pine budworm, Cacoecia fumiferana Clem.
R.R. Lejeune	Hawk Lake, Ontario.	July 22	Special	Jack pine	66 male pupae, 1 female pupa, 13 male adults and 2 female adults of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 dipterous parasite from the above.
R.R. Lejeune	Hawk Lake, Ontario.	July 22	Special	Jack pine	68 male and 164 female pupae of the Jack pine budworm, Cacoecia fumiferana Clem.
F.B. Rabkin	Sandilands For Reserve, Manitoba.	July 26	73967 & Special	Jack pine	86 male pupae, 96 female pupae, 210 male adults and 189 female adults of the Jack pine budworm, Cacoecia fumiferana Clem.; 5 dipterous larvae parasitic on the above; 1 larva, 3 pupae and 2 adults of a small parasitic wasp, Glypta sp.; 1 larva of a small leaf-roller, Tortricidae sp.

1943 FOREST INSECT SURVEY REPORT

WINNIPEG LABORATORY

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
F.B. Rabkin	Lake Katherine, Riding Mt. Nat. Park, Manitoba.	July 28	73999	Larch	58 larvae and 4 cocoons of the European larch sawfly, Pristiphora erichsonii Htg.; 1 larva of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 1 larva of the green larch looper, Semiothisa sexmaculata Pack.
F.B. Rabkin	Riding Mt. Nat. Park, vicinity of Townsite.	July 29	74000	Jack pine	55 male pupae, 93 female pupae, 12 male adults and 6 female adults of the Jack pine budworm, Cacoecia fumiferana Clem.; 16 dipterous pupae and 3 dipterous larvae from the above.
R. Barker	Lab. nursery	Aug. 23	Special	Hazel White Spruce	1 larva of a woolly bear (tiger moth), Arctiidae sp.; 1 larva of a prominent, Schizura sp.
R. Barker	Grounds	Sept. 8	Special	--------	1 larva of a prominent, Notodontidae sp.

1943 FOREST INSECT SURVEY REPORT

DRYDEN PAPER CO. LIMITED, DRYDEN, ONTARIO.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
O.S. Jackson	Lot 23, Con. 10, Twp. of Zealand.	July 17	74394	Jack pine	134 male pupae, 106 female pupae, 1 male moth, 2 female moths, and 9 emerged Diptera of the Jack pine budworm, *Cacoecia fumiferana* Clem.
O.S. Jackson	Lot 23, Con. 10, Twp. of Zealand.	July 19	74395	Jack pine	137 male pupae, 167 female pupae, 7 male moths, 2 female moths, and 18 emerged Diptera of the Jack pine budworm, *Cacoecia fumiferana* Clem.
O.S. Jackson	Lot 23, Con. 10, Twp. of Zealand.	July 20	74396	Jack pine	153 male pupae, 163 female pupae, 5 male moths, 1 female moth, and 24 emerged Diptera of the Jack pine budworm, *Cacoecia fumiferana* Clem.
O.S. Jackson	Lot 9, Con. 3, Twp. of Mutrie.	July 22	74398	Jack pine	35 male pupae, 41 female pupae, 3 male moths, and 3 female moths of the Jack pine budworm, *Cacoecia fumiferana* Clem.
O.S. Jackson	Lot 6, Con. 1, Twp. of Mutrie.	July 22	74399	Jack pine	61 male pupae, 107 female pupae, 18 male moths, 21 female moths and 7 emerged Diptera of the Jack pine budworm, *Cacoecia fumiferana* Clem.
O.S. Jackson	Lot 23, Con.10, Twp. of Zealand.	July 24	74400	Jack pine	36 male pupae, 109 female pupae, 49 male moths, 44 female moths and 8 emerged Diptera of the Jack pine budworm, *Cacoecia fumiferana* Clem.

1943 FOREST INSECT SURVEY REPORT

ABITIBI POWER & PAPER COMPANY LIMITED, PORT ARTHUR, ONTARIO.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
E.H. Berglund	G.T.P. Block No. 1, N. of Forbes Twp.	July 16	74281	Spruce	1 larva of a ladybird beetle, Coccinellidae sp.; 1 adult of a click beetle, Ludius splendens Zieg.
A.J. Auden	Near Cooke Point, about 3 miles west of Virgin Falls, Lake Nipigon.	July 16	Special	Spruce Balsam	5 pupae and 7 moths of the spruce budworm, Cacoecia fumiferana Clem.; 1 injured pupa of same; 3 larvae of a parasitic fly, Diptera sp.; presumably from 3 pupae of the budworm; 1 pupa of a tussock moth, Liparidae sp.
R. Pike	Ombabika	July 27	74277	Spruce	1 larva of the hemlock looper, Ellopia fiscellaria Gn.; 1 adult of a ground beetle, Carabidae sp.; 1 adult of a flat-headed borer, Buprestis sp.
R. Pike	Camp 5	Aug. 24	73188	Spruce Tamarack	2 adults of the black sawyer, Monochamus scutellatus Say; 1 adult of the white pine weevil, Pissodes strobi Peck.; 1 adult of a flat-headed borer, Dicerca tenebrosa Kby.; 1 adult of a small parasitic wasp, Braconidae sp.; 1 nymph of the common bedbug, Cimex lectularius L.

1943 FOREST INSECT SURVEY REPORT

GREAT LAKES PAPER COMPANY, PORT WILLIAM, ONTARIO.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
Wm. Henderson	Black Sturgeon Con., Circle Creek area.	July 16	67474	Balsam Jack pine	2 dead larvae of a climbing cutworm, Phalaenidae sp.; 1 dead larva and 1 dead pupa of the Jack pine budworm, Cacoecia fumiferana Clem.

1943 FOREST INSECT SURVEY REPORT

W.J. & O.R. GREER, HUDSON, ONTARIO.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
O.R. Greer	Hudson, Ontario, Mile Post 9E of.	June 26	74138	Spruce Balsam	10 larvae of the spruce budworm, *Cacoecia fumiferana* Clem.; 1 dead larva of same, the appearance of which suggests parasitism by a species of fly.

1943 FOREST INSECT SURVEY REPORT

RIDING MOUNTAIN NATIONAL PARK, MANITOBA.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R.T. Hand	Sec.27-23-19	May 12	74826	White Spruce	1 larva and 2 cocoons of a needle-mining moth, Gelechiidae sp.; 1 cocoon of a small parasitic wasp, Braconidae sp. This apparently accounted for another cocoon of the above. Base injury probably due to bark beetles or wood borers entering tree after a ground fire had weakened its resistance.
J. Hyska	Tilson Lake area, Sec.19-22-24.	June 23	74870	Tamarack Spruce Poplar	67 larvae of a leaf-beetle, Chrysomelidae sp.
D.B. Binkley	17-21-21W.P.M.	June 27	73043	White Spruce Tamarack	2 adults of the 3-barred click beetle, Ludius triundulatus Rand.; 6 adults of the 2-barred click beetle, Ludius propola Lec.; 1 adult of the tiger ladybeetle, Neomysia subvittata Muls.; 1 adult of a caddice fly, Trichoptera sp.
J. Hyska	Sec.2-22-25	July 3	74871	Tamarack Spruce	1 adult of the European larch saw-fly, Pristiphora erichsonii Htg.

1943 FOREST INSECT SURVEY REPORT

RIDING MOUNTAIN NATIONAL PARK, MANITOBA.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
R.D. McKinnon	Twp.23	July 18	74844	Poplar	1 cocoon of the forest tent caterpillar, *Malacosoma disstria* Hbn.; 1 larva of a climbing cutworm, *Phalaenidae* sp.
D.B. Binkley	Sec.25-21-21 Sec.31-21-20	July 20	74756	White Spruce Balsam Tamarack	22 larvae of the European larch sawfly, *Pristiphora erichsonii* Htg.; 2 cocoons of same; 1 larva of Marlatt's larch sawfly, *Anoplonyx laricis* Marl.; 1 cocoon of a parasitic wasp, *Braconidae* sp.; 1 adult of a caddice fly, *Trichoptera* sp.
D.B. Binkley	28-20-20W.P.M.	July 22	74759	Spruce Tamarack	20 living and 30 dead larvae of the European larch sawfly, *Pristiphora erichsonii* Htg.; 10 cocoons of same; 1 larva of Marlatt's larch sawfly, *Anoplonyx laricis* Marl.; 1 pupa of the hemlock looper, *Ellopia fiscellaria* Gn.; 1 adult of a lantern-fly, *Epiptera* sp.

1943 FOREST INSECT SURVEY REPORT

RIDING MOUNTAIN NATIONAL PARK, MANITOBA.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Hyska	Sec.2-22-25	July 24	74872	Tamarack Spruce	79 larvae and 1 cocoon of the European larch sawfly, *Pristiphora erichsonii* Htg. 8 dead larvae of same; 1 larva of Marlatt's larch sawfly, *Anoplonyx laricis* Marl.
D.B. Binkley	16-20-19W.P.M.	July 27	74760	Spruce Tamarack	16 larvae of the yellow-headed spruce sawfly, *Pikonema alaskensis* Roh.; 1 larva of Marlatt's larch sawfly, *Anoplonyx laricis* Marl.; 59 larvae of the European larch sawfly, *Pristiphora erichsonii* Htg.
J. Hyska	Gilson Lake Area, Sec.19-22-25	July 31	74874	Tamarack Spruce	75 living larvae, 34 dead larvae and 9 cocoons of the European larch sawfly, *Pristiphora erichsonii* Htg.; 1 larva of Marlatt's larch sawfly, *Anoplonyx laricis* Marl.; 1 larva of a looper, *Geometridae* sp.

1943 FOREST INSECT SURVEY REPORT

RIDING MOUNTAIN NATIONAL PARK, MANITOBA.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
J. Hyska	Deep Lake Area, Sec.15-22-25	July 31	74873	Tamarack Spruce	93 larvae and 1 cocoon of the European larch sawfly, Pristiphora erichsonii Htg.; 28 dead larvae of same; 4 larvae of Marlatt's larch sawfly, Anoplonyx laricis Marl.
R.D.McKinnon	Twp.22, R.22.	Aug. 10	74843	Tamarack	30 cocoons of the European larch sawfly, Pristiphora erichsonii Htg.
J. Hyska	Gunn Lake Area, Sec.5-22-23	Aug. 10	74875	Tamarack	30 cocoons of the European larch sawfly, Pristiphora erichsonii Htg.; 1 larva of a crane fly, Tipulidae sp.
D.B. Binkley	Lake Audy	Sept. 17	67332	Oak	Numerous leaf and stem galls of oak, close to Amphibolips coelebs. These are Cynipid gall-wasps. Over 300 species of such are known to attack oak.

1943 FOREST INSECT SURVEY REPORT

PRINCE ALBERT NATIONAL PARK, SASKATCHEWAN.

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
E.L. Millard	P.A.N.P. Dist. 6, Twp.53,R3W3M.	June 27	74626	Poplar	4 larvae and 12 pupae of a leaf-beetle, apparently the aspen leaf-beetle, Chrysomela tremulae Fab.; several dead larvae of same.
W. Anderson	P.A.N.P., 19-53-2W3M.	June 30	74659	Jack pine Spruce	1 badly damaged pupa of a climbing cutworm, Phalaenidae sp. No evidence of insect damage on Jack pine sample enclosed.
H.E. Harrison	Twp.59,R3W3M, near lake shore.	June 30	74669	Spruce	1 adult of a stink bug, Meadorus lateralis Say; 1 adult of a small beetle, Coleoptera sp.; 1 adult of the polished click beetle, Ludius nitidulus (Lec.); 1 adult of the insidious click beetle, Ludius insidiosus Lec.
H. Genge	East of Heart Lake,Twp.58,R2W 3M.	Aug. 18	55816	Spruce	1 adult of the large spruce weevil, Hypomolyx piceus DeG.; 1 adult of aground beetle, probably Platynus sinuatus Deq.

1943 FOREST INSECT SURVEY REPORT

HUDSON'S BAY COMPANY

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
Reg.W. Shaw	Hudson Hope, B.C.	----------	67702	----------	1 adult of a long-horned borer, Cerambycidae sp.; numerous plant lice, Aphiidae sp.; 1 adult moth, Lepidoptera sp.; 1 adult of a Rove beetle, Staphylinidae sp.; 1 adult of a firefly, Lampyridae sp.; 1 adult of another species of firefly, Lampyridae sp.

1943 FOREST INSECT SURVEY REPORT

OTHER COOPERATORS

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
Department of Agriculture: Canada: Field Crop Insects.					
Dr. R.D. Bird (Brandon)	Winnipegosis, Manitoba.	c.July 3	Special	Aspen	Injury to aspen leaves. Primary cause: gall-forming mite. Also present, *Marssonina? populi* (Lib.) Magn., a leaf-spot.
Department of Agriculture: Canada: Plant Protection Service.					
D.J. Petty (Ft. William)	---------	Aug. 19	Special	Spruce Aspen	1 larva of a spruce looper, *Eupithecia* sp., possibly the fir inchworm, *E. luteata* Pack.; 1 pupa of the pine hairstreak, *Incisalia niphon clarkii* Frmn.; 1 pupa of a climbing cutworm, *Phalaenidae* sp.; 1 adult of the apple ladybird, *Anatis mali* Say; 5 adults of more than one species of leaf-hopper, *Cicadellidae* sp.; 2 adults of a spittle bug, *Aphrophora* sp.; 1 adult of a weevil, *Curculionidae* sp.; 1 adult of a leaf-bug, *Miridae* sp.; 1 adult of a flat-headed borer, *Dicerca* sp.; 1 adult of a pygmy locust, Acrydium sp.; 1 adult of a leaf-beetle, *Calligrapha* sp.;

(Cont'd)

OTHER COOPERATORS

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
D.J. Petty (Cont'd)					4 adults of a flat-headed borer, Buprestidae sp.; 1 larva of an aphid-eater, Syrphidae sp.; 1 larva of a sawfly, Tenthredinidae sp.
Department of Agriculture: Manitoba: Extension Service.					
J.F. Muirhead (Holland)	Holland, Manitoba.	July 3	--------	Elm	A large number of plant lice, Aphidae sp.; 1 adult of a small parasitic wasp, Chalcidae sp., presumably from the above; 1 nymph and 1 adult of a stink bug, Pentatomidae sp.
Individuals Cooperating.					
Dr. J.D. Grandy (Loon Lake)	---------	July 10	74935	White Spruce	1 cocoon of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.
Mrs. W.J. Dowler (Winnipeg)	Tuxedo	July 16	Special	White Spruce	Infested twig of white spruce bearing a large number of female scales of the pine needle scale, Phenacaspis pinifoliae Fitch. Many of these scales bear evidence of parasitism by small wasps.

OTHER COOPERATORS

Collector	Locality	Date Collected	Box No.	Host Tree	Contents
Individuals Cooperating (Cont'd)					
H.C. Lillijard (Arnaud, Man.)	---------	Aug. 4	Special	White Spruce Ash	Several larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; numerous nymphs of a tarnished plant bug, may be the ash leaf bug, Neoborus amoenus.
R. Rannie (Binscarth, Man.)	9 miles north of Binscarth	Sept. 6	Special	Choke-cherry	Fungus disease condition caused by the cherry black-knot, Plowrightia morbosa.

VIII. POST WAR PROPOSALS FOR FOREST INSECT INVESTIGATIONS IN CENTRAL CANADA

VIII. POST WAR PROPOSALS FOR FOREST INSECT INVESTIGATIONS IN CENTRAL CANADA

For the purpose of efficient forest insect investigations in central Canada, it is suggested that the entire territory should be set up as one region, the eastern extremity being the Ontario-Manitoba boundary and the western limit the British Columbia-Alberta boundary, excluding all territory contained within the National Parks of Banff and Jasper.

This territory would constitute a region and sub-laboratories throughout it would operate directly under one regional headquarters at Winnipeg. While the functions of such a regional headquarters are given below in detail, it might be pointed out that the setup as suggested is planned to facilitate research, with the elimination of as much office and administrative routine as possible from these sub-laboratories. In keeping with this aim, it is therefore proposed that central Canada be set up as if it were a single province and there would be no provincial headquarters. Each sub-laboratory would be directly responsible to Winnipeg. It is felt that a provincial headquarters laboratory in these provinces of limited forest resources would develop an undue amount of office and administrative detail out of proportion to the work (This is discussed further under function of regional headquarters). Hence, the proposal would place year-round sub-laboratories independent of one another and directly responsible to the regional headquarters in Winnipeg. In order to facilitate cooperation between ourselves and the forest services concerned, the senior man in each province could operate as liaison officer when necessary.

A. Divisions of Work

Three separate and distinct phases of work are proposed: (1) Forest insect research, (2) forest insect survey, and (3) shelterbelt work. The heads of each of these divisions would be located in Winnipeg.

B. Organization of Territory

1. Manitoba

(a) Winnipeg

Regional headquarters located at present University site. Its function would be:

1. To plan, direct and coordinate all work undertaken throughout central Canada, thus making for efficiency and the elimination of duplication. Since many problems are common throughout the region, this is particularly important and seemingly indispensable during the establishment of the organization.

2. To summarize and analyze all forest insect survey data and to maintain supervision and uniformity of procedure throughout the region. It is suggested that through the construction of adequate cold-storage and incubator facilities at Winnipeg, a portion of this type of work could be centralized and handled by more experienced men and better equipment than would be the case if such work were scattered throughout the sub-laboratories.

3. To maintain a central reference collection and provide the majority of determinations of survey material. This, of course, requires the necessary technical personnel but the eventual centralization of such specialists seems of paramount importance for an efficient survey organization. The territory is large enough and the volume of material should be sufficient to warrant such specialized taxonomists as would be necessary.

4. To provide bibliographies and library facilities as required by sub-laboratories from time to time.

5. To maintain specialized equipment at one point available for use by sub-laboratories, such as photographic equipment, microtone, field instruments and many other items that can be loaned throughout the region as occasion requires.

6. To centralize a great deal of administrative detail and regular office routine so that duplication of work is eliminated. The preparation of miscellaneous memoranda, reports, statements as required throughout the year, monthly accounts, and many other matters of a routine nature can be handled at one central point and, by relieving sub-laboratories of this work, the maximum of man-hours can go into research problems.

(i) Sandilands (Seasonal sub-laboratory). This is a particularly important region and the reserve will be increased in size to several times its present area in the post war provincial program. The Sandilands Reserve will take in all of the southeastern section of the province. An entirely new forest service headquarters is to be built, its location as yet undecided, but our station should be erected on that site at the same time as the province's building program. This building should be adequate to accommodate 4 or 5 men and there should be included an insectary.

As a subsection to the Sandilands, it is suggested that the Turtle Mountains in southwestern Manitoba be included. This is a relatively small region and could be handled by the Sandilands laboratory.

(ii) Lac du Bonnet (Seasonal sub-laboratory). This station would cover the Eastern Forest District of Manitoba; it is a large and important country and includes many timber and pulpwood berths and the Pine Falls pulp mill. Lac du Bonnet is also the air base of the Provincial Air Service and the forest ranger headquarters. Several provincial forest reserves are planned for eastern Manitoba and these, together with the existing Whiteshell Reserve could be handled from this centre. Accommodations should be similar to those at Sandilands.

(iii) Riding Mountain National Park (Seasonal sub-laboratory). This laboratory is proposed in conjunction with the Dominion Forest Service station at Clear Lake. Its location is suggested adjacent to the Forest Service office building at the old air base site. Its construction would be of necessity log to conform with existing park architecture. A building to accommodate 4 men is suggested and, as well, an insectary would also be required.

This laboratory is the only one proposed for the Western District. Whether its activities should be restricted to the National Park or whether it should cover a part of the Western District as well is a point to be determined. For the present, however, it is suggested that the Riding Mountain station could handle, in addition to the Park, the Duck Mountain Forest Reserve. The latter is an important timber region and the centre of the old Dominion Forest Service experimental station at Singoosh Lake. In this connection, the buildings erected there by the Dominion Forest Service are still in good repair and one of these may be obtained as a station in the Duck Mountains for use as a substation of Riding Mountain. The remainder of the territory in the Western District could be administered from The Pas.

(iv) The Pas (Year-round laboratory). This year-round laboratory would cover all of the Northern Forest District and would include the Winnipegosis and Turtle Mountain area of the Western District. The Pas would be a receiving station for the forest insect survey for the north. Office space for winter use could be procured in the town itself but, for insectary work, a location outside a short distance away might be of advantage. This would require some investigation.

(v) Spruce Woods (Occasional sub-laboratory). A field laboratory is proposed for the Spruce Woods to be used as needed. It is not suggested that this be manned as an annual seasonal centre, except when work so demands. Its location should be in the centre of the reserve. A small insectary should also be incorporated in the plans for this reserve.

2. Saskatchewan

(a) Prince Albert (Year-round laboratory)

This centrally located laboratory would serve all of northern Saskatchewan and would be the receiving station for all survey material. Three ranger districts are suggested, corresponding to the three forest districts: Meadow Lake, Prince Albert and Hudson Bay Junction. Field laboratories have not been proposed. One reason for this is because of peculiarities of this country. Roads are scarce and the clay soil makes car travel impossible after even light rains. Field headquarters must necessarily be located on the spot where the work is actually in progress. For the time being, no permanent field stations are suggested. A portable type of field laboratory might be more advantageous.

(i) Prince Albert National Park (Seasonal laboratory). This is suggested as a sub-station of Prince Albert, although it might better be classed as a separate unit in itself. The problem of the Riding Mountain laboratory also applies to the Prince Albert Park. As a sub-station to Prince Albert, its personnel would move to Prince Albert during the winter. Its location would be either at the Parks headquarters or a distance from the townsite on Lake Waskesiu.

(b) Indian Head (Year-round laboratory)

This existing laboratory would continue with shelterbelt work and would be the survey receiving station for Saskatchewan shelterbelt regions. A sub-laboratory is proposed in the Cypress Hills, which would facilitate work in that section of the province.

(i) Cypress Hills. This is a problem that requires considerable thought before any definite proposals can be made. The Cypress Hills is definitely a prairie forest and, as such, has much in common with shelterbelt work. It lies across the Saskatchewan-Alberta boundary, the greater part in Alberta, but the railway station and postal address is

Maple Creek, Saskatchewan. The timber is pine and poplar. The main forest service personnel are located in Alberta at a Forest Reserve Headquarters. The problem is to decide whether Cypress Hills should be a division of shelter-belt work, a sub-laboratory of Saskatchewan or Alberta, or an independent station. For the present, it is proposed as a subdivision of Indian Head.

3. Alberta

Information on the existing Forest Service organization of that province is limited and, before any concrete proposals can be advanced, further investigation will be necessary. The following sets forth roughly the present setup in that province.

The principal forest region extends along the foothills in what is called the Rocky Mountain Forest Reserve, skirting the eastern side of Jasper and Banff Parks, south to Waterton Lakes National Park. There are two Forest Reserve Headquarters, one at Calgary and one at Rocky Mountain House. A second forest reserve which projects into Saskatchewan is established in the Cypress Hills, with a Forest Reserve Headquarters located on the reserve. Additional to these reserves, are other forest areas in the province, but they are handled on a much less intensive scale. The accompanying map delineates these areas.

As a tentative proposal, it is suggested that perhaps two year-round laboratories be established, one for the southern portion and one for the northern portion of the province. Locations are indefinite. It seems fairly evident that the southern laboratory should be at Kananaskis, the Dominion Forest Experimental Station, or perhaps at Calgary, the Forest Reserve Headquarters. The location of the northern laboratory is indefinite. It is indicated for the present as Edmonton, for existing information does not permit a detailed analysis of the situation.

(a) Southern Laboratory (Kananaskis or Calgary)

This year-round laboratory would handle the forest regions from the United States boundary to the Saskatchewan River. Two seasonal stations might be necessary, one at Waterton Lakes National Park and one at Rocky Mountain House. It is suggested that the region north of the Saskatchewan River be administered from the northern laboratory due to the fact that it is accessible by branch lines from the C.N.R. which extend into Lovett, Coalspur, Mountain Park, etc. A seasonal station might be needed in the Porcupine Hills due to the fact that this was, at one time, an important area of logging. Conditions and importance of this area at present are not known.

(b) Northern Laboratory (Possibly Edmonton)

This year-round laboratory would cover from the Saskatchewan River north, including the northern and north-eastern forest areas. It would connect with the forest areas of northwestern Saskatchewan. One or more seasonal stations might be required, but no estimate of this can be given at present.

(c) Shelterbelt Laboratory

A year-round headquarters for shelterbelt work is proposed. This might be run in conjunction with one of the other laboratories as a separate unit.

(d) Cypress Hills

This laboratory has been discussed in connection with Indian Head, Saskatchewan, and, as mentioned, might be a part of the Alberta or Saskatchewan shelterbelt work.

C. Summary of Proposed Organization

1. Buildings

6 Year-round laboratories

2 existing (Winnipeg, Indian Head)
2 to rent (The Pas, Prince Albert)
2 to build or possibly rent (Southern and northern Alberta)

8 (Plus) Seasonal field laboratories

8 to build (MANITOBA: (1) Sandilands, (2) Turtle Mt., small occasional station, (3) Lac du Bonnet, (4) Spruce Woods, (5) Riding Mt. Park, (6) The Pas; SASKATCHEWAN: (7) Prince Albert Park, (8) Cypress Hills; ALBERTA: Unknown.)

10 (Plus) Insectaries

10 to build (MANITOBA: (1) Winnipeg, (2) Sandilands, (3) Lac du Bonnet, (4) Spruce Woods, (5) Riding Mt., (6) The Pas; SASKATCHEWAN: (7) Prince Albert, (8) Prince Albert Park, (9) Indian Head, (10) Cypress Hills; ALBERTA: Unknown.)

2. Transportation

11 Cars

(MANITOBA: Winnipeg 4, The Pas 1;
SASKATCHEWAN: Prince Albert 1, Indian Head 1;
Cypress Hills 1;
ALBERTA: Estimate 3.)

19 Trucks

(MANITOBA: Winnipeg 2, Sandilands 1, Lac du Bonnet 1, Riding Mountain Park 1, The Pas 1;
SASKATCHEWAN: Prince Albert 3, Prince Albert Park 1, Indian Head 2, Cypress Hills 1;
ALBERTA: Estimate 6.)

Other Accommodations & Improvements

Winnipeg;
- Greenhouse attached to laboratory;
- 4-car garage with storage facilities for equipment, canoes, etc.;
- Cold storage facilities;
- Automatic stoker to furnace.

3. Personnel

	Technical	Non-Technical Rangers	Stenographers
Winnipeg	10	0	2
Sandilands	1	1	
Lac du Bonnet	2	1	
Riding Mt. Nat. Park	2	1	
The Pas	3	1	
Prince Albert	5	2	1
Prince Albert Nat. Park	1	1	
Indian Head	4	1	1
Cypress Hills	1	1	
S. Alberta	3	1	1
Waterton Lakes	1	1	
N. Alberta	4	2	1
TOTAL PERSONNEL	37	13	6

GRAND TOTAL: 56

<u>MANITOBA</u>

Laboratory and Tenure	Proposed Personnel	Travel Equipment	Location and Territory	Construction and New Facilities Needed
1.WINNIPEG Year-round	1.REGIONAL HEAD 2.RESEARCH HEAD (also assistant to regional head 3.Research worker) 4.Research worker) 5.FOREST INSECT SURVEY HEAD 6.F.I.S. laboratory worker in charge of survey Winnipeg Laboratory. 7.F.I.S. insectary man 8.F.I.S. worker, miscellaneous duties 9.SHELTERBELT HEAD 10.Shelterbelt worker for Manitoba 11.Head stenographer 12.Asst.stenographer	Car Car Truck, 2 outboards, 2 canoes. Car Car Truck	Location:Present site	(a)Greenhouse (b)4-car garage with storage space (c)New insectary (d)Cold storage facilities
2.SANDILANDS Seasonal	1.Officer in charge (research man) 2.Insect ranger. An assistant research man would be required occasionally but could be shifted from some other point.	Truck	Located at proposed new Forest Service Headquarters. Territory southern Manitoba, including Turtle Mts.	(a)Field lab. to accommodate 3-4 men (b)Insectary (c)Small station in Turtle Mountains

MANITOBA CONT'D

Laboratory and Tenure	Proposed Personnel	Travel Equipment	Location and Territory	Construction and New Facilities Needed
3.LAC DU BONNET Seasonal	1.Officer in charge (research) 2.Assistant worker 3.Insect ranger	Truck Canoe Outboard	Located at Air Base, Lac du Bonnet. Territory eastern district.	(a) Field lab. like Sandilands (b) Insectary
4.RIDING MOUNTAIN NATIONAL PARK Seasonal	1.Officer in charge 2. Assistant worker 3.Insect ranger	Truck	Location: At Dominion Forest Service Station. Territory also includes Duck Mountain.	(a) Field lab. to accommodate 4 men, log construction as required by Park (b) Insectary
5.THE PAS Year-round	1.Officer in charge 2.Assistant in charge of survey 3.Assistant worker 4.Insect ranger	Car Truck 1 outboard 1 canoe	Location in The Pas vicinity. Territory northern Forest District, Porcupine Mt. and Winnipegosis area.	(a) Headquarters rented in town (b) Summer lab. erected in better location, probably Cormorant Lake (c) Insectary at summer station
6.SPRUCE WOODS Occasional	No personnel. Work to be handled by shifting men from other stations as required.		Location: In centre of Reserve	(a) Field lab for occupation as required. (b) Small insectary.

SASKATCHEWAN

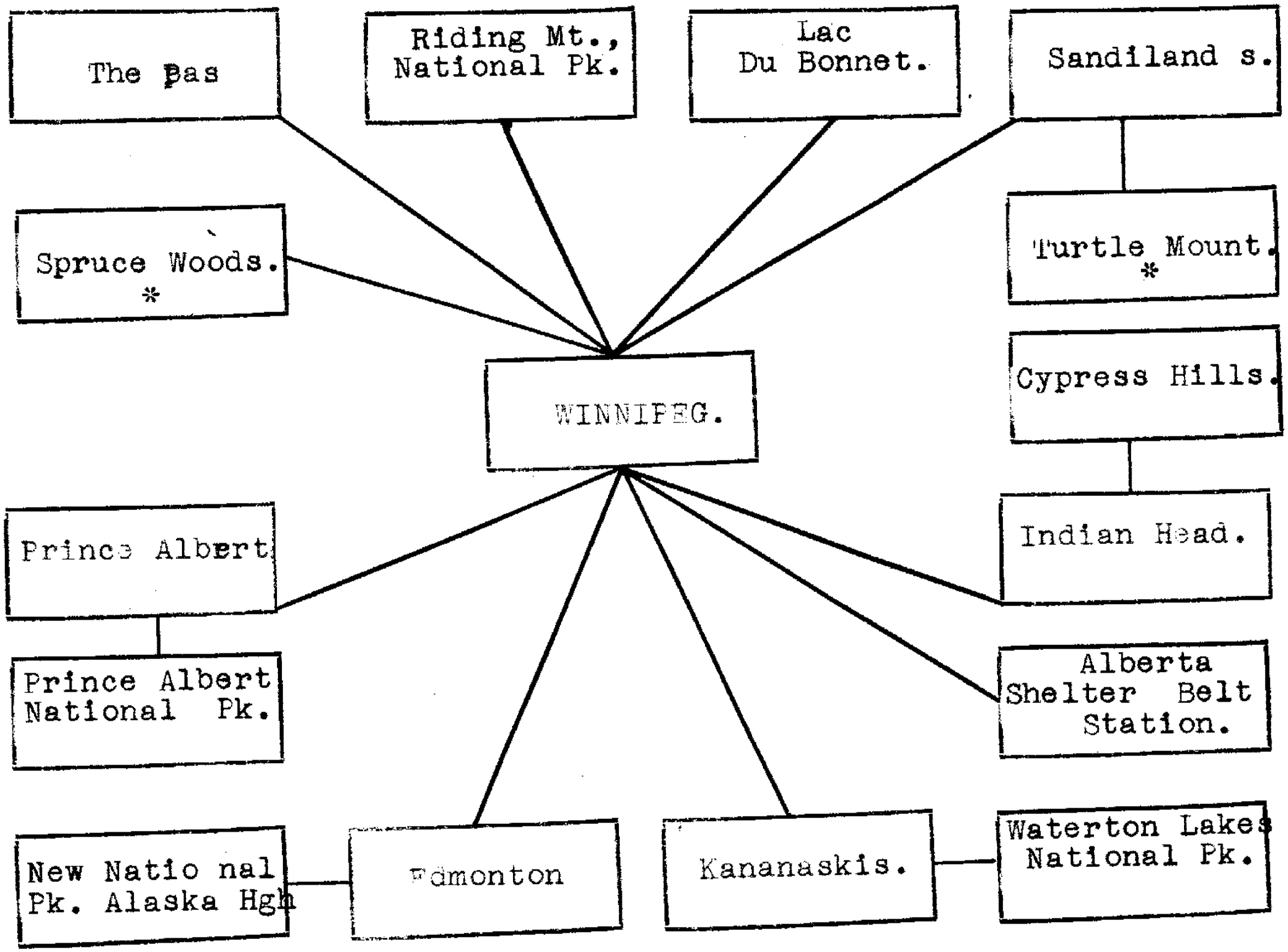
Laboratory and Tenure	Proposed Personnel	Travel Equipment	Location and Territory	Construction and New Facilities Needed
7.PRINCE ALBERT Year-round	1.Officer in charge 2.Assistant research man 3.Assistant research man 4.Assistant in charge of F.I.S. 5.F.I.S. worker 6.Insect ranger (W. of 3rd Meridian) 7.Insect ranger (E. of 3rd Meridian) 8.Stenographer	Car Truck Jeep Jeep plus 1 canoe & 1 outboard	Location at Prince Albert. Territory:Forest areas of northern Saskatchewan, including Prince Albert Park. In charge of sub-lab. at Park.	(a) Town headquarters rented (b) Insectary
8.PRINCE ALBERT NATIONAL PARK Seasonal	1.Officer in charge 2.Insect ranger	Truck Canoe Outboard	Location:Park's headquarters or vicinity. Sub-station of Prince Albert lab.	(a) Field laboratory for 3 or 4 men, log construction as required (b) Small insectary
9.INDIAN HEAD Year-round	1.Officer in charge 2.Assistant research man 3.Assistant in charge of F.I.S. 4.F.I.S. worker 5.Insect ranger 6.Stenographer	Car Truck Truck	Location:Present site. Territory shelterbelt regions in Sask. Sub-station at Cypress Hills.	Requirements not known.
10.CYPRESS HILLS	1.Officer in charge 2.Insect ranger	Car Truck	Location: At Forest Service Headquarters. Sub-station of Indian Head.	(a) Field laboratory (b) Small insectary

280

ALBERTA

(PROPOSALS INDEFINITE UNTIL FURTHER INFORMATION IS OBTAINED.)

Laboratory and Tenure	Proposed Personnel	Travel Equipment	Location and Territory	Construction and New Facilities Needed
11. SOUTHERN REGION (Kananaskis suggested) Year-round	1. Officer in charge 2. Assistant worker 3. Assistant in charge of F.I.S. 4. Insect ranger 5. Stenographer	Car Truck	Sub-station under this laboratory at Waterton Lakes Park	Inadequate information to formulate any definite proposals
12. WATERTON LAKES NATIONAL PARK Seasonal	1. Officer in charge 2. Insect ranger	Car Truck	Sub-station under the above lab. Territory to include Porcupine Hills to Highwood R.	Ditto
13. NORTHERN REGION (Edmonton or some suitable location)	1. Officer in charge 2. Assistant research man 3. Assistant in charge of F.I.S. 4. F.I.S. worker 5. Insect ranger 6. Insect ranger 7. Stenographer	Car Truck Truck Truck	Seasonal stations would be needed but knowledge of Forest Service organization too vague to set forth proposals.	Ditto
14. CYPRESS HILLS	(See Saskatchewan)			



RED : Year-round laboratories.
BLUE: Annual seasonal stations.
* Field stations of occasional occupancy.

IX. REPORT ON TREE INJECTIONS
AS DISCUSSED BY A. WHITE, PORT ARTHUR.

IX. REPORT ON TREE INJECTIONS AS DISCUSSED BY A. WHITE, PORT ARTHUR.

In the report that follows, the writer has endeavored to set forth the main points of tree injection as proposed by Mr. Alexander R. White, Port Arthur. His objects, methods and reputed results are given and the results of other workers are compared herein. (NOTE: Quotations made by Mr. White are taken from typed manuscripts prepared by him and given to the writer.)

OBJECTS:

Mr. White sets forth four main objects for the impregnation of trees with chemicals:

(a) To enable the peeling of bark to proceed throughout all seasons of the year. By his method, he claims, poles could be peeled as easily in December as in June.

(b) To reduce the weight of timber by 25% through the lowering of the water content before cutting and, at the same time facilitating peeling, as in the above.

(c) To impregnate heart wood as well as sapwood with preservatives prior to cutting. Application at present is said to be possible for poles of small sizes, as fence posts, mine props, etc.

(d) To impregnate trees with chemicals toxic to insects, thus killing those feeding on the foliage and, at the same time, protecting the dying tree from bark- and wood-feeding insects until eventually salvaged.

METHODS:

The method of impregnation is the same in all instances and is described by him as follows:

The tree is girdled by removing 2½ inches of bark. A special two-bladed saw has been prepared for this purpose, the blades being 2½ inches apart and offset so that by the time the upper blade has cut through the bark, the lower blade has cut 1/4 inch into the sapwood. A band of bark 2½ inches wide is then peeled away, completely girdling the tree. The purpose of this, as recorded by Mr. White, is: "First we require to sever all conducting fibres between the part of the tree to be treated and the root in order that the root of the tree shall live on unchanged. Secondly we make a saw kerf into the sapwood in order that our chemical can quickly enter the crude sap stream. Thirdly we require a smooth wet surface upon which to place our chemical." A crinkly kraft paper bandage is put around the tree and secured with a thumb tack. The chemicals are applied in the form of a paste and poured into the girdled portion until the bandage is full. The operation is then complete.

It should be mentioned here that, fundamentally, this method is a duplication of that used by Dr. F.C.Craighead in the United States in 1937, whose work is compared later in this report. Craighead used chemicals in liquid form.

This being the method, it would be in order to consider how the above mentioned objects are to be accomplished and Mr. White's explanation of the action of the chemicals employed.

(a) Bark Removal

The bark removal chemical is known as "cambicide," consisting of 3 parts calcium chloride and 1 part sodium chlorate. To quote Mr. White, "The chemical is quickly drawn through the saw kerf into the upward rapidly moving sap stream and in a few hours has ascended to the tree top attacking the crown buds, the source of all protoplasm and cellular production* breaking down and destroying the cells so quickly that the tree remains in the same condition as before treatment began. Since one of the chemicals has a terrific affinity for moisture and since transpiration through the leaves has now been cut off and since the return of elaborated sap to the roots has been prevented by girdling, the new cambium becomes flooded with sap and remains so for many months. In about six days the tree is completely dead but preserved and it is impossible for the bark to adhere to the sapwood."

Mr. White states that this treatment has proven decidedly effective and is already in great demand by pulpwood operators. He claims outstanding success with this treatment. This matter has been reviewed by Dr. H.J. Brodie, Department of Botany, and Dr. H.H. Saunderson, Department of Chemistry, both of the University of Manitoba. Dr. Brodie has considered it from the standpoint of tree physiology. His conclusion is that, if it works, it does so for reasons other than those advanced by Mr. White. There is no evident logic in the statement

*Note: This statement is in error. These buds are not the source of all cellular production. Even when these buds are dead, the increment of the tree continues.

that "transpiration through the foliage has now been cut off," and no apparent object in doing this, for he has previously stated, "We require to sever all conducting fibres between the part of the tree to be treated and the root in order that the root shall live on unchanged." This I understand is so that water may still enter the tree through the roots. If the operation of the crown is so completely paralyzed, there is little reason to believe that the root functions are progressing unimpaired. Dr. Saunderson's only comment on the chemical aspect is that the first consideration should be a determination of the fire hazard of sodium chlorate. This is an extremely hazardous chemical to use in quantity anywhere and trees impregnated should above all be considered first from this standpoint. Both of these men find no logic in Mr. White's explanation of the action of his treatment in the removal of bark. It should be definitely understood, however, that neither these men nor the writer discredit Mr. White's statements on the marked "results" he reports. This process may be entirely satisfactory in spite of Mr. White's explanations and, if its removal of bark is a fact, certainly it warrants some intensive study. I view the matter with an open mind and have not been convinced that it does nor that it does not work. It appears to be the most interesting of his four objects of tree impregnation.

(b) The Application of Chemicals to Live Trees for Rapid Bark Removal and the Dehydration of Standing Timber

The chemical used in this instance is called "cambicide B," the formula of which I do not know. It is an alkali and, as explained by Mr. White, acts as follows:

The elaborated sap (downward flowing) is slightly acid and, by the use of this chemical, this sap is changed over to the alkaline side of the scale. Quoting Mr. White's further explanation, "This change in pH value does not at once kill the cellular life of the tree but prevents cellular multiplication without which there can be no new wood developed or new ring completed during the season in which treatment has been made. It therefore seems reasonable that we have gradually suspended the law of osmosis by girdling and cutting the saw kerf into the sapwood of the tree in order to enter the transporation system within the sapwood with our chemical and we have not at once destroyed the major cells within the tree already active (before our treatment). The needles remain green and active as long as the tree can supply sufficient moisture, therefore, when the moisture content of the tree falls below the amount necessary for the well being of the needles they will die and you should then have a tree 2 months after treatment but before cutting that has lost 25% of its wood water weight."

He further states, "Since we have now introduced an alkali into the sap stream of the tree it is reasonable to suppose we have now changed the oleo resin (a fat or oil) so as to at least make it more water soluble than in its normal state, so that the bark, notwithstanding that we have dehydrated that portion of the tree prized by industry should be soft and pliable and easy to remove."

In commenting on the above, I find it impossible to follow the line of reasoning as set forth. I have seen no evidence whatever to show that the trees died from anything more than the effects of girdling or that the loss of water was as indicated by Mr. White.

(c) The Chemical Treatment of Live Trees for Wood Preservation

In the same manner previously mentioned, chemicals are diffused through the wood and he claims the treatment is necessary only "two weeks previous to such trees or timber being cut down by the lumberman. This new process provides a method for the chemical treatment of living trees of all species." (Quotations and underlining are Mr. White's.) "This treatment is only intended for the time being to deal with timbers that may be used in their round state such as mine timbers, piling, poles and fence posts. ... A new drying method will be introduced one that will guarantee the timbers against checking, splitting or honeycombing up to a reasonable specification." His claim is that diffusion occurs throughout the heart wood and sap wood alike.

The preservative ingredient used in this treatment consists of chromated zinc chloride. Samples of treated wood shown the writer were tested for zinc chloride, using a solution composed of potassium ferricyanide, potassium iodide and well boiled starch. When sprayed on the cross sections of treated poles, a marked blue reaction occurred, which Mr. White states establishes the presence of zinc. The presence of the blue stain in the sample shown the writer extended almost to the core of the tree but it should be stated that the sample was only 3½ inches in diameter.

A word might be included here in regard to the above test. It is stated by Mr. White that this is the approved standard test. This matter was taken before Dr. H.H. Saunderson, Department of Chemistry, University of Manitoba, for comment. Neither the writer nor Dr. Saunderson would intimate that the test is not satisfactory. It may be quite authentic. Dr. Saunderson, however, would refuse to accept it as evidence of the presence of zinc. He was not in a position to condemn it nor to advance a better one that could be used as a spray on wood. To him, the only acceptable proof of zinc penetration would be by the actual recovery of zinc through a quantitative analysis of the wood. Doubts for the accuracy of Mr. White's test lie in the likelihood of the iodide being oxidized by the chromate rather than the zinc, producing the blue color. Furthermore, if such occurs, it would have to be established that the chromate does not penetrate deeper than the zinc. Be that as it may, the use of zinc chloride for tree injection has been established as quite satisfactory for the protection of wood from beetle attack as well as for wood preservation. (Craighead & St. George, Jour. Forestry, Vol. 36, 1938.) Another ingredient, urea, a common fertilizer constituent, is reported as having antidotal properties on some fungus toxins. (P.P. Pirone, American Forests, Vol. 48, 1942.) There appears nothing particularly wrong with the constituents of his preservative, but it would be well to consider what other workers have done along these same lines, the similarity of methods and the comparison of results.

As mentioned earlier, Mr. White's method is almost a duplication of the work done by Dr. F.C. Craighead, as set forth in Bulletin E-409, U.S.D.A. Bureau of Entomology and Plant Quarantine, June, 1937. Two methods are recommended.

(a) The first method, most comparable with Mr. White's, consists of removing the bark around the tree, making a band 12 inches wide. A saw kerf is cut into the sapwood horizontally so that the two ends meet, exactly as Mr. White has done. A tin or paper collar is fitted around the tree below the saw kerf with its sides flaring out funnel-fashion. After making water tight, the liquid chemical is poured in.

(b) A second method is similar, except that the saw kerf is spiral, the two ends overlapping some 2 inches, one end being 2 to 3 inches below the other. A rubber band is stretched over the kerf, thus enclosing it, and the liquid chemical circulates through this kerf by appropriate means.

A further elaboration of Craighead's method has been tried by workers in Ottawa. By this means, the collar of bark was removed, the saw kerf cut, after which two holes were drilled completely through the tree so that they intersected at right angles in the centre of the heart wood, forming a cross. Both openings of each hole were made in the saw kerf. By means of a sealed tin collar, liquid was circulated completely around and through the tree by means of a siphon.

The above three methods, while sketchy, serve to indicate that other workers have experimented along much the same lines as Mr. White. Workers in Ottawa using the drilled holes alone and the holes plus the peripheral incision, as described above, found that in their tests the incision did not increase the distribution of eosin stain at higher levels in the trees studied. This is of interest in that it is the peripheral incision on which Mr. White bases his claims for success.

Craighead, on the other hand, injected simply by use of the girdling incision and he reports his results as follows: "Chemical analyses of cross sections of this treated material show that the sap wood is impregnated with salts of metals, such as copper sulphate or zinc chloride, in concentrations ranging from ½ to 1½ pounds per cubic foot. Service tests with a number of chemicals indicate that after 6 years in the ground, posts and poles of treated material are still in perfect state of preservation showing no insect injury or decay."

In relation to the absorption, a comparison between Craighead's saw kerf method, using liquids, and White's same method, using a paste, is quoted as follows: Craighead states, "Although ordinarily the solution will be entirely absorbed by the tree within from 4 to 12 hours, it usually takes about 2 weeks before distribution through the entire sap wood is complete." (This refers to the use of liquids.)

White, on the other hand, in a bulletin put out for timber operators, states, "We mix our chemical to a stiff paste and spread lightly on the exposed sapwood and place crinkly kraft paper bandage tightly around the stem. ... The chemical is quickly drawn through the saw kerf into the upward rapidly moving sap stream and <u>in a few hours</u> has ascended to the tree top, <u>attacking the crown buds</u>."

All of the above I mention merely to show how in most respects there is nothing fundamentally new or untried in Mr. White's methods.

As for a comparison of results, I would reiterate that Mr. White had pronounced indication of penetration, according to the test used, on the sample 3½" in diameter. Dr. Craighead, using his saw kerf method with liquid zinc chloride says, "If the tree contains no heart wood, the entire volume of the stem is considered for treatment. In larger trees with a narrow band of sap wood, the dosage is estimated on the basis of the cubic contents of the sap wood cylinder. The heart wood cannot be treated satisfactorily." Mr. White is emphatic that the impregnation of heart wood is possible. The evidence submitted, however, could not be classed as a pole with typical dead heart wood and, in view of Craighead's statement, just quoted, I see no reason to assume that the results of White's are in any way better than those reported by Craighead.

(d) Tree Injection for Insect Control

The injection of trees for insect control as advocated by Mr. White is a point on which I cannot agree. His proposal is to inject an arsenical into a tree, poisoning the foliage and the insects feeding thereon, protecting the wood from future bark- and wood-feeding insects and enabling its eventual salvage. It is my understanding that Mr. White has done no work on the injection of such toxicants into trees for this purpose, and any suggestions made by him are entirely suppositional. By way of illustration, it might be mentioned that sodium arsenite has been reported to immunize a tree from bark beetle attack but that wood borers entered one year after impregnation (R.C. Fisher, Empire Forestry Journal 18, 1939.) A resume of work done in this respect is far too extensive to even indicate here. Suffice it to say that the problem is not as simple as it sounds. Present knowledge discriminates against the use of such poisons as arsenicals for this work because of their danger to man. Other non-toxic or less harmful ingredients may eventually be used that will achieve this result. Granting such possibilities, there is no reason to believe that it would ever achieve the status of a universal forest insect control agent, even when applied to small incipient outbreaks. Its application in the present budworm infestation is obviously impossible. Under some circumstances and in relation to certain specific insects, it may have an application and much work has been and is being done in this regard both in Canada and in the United States. I therefore criticize Mr. White's positive statements on its application, which he agreeably accepts, but maintains his original ideas in this regard.

SUMMARY

In summarizing, I may say that I find it impossible to accept Mr. White's explanations of the workings of his chemicals or the results obtained. I saw no data whatever to indicate that bark is removed more easily by use of his chemicals than without their use; that a treated tree is in any way lighter than a similarly girdled untreated tree; that preservative solutions can be made to penetrate dead heart wood; or that any ideas advanced on insect control have ever been tested or used by him. In other words, it is my feeling that the entire matter has been put forth without a semblance of scientific tests and that the claims are nothing more than suppositional.

On the other hand, I am told that more than 300 thousand trees have been treated with "cambicide" and that the results are more than satisfactory. If this is so, it would seem inconceivable that so many operators would blindly accept it without accumulating some proof that treated trees are more easily peeled than untreated ones. Likewise, I am told that excellent authorities have endorsed Mr. White's wood preservation treatment as superior to any other of its kind. If so, such authorities must certainly be basing their statements on proven facts. If such proof can be advanced, it would assist greatly in clarifying the situation.

All in all, the writer is open to conviction but such would be based only on scientifically designed experimental work. To repeat the statement of Dr. H.J. Brodie, if these chemicals produce the reputed results, they do so for reasons other than those advanced by Mr. White.

X. FINANCIAL STATEMENT & PROJECT COSTS

FINANCIAL STATEMENT & PROJECT COSTS

1943-1944

	GENERAL ADMIN-ISTRATION	FOREST INSECT SURVEY	SPRUCE BUDWORM	BARK BEETLES & BORERS	LARCH SAWFLY	LAB. IMPROVE-MENTS	GROUNDS	LAB. MAINT-ENANCE	PHOTO-GRAPHY	CAPITAL	TOTALS
A1 Permanent Salaries	1255.47	129.04	721.85	361.43		10.33					2478.12
A2 Temporary Salaries	902.26	2315.04	1398.76	481.09	39.11	96.00		83.42			5315.68
A3 Wages	144.09	769.88	621.03					414.15			1949.15
C. Buildings & Repairs								8.90			8.90
F. Express & Freight, Ctge.	9.63	6.88	31.21								47.72
J. Miscellaneous	10.50							60.45			70.95
R. Supplies	105.83	46.00	248.35			66.03	2.45	78.06	21.65	58.95	627.32
S. Telegraph, Telephone & Postage	89.00		3.09								92.09
T. Travel	678.04	55.03	585.38	113.59	31.46						1463.50
TOTALS	3194.82	3321.87	3609.67	956.11	70.57	172.36	2.45	644.98	21.65	58.95	12053.43

<u>NOTE</u>: Expenditures under "Lab. Maintenance" and "Lab. Improvements" include in the above some items unrelated to these designations, as equipment construction, repairs, materials, etc., and hence figures shown in these two columns are somewhat misleading.

Northern 1943 Winnipeg Insect and Disease Species Index